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MEF W139

v0.2

Internet Access Product Schemas and Developer Guide

December 2022

This draft represents MEF work in progress and is subject to change.

Kod pola został zmieniony

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1 List of Contributing Members

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

Editor Note 1:   *This list will be finalized before Letter Ballot. Any member that comments in at least one CfC is eligible to be included by opting in before the Letter Ballot is initiated. Note it is the MEF member that is listed here (typically a company or organization), not their individual representatives.*

2 Abstract

The MEF Standard consisting of this schema guide and its associated software artifacts (JSON Schemas) defines and describes the product-specific information used in LSO Cantata and LSO Sonata APIs for a set of Business Functions - specifically, Product Offering Qualification, Quote, Product Ordering, and Product Inventory - for Basic and Advanced Internet Access product. The document starts with an overview of LSO Cantata, LSO Sonata, and Internet Access services. It then provides a basic information model for the MEF Internet Access Service Attributes. The final sections describe the Data Model focused on the JSON Schemas associated with this specification.

This document can be thought of as a user's guide for the Internet Access Data Model and the schemas provided that embody the Data Model. MEF Services are described by a set of Service Attributes. Each Service Attribute describes an aspect of the service that is agreed upon between the provider and the user of the service. The documents that describe the Service Attributes for Internet Access Services are MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.** and MEF 61.1.1 [9]. The Basic and Advanced services are specified in MEF 69.1 [10] based on the Service Attributes defined in MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.**.

MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.** and MEF 61.1.1 [9] specify Service A ttributes to describe the various components that compose a Basic Internet Access service and Advanced Internet Access. This document defines a data model that includes these Service Attributes respectively and also lists the Service Attributes that are not included in the data model or are present in modified form, and the reason why each is not included or modified.

This Standard normatively incorporates the following files by reference as if they were part of this document, from GitHub repository https://github.com/MEF-GIT/MEF-LSO-Sonata-SDK:

productSchema/ip/

- common/ipCommon.yaml

- common/ipCsl.yaml

- internetAccess/advancedInternetAccessIpvc/advancedInternetAccessIpvc.yaml

- internetAccess/basicInternetAccess/basicInternetAccess.yaml

- internetAccess/exclusiveAdvancedInternetAccess/exclusiveAdvancedInternetAccess .yaml

- internetAccess/internetAccessCommon/internetAccessCommon.yaml

- ipUni/ethernetUniAccessLinkTrunk.yaml

- ipUni/ipUni.yaml

- ipUni/ipUniAccessLink.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 MEF or external documents. If the reference includes an asterisk (*), the definition has been adapted from the original.

In addition, terms defined in the standards referenced below are included in this document by reference and are not repeated in the table below:

- MEF 55.1 Lifecycle Service Orchestration (LSO): Reference Architecture and Framework [6]
- MEF 57.2 Product Order Management Requirements and Use Cases [7]
- MEF 61.1 IP Service Attributes [8]
- MEF 61.1.1 Amendment to MEF 61.1: UNI Access Link Trunks, IP Addresses, and Mean Time to Repair Performance Metric [9]
- MEF 69.1 Subscriber IP Service Definitions [10]
- MEF 78.1 MEF Core Model [11]
- MEF 79 Address, Service Site, and Product Offering Qualification Management, Requirements and Use Cases [12]
- MEF 106 LSO Sonata Access E-Line Product Schemas and Developer Guide [16]

Term	Definition	Reference
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 [8]
IP User Network Interface	A UNI at which an IP Service is accessed.	MEF 61.1 [8]
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 [8]
IPVC End Point	A logical entity at a given External Interface to which a distinct subset of IP Packets passing over that External Interface is mapped.	MEF 61.1 [8]
UNI Access Link Trunk	A construct that encapsulates the details of the Layer 1 and Layer 2 configuration shared by one or more UNI Access Links.	MEF 61.1.1 [9]

Table 1 Terminology and 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 [4]) 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   Introduction

LSO Cantata provides a programmatic interface for establishing (quoting, ordering, etc.) products between Service Provider (Seller) and the Subscriber (Buyer). This API is 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., Product Order Qualification or Quote, etc.) and the inner-most structure contains information relating to the specific product, in this specification Basic or Advanced Internet Access.

Internet Access is a Subscriber IP Service that connects the Subscriber to the Internet. The Service Attributes that are agreed to between the parties are defined in MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.** and MEF 61.1.1 [9] The Service definition for Basic and Advanced Internet Access which is, in effect, a set of constraints on the values of the Service Attributes, is provided in MEF 69.1 [10].

This specification is accompanied by a Data Model for the Internet Access components instantiated as a set of JSON schemas that can be used within the LSO Cantata or LSO Sonata API to perform Product Order Qualification, Quotation, Order, and request an Inventory for the Internet Access Product consisting of:

- IPVC, including exactly one End Point

- IP UNI

- IP UNI Access Link

- IP UNI Access Link Trunk

The document contains the following sections:

- An overview of LSO Cantata and LSO Sonata (section 6)

- An overview of the Internet Access Service (section 7)

- Data Model Design Principles (section 8)

- Order Milestones (section 9)

- An abbreviated Information Model for Internet Access and explanation of the organization of the Service Attributes in MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.** and MEF 61.1.1 [9] (section 10)

- Organization of the Data Model for Internet Access (section 11)

- The relationship between the entities in the service (section 12)

- The detailed comparison of Service Attributes of Basic and Advanced Products with a list of ones that are not included in the Data Model (section 13)

These sections are followed by two sections that contain tables that describe the details of the data model. The tables include information about each class and a list of properties in each class. For each property, the JSON Name, description, data type, details about allowed values, and, in some cases, some additional information about relationships between Service Attributes are provided.

- Section 14 contains the details of all of the Service Attributes

472 # 6   Overview of LSO Cantata and LSO Sonata

473   MEF 55.1 [6] describes the Reference Architecture for Lifecycle Service Orchestration (LSO) of
474   MEF-defined services. MEF 55.1 defines seven LSO Interface Reference Points (see Figure 1)
475   that are abstract interconnection points between different entities—either within the Service
476   Provider domain (intra-domain) or between Service Provider and other business entities (inter-
477   domain). One of these LSO Reference Points is LSO Cantata which defines the abstract
478   interconnection point between a Subscriber (Buyer) and a Service Provider (Seller) and another is
479   LSO Sonata which defines the abstract interconnection point between a Service Provider (Buyer)
480   and an Operator (Seller). It is at these Interface Reference Points – LSO Cantata and LSO Sonata
481   – that the Buyer and the Seller interact to orchestrate business transactions for the different
482   Business Functions. Inter-provider Business Functions include Address Qualification, Site Query,
483   Product Offering Qualification, Quote, Product Ordering, Product Inventory, Trouble Ticketing,
484   and Billing In the context of this document, the following 4 business functions are relevant as ones
485   exchanging product information:

486   - Product Offering Qualification, MEF 79 [12]

487   - Quote, MEF 80 [13]

488   - Product Ordering, MEF 57.2 [7]

489   - Product Inventory, MEF 81 [14]

490
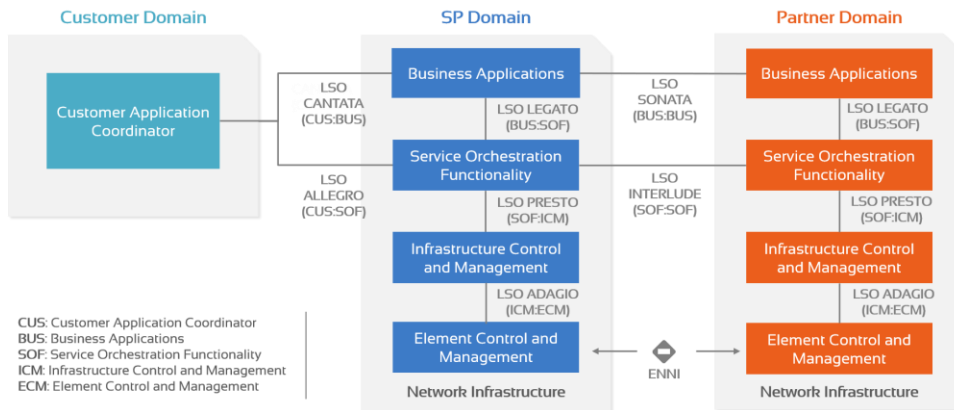
491   **Figure 1 LSO Cantata and LSO Sonata Reference Diagram**

492   The mutual access to Business Functionalities is automated via APIs at the LSO Cantata and LSO
493   Sonata Interface Reference Points which are standardized by MEF as LSO Cantata and LSO
494   Sonata APIs, and which are made available by MEF in a series of releases of the LSO Cantata

495 SDK and LSO Sonata SDK. The APIs are standardized by following API and Developer Guide
496 documents:

497 • Product Offering Qualification, MEF 87 [15]

498 • Quote, MEF 115 [17]

499 • Product Ordering, MEF 123 [19]

500 • Product Inventory, MEF 116 [18]

501 The LSO Cantata and LSO Sonata APIs comprise two parts—a product-agnostic API and a set of
502 product-specific data models, as shown in Figure 2.

503

Function Specific
(e.g., POQ, Quote, Order, Inventory)

Product/Service Agnostic

Product/Service Specific
(e.g. Access E-Line, EPL, EVPLAN, etc.)

Focus of this document
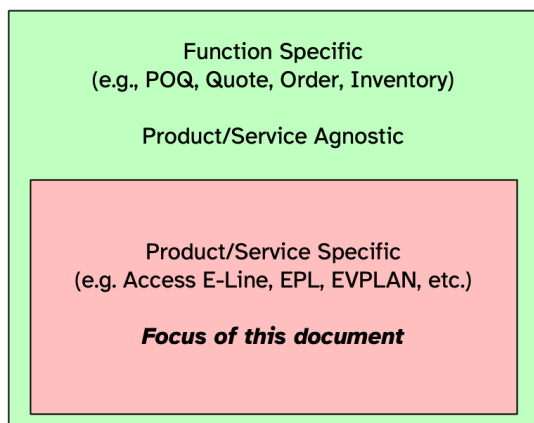
504 **Figure 2 LSO Cantata and LSO Sonata API Structure**

505 This document describes the product-specific Data Model for a MEF Internet Access service as
506 defined in MEF 61.1**Błąd! Nie można odnaleźć źródła odwołania.**.

507

7 Overview of Internet Access Services

This specification describes a data model for MEF-defined Internet Access Services. An Internet Access Service is a Subscriber IP Service which means it is provided to an end-user (the Subscriber) by a Service Provider. A Subscriber can be an enterprise, a mobile operator, an IT system integrator, a government department, etc. An Internet Access Service provides the Subscriber with connectivity to the global Internet. In this case, the Service Provider is acting as an Internet Service Provider.

Internet Access is composed of 5 main building blocks:

- IPVC: An IP Service is formed of an IP Virtual Connection (IPVC) that links together IPVC End Points at a UNI (or IPVC End Points and "the Internet" as in the Internet access case).

- IPVC End Point: A logical entity at a UNI, to which a subset of packets that traverse thatUNI is mapped.

- UNI – A User Network Interface (UNI), 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.

- IP UNI Access Link: An individual IP connection (i.e. a subnetwork corresponding to a distinct IP subnet) between the Subscriber and the Service Provider that forms part of that UNI.

- IP UNI Access Link Trunk: An underlying construct that encapsulates the Layer 1 and Layer 2 characteristics of the link. A UNI Access Link Trunk may carry packets for a single UNI Access Link, as in the case where the UNI Access Link is a direct physical connection, or may carry packets for multiple UNI Access Links, for example when the UNI Access Link is an Ethernet VLAN. The UNI Access Link Trunk itself may be a single physical link, may comprise multiple physical links such as an Ethernet Link Aggregation Group, or may be logical such as an IP tunnel.

533
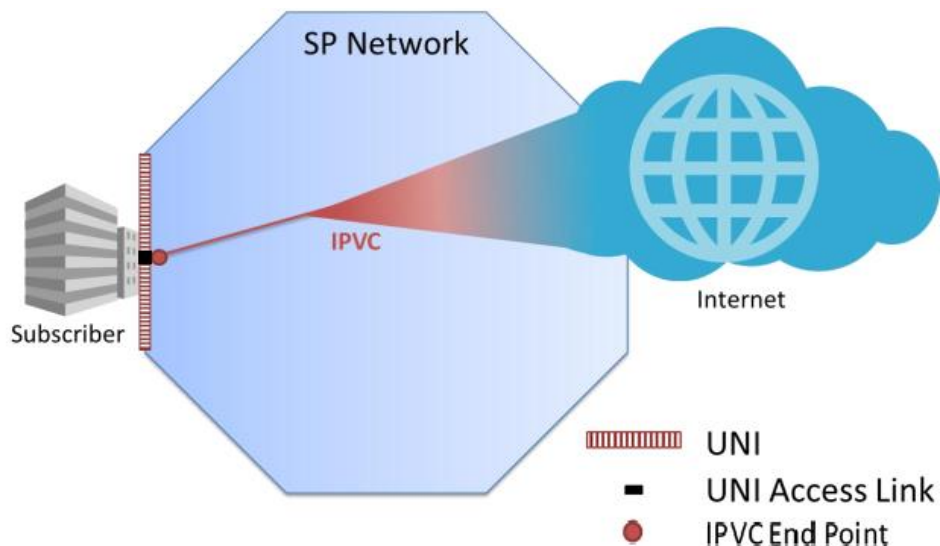
534   **Figure 3 Internet Access Service - concept** Błąd! Nie można odnaleźć źródła odwołania.

535   Subscribers' perception of Internet access is that it allows general access to a range of content
536   available on the Internet. The content can be served from within the SP Network, or typically from
537   outside of it. There is no strict boundary between the IPVC that provide access to the Internet, and
538   the Internet itself (as shown in the Figure above). The IPVC thus has only one IPVC End Point at
539   the UNI that connects to the Subscriber but does not have one that would connect it to the Internet.

540   Figure 4 shows some examples of how UNI Access Links in a given UNI can be connected to one
541   or multiple devices at the Subscriber and at the Service Provider. Other arrangements are also
542   possible.

Single UNI
Access Link

UNI Access Links
terminating on
different devices
at the SP

UNI Access Links
terminating on
different devices
at the SP and
Subscriber

UNI Access Links
terminating on
different devices
at the Subscriber

UNI

UNI Access Link

543
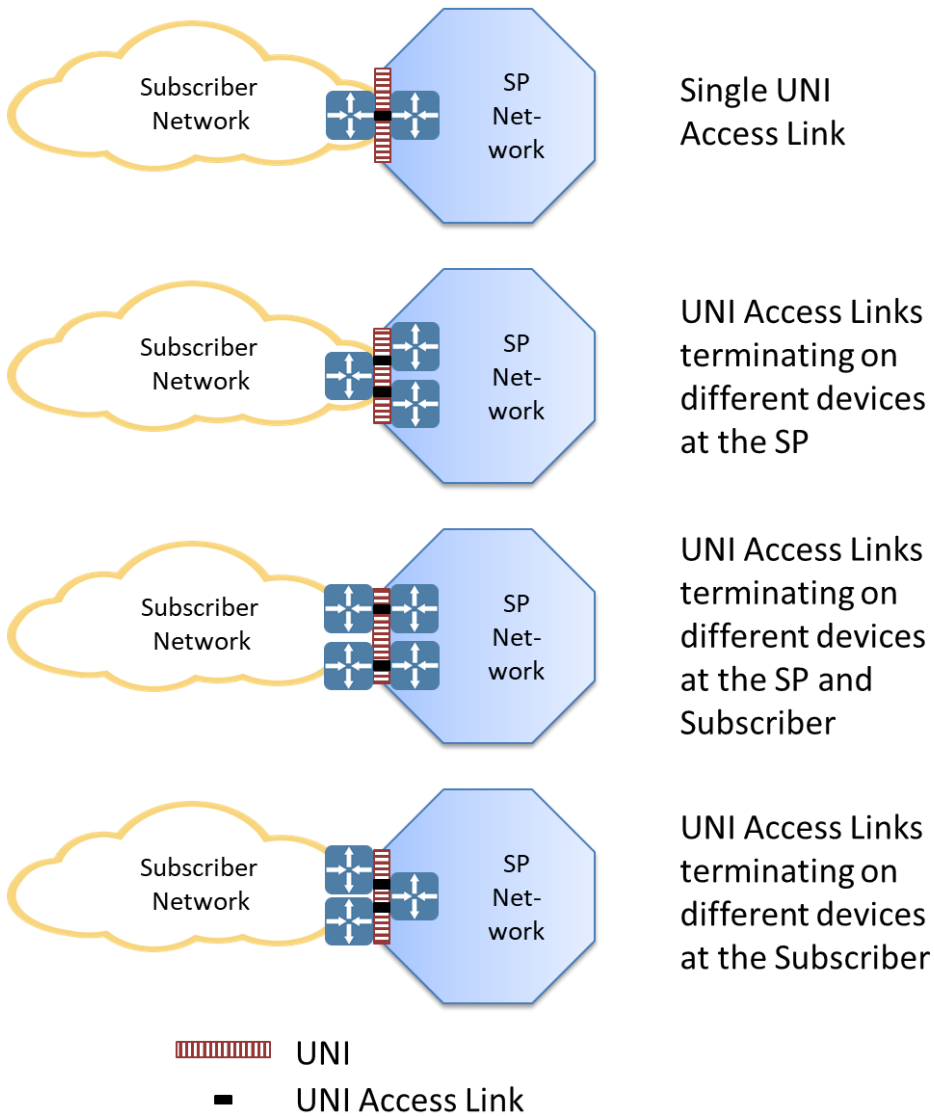
544   **Figure 4 Examples of UNI Access Links in a Single UNI** Błąd! Nie można odnaleźć źródła odwołania.

545

546 Two types of Internet Access can be offered: Basic and Advanced. The possible values for certain
547 Service Attributes differ between these two types. Basic Internet Access is typically delivered to
548 residential dwellings. It may be offered to small/medium businesses. Its service characteristics
549 typically include:

550 • plug-and-play ease of use

551 • low-cost

552 • For Ipv4, a few (or shared) publicly routed addresses

553 Advanced Internet Access is typically delivered to business locations. Its service characteristics
554 include:

555 • redundancy features

556 • dynamic routing protocol support (e.g., BGP [1] routing)

557 • options for Subscriber-supplied IP addressing

558 • proactive monitoring to support a Service Level Specification (SLS)

559

8 Data Model Design Principles and Assumptions

A Service Attribute for a Product 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 such as a Bandwidth Profile or a composition of objects such as an Ipv4 Secondary Subnet List. Within this document, each simple value (integer, string, boolean, etc.) is referred to as a Product-Specific Attribute. A Product-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). There are no Product-Specific Attributes that are tagged as "Required" in the Internet Access data model and, as such, each must be assigned by each Seller into one of three classifications as defined below.

Note: The one exception to the previous paragraph is the IPVC End Point defined for the IPVC (and subclasses). This must be included in the Internet Access data model since the IPVC is incomplete without them and is therefore tagged as "Required".

The design for the Internet Access data model is based on several assumptions:

- None of the Product-Specific Attributes included in the schemas are coded as "Required".

- The Buyer and Seller agree to assign each Product-Specific Attribute included in the schemas into one of three classifications. The classification for each Product-Specific Attribute may be different across Business Functions, Product Actions, and Product Offerings.

  o Mandatory – attributes that must be provided by the Buyer in a POQ/Quote/Order request or must be returned by the Seller for an Inventory request as specified in section 8.1.

  o Optional – attributes that may be provided by the Buyer in a POQ/Quote/Order request and may be returned by the Seller for an Inventory request as specified in section 8.2.

  o Fixed – attributes that are hard-coded and may be specified by the Buyer in a POQ/Quote/Order request (subject to agreement between the Buyer and Seller) and may be returned by the Seller for an Inventory request (subject to agreement between the Buyer and Seller) as specified in section 8.3.

As noted above, the classification may depend on:

- Business Function – a given Product-Specific Attribute may, for example, be classified as Fixed for the Create POQ request; while it may be classified as Mandatory for the Create Product Order request.

594 • Product Action – a given Product-Specific Attribute may, for example, be classified as
595   Mandatory for the Create POQ request for an INSTALL of a new product, while it may be
596   classified as Fixed for the Create POQ request for a CHANGE of an installed Product.

597 • Product Offering – a given Product-Specific Attribute may, for example, be classified as
598   Mandatory for the Create POQ request for a Product Offering (e.g., Premium Service),
599   while it may be classified as Fixed for the Create POQ request for a different Product
600   Offering (e.g., Basic Service).

601 The Product-Specific Attribute classification can be defined and negotiated during the onboarding
602 process or defined in a Product Catalog.

603 **[R1]** The Seller and Buyer **MUST** agree, for each Product-Specific Attribute,
604   whether the attribute is Mandatory, Optional, or Fixed for each Business
605   Function (POQ, Quote, Order) and Product Action (INSTALL, CHANGE) for
606   a Product Offering.

607 **[R2]** The Seller and Buyer **MUST** agree, for each Product-Specific Attribute,
608   whether the attribute is Mandatory, Optional, or Fixed for Inventory for a
609   Product Offering.

610 **[R3]** If, for a Product Offering, a Product-Specific Attribute is classified as Optional
611   for any Business Function and, if applicable, Product Action, the Seller and
612   Buyer **MUST** agree on the default value for the attribute.

613 **[R4]** The Seller **MUST** reject an API request if the value for a Product-Specific
614   Attribute requested by the Buyer is not a supported value for the applicable
615   Product Offering.

616 The Internet Access data model supports both INSTALL and CHANGE actions for POQ, Quote,
617 and Order for all specified products. Note that the DISCONNECT action does not require support
618 from the data model.

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

622 **8.1   Mandatory Product-Specific Attributes**

623 **[R5]** If a Product-Specific Attribute is agreed to be Mandatory for a Business
624   Function (POQ, Quote, Order), Product Action (INSTALL, CHANGE), and
625   Product Offering, then the Buyer **MUST** include a value for the attribute in the
626   corresponding API request.

[R6]   If a Product-Specific Attribute is agreed to be Mandatory for Inventory for a Product Offering, then the Seller **MUST** include a value for the attribute in the corresponding API response.

[R7]   When the Seller receives a POQ, Quote, or Order request in which any of the Mandatory Product-Specific Attributes are not included, the request **MUST** be rejected by the Seller.

8.2   Optional Product-Specific Attributes

[O1]   If a Product-Specific Attribute is agreed to be Optional for a Business Function (POQ, Quote, Order), Product Action (INSTALL, CHANGE), and Product Offering, then the Buyer **MAY** include a value for the attribute in the corresponding API request.

[R8]   The Seller **MUST** apply the agreed default value for an Optional Product-Specific Attribute if a value is not included by the Buyer in the corresponding API request.

[R9]   If a Product-Specific Attribute is agreed to be Optional for Inventory for a Product Offering, then the Seller **MUST** include a value for the attribute in the corresponding API response if the value is not the agreed default value.

[O2]   If a Product-Specific Attribute is agreed to be Optional for Inventory for a Product Offering, then the Seller **MAY** include a value for the attribute in the corresponding API response if the value is the agreed default value.

8.3   Fixed Product-Specific Attributes

A Product-Specific Attribute may be classified as Fixed for a Business Function, Product Action, and Product Offering when only one value is applicable for the Seller. This can be the case for example if:

- the Seller supports only a single value, or

- the value is derived by the Seller from the value of one or more other Product-Specific Attributes, or

- the Seller specifies a single value in the Product Catalog for a specific Product Offering, or

- the Buyer and the Seller agree on a single value during onboarding

Since these are Product-Specific Attributes, each value must still be agreed upon in some way between the Buyer and the Seller, which implies that even in the first two cases, the Seller must make the Buyer aware of what the value is or how it is derived, before the Buyer places an order. How this is done is outside the scope of this document.

661 The Seller applies the one applicable value for every request for which the Product-Specific
662 Attribute is classified as Fixed.

663 **[R10]** The Buyer and Seller **MUST** agree on whether the Buyer can include Product-
664 Specific Attributes that have been classified as Fixed in API requests for POQ,
665 Quote, and Order.

666 **[R11]** If the Buyer and Seller agree that Product-Specific Attributes classified as
667 Fixed cannot be included in API requests (see [R10]), the Buyer and Seller
668 **MUST** agree on whether the Seller includes Product-Specific Attributes
669 classified as Fixed in the corresponding API responses.

670 **[R12]** If the Buyer and Seller agree that Product-Specific Attributes classified as
671 Fixed cannot be included in API requests (see [R10]), the Seller **MUST** reject
672 an API request from the Buyer if it includes a Product-Specific Attribute that
673 has been classified as Fixed for the Business Function (POQ, Quote, Order),
674 Product Action (INSTALL, CHANGE), and Product Offering.

675 **[R13]** If the Buyer and Seller agree that Product-Specific Attributes classified as
676 Fixed cannot be included in API requests (see [R10]), and if a Product-Specific
677 Attribute is classified to be Fixed for Inventory for a Product Offering, then the
678 Seller **MUST NOT** include a value for the Product-Specific Attribute in the
679 Inventory API responses.

680 **[R14]** If the Buyer and Seller agree that Product-Specific Attributes classified as
681 Fixed can be included in API requests (see [R10]), the Seller **MUST** reject an
682 API request from the Buyer if it includes a Product-Specific Attribute that has
683 been classified as Fixed for the Business Function (POQ, Quote, Order),
684 Product Action (INSTALL, CHANGE), and Product Offering and includes a
685 value that is different than the agreed-on fixed value.

686 **[R15]** If the Buyer and Seller agree that Product-Specific Attributes classified as
687 Fixed can be included in API requests (see [R10]), and if a Product-Specific
688 Attribute is classified to be Fixed for Inventory for a Product Offering, then the
689 Seller **MUST** include a value for the Product-Specific Attribute in the
690 Inventory API responses.

691 ⎯⎯⎯⎯⎯

692 # 9 Order Milestones

693 The Service Provider (Seller) can provide Product-Specific Product Order Item Milestone
694 notifications to the Buyer on the status of an Order as a sequence of Milestones for that Order as
695 they are achieved. For ordering an Internet Access Service (IPVC and UNI) the following
696 milestones are commonly used (a Service Provider may support some or all these milestones and
697 not all milestones are applicable for all orders):

Milestone Value	Description	Applies To
SITE_SURVEY_SCHEDULED	Site Survey Scheduled	UNI
SITE_SURVEY_COMPLETE	Site Survey Complete	UNI
PLANNING_COMPLETE	Planning Complete	UNI, IPVC
FIRM_DELIVERY_DATE_PROVIDED	Firm Delivery Date Provided	UNI, IPVC
AWAITING_MUNICIPAL_APPROVAL	Awaiting Municipal Approval	UNI
MUNICIPAL_APPROVAL_GRANTED	Municipal Approval Granted	UNI
AWAITING_LANDLORD_APPROVAL	Awaiting Landlord Approval	UNI
LANDLORD_APPROVAL_GRANTED	Landlord Approval Granted	UNI
CONSTRUCTION_STARTED	Construction Started	UNI
CONSTRUCTION_COMPLETED	Construction Completed	UNI
AWAITING_ACCESS	Awaiting Site Access Permission (for end-to-end test)	UNI, IPVC
ACCESS_DENIED	Site Access Denied (for end-to-end test). Issue is to be resolved with the Buyer and access may be re-attempted.	UNI, IPVC
AWAITING_WIRING	Awaiting Installation of Inside Wiring by Landlord	UNI
WIRING_COMPLETE	Installation of Inside Wiring by Landlord Complete	UNI
EQUIPMENT_DISPATCHED	Equipment Dispatched	UNI
EQUIPMENT_DELIVERED	Equipment Delivered	UNI
EQUIPMENT_INSTALLED	Equipment Installed	UNI
E2E_TESTING_SCHEDULED	End-to-End Testing Scheduled	IPVC
E2E_TESTING_COMPLETED	End-to-End Testing Completed	IPVC
E2E_TESTING_FAILED	End-to-End Testing Failed. Issue is to be resolved and testing may be re-attempted.	IPVC

698 **Table 2 Order Milestones for Internet Access**

699 The Milestone Value in the first column of Table 2 is included in *ProductOrderItem.milestone* and
700 *ProductOrderEventPayload.milestoneName* in the Product Order API (see MEF 123 [19]).

701 Note: Milestones and their notifications are independent of Product Order Item's state.

10 Information Model for Internet Access Product Data Model

Internet Access Services are composed of five primary classes of objects: IPVC, IPVC End Point, IP UNI, IP UNI Access Link, and IP UNI Access Link Trunk. A complete Internet Access product consists of:

- Exactly one IPVC (see section 14.3)
- One IP UNI where the Subscriber accesses the service (see section 14.4).
- Exactly one IPVC End Point for the IPVC at this IP UNI. (see section 14.3.4).
- One (for Basic and Exclusive Internet Access) or more UNI Access Links in each UNI, (see section 14.5).
- One (for Basic and Exclusive Internet Access) or more UNI Access Link Trunks each carrying one or more UNI Access Links (see section 14.6).

Based on the above there are two main types of Internet Access defined – Basic and Advanced. The Advanced one comes with an additional flavor called "Exclusive". The differences between them are explained by the following figures. The convention is as follows:

- The surrounding rectangle designates the scope of a given product and provides its name and urn.
- The model shows only the main components listed above and the relations between them, including cardinalities. All other attributes and types are hidden.
- Relations between other products (crossing the big rectangles) or locations are provided on the envelope level (as specified in section 12). The source and target of such relations on the diagrams are bound to objects that are their logical sides, yet technically the relation on the envelope is on the root product level.
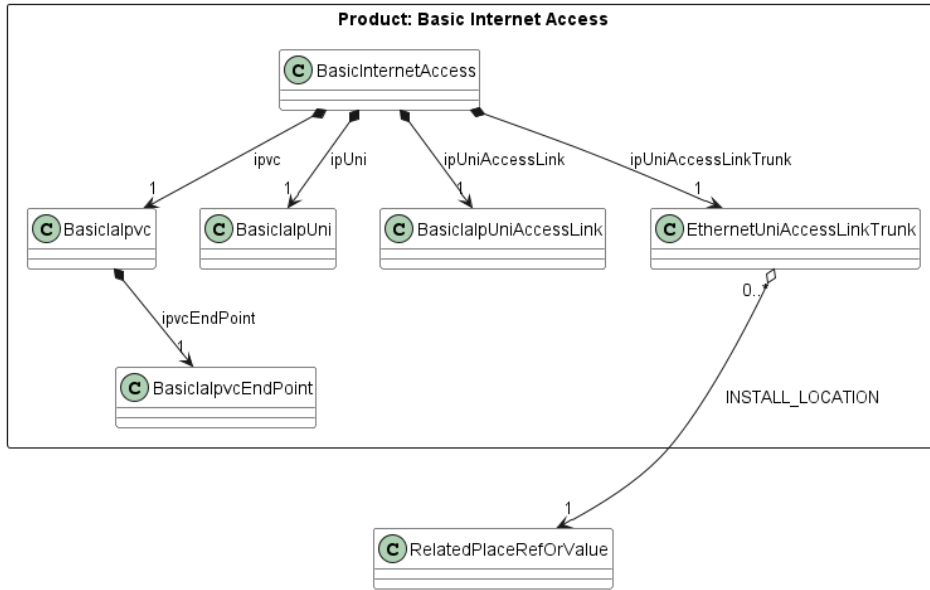
Figure 5 Information model for Basic Internet Access product

Figure 5 presents the information model for Basic Internet Access. MEF 69.1 [10] defines restrictions for Basic Internet Access such that all relations' cardinalities have exactly the value of 1 and that they are exclusive for a given product instance (meaning that all components serve only one IPVC). This allows this product to be modeled in a simplified way as one main type (BasicInternetAccess) having all components as single ref attributes. This means that all components (IPVC, IPVC End Point, UNI, UNI Access Link, and UNI Access Link Trunk) are ordered with a single Product Order Item. Since all components are within the same order, the only envelope-level relation is the one to a place. It is the UNI Access Link Trunk that is the logical owner of the relationship

738

739
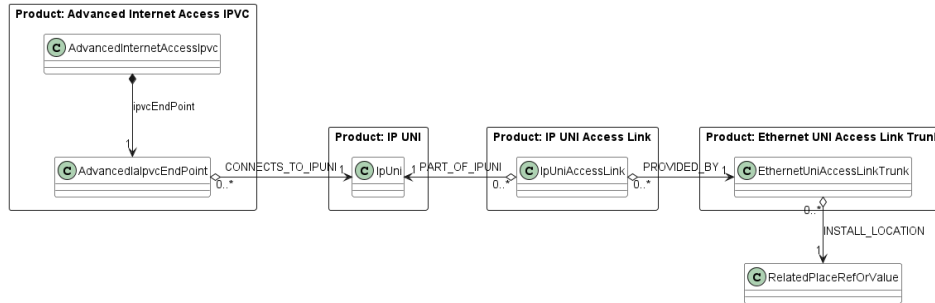
Figure 6 Information model for Advanced Internet Access product

741 Figure 6 shows the building blocks of an Advanced Internet Access product. It implements the
742 Advanced flavor of Internet Access as specified by MEF 69.1 [10]. In fact, it is a set of 4 distinct
743 products that must be ordered separately by different Product Order Items of one (or more) Product
744 Orders. Note the main differences compared to Basic Internet Access:

745 • IP UNI can serve more than one Advanced Internet Access product (and possibly other IP
746   products such as IP VPN).

747 • IP UNI can be provided by more than one IP UNI Access Link.

748 • Ethernet UNI Access Link Trunk can serve more than one IP UNI Access Link.

749 • All relations between components are specified by envelope-level product or order item
750   relationships (as specified in section 12).

751 • The place relationship is specified by the Ethernet UNI Access Link Trunk product.

752
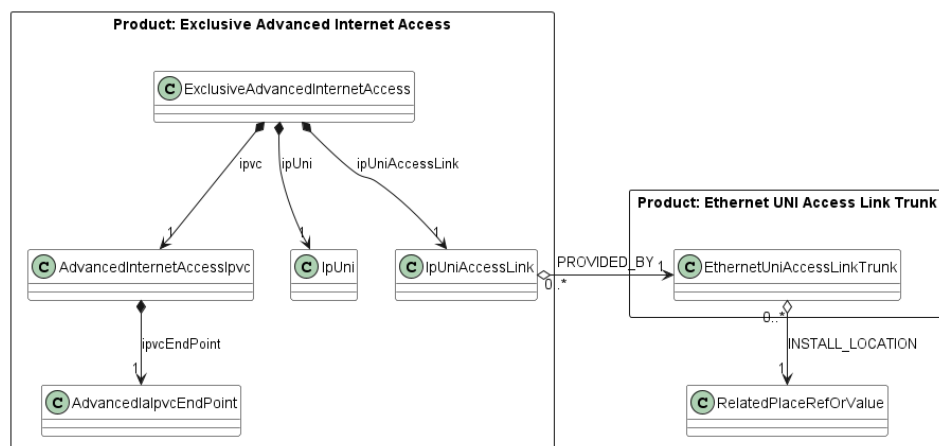
Figure 7 Information model for Exclusive Advanced Internet Access IPVC product

MEF 69.1 [10] defines 2 types of Internet Access: Basic and Advanced. They differ by several requirements summarized in section 13. However, the flexibility of Advanced Internet Access comes with the burden of the necessity of ordering 4 different products. This is addressed by introducing the Exclusive Advanced Internet Access product. It is still an Advanced Internet Access as specified by MEF 69.1 [10], but adds some assumptions that cover most of the probable common deployment configurations. These are:

- The IPVC is served exclusively by one IP UNI (hence the product name)

- The IP UNI is served exclusively by one IP UNI Access Link.

This allows merging the IPVC, IP UNI, and IP UNI Access Link into one product definition called Exclusive Advanced Internet Access. This also reduces the number of product relations defined on the envelope level to only 1. The Ethernet UNI Access Link Trunk remains a separately ordered product, allowing for serving multiple IP UNI Access Links.

10.1 Organization of Service Attributes

The data model of Internet Access products is based on Service Attributes defined in MEF 61.1 [8], and MEF 61.1.1 [9], and implements Service Definition Requirements as specified in MEF 69.1 [10] Section 9. These requirements result in Basic and Advanced versions being a variation of Service Attributes defined in MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.**. A set of Common classes was introduced to gather the attributes shared by Basic and Advanced flavors. Note that the Common types are not as specified by MEF 61.1 [8] or MEF 61.1.1 [9] but only subsets of them.

774
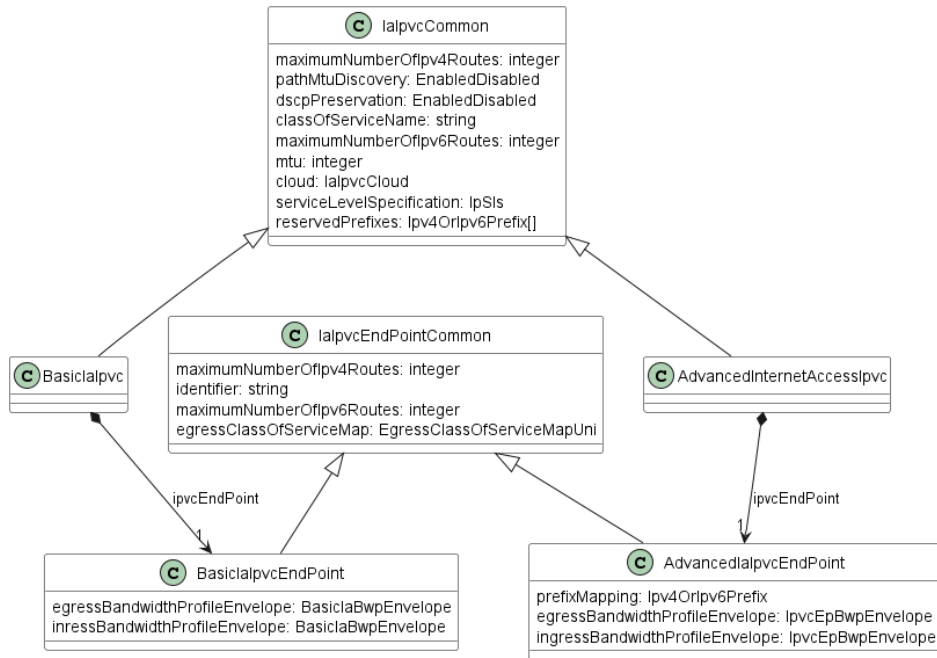
775

776 **Figure 8 IPVC and IPVC End Points Common classes**

777 Figure 8 presents the organization of Common IPVC and IPVC End Point types and differences
778 in their respective Basic and Advanced subtypes. The IPVC flavors differ only by the type of
779 referenced IPVC End Points which have different types used for ingress and egress bandwidth
780 profiles envelopes and the AdvanceIaIpvcEndPoint additionally specifies prefixMapping. The
781 details of the differences are described in section 13.

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782
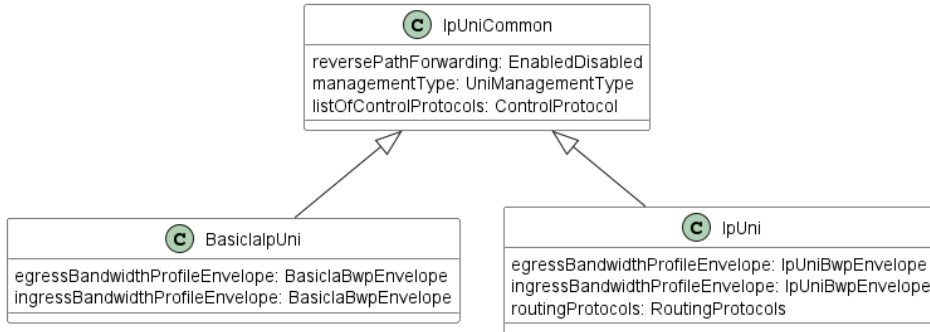
783 **Figure 9 IP UNI Common class**

784 Figure 9 shows that the difference between the Basic and Advanced flavors of UNI is how the
785 bandwidth profiles envelopes are specified and the IpUni can additionally provide
786 routingProtocols configuration. Note that the Advanced prefix is not present for the IpUni model
787 used by Advanced Internet Access. This is because this form does not introduce any Internet
788 Access specific restrictions and can be shared by different IP products (i.e. IP VPN) both on the
789 data model and instance level.

790
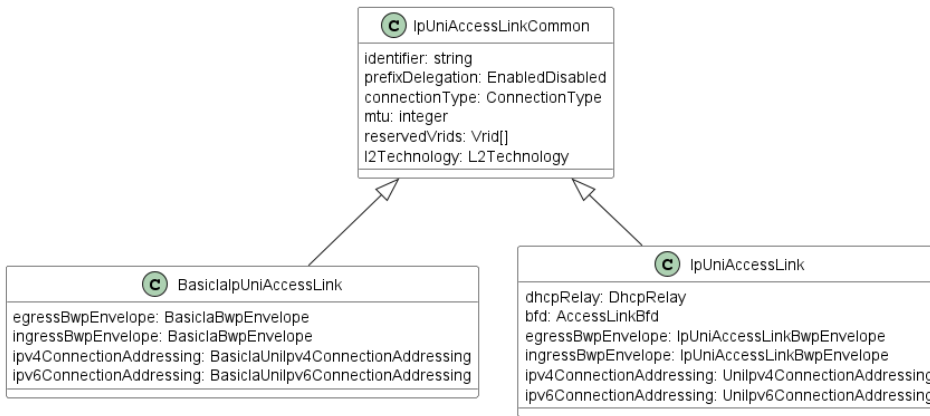
791 **Figure 10 IP UNI Access Link**

792 Figure 10 shows the differences between the Basic and Advanced flavors of IpUniAccessLink.
793 They differ on how the Bandwidth profile envelope and Ipv4/Ipv6 Connection Addressing are
794 specified. Additionally, IpUniAccessLink allows the specification of DHCP relay and BFD
795 attributes. As in the IpUni case – only BasicIaIpUniAccessLink is Internet Access specific.
796 IpUniAccessLink may also be used by other IP products.

797
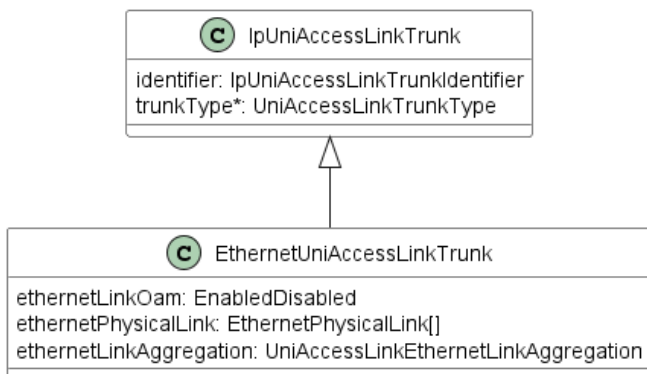
Figure 11 Ethernet Uni Access Link Trunk

799 The Ethernet Uni Access Link Trunk has the same representation in all flavors. Figure 11 shows
800 its inheritance from IpUniAccessLinkTrunk. MEF 61.1.1 [9] specifies Ethernet Uni Access Link
801 Trunk as the only available implementation of the IpUniAccessLinkTrunk.

802   11   Data Models for Internet Access Product

803   The data models for the Internet Access product configuration are expressed as a set of JSON
804   schemas based on JSON schema draft 7 [1] and encoded in YAML. These schemas accompany
805   this document. This section explains the organization and structure of these schemas.

806   11.1   Organization and Structure of the Schemas

807   The schemas are organized into a file structure as shown in Figure 12.

```
└ ip
  ┬ common
  │ ├─• ipCommon.yaml
  │ └─• ipSls.yaml
  ┬ internetAccess
  │ ┬ advancedInternetAccessIpvc
  │ │ └─• advancedInternetAccessIpvc.yaml
  │ ┬ basicInternetAccess
  │ │ └─• basicInternetAccess.yaml
  │ ┬ exclusiveAdvancedInternetAccess
  │ │ └─• exclusiveAdvancedInternetAccess.yaml
  │ ┬ internetAccessCommon
  │ │ └─• internetAccessCommon.yaml
  ┴ ipUni
    ├─• ethernetUniAccessLinkTrunk.yaml
    ├─• ipUni.yaml
    └─• ipUniAccessLink.yaml
```

808

809   **Figure 12 Schema Files Organization**

810   There are 3 root product specifications for Internet Access, namely *BasicInternetAccess*,
811   *AdvancedInternetAccessIpvc*, and *ExclusiveAdvancedInternetAccess*. They are specified by
812   schemas in separate dedicated directories and files inside the *internetAccess* directory. There is
813   also the *internetAccessCommon.yaml* that holds the definitions of types shared among the Internet
814   Access products. The *ipUni* catalog holds schemas for separately orderable products that are
815   building blocks for Advanced and Exclusive Advanced Internet Access Products. The *common*
816   catalog keeps the definition of types that are shared among other IP services.

817   Note: A CHANGE request cannot change a single Service Attribute. The Buyer must send a full
818   product configuration including all Mandatory Service Attributes (section 8.1) and all Optional
819   Service Attributes (section 8.2) that were previously specified by the Buyer (in an INSTALL
820   request or previous CHANGE request). Any Optional Service Attributes that are not specified in
821   a CHANGE request are reset to their default value.

822 **11.2   Additional Details**

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

826 **11.2.1   Naming Conventions**

827 In the schemas, class and type names are UpperCamelCase and Service Attribute/property names
828 are lowerCamelCase. Enumeration values are defined using UPPER_SNAKE_CASE.

829 **11.2.2   IPVC End Point Service Attributes**

830 IPVC End Points are not separately orderable items. They are part of the IPVC. The IPVC End
831 Points are the repositories for IPVC Service Attributes that can be different at each UNI.whereas
832 the IPVC Service Attributes have the same value at every point in the IPVC. The Internet Access
833 information model requires the IPVC to include exactly one IPVC End Point of type UNI hence
834 there is an explicit single attribute defined for IaIpvcCommon: `ipvcEndPoint`.

835 Internet Access allows this simplified coding since it has exactly one End Point and exactly of type
836 UNI. In the general case of a service that allows an arbitrary number of End Points (e.g., a
837 multipoint service) or where the external interface types are not predetermined, the End Points will
838 most likely be modeled as separately orderable products instead of being attributes of the IPVC.

839 Note that one of the IPVC End Point Service Attributes is IPVC End Point EI Type (**Błąd! Nie
840 można odnaleźć źródła odwołania.** section 11.2) which can be "UNI" or "ENNI". Since this
841 information is implicit, this Service Attribute is not included in the schema for Internet Access,
842 but likely would be included for other IP Services.

843 ## 12 Relationships Between Entities

844 This section describes the relationships (and their constraints) between the separately orderable
845 products and between the products and places.

846 The use case for Advanced Internet Access is based on purchasing the AdvancedIaIpvc,
847 AdvancedIaUni, and an AdvancedIaUniAccessLink

848 The relationship between separately managed products is captured in the product-agnostic part of
849 the POQ, Quote, and Order APIs. The values in the Relationship Type column in the table below
850 are used in the *relationshipType* field of the *ProductRelationship*, *QualificationItemRelationship*,
851 *QuoteItemRelationship,* and *OrderItemRelationship* types. Specification of the UNI is mandatory
852 at INSTALL and CHANGE of the product.

853 The final column notes that during POQ and Quote, a list of references might be provided or not.
854 The list denotes that a range of related objects is provided to choose from.

Source Product	Relationship Type	INSTALL	CHANGE	Target Product	Cardinality
Advanced Internet Access IPVC	CONNECTS_TO_IPUNI	Mandatory	Mandatory	**IP UNI**	1
IP UNI Access Link	PART_OF_IPUNI	Mandatory	Mandatory	**IP UNI**	1
IP UNI Access Link	PROVIDED_BY	Mandatory	Mandatory	**Ethernet UNI Access Link Trunk**	1
Exclusive Advanced Internet Access IPVC	PROVIDED_BY	Mandatory	Mandatory	**Ethernet UNI Access Link Trunk**	1

855 **Table 3 Product Relationship Roles**

856 **[R16]** For a product listed in the Source Product column of Table 3, the *Relationship*
857 *Type* field of the *Product Relationship, POQ Item Relationship, Quote Item*
858 *Relationship, and Order Item Relationship* types **MUST** contain the
859 corresponding value shown in the Relationship Type column.

860 **[R17]** For POQ, Quote, and Order, relationships listed in Table 3 **MUST** be specified
861 for every INSTALL of, or CHANGE to, a product listed in the Source Product
862 column of Table 3.

863 **[R18]** For a product listed in the Source Product column of Table 3, the relationship
864 **MUST** reference the respective product listed in the Target Product column or
865 an equivalent POQ Item, Quote Item, or Order Item.

866 **[R19]** For a CHANGE to a product listed in the Source Product column of Table 3
867 the specified relationship **MUST NOT** be changed from the value present in
868 the Product Inventory.

869 Note that [R19] indicates that once Advanced Internet Access IPVC or Ip Uni Access Link product
870 is associated with an IP UNI, it cannot be associated with a different IpPUNI.

871 The Ethernet UNI Access Link Trunk is the location-oriented component that builds the Internet
872 Access product. In the case of Basic Internet Access, the Ethernet UNI Access Link Trunk is part
873 of the whole product definition, thus it is the Basic Internet Access product that needs to have a
874 relationship to the location. In Advanced Internet Access cases, the Ethernet UNI Access Link
875 Trunk is a separately orderable product, so the location relation must be set from this product. The
876 Ethernet UNI Access Link Trunk is associated with a specific INSTALL_LOCATION and as
877 noted below, it is required at INSTALL and CHANGE and once it is associated with a specific
878 location, the INSTALL_LOCATION cannot be changed. The install location is captured in the
879 product-agnostic part of the POQ, Quote, and Order APIs. The value in the Place Relationship
880 Role column in the table below is used in the *role* field of the *RelatedPlaceRefOrValue* type.

881 **Table 4**

Product	Place Relationship Role	INSTALL	CHANGE
Basic Internet Access	INSTALL_LOCATION	Mandatory	Mandatory
Ethernet UNI Access Link Trunk	INSTALL_LOCATION	Mandatory	Mandatory

882 **Table Place Relationship Role**

883 **[R20]** For Basic Internet Access or Ethernet UNI Access Link Trunk products, the
884 Role field (*role*) of the Related Place (*RelatedPlaceRefOrValue)* type **MUST**
885 contain the INSTALL_LOCATION value shown in the Place Relationship
886 Role column in.

887 **[R21]** For POQ, Quote, and Order, the Related Place (*RelatedPlaceRefOrValue)*
888 **MUST** be specified for every INSTALL of, or CHANGE to, a Basic Internet
889 Access and Ethernet UNI Access Link Trunk.

890 **[R22]** For a CHANGE to a Basic Internet Access or Ethernet UNI Access Link Trunk
891 product, the Related Place **MUST NOT** be changed from the value present in
892 the Product Inventory.

893

13 Basic vs. Advanced Service Attributes requirements

There are several Service Attributes defined by MEF 61.1 **Błąd! Nie można odnaleźć źródła odwołania.** that MEF 69.1 [10] puts additional requirements when applying to Basic or Advanced Internet Access definition. This results in some attributes differing from their original definition or missing from the Product Schema specified by this document.

These variations are presented for both Basic and Advanced versions, side by side in the Tables below (all numbered requirements come from MEF 69.1 [10] and thus the document number is not mentioned each time):

Service Attribute	Basic Internet Access (BasicIaIpvc)	Advanced Internet Access (AdvancedIaIpvc)
IPVC Identifier	**Not present** There is no need for an additional Identifier. The IPVC product instance gets the product.is assigned upon creation in the Seller's system, which then can be used for inter-product references.	
IPVC Topology	**Not present** [R4] IPVC Topology MUST be *Cloud Access*	
IPVC End Point List	[R5] IPVC End Point List MUST have exactly one entry.	
	Single attribute instead of a list: BasicIaIpvc.ipvcEndPoint **Ref type: BasicIaIpvcEndPoint**	**Single attribute instead of a list: AdvancedIaIpvc.ipvcEndPoint** **Ref type: AdvancedIaIpvcEndPoint**
IPVC Packet Delivery	**Not present.** Packet Delivery is an enumeration with 2 values: *Static Routing* and *Policy Based Routing*. But according to the description "*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*". That leaves the *Standard Routing* the only available option, so there is no need to specify it.	
IPVC DSCP Preservation	[D3]IPVC DSCP Preservation SHOULD be Disabled. **The requirement is stated in the attribute's description.**	
IPVC List of Class of Service Names	[R7] The IPVC List of Class of Service Names MUST have exactly one entry **Single attribute instead of a list: *classOfServiceName***	
IPVC Fragmentation	**Not present.** [R8] IPVC Fragmentation MUST be Enabled. Note: Fragmentation is necessary for an Internet Access Service as the Subscriber has no control over the size of packets received from the Internet. IPVC Fragmentation Enabled ensures the ISP will not discard any packets destined for the Subscriber that exceed the allowable IPVC MTU size.	

Service Attribute	Basic Internet Access (BasicIaIpvc)	Advanced Internet Access (AdvancedIaIpvc)
IPVC Cloud Cloud Type	**Not present.** [R9] IPVC Cloud. Cloud Type MUST be *Internet Access*.	
IPVC Cloud Cloud Ingress Class of Service Map	**Not present.** [R10] Cloud Ingress Class of Service Map (F, M, D), map M MUST be empty. [R11] Cloud Ingress Class of Service Map (F, M, D), default CoS name, D, MUST NOT be *Discard*. When map M is empty, the F has no effect. Additionally, only one Class of Service can be specified, so with R11, that means there is no point in specifying the whole Ingress Class of Service Map.	
IPVC Cloud Cloud DNS Service	[R12] For a Basic Internet Access Service, Cloud DNS MUST NOT be *None*. **The requirement is stated in the attribute's description.**	For an Advanced Internet Access Service, a value of None for Cloud DNS is not precluded.
IPVC Cloud Cloud DNS Service	[R13] If the Cloud DNS parameter of the IPVC Cloud Service Attribute is *Static*, the associated list of DNS Servers MUST have at least one entry. [D4] If the Cloud DNS parameter of the IPVC Cloud Service Attribute is *Static*, the associated list of DNS Servers SHOULD contain at least two DNS servers. **Requirements are stated in the attribute's description.**	
IPVC Reserved Prefixes	[R14] IPVC Reserved Prefixes MUST be either empty or free from any public address prefixes. **The requirement is stated in the attribute's description.**	

902   **Table 5 IPVC Service Attributes requirements**

903

Service Attribute	Basic Internet Access (BasicIaIpvcEndPoint)	Advanced Internet Access (AdvancedIaIpvcEndPoint)
IPVC EP EI	**Not present.** **IpUni is a composite of BasicInternetAccess there is no need to use additional references.**	**Not present.** **IpUni is either a composite of ExclusiveAdvancedInternetAccess and there is no need to use additional references or is referenced on the envelope level in the case of AdvancedInternetAccessIpvc product**
IPVC EP EI Type	**Not present.** Always the value of *UNI*	

Service Attribute	Basic Internet Access (BasicIapvcEndPoint)	Advanced Internet Access (AdvancedIapvcEndPoint)
IPVC EP Role	**Not present.** [R16] IPVC EP Role MUST be *Root*.	
IPVC EP ENNI Service Mapping Identifier	**Not present.** Not relevant for Internet Access	
IPVC EP Ingress Class of Service Map	**Not present.** [R17] IPVC Ingress EP Class of Service Map (F, M, D), map M MUST be empty. [R18] IPVC Ingress EP Class of Service Map (F, M, D), default CoS name, D, MUST NOT be *Discard*. When map M is empty, the F has no effect. Additionally, only one Class of Service can be specified, so with R11, that means there is no point in specifying the whole Ingress Class of Service Map.	
IPVC EP Ingress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D5] For a Basic Internet Access Service, the IPVC EP Ingress Bandwidth Profile Envelope SHOULD be *None*. **The requirement is stated in the attribute's description.**	**Ref type: IpvcEpBwpEnvelope**
IPVC EP Egress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D6] For a Basic Internet Access Service, the IPVC EP Egress Bandwidth Profile Envelope SHOULD be *None*. **The requirement is stated in the attribute's description.**	**Ref type: IpvcEpBwpEnvelope**
IPVC EP Prefix Mapping	**Not present.** [R19] For a Basic Internet Access Service, the IPVC EP Prefix Mapping MUST be Empty.	--

Table 6 IPVC End Point Service Attributes requirements

Service Attribute	Basic Internet Access (BasicIapUni)	Advanced Internet Access (IpUni)
UNI Identifier	**Not present** There is no need for an additional Identifier. The IpUni product instance gets the product.is assigned upon creation in the Seller's system, which then can be used for inter-product references	

Service Attribute	Basic Internet Access (BasicIaIpUni)	Advanced Internet Access (IpUni)
UNI List of UNI Access Links Service Attribute	**Not present.** IpUniAccessLink is a composite of BasicInternetAccess there is no need to use additional references.	**Not present.** IpUniAccessLink is either a composite of ExclusiveAdvancedInternetAccess and there is no need to use additional references or is referenced on the envelope level in the case of IpUni product
UNI Ingress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D7] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Ingress Bandwidth Profile Envelope is not *None*, it SHOULD have Bandwidth Profile Flows that contain all Ingress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 Table 28). **The requirement is stated in the attribute's description.**	**Ref type: IpUniBwpEnvelope**
UNI Egress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D8] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Egress Bandwidth Profile Envelope is not *None*, it SHOULD have Bandwidth Pro-file Flows that contain all Egress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1Table 28). **The requirement is stated in the attribute's description.**	**Ref type: IpUniBwpEnvelope**
UNI List of Control Protocols	[D9] At a UNI with an IPVC EP for an Internet Access Service, if the UNI has at least one UNI Access Link where the UNI Access Link IPv4 Connection Addressing is not None, the UNI List of Control Protocols SHOULD include ICMP with a list of applicable ISP IP addresses. [D10] At a UNI with an IPVC EP for an Internet Access Service with at least one UNI Access Link where the UNI Access Link IPv6 Connection Addressing is not None, the UNI List of Control Protocols SHOULD include ICMPv6 with a list of applicable SP IP addresses. **The requirement is stated in the attribute's description.**	
UNI Routing Protocols	**Not present.** [R21] At a UNI with an IPVC EP for a Basic Internet Access Service, the UNI Routing Protocols list MUST be empty.	--
UNI Reverse Path For-warding	[D11] At a UNI with an IPVC EP for an Internet Access Service, UNI Reverse Path Forwarding SHOULD be Enabled. **The requirement is stated in the attribute's description.**	

906   **Table 7 IP UNI Service Attributes requirements**

Service Attribute	Basic Internet Access (BasicIaIpUniAccessLink)	Advanced Internet Access (IpUniAccessLink)
UNI Access Link IPv4 Connection Addressing	[R23] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, UNI Access Link IPv4 Connection Addressing MUST be DHCP or None. **Ref type:** *BasicIaUniIpv4ConnectionAddressing* **does not have the** *ipv4AddressType* **attribute, as if set it MUST be** *DHCP*	[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 None. **IpUniAccessLink is a type that is shared among other IP Services so it does not contain InternetAccess-specific restrictions, thus the requirement is only stated in the attribute's description.**
UNI Access Link IPv4 Connection Addressing	[R24] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Access Link IPv4 Connection Addressing is DHCP, the UNI Access Link IPv4 Connection Addressing Secondary Subnet List parameter MUST be empty. **Ref type:** *BasicIaUniIpv4ConnectionAddressing* **does not have the** *ipv4SecondarySubnetList* **attribute.**	--
UNI Access Link IPv4 Connection Addressing	[R25] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Access Link IPv4 Connection Addressing is DHCP, the UNI Access Link IPv4 Connection Addressing Primary Subnet parameter MUST contain only a single Service Provider IPv4 Address. **The requirement is stated in the attribute's description.**	--
UNI Access Link IPv6 Connection Addressing	[R27] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, UNI Access Link IPv6 Connection Addressing MUST be DHCP or SLAAC or None. **BasicIaUniIpv6ConnectionAddressing:** *ipv6AddressType* **attribute only contains possible values:** *DHCP, SLAAC*	[R26] At a UNI Access Link in a UNI with an IPVC EP for an Advanced Internet Access Service, UNI Access Link IPv6 Connection Addressing MUST be Static or None. **IpUniAccessLink is a type that is shared among other IP Services so it does not contain InternetAccess-specific restrictions, thus the requirement is only stated in the attribute's description.**
UNI Access Link IPv6 Connection Addressing	[R28] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Access Link IPv6 Connection Addressing is DHCP or SLAAC, the UNI Access Link IPv6 Connection Address Subnet List parameter MUST contain a single entry.	--

Service Attribute	Basic Internet Access (BasicIaIpUniAccessLink)	Advanced Internet Access (IpUniAccessLink)
	BasicIaUniIpv6ConnectionAddressing: *ipv6Subnet* **is a single attribute instead of a list**	
UNI Access Link IPv6 Connection Addressing	[R29] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Access Link IPv6 Connection Addressing is DHCP or SLAAC, the UNI Access Link IPv6 Connection Addressing Subnet List parameter MUST contain only a single Service Provider IPv6 Address. **The requirement is stated in the attribute's description.**	--
UNI Access Link DHCP Relay	**Not present.** [R30] For a Basic Internet Access Service, where the UNI contains only a single IP Service, the UNI Access Link DHCP Relay MUST be empty.	--
UNI Access Link BFD	**Not present.** [R31] For a Basic Internet Access Service, UNI Access Link BFD MUST be *None*.	--
UNI Access Link Ingress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D12] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, UNI Access Link Ingress Bandwidth Profile Envelope SHOULD be *None*. **The requirement is stated in the attribute's description.**	**Ref type: IpUniAccessLinkBwpEnvelope**
UNI Access Link Egress Bandwidth Profile Envelope	**Ref type: BasicIaBwpEnvelope** [D13] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, UNI Access Link Egress Bandwidth Profile Envelope SHOULD be *None*. **The requirement is stated in the attribute's description.**	**Ref type: IpUniAccessLinkBwpEnvelope**
UNI Access Link Reserved VRIDs Service Attribute	[D14] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, UNI Access Link Reserved VRIDs Service Attribute SHOULD be None. **The requirement is stated in the attribute's description.**	--

907 **Table 8 IP UNI Access Link Service Attributes requirements**

14 Internet Access Service Attributes

This section provides a guide to the detailed model of the Internet Access product in all flavors. It starts with the model of the top-level product types, then dives into the models of main components (IPVC, IP UNI, etc.).

Not all MEF 61.1 [8] and MEF 61.1.1[9] Service Attributes are included in the data model. The Service Attributes that are not included are also listed in section 13. Some Service Attributes are not included because they are included in the Product Independent information portion of the API (e.g., many of the Identifiers), and some Service Attributes are not included because they are constants in the context of Internet Access (i.e., can only have one possible value) or are simple attributes instead of lists because the cardinality is restricted to 1.

In figures below some classes' attributes or further class tree are skipped for diagram readability. This is denoted by the *"<<skipped>>"* clause.

Some requirements define Service Attributes as mutually exclusive. This means that either one or the other must be provided, but 2 (or more) of them at the same time. This is defined in the schema using the "oneOf" statement at the "required" section of the type definition.

For example the IpvcEpBwpEnvelope has 2 attributes: bwpFlowPerCosName and bwpFlowAll, but only one of them must be set at the same time. This part of schema defines this requirement looks as follows:

```
oneOf:
  - required: [bwpFlowPerCosName]
  - required: [bwpFlowAll]
```

In following sections, where applicable, this information is provided by including this section after the table with the attributes.

14.1   BasicInternetAccess

File: \ip\internetAccess\basicInternetAccess\basicInternetAccess.yaml

URN: urn:mef:lso:spec:cantata-sonata:basic-internet-access:v0.2.0:all

934
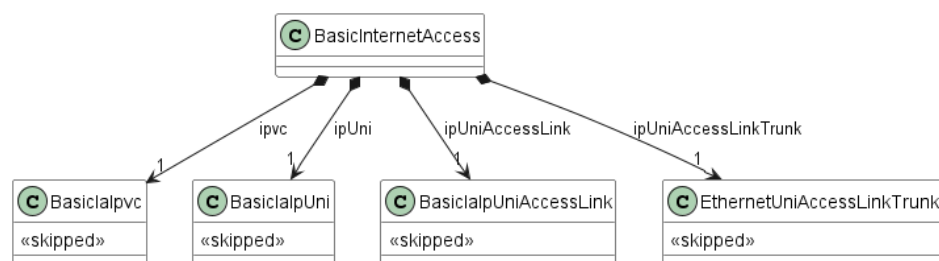
Figure 13 Basic Internet Access product

936 Figure 13 presents the model of *BasicInternetAccess*, as specified in *basicInternetAccess.yaml*. As
937 described in section 19, it gathers the configuration of all main product components in a single
938 "top-level" product. The details of components are skipped for readability and will be described
939 in later sections.

940 The Basic Internet Access IPVC is a MEF 69.1 defined version of MEF 61.1 IPVC. Reference
941 MEF 69.1 Section 9.1 Internet Access IPVC Requirements. It holds a complete configuration of
942 all needed product components: BasicIaIpvc, BasicIaIpUni, BasicIaIpUniAccessLink, and
943 ethernetUniAccessLinkTrunk.

Name	Type	Multiplicity	Description
ipUniAccessLink*	BasicIaIpUniAccessLink	1	Configuration of Service Attributes for Basic Internet Access IP UNI Access Link
ipUni*	BasicIaIpUni	1	Configuration of Service Attributes for Basic Internet Access IP UNI
ipUniAccessLinkTrunk*	ethernetUniAccessLinkTrunk	1	Configuration of Service Attributes for Basic Internet Access IP UNI Access Link Trunk
ipvc*	BasicIaIpvc	1	Configuration of Service Attributes for Basic Internet Access IPVC

944 **Table 9 BasicInternetAccess**

945 **14.2   ExclusiveAdvancedInternetAccess**

946 File: \
947 ip\internetAccess\exclusiveAdvancedInternetAccess\exclusiveAdvancedInternetAccess.yaml

948 URN: urn:mef:lso:spec:cantata-sonata:exclusive-advanced-internet-access:v0.2.0:all

949

950
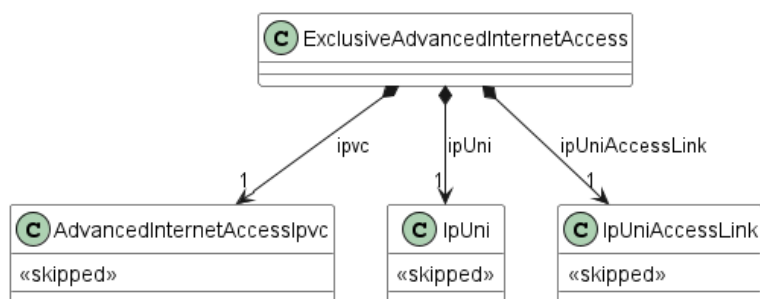
Figure 14 Exclusive Advanced Internet Access product

952 Figure 14 Exclusive Advanced Internet Access product presents the model of
953 *ExclusiveAdvancedInternetAccess*, as specified in *exclusiveAdvancedInternetAccess.yaml*. As
954 described in section 19, for simplicity it gathers the configuration of IPVC, IP UNI, and IP UNI
955 Access Link components in a single "top-level" product. The details of components are skipped
956 for readability and will be described in later sections.

957 The Advanced Internet Access IPVC is a MEF 69.1 defined version of MEF 61.1 IPVC. Reference
958 MEF 69.1 Section 9.1 Internet Access IPVC Requirements. It holds the configuration for most of
959 the required components: AdvancedInternetAccessIpvc, IpUni, and IpUniAccessLink. A reference
960 to EthernetUniAccessLinkTrunk must be provided on the product level.

Name	Type	Multiplicity	Description
ipUniAccessLink*	ipUniAccessLink	1	Configuration of Service Attributes for IP UNI Access Link
ipUni*	ipUni	1	Configuration of Service Attributes for IP UNI
ipvc*	advancedInternetAccessIpvc	1	Configuration of Service Attributes for Advanced Internet Access IPVC

961 **Table 10 ExclusiveAdvancedInternetAccess**

962 **14.3   IPVC**

963

964

965
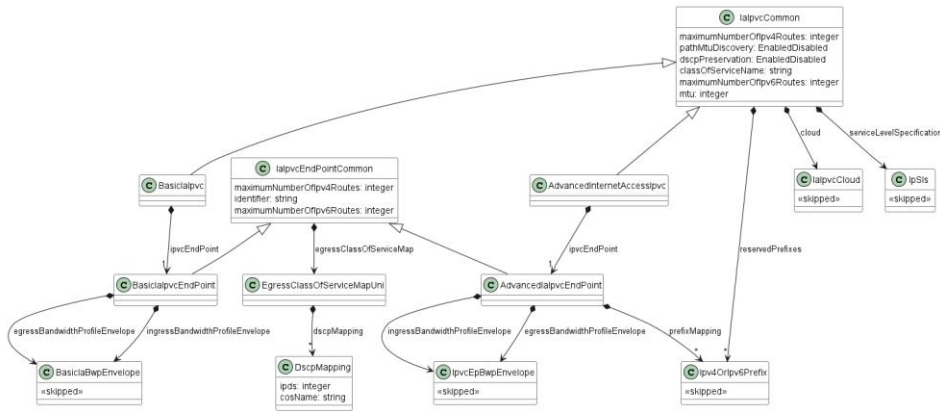
Figure 15 IPVC

Figure 15 shows the model of the IPVC. In the case of Internet Access, the list of endpoints is restricted to having only 1 item, so the endpoint relations are modeled as simple ones. Also, differences between the Basic and Advanced versions are depicted.

14.3.1   IaIpvcCommon

File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

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

Name	Type	Multiplicity	Description
maximumNumberOfIpv4Routes	integer	0..1	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.
maximumNumberOfIpv6Routes	integer	0..1	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.
dscpPreservation	EnabledDisabled	0..1	Indicates whether the Service Provider 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. MEF 69.1 [D3] For an Internet Access Service, IPVC DSCP Preservation SHOULD be Disabled.
classOfServiceName	string	0..1	The Class of Service Name supported by the IPVC. Reference MEF 61.1 Section 10.8 IPVC List of Class of Service Names Service Attribute. This is "listOfClassOfServiceNames" attribute narrowed to single ref per Reference MEF 69.1 Section 9.1 [R7]
serviceLevelSpecification	IpSls	0..1	The set of performance objectives for 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.
mtu	integer	0..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	0..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.
cloud	IaIpvcCloud	0..1	Details of the cloud service being accessed. Reference MEF 61.1 Section 10.13 IPVC Cloud Service Attribute.
reservedPrefixes	Ipv4OrIpv6Prefix[]	0..1	Reference MEF 61.1 Section 10.14 IPVC Reserved Prefixes Service Attribute. For an Internet Access Service, IPVC Reserved Prefixes MUST be either empty, or free from any public address prefixes. (Reference MEF 69.1 Section 9.1 [R14])

974   **Table 11 IaIpvcCommon**

975 **14.3.2   BasicIaIpvc**

976 File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

977 The Basic Internet Access IPVC is a MEF 69.1 defined version of MEF 61.1 IPVC. Reference
978 MEF 69.1 Section 9.1 Internet Access IPVC Requirements.

979 Inherits from: IaIpvcCommon

Name	Type	Multiplicity	Description
ipvcEndPoint*	BasicIaIpvcEndPoint	1	Basic IPVC End Point. Reference MEF 61.1 Section 10.3 IPVC End Point List Service Attribute. This is narrowed to multiplicity = 1 and to BasicIaIpvcEndPoint type. Reference MEF 69.1 Section 9.1 [R5] AdvancedIaIpvc

980   **Table 12 BasicIaIpvc**

981 **14.3.3   AdvancedInternetAccessIpvc**

982 File: \ip\internetAccess\advancedInternetAccessIpvc\advancedInternetAccessIpvc.yaml

983 URN: urn:mef:lso:spec:cantata-sonata:advanced-internet-access-ipvc:v0.2.0:all

984 The Advanced Internet Access IPVC is a MEF 69.1 defined version of MEF 61.1 IPVC. Reference
985 MEF 69.1 Section 9.1 Internet Access IPVC Requirements. A complete product setup requires
986 also ordering of IpUni, IpUniAccessLink, EthernetUniAccessLinkTrunk.

987 Inherits from: IaIpvcCommon

Name	Type	Multiplicity	Description
ipvcEndPoint*	AdvancedIaIpvcEndPoint	1	Advanced IPVC End Point. Reference MEF 61.1 Section 10.3 IPVC End Point List Service Attribute. This is narrowed to multiplicity = 1 and to AdvancedIaIpvcEndPoint type. Reference MEF 69.1 Section 9.1 [R5] AdvancedIaIpvc

988   **Table 13 AdvancedInternetAccessIpvc**

989 **14.3.4   IaIpvcEndPointCommon**

990 File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

991 The Advanced Internet Access IPVC End Point is a MEF 69.1 defined version of MEF 61.1 IPVC
992 End Point. Reference MEF 69.1 Section 9.2 Internet Access IPVC End Point Requirements.

Name	Type	Multiplicity	Description
maximumNumberOfIpv4Routes	integer	0..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".
identifier	string	0..1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - it is not the same thing as the potential Product identifier if IPVC Endpoint is an instance of a Product.
egressClassOfServiceMap	EgressClassOfServiceMapUni	0..1	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.
maximumNumberOfIpv6Routes	integer	0..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".

993   **Table 14 IaIpvcEndPointCommon**

994   **14.3.5   BasicIaIpvcEndPoint**

995   File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

996   The Basic Internet Access IPVC End Point is a MEF 69.1 defined version of MEF 61.1 IPVC End
997   Point. Reference MEF 69.1 Section 9.2 Internet Access IPVC End Point Requirements.

998   Inherits from: IaIpvcEndPointCommon

Name	Type	Multiplicity	Description
egressBandwidthProfileEnvelope	BasicIaBwpEnvelope	0..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. Reference MEF 69.1 Section 9.2. [D6] For a Basic Internet Access Service, the egressBandwidthProfileEnvelope SHOULD be empty.
ingressBandwidthProfileEnvelope	BasicIaBwpEnvelope	0..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. Reference MEF 69.1 Section 9.2. [D5] For a Basic Internet Access Service, the ingressBandwidthProfileEnvelope SHOULD be empty.

999 **Table 15 BasicIaIpvcEndPoint**

1000 **14.3.6 AdvancedIaIpvcEndPoint**

1001 File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1002 The Advanced Internet Access IPVC End Point is a MEF 69.1 defined version of MEF 61.1 IPVC
1003 End Point. Reference MEF 69.1 Section 9.2 Internet Access IPVC End Point Requirements.

1004 Inherits from: IaIpvcEndPointCommon

Name	Type	Multiplicity	Description
prefixMapping	Ipv4OrIpv6Prefix[]	0..*	Indicates which IP Prefixes can send and receive traffic to/from the IPVC. Reference MEF 61.1 Section 11.5 IPVC EP Prefix Mapping Service Attribute.
egressBandwidthProfileEnvelope	IpvcEpBwpEnvelope	0..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. Reference MEF 69.1 Section 9.2. [D6] For a Basic Internet Access Service, the egressBandwidthProfileEnvelope SHOULD be empty.
ingressBandwidthProfileEnvelope	IpvcEpBwpEnvelope	0..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. Reference MEF 69.1 Section 9.2. [D5] For a Basic Internet Access Service, the ingressBandwidthProfileEnvelope SHOULD be empty.

1005 **Table 16 AdvancedIaIpvcEndPoint**

1006 **14.3.7   EgressClassOfServiceMapUni**

1007 File: \ip\common\ipCommon.yaml

1008 Pair of values (D,P). D specifies how to set the DS field in Egress IP Data Packets based on CoS
1009 Name. It is either None, or a mapping from CoS Names to DSCP values. P specifies how to set
1010 the PCP field in VLAN Tagged Ethernet Frames containing Egress IP Data Packets based on CoS
1011 Name. It is either None, or a mapping from CoS Names to PCP values. Reference MEF 61.1
1012 Section 11.10 IPVC EP Egress Class of Service Map Service Attribute. The "Uni" version of this
1013 class does not have the "pcpMapping" attribute - MEF 61.1 [R95] The value of P in the IPVC EP
1014 Egress Class of Service Map Service Attribute MUST be None unless the following conditions are
1015 met: The IPVC EP is at an ENNI using Option A; and All of the ENNI Links in the ENNI have a
1016 value for the ENNI Link L2 Technology Attribute (section 16.2) that indicates that VLAN Tagged
1017 Ethernet Frames are used to carry IP Packets across the ENNI.

Name	Type	Multiplicity	Description
dscpMapping	DscpMapping[]	0..*	Reference to CoS to IP DSCP mapping.

1018   **Table 17 EgressClassOfServiceMapUni**

1019   **14.3.8   DscpMapping**

1020   File: \ip\common\ipCommon.yaml

1021   IP DSCP mapping of CoS name to DSCP value Reference MEF 61.1 Section 11.9 IPVC EP Ingress
1022   Class of Service Map Service Attribute, 11.10 IPVC EP Egress Class of Service Map Service
1023   Attribute

Name	Type	Multiplicity	Description
ipds	integer	0..1	DSCP value
cosName	string	0..1	Class of Service name

1024   **Table 18 DscpMapping**

1025   **14.3.9   IaIpvcCloud**

1026

1027
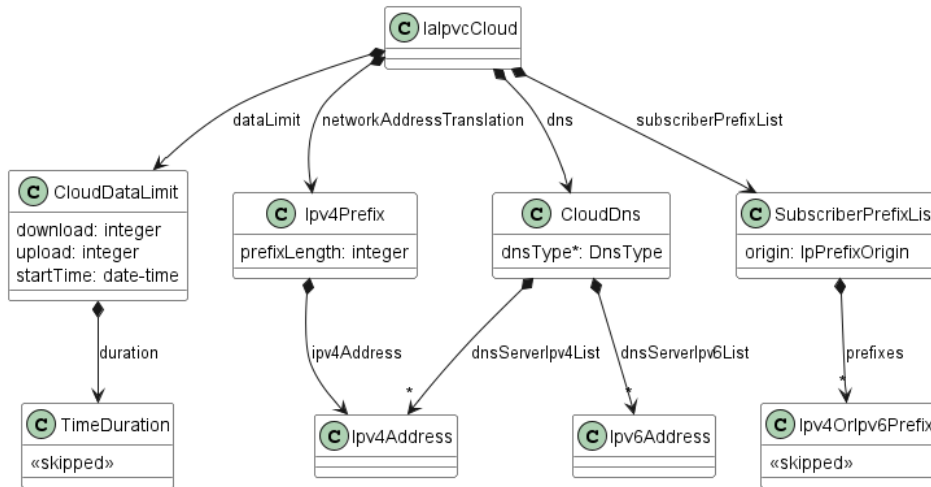
1028   **Figure 16 IaIpvcCloud**

1029   Figure 16 presents a class diagram of IaIpvcCloud

1030   File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1031   The IPVC Cloud Service Attribute is a set of parameters describing the access connectivity to the
1032   cloud service. Reference MEF 61.1 Section 10.13 IPVC Cloud Service Attribute.

Name	Type	Multiplicity	Description
networkAddressTranslation	Ipv4Prefix	0..1	Specifies 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.
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	Specifies whether and how DNS is provided for the service. Reference MEF 61.1 Section 10.13.5 Cloud DNS Service. [R12] For a Basic Internet Access Service, Cloud DNS MUST NOT be None.
subscriberPrefixList	SubscriberPrefixList	0..1	List of public IP Prefixes used in the Subscriber Network and their origin. 2-tuple containing the list of IP Prefixes and the origin of the IP Prefixes. Reference MEF 61.1 Section 10.13.6 Cloud Subscriber Prefix List. Reference MEF 61.1 Section 10.13 IPVC Cloud Service Attribute

Table 19 IaIpvcCloud

14.3.10   CloudDataLimit

File: \ip\common\ipCommon.yaml

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, tcdl, ucdl, dcdl). Reference MEF 61.1 Section 10.13.3 Cloud Data Limit.

Name	Type	Multiplicity	Description
duration	TimeDuration	0..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.
download	integer	0..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.
upload	integer	0..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.
startTime	date-time	0..1	Specifies a start time.

1039 **14.3.11   CloudDns**

1040   File: \ip\common\ipCommon.yaml

1041   Data type representing a Domain Name System. Reference MEF 61.1 Sn 10.13.5. Reference MEF
1042   69.1 Section 9.1[R12] For a Basic Internet Access Service, Cloud DNS MUST NOT be NONE.
1043   [R13] For an Internet Access Service, if the Cloud DNS parameter of the IPVC Cloud Service
1044   Attribute is STATIC, the associated list of DNS Servers MUST have at least one entry. [D4] For
1045   an Internet Access Service, if the Cloud DNS parameter of the IPVC Cloud Service Attribute is
1046   STATIC, the associated list of DNS Servers SHOULD contain at least two DNS servers.

Name	Type	Multiplicity	Description
dnsType*	DnsType	1	Domain Name System type.
dnsServerIpv6List	Ipv6Address[]	0..*	DNS server list an IPv6 addresses
dnsServerIpv4List	Ipv4Address[]	0..*	DNS server list an IPv4 addresses

1047   **Table 20 CloudDns**

1048 **14.3.12   DnsType**

1049   File: \ip\common\ipCommon.yaml

1050   Enumeration representing the different types of DNS. Reference MEF 61.1 10.13.5 Cloud DNS
1051   Service

Value
NONE
DHCP
PPP
STATIC
SLAAC

1052   **Table 21 DnsType**

1053 **14.3.13   IpPrefixOrigin**

1054 File: \ip\common\ipCommon.yaml

1055 Enumeration of possible values of Ip Prefix Origin.

Value
SP
OTHER

1056   **Table 22 IpPrefixOrigin**

1057 **14.3.14   SubscriberPrefixList**

1058 File: \ip\common\ipCommon.yaml

1059 The value of the Cloud Subscriber Prefix List parameter is None or a 2-tuple <prefixes, origin>,
1060 where:

1061   • prefixes is a non-empty list of public IP Prefixes that are used in the Subscriber Network,
1062   and

1063   • origin is either SP or Other and indicates whether the IP Prefixes are assigned to the
1064   Subscriber by the SP or obtainedby the Subscriber from another source. Reference MEF
1065   61.1 Section 10.13.6 Cloud Subscriber Prefix List.Reference MEF 61.1.1 Section 10.13
1066   IPVC Cloud Service Attribute

Name	Type	Multiplicity	Description
prefixes	Ipv4OrIpv6Prefix[]	1..*	Non-empty list of public IP Prefixes that are used in the Subscriber Network
origin	IpPrefixOrigin	0..1	The origin of the IP Prefixes. Either `SP` or `Other` and indicates whether the IP Prefixes are assigned to the Subscriber by the SP or obtained by the Subscriber from another source.

1067 **Table 23 SubscriberPrefixList**

1068 ## 14.4   IP UNI

1069
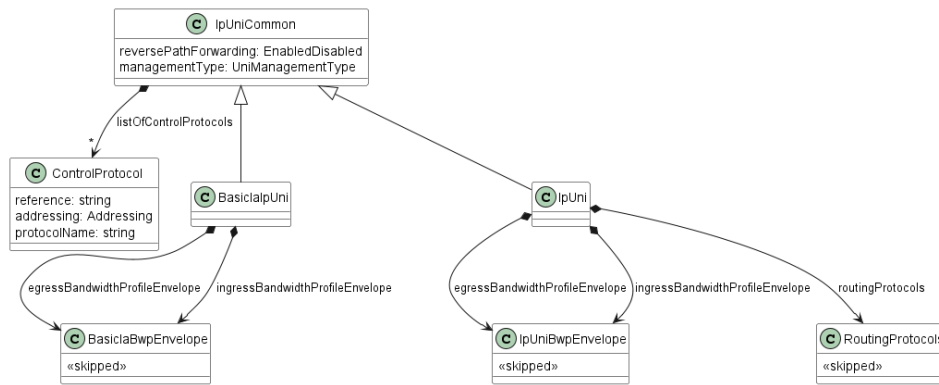
1070 **Figure 17 IP UNI**

1071 Figure 17 Shows the model of the IP UNI and also the differences between the Basic and Advanced
1072 versions.

1073 ### 14.4.1   IpUni

1074 File: \ip\ipUni\ipUni.yaml

1075 URN: urn:mef:lso:spec:cantata-sonata:ip-uni:v0.2.0:all

1076 The IP UNI is a MEF 69.1 defined version of MEF 61.1 UNI. Reference MEF 69.1 Section 8.3
1077 Internet Access UNI Requirements.

1078 Inherits from: IpUniCommon

Name	Type	Multiplicity	Description
egressBandwidthProfileEnvelope	IpUniBwpEnvelope	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". [D8] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Egress Bandwidth Profile Envelope is not None, it SHOULD have Bandwidth Profile Flows that contain all Egress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [8] Table 28). Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.
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". [R21] At a UNI with an IPVC EP for a Basic Internet Access Service, the UNI Routing Protocols list MUST be empty.
ingressBandwidthProfileEnvelope	IpUniBwpEnvelope	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". [D7] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Ingress Bandwidth Profile Envelope is not None, it SHOULD have Bandwidth Profile Flows that contain all Ingress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [8] Table 28). Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.

1079 **Table 24 IpUni**

1080 **14.4.2   IpUniCommon**

1081 File: \ip\common\ipCommon.yaml

1082 A User Network Interface (UNI) is the demarcation point between the responsibility of the SP and
1083 the responsibility of the Subscriber. Note that a given UNI always relates to a single SP and a
1084 single Subscriber. Reference MEF 61.1 Section 12. UNI Service Attributes

Name	Type	Multiplicity	Description
reversePathForwarding	EnabledDisabled	0..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. [D11] At a UNI with an IPVC EP for an Internet Access Service, reversePathForwarding SHOULD be ENABLED. Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.
listOfControlProtocols	ControlProtocol[]	0..*	Indication of IP Control Protocols that are not forwarded transparently by the SP. Reference MEF 61.1 Section 12.6 UNI List of Control Protocols Service Attribute. Absence of this attribute corresponds to a value of "None". [D9] At a UNI with an IPVC EP for an Internet Access Service, if the UNI has at least one UNI Access Link where the UNI Access Lin IPv4 Connection Addressing is not None, the UNI List of Control Protocols SHOULD include ICMP with a list of applicable ISP IP addresses. [D10] At a UNI with an IPVC EP for an Internet Access Service with at least one UNI Access Link where the UNI Access Link IPv6 Connection Addressing is not None, the UNI List of Control Protocols SHOULD include ICMPv6 with a list of applicable SP IP addresses. Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.
managementType	UniManagementType	0..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.

1085   **Table 25 IpUniCommon**

1086   **14.4.3   BasicIpUni**

1087   File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1088   The Basic Internet Access IP UNI is a MEF 69.1 defined version of MEF 61.1 IP UNI. Reference
1089   MEF 69.1 Section 9.3 Subscriber Internet Access Service: UNI Requirements

1090   Inherits from: IpUniCommon

Name	Type	Multiplicity	Description
egressBandwidthProfileEnvelope	BasicIaBwpEnvelope	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". [D8] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Egress Bandwidth Profile Envelope is not None, it SHOULD have Bandwidth Profile Flows that contain all Egress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [8] Table 28). Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.
ingressBandwidthProfileEnvelope	BasicIaBwpEnvelope	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". [D7] At a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Ingress Bandwidth Profile Envelope is not None, it SHOULD have Bandwidth Profile Flows that contain all Ingress IP Data Packets at the UNI that are mapped to any of a given set of IPVC EPs (as defined in MEF 61.1 [8] Table 28). Reference MEF 69.1 Section 9.3 Internet Access UNI Requirements.

1091 **Table 26 BasicIaIpUni**

1092 **14.4.4   ControlProtocol**

1093   File: \ip\common\ipCommon.yaml

1094   Data type representing Control Protocol. Each entry consists of a 3-tuple containing the protocol
1095   name, addressing information (either SP/Operator Addresses or Any) and one or more references.
1096   Reference MEF 61.1 Section 12.6 UNI List of Control Protocols Service Attribute

Name	Type	Multiplicity	Description
reference	string[]	1..*	Protocol reference.
addressing	Addressing	0..1	Enumeration representing the addressing.
protocolName	string	0..1	Protocol name.

1097   **Table 27 ControlProtocol**

1098   **14.4.5   Addressing**

1099   File: \ip\common\ipCommon.yaml

1100   Enumeration representing the Address type for the Control Protocols data
1101   type. Reference MEF 61.1 Section 12.6 UNI List of Control Protocols
1102   Service Attribute

1103   • SP_OPERATOR_ADDRESSES: If the addressing information is SP/Operator Addresses,
1104   then Ingress IP Packets for the specified protocol that have a multicast or broadcast
1105   destination address, or a unicast destination address that is reachable within the SP's or
1106   Operator's network, are considered to be IP Control Protocol Packets, and Egress IP
1107   Packets for the specified protocol that have a source address that is reachable within the
1108   SP's or Operator's network are considered to be IP Control Protocol Packets.

1109   • ANY: If the addressing information is Any, then all IP Packets for the specified protocol
1110   that cross the UNI are considered to be IP Control Protocol Packets.

Value
SP_OPERATOR_ADDRESSES
ANY

1111   **Table 28 Addressing**

1112   **14.4.6   UniManagementType**

1113   File: \ip\common\ipCommon.yaml

1114   Enumeration representing the UNI Management Type options. Reference MEF 61.1 Section 12.2
1115   UNI Management Type Service Attribute.

Value
SUBSCRIBER_MANAGEMENT
PROVIDER_MANAGEMENT

1116   **Table 29 UniManagementType**

1117 **14.5   IP UNI Access Link**

1118

1119   **Figure 18 IP UNI Access Link**

1120 Figure 18 depicts the model of Basic and Advanced IP UNI Access Links and differences thei
1121 dofferences.

1122 **14.5.1   IpUniAccessLinkCommon**

1123 File: \ip\common\ipCommon.yaml

1124 An individual connection between the Subscriber and the SP that forms part of a UNI. Reference
1125 MEF 61.1 Section 7.3 UNIs and UNI Access Link.

Name	Type	Multiplicity	Description
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.
identifier	string	0..1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - it is not the same thing as the potential Product identifier if IPVC Endpoint is an instance of a Product.
l2Technology	L2Technology	0..1	Specifies the UNI Access Link Trunk (61.1.1 section A1-1) used to carry IP Packets across the UNI along with information needed to identify IP Packets for this UNI Access Link.
prefixDelegation	EnabledDisabled	0..1	Indicates whether DHCP Prefix delegation is enabled. Reference MEF 61.1 Section 13.7 UNI Access Link Prefix Delegation Service Attribute.
connectionType	ConnectionType	0..1	Indicates whether the UNI Access Link is point-to-point or multipoint.
mtu	integer	0..1	Maximum size, in octets of an IP Packet that can traverse the UNI Access Link. Reference MEF 61.1 Section 13.9 UNI Access Link IP MTU Service Attribute.

1126 **Table 30 IpUniAccessLinkCommon**

1127 **14.5.2   IpUniAccessLink**

1128   File: schema\productSchema\ip\ipUni\ipUniAccessLink.yaml

1129   URN: urn:mef:lso:spec:cantata-sonata:ip-uni-access-link:v0.2.0:all

1130   An individual connection between the Subscriber and the SP that forms part of a UNI. Reference
1131   MEF 61.1 Section 7.3 UNIs and UNI Access Link. Inherits from: IpUniAccessLinkCommon

Name	Type	Multiplicity	Description
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".
bfd	AccessLinkBfd	0..1	Indication of whether BFD is used on the IpServicesExternalInterfaceLink. Reference MEF 61.1 Section 16.5 ENNI Link BFD Attribute and MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute.
ipv4ConnectionAddressing	UniIpv4ConnectionAddressing	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	UniIpv6ConnectionAddressing	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".
egressBwpEnvelope	IpUniAccessLinkBwpEnvelope	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".
ingressBwpEnvelope	IpUniAccessLinkBwpEnvelope	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".

Table 31 IpUniAccessLink

14.5.3 BasicIpUniAccessLink

File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

The Basic Internet Access UNI Access Link is a MEF 69.1 defined version of MEF 61.1 UNI Access Link. Reference MEF 69.1 Section 9.4 Internet Access UNI Access Link Requirements.

Inherits from: IpUniAccessLinkCommon

Name	Type	Multiplicity	Description
ipv4ConnectionAddressing	BasicIaUniIpv4ConnectionAddressing	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	BasicIaUniIpv6ConnectionAddressing	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".
egressBwpEnvelope	BasicIaBwpEnvelope	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".
ingressBwpEnvelope	BasicIaBwpEnvelope	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".

1138   **Table 32 BasicIaIpUniAccessLink**

1139   **14.5.4   AccessLinkBfd**

1140   File: \ip\common\ipCommon.yaml

1141   The Access Link BFD Service Attribute indicates whether Bidirectional Forwarding Detection
1142   (BFD) is enabled on the UNI Access Link. Reference MEF 61.1 Section 13.8 UNI Access Link
1143   BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.

Name	Type	Multiplicity	Description
activeEnd	BfdActiveEnd	0..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.
transmissionInterval	integer	0..1	Transmission Interval Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.
authenticationType	BfdAuthenticationType	0..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.
connectionAddressFamily	AddressFamilyIpv4Ipv6Both	0..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.
detectMultiplier	integer	0..1	BFD Detect multiple as an Integer. Reference MEF 61.1 Section 13.8 UNI Access Link BFD Service Attribute and Section 16.5 ENNI Link BFD Attribute.

1144   **Table 33 AccessLinkBfd**

1145   **14.5.5   AddressFamilyIpv4Ipv6Both**

1146   File: \ip\common\ipCommon.yaml

1147   Specifies whether the session is established over IPv4 or IPv6 or whether two separate session are
1148   established using IPv4 and IPv6.

Value
IPV4
IPv6
BOTH

1149

Table 34 AddressFamilyIpv4Ipv6Both

1150   **14.5.6   BfdActiveEnd**

1151   File: \ip\common\ipCommon.yaml

1152   At least one end of the BFD session must have an active role, meaning that it sends out
1153   asynchronous control messages regardless of whether it has received any. This enumeration
1154   represents the values that can be set for the BFD Active End. Reference MEF 61.1 Section 13.8
1155   UNI Access Link BFDService Attribute [R171] and [R172].

1156   SUBSCRIBER: Subscriber takes active BFD role.

1157   SP: Service Provider takes active BFD role.

1158   BOTH: Subscriber and Service Provider take active BFD role.

Value
SUBSCRIBER
SP
BOTH

1159

Table 35 BfdActiveEnd

1160   **14.5.7   BfdAuthenticationType**

1161   File: \ip\common\ipCommon.yaml

1162   RFC 7419 specifies a set of common intervals which are used to ensure interoperability.

1163   • 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.

Value
NONE
SIMPLE_PASSWORD
KEYED_MD5
METICULOUS_KEYED_MD5
KEYED_SHA1
METICULOUS_KEYED_SHA1

Table 36 BfdAuthenticationType

14.5.8   ConnectionType

File: \ip\common\ipCommon.yaml

An enumeration representing the connection type.

- POINT_TO_POINT indicates that the link is logically point to Point.

- MULTIPOINT indicates the link is logically multipoint.

Value
POINT_TO_POINT
MULTIPOINT

Table 37 ConnectionType

14.5.9   DhcpRelay

File: \ip\common\ipCommon.yaml

Dynamic Host Configuration Protocol (DHCP) Relay functionality is useful when the Subscriber
uses DHCP (per RFC 2131 and RFC 8415) in the Subscriber Network but does not want to place

1201   a DHCP server (or possibly a pair of redundant DHCP servers) in each part of the network.
1202   Reference MEF 61.1 Section UNI Access Link DHCP Relay Service Attribute

Name	Type	Multiplicity	Description
dhcpServerList	Ipv4OrIpv6Address[]	1..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	IpvcEndPointIdentifier	0..1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - It points to the value of IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product identifier if IPVC Endpoint is an instance of a Product.

1203   **Table 38 DhcpRelay**

1204   oneOf:

1205   - required: [dhcpServerList]

1206   - required: [ipvcEndPointIdentifier]

1207   **14.5.10   Vrid**

1208   File: \ip\common\ipCommon.yaml

1209   Data type definition: VRID (Virtual Router ID) as defined in RFC 5798 is a number between 1
1210   and 255

1211   **14.5.11   BasicIaUniIpv4ConnectionAddressing**

1212   File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1213
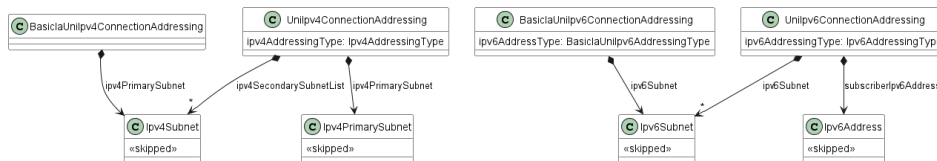
1214   **Figure 19 IPV4 and IPV6 Connection Addressing**

1215   Figure 19 shows the both IPv4 anf IPv6 versions of Connection Addressing.

1216   Represents how IPv4 addresses are allocated to the devices on the UNI Access Link in case of
1217   Basic Internet Access. Reference MEF 61 Section 13.4 UNI Access Link IPv4 Connection

1218 Addressing Service Attribute. [R23] At a UNI Access Link in a UNI with an IPVC EP for a Basic
1219 Internet Access Service, UNI Access Link IPv4 Connection Addressing MUST be DHCP or None.
1220 [R25] If IPv4 Connection Addressing is DHCP, the UNI Access Link IPv4 Connection Addressing
1221 Primary Subnet parameter MUST contain only a single Service Provider IPv4 Address. Reference
1222 MEF 69.1[1] Section 9.4 Subscriber Internet Access Service: UNI Access Link Requirements.

Name	Type	Multiplicity	Description
ipv4PrimarySubnet	Ipv4Subnet	0..1	Primary IPv4 Subnet. Includes IPv4 Prefix and 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 Provider IPv4 Address. Reference MEF 69.1[1] Section 9.4 Subscriber Internet Access Service: UNI Access Link Requirements

1223   **Table 39 BasicIaUniIpv4ConnectionAddressing**

1224 **14.5.12   UniIpv4ConnectionAddressing**

1225 File: \ip\common\ipCommon.yaml

1226 UniIpv4ConnectionAddressing is a data type representing how IPv4 addresses are allocated to the
1227 devices on the UNI Access Link. Reference MEF 61 Section 13.4 UNI Access Link IPv4
1228 Connection Addressing Service Attribute. [R22] At a UNI Access Link in a UNI with an IPVC EP
1229 for an Advanced Internet Access Service, UNI Access Link IPv4 Connection Addressing MUST
1230 be Static or None. Reference MEF 69.1 Section 9.4

Name	Type	Multiplicity	Description
ipv4AddressingType	Ipv4AddressingType	0..1	IPv4 Connection Addressing.
ipv4SecondarySubnetList	Ipv4Subnet[]	0..*	Secondary IPv4 Subnet List. Includes IPv4 Prefix and Service Provider IPv4 Addresses.
ipv4PrimarySubnet	Ipv4PrimarySubnet	0..1	Primary IPv4 Subnet. Includes IPv4 Prefix and Service Provider IPv4 Addresses.

1231   **Table 40 UniIpv4ConnectionAddressing**

1232 **14.5.13   BasicIaUniIpv6ConnectionAddressing**

1233 File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1234 Represents how IPv6 addresses are allocated to the devices on the UNI Access Link in case of
1235 Basic Internet Access. Reference MEF 61 Section 13.5 UNI Access Link IPv6 Connection

1236 Addressing Service Attribute. [R27] At a UNI Access Link in a UNI with an IPVC EP for a Basic
1237 Internet Access Service, UNI Access Link IPv6 Connection Addressing MUST be DHCP or
1238 SLAAC or None. Reference MEF 69.1[1] Section 9.4 Subscriber Internet Access Service: UNI
1239 Access Link Requirements. [R29] At a UNI Access Link in a UNI with an IPVC EP for a Basic
1240 Internet Access Service, if the UNI Ac-cess Link IPv6 Connection Addressing is DHCP or
1241 SLAAC, the UNI Access Link IPv6 Connection Ad-dressing Subnet List parameter MUST contain
1242 only a single Service Provider IPv6 Address.

Name	Type	Multiplicity	Description
ipv6AddressType	BasicIaUniIpv6AddressingType	0..1	Basic Internet Access IPv6 Connection Address mechanism.
ipv6Subnet	Ipv6Subnet	0..1	IPv6 Subnet. [R29] At a UNI Access Link in a UNI with an IPVC EP for a Basic Internet Access Service, if the UNI Ac-cess Link IPv6 Connection Addressing is DHCP or SLAAC, the UNI Access Link IPv6 Connection Ad-dressing Subnet List parameter MUST contain only a single Service Provider IPv6 Address.

1243   **Table 41 BasicIaUniIpv6ConnectionAddressing**

1244 **14.5.14   UniIpv6ConnectionAddressing**

1245 File: \ip\common\ipCommon.yaml

1246 UniIpv6ConnectionAddressing is a data type representing how IPv6 addresses are allocated to the
1247 devices on the UNI Access Link. Reference MEF 61 Section 13.5 UNI Access Link IPv6
1248 Connection Addressing Service Attribute. [R26] At a UNI Access Link in a UNI with an IPVC EP
1249 for an Advanced Internet Access Service, UNI Access Link IPv6 Connection Addressing MUST
1250 be Static or None. Reference MEF 69.1 Section 9.4

Name	Type	Multiplicity	Description
ipv6AddressingType	Ipv6AddressingType	0..1	IPv6 Connection Addressing.
ipv6Subnet	Ipv6Subnet[]	0..*	Ipv6 Subnet
subscriberIpv6Address	Ipv6Address	0..1	Subscriber IPv6 address.

1251   **Table 42 UniIpv6ConnectionAddressing**

1252 **14.5.15   Ipv4AddressingType**

1253 File: \ip\common\ipCommon.yaml

1254   Enumeration representing IPv4 Address Types specific for UNI Access Links.

1255   • DHCP: Dynamic Host Configuration Protocol (DHCP) is used the Subscriber devices to
1256   request IPv4 addresses in a given subnet from the SP or Operator.

1257   • STATIC: IPv4 addresses in a given IPv4 subnet are statically assigned to the SP or
1258   Operator and to the Subscriber.

1259   • UNNUMBERED: The SP or Operator and the Subscriber each assigned an IPv4 address
1260   (from their own address pools) independently. These addresses can be on different subnets,
1261   and so an interface-based routing protocol is needed to ensure reachability.

Value
DHCP
STATIC
UNNUMBERED

1262   **Table 43 Ipv4AddressingType**

1263   **14.5.16   BasicIaUniIpv6AddressingType**

1264   File: \ip\internetAccess\internetAccessCommon\internetAccessCommon.yaml

1265   Enumeration representing IPv6 Address Types specific for UNI Access Links.

1266   • DHCP: Dynamic Host Configuration Protocol (DHCP) is used by the Subscriber devices
1267   to request IPv6 addresses in a given subnet from the SP or Operator.

1268   • SLAAC: Stateless Address Autoconfiguration (SLAAC) is used by the Subscriberdevices
1269   to create unique IPv6 global addresses within an IP Prefix advertised by the SP or Operator
1270   as describer in RFC 4862.

Value
DHCP
SLAAC

1271   **Table 44 BasicIaUniIpv6AddressingType**

1272 **14.5.17   Ipv6AddressingType**

1273 File: \ip\common\ipCommon.yaml

1274 Ipv6AddressingType

1275 Enumeration representing IPv6 Address Types specific for UNI Access Links.

1276 • DHCP: Dynamic Host Configuration Protocol (DHCP) is used by the Subscriber devices
1277 to request IPv6 addresses in a given subnet from the SP or Operator.

1278 • SLAAC: Stateless Address Autoconfiguration (SLAAC) is used by the Subscriber devices
1279 to create unique IPv6 global addresses within an IP Prefix advertised by the SP or Operator
1280 as describer in RFC 4862.

1281 • STATIC: IPv6 addresses in a given IPv6 subnet are statically assigned to the SP or
1282 Operator and to the Subscriber.

1283 • LL_ONLY: If the value is LL-only, these are only IPv6 addresses used onthe UNI Access
1284 Link.

Value
DHCP
SLAAC
STATIC
LL_ONLY

1285   **Table 45 Ipv6AddressingType**

1286 **14.5.18   L2Technology**

1287
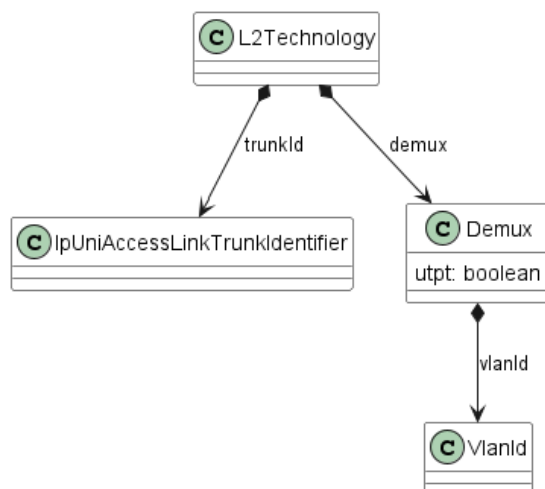
1288   **Figure 20 L2Technology**

1289   Figure 20 presents the diagram of L2 Technology Service Attribute.

1290   File: \ip\common\ipCommon.yaml

1291   Specifies the UNI Access Link Trunk used to carry IP Packets across the UNI along with
1292   information needed to identify IP Packets for this UNI Access Link. Reference MEF 61.1.1 Section
1293   13.3 UNI Access Link Trunk Service Attributes

Name	Type	Multiplicity	Description
trunkId	IpUniAccessLinkTrunkIdentifier	0..1	UNI Access Link Trunk Identifier. Reference MEF 61.1.1 described in section A1-1
demux	Demux	0..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 Link1

1294   **Table 46 L2Technology**

1295   **14.5.19   IpUniAccessLinkTrunkIdentifier**

1296   File: \ip\common\ipCommon.yaml

1297 IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - It points to the value of
1298 IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product
1299 identifier if IPVC Endpoint is an instance of a Product.

1300 maxLength: 53

1301 pattern: "[\x20-\x7F]+"

1302 **14.5.20 Demux**

1303 File: \ip\common\ipCommon.yaml

1304 Is a value that is specific to each type of UNI Access Link Trunk and indicates which Layer 2 sub-
1305 channel should be select for this UNI Access Link. [A1-R8] If the UNI Access Link Trunk
1306 identified by trunkID is of type ETHERNET, then the value of the demux element MUST be either
1307 UT/PT or a VLAN ID in the range 1 to 4094.

Name	Type	Multiplicity	Description
utpt	boolean	0..1	Untagged and priority tagged frames.
vlanId	VlanId	0..1	VLAN ID.

1308   **Table 47 Demux**

1309 **14.5.21 VlanId**

1310 File: \ip\common\ipCommon.yaml

1311 Data type used for VLAN id configuration. Defined as a Integer. Value 1 to 4094.

1312 **14.6   Ethernet Uni Access Link Trunk**

1313
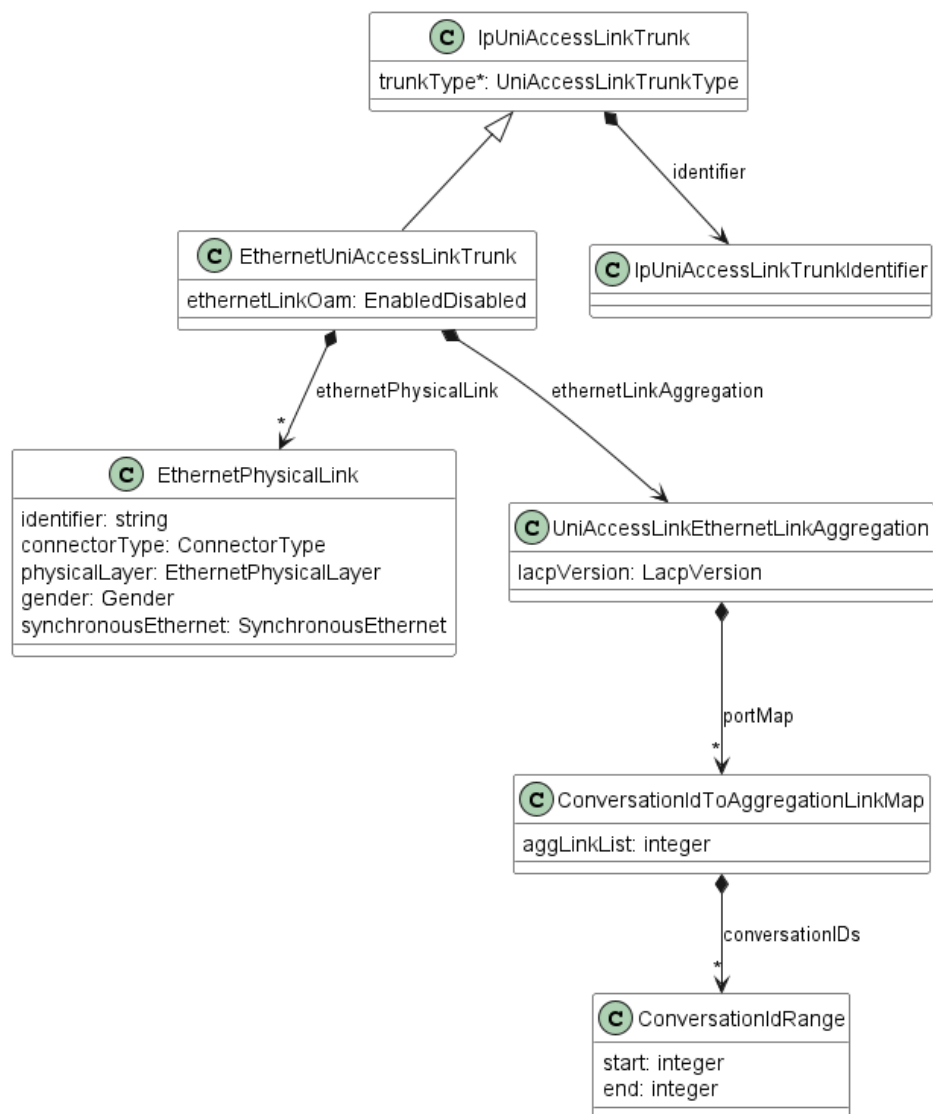
1314   **Figure 21 EthernetUniAccessLinkTrunk**

1315 Figure 21 Shows the diagram of Thernet Uni Access Link Trunk. It is the only specified sublass
1316 of an abstract class IP UNI Access Link Trunk. It is used by all 3 Internet Access Product flavors
1317 without any changes.

14.6.1   IpUniAccessLinkTrunk

1319 File: \ip\common\ipCommon.yaml

1320 A UNI Access Link Trunk is a construct that encapsulates the details of Layer 1 and Layer 2
1321 configuration shared by one or more UNI Access Links. Reference MEF 61.1.1 Section A1-1 UNI
1322 Access Link Trunk Service Attributes.

Name	Type	Multiplicity	Description
identifier	IpUniAccessLinkTrunkIdentifier	0..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.
trunkType*	UniAccessLinkTrunkType	0..1	The type of Layer 2 technology of the UNI Access Link Trunk

1323   **Table 48 IpUniAccessLinkTrunk**

14.6.2   EthernetUniAccessLinkTrunk

1325 File: \ip\ipUni\ethernetUniAccessLinkTrunk.yaml

1326 URN: urn:mef:lso:spec:cantata-sonata:ethernet-uni-access-link-trunk:v0.2.0:all

1327 A single point-to-point physical Ethernet channel or multiple physical Ethernet links combined
1328 into a Link Aggregation Group. The Ethernet frames associated with a given UNI Access Link can
1329 be either untagged/priority-tagged or VLAN tagged. Reference MEF 61.1.1 A1-1.3 Ethernet UNI
1330 Access Link Trunk Service Attributes

1331 Inherits from: IpUniAccessLinkTrunk

Name	Type	Multiplicity	Description
ethernetPhysicalLink	EthernetPhysicalLink[]	1..*	A list of the physical link types along with some additional capabilities
ethernetLinkAggregation	UniAccessLinkEthernetLinkAggregation	0..1	Configuration of Link Aggregation for the UNI Access Link Trunk
ethernetLinkOam	EnabledDisabled	0..1	Indicates whether Link OAM is used on the UNI Access Link Trunk

1332 **Table 49 EthernetUniAccessLinkTrunk**

1333 ### 14.6.3 UniAccessLinkTrunkType

1334 File: \ip\common\ipCommon.yaml

1335 Enumeration representing the UNI Access Link Trunk Type Service Attribute. MEF 61.1 Specifies
1336 value of ETHERNET and OTHER. Yet since OTHER means to practical implementation, only
1337 ETHERNET is used. The enumeration is remained though for future enhancements.

Value
ETHERNET

1338 **Table 50 UniAccessLinkTrunkType**

1339 ### 14.6.4 EthernetPhysicalLink

1340 File: \ip\common\ipCommon.yaml

1341 Data type representing UNI Access Link Trunk List of Ethernet Physical Links of form
1342 <id,pl,fs,ct,gn> as defined in MEF 61.1.1 Section A1-1.3.1.

Name	Type	Multiplicity	Description
identifier	string	0..1	Identifier of the Physical LInk
connectorType	ConnectorType	0..1	Enumeration representing type of connector presented to Subscriber.
physicalLayer	EthernetPhysicalLayer	0..1	Enumeration representing the different Ethernet physical layers. Reference MEF 61.1.1 Table A1-4 Ethernet PHYs for UNI Access Link Trunks.
gender	Gender	0..1	Enumeration representing the gender of the connector presented to the Subscriber.
synchronousEthernet	SynchronousEthernet	0..1	Enumeration indicating if the physical link supports Synchronous Ethernet.

1343   **Table 51 EthernetPhysicalLinkEthernetPhysicalLink**

1344   **14.6.5   ConnectorType**

1345   File: \ip\common\ipCommon.yaml

1346   Enumeration representing type of connector presented to Subscriber.

Value
RJ45
SC
LC
OTHER

1347   **Table 52 ConnectorTypeConnectorType**

1348   **14.6.6   EthernetPhysicalLayer**

1349   File: \ip\common\ipCommon.yaml

1350   Enumeration representing the different Ethernet physical layers. Reference MEF 61.1.1 Table A1-
1351   4 Ethernet PHYs for UNI Access Link Trunks.

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_CX4
10GBASE_E	10GBASE_ER	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_W
10GBASE_X	25GBASE_CR	25GBASE_CR_S
25GBASE_ER	25GBASE_LR	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

1352   **Table 53 EthernetPhysicalLayer**

1353   **14.6.7   Gender**

1354   File: \ip\common\ipCommon.yaml

1355   Enumeration representing the gender of the connector presented to the Subscriber.

Value
SOCKET
PLUG

1356   **Table 54 Gender**

1357   **14.6.8   SynchronousEthernet**

1358   File: \ip\common\ipCommon.yaml

1359   Enumeration indicating if the physical link supports Synchronous Ethernet.

Value
DISABLED
ESMC
NO_ESMC

1360   **Table 55 SynchronousEthernet**

1361   **14.6.9   UniAccessLinkEthernetLinkAggregation**

1362   File: \ip\common\ipCommon.yaml

1363   Link Aggregation, as described in IEEE Std. 802.1AX-2020 allows one or more parallel instances
1364   of full-duplex point-to-point Ethernet links to be aggregated to form a Link Aggregation Group
1365   (LAG) such that the MAC Client (the UNI Access Link) can treat the LAG as if it were a single
1366   link. Reference MEF 61.1.1 Section A1-1.3.2 UNI Access Link Trunk Ethernet Link Aggregation
1367   Service Attribute.

Name	Type	Multiplicity	Description
lacpVersion	LacpVersion	0..1	The value of LACPv1, LACPv2, or Static and indicates which version of the Link Aggregation Control Protocol, LACP, is used. (See clause 6.4 in IEEE Std 802.1AX-2020 [A1-4].). If the value is Static, LACP is not used.
portMap	ConversationIdToAggregationLinkMap[]	0..*	A list of 2-tuples ⟨vid, lspl⟩ that represents a VLAN ID to Aggregation Link Map (in clause 6.6 of IEEE Std 802.1AX-2020 this is referred to as "Admin_Conv_Link_Map"). The first element, vid, is a VLAN ID, and the second element, lspl, (Link Selection Priority List) is a list of Link Number IDs.

1368 **Table 56 UniAccessLinkEthernetLinkAggregation**

1369 **14.6.10   LacpVersion**

1370 File: \ip\common\ipCommon.yaml

1371 This is a 2-tuple <x,y> where x is a list of Port Conversation IDs or ranges of Port Conversation
1372 IDs (a Port Conversation ID is a VLAN ID or 0 for untagged frames) and y is a list of Link
1373 Numbers. This is used in the Port Conversation to Aggregation Link Map for the UNI and ENNI.

Value
LACPV1
LACPV2
STATIC

1374 **Table 57 LacpVersion**

1375 **14.6.11   ConversationIdToAggregationLinkMap**

1376 File: \ip\common\ipCommon.yaml

1377 This is a 2-tuple <x,y> where x is a list of Port Conversation IDs or ranges of Port Conversation
1378 IDs (a Port Conversation ID is a VLAN ID or 0 for untagged frames) and y is a list of Link
1379 Numbers. This is used in the Port Conversation to Aggregation Link Map for the UNI and ENNI.

Name	Type	Multiplicity	Description
conversationIDs	ConversationIdRange[]	1..*	802.1AX-2014 sec. 6.6.2.1 - A Port Conversation ID is a VLAN ID (1 to 4094) or 0 to represent untagged and priority-tagged frames.
aggLinkList	integer[]	1..*	802.1AX-2014 sec. 6.6.2.1 - An ordered list of Aggregation Link Numbers

1380 **Table 58 ConversationIdToAggregationLinkMap**

1381 **14.6.12 ConversationIdRange**

1382 File: \ip\common\ipCommon.yaml

1383 A range of ConversationID (either a VLAN Id or 0 for untagged frames)

Name	Type	Multiplicity	Description
start	integer	0..1	The starting Conversation ID of the range or the only Conversation ID if there is no end value
end	integer	0..1	The final Conversation ID in the range

1384 **Table 59 ConversationIdRange**

1385 **14.7 IP SLS**

1386

1387 **Figure 22 IpSls**

1388 Figure 22 shows the model of the IP SLS with all available metrics.

1389 **14.7.1 IpSls**

1390 File: \ip\common\ipSls.yaml

1391 The IPVC Service Level Specification Service Attribute is either None, or a four-tuple of the form
1392 (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
1393 of locations as described in section 10.9.1. Each SLS entry in E contains the Performance Metric,
1394 the CoS Name, and number of other parameters specific to the Performance Metric, as described
1395 in the subsections below. Reference MEF 61.1 Section 10.9 IPVC Service Level Specification
1396 Service Attribute.

Name	Type	Multiplicity	Description
oneWayPacketDelayPercentile	OneWayPacketDelayPercentile[]	0..*	List of SLS Entries for the One-way Packet Delay Percentile metric.
locationList	Location[]	1..*	A Location is associated with one or more IPVC EPs or with a cloud service. A Location can refer to a specific address (such as the SP's premises where the PE is located), a city, a region, or even a country.
oneWayInterPacketDelayVariation	OneWayInterPacketDelayVariation[]	0..*	List of SLS Entries for the One-way Inter-Packet Delay Variation metric.
oneWayPacketDelayRange	OneWayPacketDelayRange[]	0..*	List of SLS Entries for the One-way Packet Delay Range metric.
serviceUptime	ServiceUptime[]	0..*	Service uptime metric.
oneWayPacketLossRatio	OneWayPacketLossRatio[]	0..*	List of SLS Entries for the One-way Packet Loss Ratio metric.
startTime	date-time	0..1	Start time of IP SLS.
oneWayMeanPacketDelay	OneWayMeanPacketDelay[]	0..*	List of SLS Entries for the One-way Mean Packet Delay metric.

periodOfTime	TimeDuration	0..1	Period of time over which IP SLS is measured.
meanTimeToRepair	MeanTimeToRepair[]	0..*	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 periods.

1397   **Table 60 IpSls**

1398   **14.7.2   OneWayInterPacketDelayVariation**

1399   File: \ip\common\ipSls.yaml

1400   The One-way Inter-Packet Delay Variation Performance Metric is the maximum, over all the
1401   ordered pairs of SLS-RPs in a given set S, of the vth percentile of differences between the one-
1402   way packet delays of Qualified Packets that arrive at time separated by a given interval tau, for a
1403   given ordered pair of SLS-RPs, a given CoS Name, and a given time period Tk. Reference MEF
1404   61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric.

Name	Type	Multiplicity	Description
slsRpPair	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.
interPacketDelayVariationPercentile	Percentage	0..1	Inter-Packet Delay Variation Percentile. Reference MEF 61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric, Table 6.
cosName	string	0..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	0..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.
interPacketDelayVariationObjective	number	0..1	Inter-Packet Delay Variation Objective. Reference MEF 61.1 Section 10.9.6 One-way Inter-Packet Delay Variation Performance Metric, Table 6.

1405 **Table 61 OneWayInterPacketDelayVariation**

1406 ### 14.7.3   OneWayMeanPacketDelay

1407 File: \ip\common\ipSls.yaml

1408 The One-way Mean Packet Delay Performance Metric is the maximum, over all the ordered pairs
1409 of SLS-RPs in a given set S, of the arithmetic mean of one-way packet delay for Qualified Packets
1410 for a given ordered pair of SLS-RPs, a given CoS Name, and a given time period Tk. Reference
1411 MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric.

Name	Type	Multiplicity	Description
slsRpPair	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.
meanPacketDelayObjective	number	0..1	Mean Packet Delay Objective. Reference MEF 61.1 Section 10.9.5 One-way Mean Packet Delay Performance Metric, Table-5.
cosName	string	0..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.

1412   **Table 62 OneWayMeanPacketDelay**

1413   **14.7.4   OneWayPacketDelayPercentile**

1414   File: \ip\common\ipSls.yaml

1415   The One-way Packet Delay Percentile Performance Metric is the maximum, over all the order
1416   pairs of SLS-RPs in a given set S, of the pth percentile of one-way packet delay for Qualified
1417   Packets for a given order pair of SLS-RPs, a given CoS Name and a given time period Tk.
1418   Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric.

Name	Type	Multiplicity	Description
slsRpPair	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.
packetDelayPercentile	Percentage	0..1	Packet Delay Range Percentile. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table 7.
packetDelayObjective	number	0..1	Packet Delay Objective. Reference MEF 61.1 Section 10.9.4 One-way Packet Delay Percentile Performance Metric, Table-4.
cosName	string	0..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.

1419   **Table 63 OneWayPacketDelayPercentile**

1420   **14.7.5   OneWayPacketDelayRange**

1421   File: \ip\common\ipSls.yaml

1422   The One-way Packet Delay Range Performance Metric is the maximum, over all the ordered
1423   pairs of SLS-RPs in a given set S, of the difference between the rth percentile of one-way packet
1424   delay and the minimum one-way packet delay, for Qualified Packets for a given ordered pair of
1425   SLS-RPs, a given CoS Name, and a given time period Tk. Reference MEF 61.1 Section 10.9.7
1426   One-way Packet Delay Range Performance Metric.

Name	Type	Multiplicity	Description
slsRpPair	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.
packetDelayRangePercentile	Percentage	0..1	Packet Delay Range Percentile. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table 7.
cosName	string	0..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.
packetDelayRangeObjective	number	0..1	Packet Delay Range Objective. Reference MEF 61.1 Section 10.9.7 One-way Packet Delay Range Performance Metric, Table 7.

1427   **Table 64 OneWayPacketDelayRange**

1428   **14.7.6**   **OneWayPacketLossRatio**

1429   File: \ip\common\ipSls.yaml

1430   The One-way Packet Loss Ratio Performance Metric is the maximum, over the ordered pairs of
1431   SLS-RPs in a given set S, of the ratio of lost packets to transmitted packets for a given ordered
1432   pair of SLS-RPs, a given CoS Name and a given time period Tk. Reference MEF 61.1 Section
1433   10.9.8 One-way Packet Loss Ratio Performance Metric.

Name	Type	Multiplicity	Description
packetLossRatioObjective	Percentage	0..1	Packet Loss Ratio Objective. Reference MEF 61.1 Section 10.9.8 One-way Packet Loss Ratio Performance Metric, Table 8.
slsRpPair	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.
cosName	string	0..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.

1434   **Table 65 OneWayPacketLossRatio**

1435 **14.7.7   Percentage**

1436   File: \ip\common\ipSls.yaml

1437   his is a number of percent - a number between 0 and 100.

1438 **14.7.8   Location**

1439   File: \ip\common\ipSls.yaml

1440   A Location is associated with one or more IPVC EPs or with a cloudservice. A Location can refer
1441   to a specific address (such as the SP'spremises where the PE is located), a city, a region, or even
1442   acountry.

1443   Inherits from: SlsReferencePoint

Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	IpvcEndPointIdentifier[]	1..*	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - It points to the value of IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product identifier if IPVC Endpoint is an instance of a Product.
name	string	0..1	Location name
description	string	0..1	Location description
cloudService	boolean	0..1	Attribute to indicate if associated with a cloud service.

1444   **Table 66 Location**

1445 **14.7.9   MeanTimeToRepair**

1446   File: \ip\common\ipSls.yaml

1447   The Mean Time To Repair Performance Metric is the arithmetic mean of the durations of all
1448   outages that start in a given time period, excluding any pre-agreed maintenance periods. Reference
1449   MEF 61.1.1. Section 10.9.10 Mean Time To Repair Performance Metric

Name	Type	Multiplicity	Description
mttrObjective	TimeDuration	0..1	Mean Time To Repair Objective

1450   **Table 67 MeanTimeToRepair**

1451 **14.7.10   ServiceUptime**

1452   File: \ip\common\ipSls.yaml

1453   The Service Uptime Performance Metric is the proportion of time, during a given time period
1454   Tk, that the service is working from the perspective of the Subscriber (for a Subscriber IP
1455   Service) or the perspective of the SP/SO (for an Operator IP Service), excluding any pre-agreed
1456   exceptions, for example maintenance intervals. Reference MEF 61.1[1] Section 10.9 Service
1457   Uptime Performance Metric.

Name	Type	Multiplicity	Description
serviceUptimeObjective	Percentage	0..1	Service Uptime Objective. Reference MEF 61.1 Section 10.9.9 Service Uptime Performance Metric, Table 9.

1458   **Table 68 ServiceUptime**

1459   **14.7.11   SlsReferencePoint**

1460   File: \ip\common\ipSls.yaml

1461   SlsReferencePoint is an abstract data type that can be subclassed to IpvcEndPoint and Location.
1462   Reference MEF 61.1 Section 10.9.1 SLS Reference Points.

1463   **14.7.12   SlsRpPair**

1464   File: \ip\common\ipSls.yaml

1465   Service Level Specification Reference Point Pair. In a multipoint or rooted multipoint IPVC,
1466   performance objectives are ideally specified as applying between pairs of IPVC EPs - in other
1467   words, they apply to the performance that IP Data Packets experience as they flow from one EI
1468   to another. The SlsRpPair is a representation of this association. Reference MEF 61.1 Section
1469   10.9.1

Name	Type	Multiplicity	Description
toSlsReferencePoint	SlsReferencePoint	0..1	Pointer to the "to" SLS Reference Point.
fromSlsReferencePoint	SlsReferencePoint	0..1	Pointer to the "from" SLS Reference Point.

1470   **Table 69 SlsRpPair**

1471   **14.7.13   IpvcEndpointRef**

1472   File: \ip\common\ipSls.yaml

1473   A subclass of a SlsReferencePoint pointing to an instance of IPVC Endpoint

Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	IpvcEndPointIdentifier	0..1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - It points to the value of IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product identifier if IPVC Endpoint is an instance of a Product.

1474   **Table 70 IpvcEndpointRef**

1475   **14.7.14   IpvcEndPointIdentifier**

1476   File: \ip\common\ipCommon.yaml

1477   IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note – It points to the value of
1478   IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product
1479   identifier if IPVC Endpoint is an instance of a Product.

1480   maxLength: 53

1481   pattern: "[\x20-\x7F]+"

1482   **14.8   Routing Protocols**
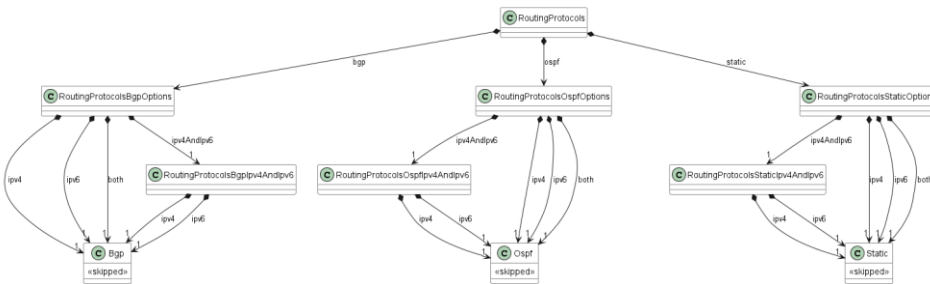
1483

1484   **Figure 23 Routing Protocols**

1485   The UNI Routing Protocols Service Attribute specifies the routing protocols and associated
1486   parameters that are used to exchange IP routes across the UNI. The value is a list of protocols
1487   (possibly empty), where each entry consists of the protocol name (one of Static, OSPF or BGP),
1488   the type of routes that will be exchanged (one of IPv4, IPv6 or Both), and a set of additional
1489   parameters as specified in the subsections below. According to [R109] The value of the UNI
1490   Routing Protocols Service Attribute MUST NOT contain more than one entry for the same

1491 protocol name, except when there are exactly two entries with a given protocol name, one with
1492 route type IPv4 and one with route type IPv6.. This means per given type of routing protocols one
1493 out of four possible sets of configuration can be provided: IPv4, IPv6, IPv4 and IPv6, Both. In
1494 order to model that in the API resource model additional type has been added
1495 *RoutingProcotolsXXXOptions* that has four mutually exclusive attributes: *ipv4, ipv6, ipv4AndIpv6,*
1496 *both*, respectively to handle this requirement.

1497 **14.8.1   RoutingProtocols**

1498 File: \ip\common\ipCommon.yaml

1499 Data type to support routing protocols and associated parameters that are used to exchange IP
1500 routes across the UNI. The value is a list of protocols (possibly empty), where each entry consists
1501 of the protocol name (one of Static, OSPF or BGP) the type of routes that will be exchanged (one
1502 of IPv4 or IPv6 or Both) and set of additional parameters as specified. Reference MEF 61.1 Section
1503 12.7 UNI Routing Protocols Service Attributes.

Name	Type	Multiplicity	Description
static	RoutingProtocolsStaticOptions	0..1	Static routing configuration options.
bgp	RoutingProtocolsBgpOptions	0..1	BGP routing protocol configuration options.
ospf	RoutingProtocolsOspfOptions	0..1	OSPF routing protocol configuration options.

1504   **Table 71 RoutingProtocols**

1505 **14.8.2   RoutingProtocolsBgpIpv4AndIpv6**

1506 File: \ip\common\ipCommon.yaml

1507 Configuration for exchanging IPv4 and IPv6 types of routes.

Name	Type	Multiplicity	Description
ipv4*	Bgp	1	Configuration for exchanging IPv4 types of routes.
ipv6*	Bgp	1	Configuration for exchanging IPv6 types of routes.

1508   **Table 72 RoutingProtocolsBgpIpv4AndIpv6**

1509 **14.8.3   RoutingProtocolsBgpOptions**

1510 File: \ip\common\ipCommon.yaml

1511 BGP routing protocol configuration options. The configuration of the BGP can be provided for the
1512 following type pf routes that will be exchanged:

1513 • ipv4, or

1514 • ipv6, or

1515 • both, or

1516 • ipv4 and ipv6

Name	Type	Multiplicity	Description
ipv4	Bgp	0..1	Configuration for exchanging IPv4 types of routes.
Ipv6	Bgp	0..1	Configuration for exchanging IPv6 types of routes.
ipv4AndIpv6	RoutingProtocolsBgpIpv4AndIpv6	0..1	Configuration for exchanging IPv4 and IPv6 types of routes.
Both	Bgp	0..1	Configuration for exchanging both IPv4 and IPv6 types of routes.

1517   **Table 73 RoutingProtocolsBgpOptions**

1518 oneOf:

1519 - required: [ipv4]

1520 - required: [ipv6]

1521 - required: [both]

1522 - required: [ipv4AndIpv6]

1523 **14.8.4   RoutingProtocolsOspfIpv4AndIpv6**

1524 File: \ip\common\ipCommon.yaml

1525 Configuration for exchanging IPv4 and IPv6 types of routes.

Name	Type	Multiplicity	Description
ipv4*	Ospf	1	Configuration for exchanging IPv4 types of routes.
ipv6*	Ospf	1	Configuration for exchanging IPv6 types of routes.

1526 **Table 74 RoutingProtocolsOspfIpv4AndIpv6**

1527 **14.8.5   RoutingProtocolsOspfOptions**

1528   File: \ip\common\ipCommon.yaml

1529   OSPF   routing   protocol   configuration   options.   The   configuration   of   the   BGP
1530   can be provided for the following type pf routes that will be exchanged:

1531   • ipv4, or

1532   • ipv6, or

1533   • both, or

1534   • ipv4 and ipv6

Name	Type	Multiplicity	Description
ipv4*	Ospf	0..1	Configuration for exchanging IPv4 types of routes.
ipv6*	Ospf	0..1	Configuration for exchanging IPv6 types of routes.
ipv4AndIpv6*	RoutingProtocolsOspfIpv4AndIpv6	0..1	Configuration for exchanging IPv4 and IPv6 types of routes.
both*	Ospf	0..1	Configuration for exchanging both IPv4 and IPv6 types of routes.

1535 **Table 75 RoutingProtocolsOspfOptions**

1536   oneOf:

1537   - required: [ipv4]

1538   - required: [ipv6]

1539   - required: [both]

1540   - required: [ipv4AndIpv6]

14.8.6   RoutingProtocolsStaticIpv4AndIpv6

1542   File: \ip\common\ipCommon.yaml

1543   Configuration for exchanging IPv4 and IPv6 types of routes.

Name	Type	Multiplicity	Description
ipv4*	Static	1	Configuration for exchanging IPv4 types of routes.
ipv6*	Static	1	Configuration for exchanging IPv6 types of routes.

1544   **Table 76 RoutingProtocolsStaticIpv4AndIpv6**

14.8.7   RoutingProtocolsStaticOptions

1546   File: \ip\common\ipCommon.yaml

1547   Static routing configuration options. The configuration of the BGP can be provided for the
1548   following type pf routes that will be exchanged: - ipv4, or - ipv6, or - both, or - ipv4 and ipv6

Name	Type	Multiplicity	Description
ipv4*	Static	0..1	Configuration for exchanging IPv4 types of routes.
ipv6*	Static	0..1	Configuration for exchanging IPv6 types of routes.
ipv4AndIpv6*	RoutingProtocolsStaticIpv4AndIpv6	0..1	Configuration for exchanging IPv4 and IPv6 types of routes.
both*	Static	0..1	Configuration for exchanging both IPv4 and IPv6 types of routes.

1549   **Table 77 RoutingProtocolsStaticOptions**

1550   oneOf:

1551   - required: [ipv4]

1552   - required: [ipv6]

1553   - required: [both]

1554   - required: [ipv4AndIpv6]

1555   **14.9   BGP**

1556
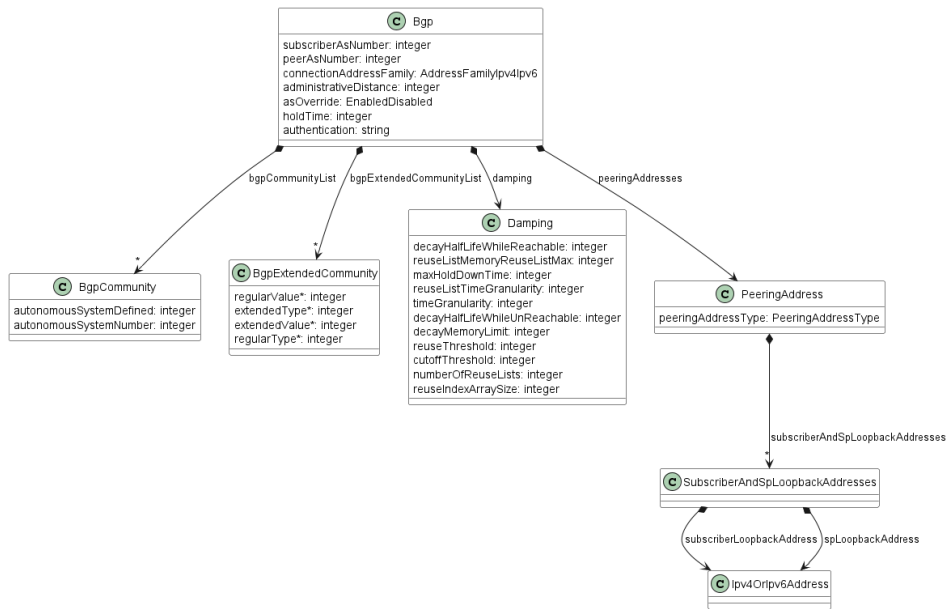
1557   **Figure 24 Bgp**

1558   Figure 24 depicts the model of BGP routing protocol configuration model.

1559   **14.9.1   Bgp**

1560   File: \ip\common\ipCommon.yaml

1561   When an entry in the UNI Routing Protocol is for BGP, BGP as specified in RFC 4271 is used
1562   across the UNI to exchange information. Reference MEF 61.1 Section 12.7.3 BGP.

Name	Type	Multiplicity	Description
subscriberAsNumber	integer	0..1	BGP Subscriber Autonomous System number.
peerAsNumber	integer	0..1	BGP Peer Autonomous System Number.
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.
connectionAddressFamily	AddressFamilyIpv4Ipv6	0..1	Connection Address Family (IPv4 or IPv6).
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.
administrativeDistance	integer	0..1	BGP Administrative Distance.
asOverride	EnabledDisabled	0..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.
peeringAddresses	PeeringAddress	0..1	Peering Addresses.
holdTime	integer	0..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.
authentication	string	0..1	BGP Authentication. It is either None or if present is it a value of MD5 Password. It is assumed that an encrypted channel is used for API session so that the password is protected.
bgpCommunityList	BgpCommunity[]	0..*	Used to control which routers are accepted, preferred, distributed, or advertised.

1563   **Table 78 Bgp**

1564 **14.9.2   BgpCommunity**

1565   File: \ip\common\ipCommon.yaml

1566   A community is a group of destinations which share some common property. Each autonomous
1567   system administrator may define which communities a destination belongs to.

Name	Type	Multiplicity	Description
autonomousSystemDefined*	integer	1	The remaining octets.
autonomousSystemNumber*	integer	1	The first two octets encoding the Autonomous System value.

1568   **Table 79 BgpCommunity**

1569   **14.9.3   BgpExtendedCommunity**

1570   File: \ip\common\ipCommon.yaml

1571   This attribute provides a mechanism for labeling information carried in BGP-4. These labels can
1572   be used to control the distribution of this information, or for other applications.

Name	Type	Multiplicity	Description
regularValue*	integer	0..1	Octets 2 - 8 of the value part of the address. Used in case only Regular Type is provided.
extendedType*	integer	0..1	Extended Type Field, 2 octets length
extendedValue*	integer	0..1	Octets 3 - 8 of the value part of the address. Used in case only Extended Type is provided.
regularType*	integer	0..1	Regular Type Field, 1 octet length

1573   **Table 80 BgpExtendedCommunity**

1574   oneOf:

1575   - required: [regularType, regularValue]

1576   - required: [extendedType, extendedValue]

1577   **14.9.4   AddressFamilyIpv4Ipv6**

1578   File: \ip\common\ipCommon.yaml

1579   Specifies whether the session is established over IPv4 or IPv6.

Value
IPV4
IPV6

1580   **Table 81 AddressFamilyIpv4Ipv6**

1581   **14.9.5   Damping**

1582   File: \ip\common\ipCommon.yaml

1583   Damping parameters as defined in RFC 2439 BGP Route Flap Damping, Section 4.2

Name	Type	Multiplicity	Description
decayHalfLifeWhileReachable	integer	0..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 if considered reachable (whether suppressed or not).
reuseListMemoryReuseListMax	integer	0..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.
maxHoldDownTime	integer	0..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.
reuseListTimeGranularity	integer	0..1	This is the time (in seconds) interval between evaluations of the reuse lists. Each reuse lists corresponds to an additional time increment.
timeGranularity	integer	0..1	This is the time granularity in seconds used to perform all decay computations.
decayHalfLifeWhileUnReachable	integer	0..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 if considered unreachable. If not specified or set to zero, no decay will occur while a route remains unreachable.
decayMemoryLimit	integer	0..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.
reuseThreshold	integer	0..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.
cutoffThreshold	integer	0..1	This value is expressed as a number of route withdrawals. It is the value above which a route advertisement will be suppressed.
numberOfReuseLists	integer	0..1	This is the number of reuse lists. It may be determined from reuse-list-max or set explicitly.
reuseIndexArraySize	integer	0..1	This is the size of reuse index arrays. This size determines the accuracy with which suppressed routes can be placed within the set of reuse lists when suppressed for a long time.

1584   **Table 82 Damping**

1585 **14.9.6   PeeringAddress**

1586   File: \ip\common\ipCommon.yaml

1587   Peering Addresses. Connection Addresses, or Loopbacks plus a list of pairs of IP addresses.
1588   Reference MEF 61.1 Section 12.7.3 BGP.

Name	Type	Multiplicity	Description
subscriberAndSpLoopbackAddresses	SubscriberAndSpLoopbackAddresses[]	0..*	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.
peeringAddressType	PeeringAddressType	0..1	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.

1589   **Table 83 PeeringAddress**

1590   **14.9.7   PeeringAddressType**

1591   File: \ip\common\ipCommon.yaml

1592 If the Peering Addresses parameter is CONNECTION_ADDRESSES, a separate BGP peering
1593 session is established over each UNI Access Link, using the primary IPv4 addresses in the UNI
1594 Access Link IPv4 Connection Addressing Service Attribute (section 13.4) or the first IPv6
1595 addresses in the UNI Access Link IPv6 Connection Addressing Service Attribute (section 13.5),
1596 as indicated by the Connection Address Family parameter. If the Peering Addresses parameter is
1597 LOOPBACKS, a list of pairs of IP addresses is additionally specified, each pair containing the
1598 Subscriber's loopback address and the SP's or Operator's loopback address. A single BGP peering
1599 session is established for each pair of addresses.

Value
CONNECTION_ADDRESSES
LOOPBACKS

1600   **Table 84 PeeringAddressType**

1601 **14.9.8   SubscriberAndSpLoopbackAddresses**

1602 File: \ip\common\ipCommon.yaml

1603 A list of pairs of IP addresses, each pair containing the Subscriber's loopback address and the SP's
1604 or Operator's loopback address. A single BGP peering session is established for each pair of
1605 addresses.

Name	Type	Multiplicity	Description
subscriberLoopbackAddress	Ipv4OrIpv6Address	0..1	Subscriber's loopback Address for BGP establishing a session
spLoopbackAddress	Ipv4OrIpv6Address	0..1	Service Provider's loopback Address for BGP establishing a session

1606   **Table 85 SubscriberAndSpLoopbackAddresses**

1607 **14.10 OSPF**

1608
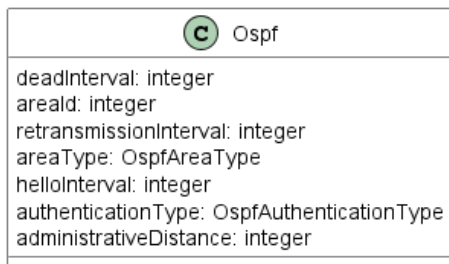
1609 **Figure 25 Ospf**

1610 Figure 25 Presents the model of OSPF configuration. It consists only of simple attributes and
1611 enumerations.

14.10.1 Ospf

1613 File: \ip\common\ipCommon.yaml

1614 When an entry in the UNI Routing Protocols is for OSPF, OSPF as specified in RFC 2328 (for
1615 IPv4) and/or RFC 5340 (for IPv6) is used across each UNI Access Link to exchange routing
1616 information. Reference MEF 61.1 Section 12.7.2 OSPF.

Name	Type	Multiplicity	Description
deadInterval	integer	0..1	Dead interval (0-429496295, in seconds)
areaId	integer	0..1	Area ID (0-429967295), normally expressed as an IPv4 address.
retransmissionInterval	integer	0..1	Retransmit interval (integer greater than 0, in seconds)
areaType	OspfAreaType	0..1	OSPF Area Type enumeration.
helloInterval	integer	0..1	Hello interval (0-65535, in seconds)
authenticationType	OspfAuthenticationType	0..1	OSPF Authentication Type.
administrativeDistance	integer	0..1	Administrative distance (integer greater than 0)

1617 **Table 86 Ospf**

1618 **14.10.2   OspfAreaType**

1619 File: \ip\common\ipCommon.yaml

1620 OSPF Area Type enumeration. Reference MEF 61.1 Section 12.7.2 OSPF

Value
NORMAL
STUB
NSSA

1621 **Table 87 OspfAreaType**

1622 **14.10.3   OspfAuthenticationType**

1623 File: \ip\common\ipCommon.yaml

1624 OSPF Authentication Type enumeration.

Value
NONE
PASSWORD
MESSAGE_DIGEST

1625 **Table 88 OspfAuthenticationType**

1626 **14.11   Static**

1627
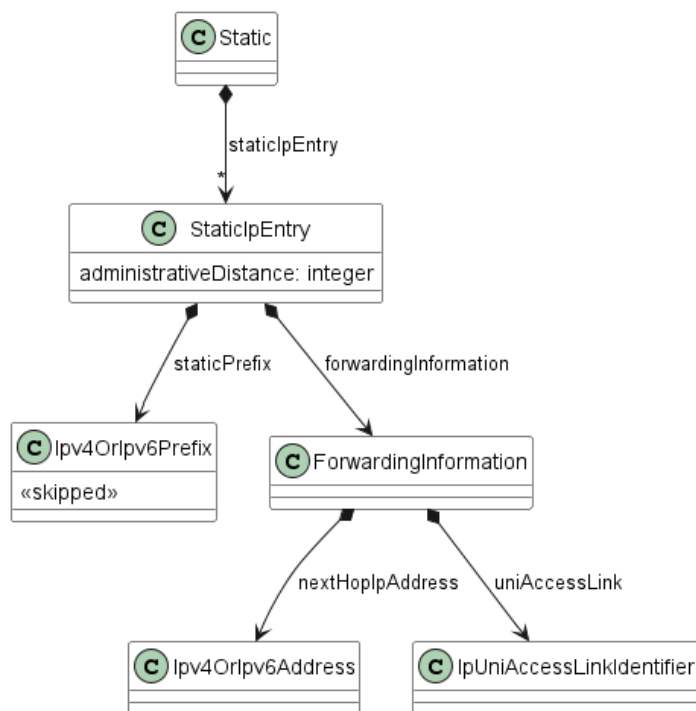
1628   **Figure 26 Static**

1629   Figure 26 shows the resource model for Static routing configuration.

1630   **14.11.1   Static**

1631   File: \ip\common\ipCommon.yaml

1632   When an entry in the UNI Routing Protocols list is for Static, the IP Prefixes used in the Subscriber
1633   Network that are reachable via this UNI are specified as additional parameters in the entry. These
1634   are known as Static IP Prefixes. Reference MEF 61.1 Section 12.7.1 Static.

Name	Type	Multiplicity	Description
staticIpEntry	StaticIpEntry[]	1..*	Static IP address entry.

1635   **Table 89 Static**

1636 **14.11.2   StaticIpEntry**

1637   File: \ip\common\ipCommon.yaml

1638   StaticIpEntry data type including IPv4/IPv6 prefixes, forwarding information and administrative
1639   distance.

Name	Type	Multiplicity	Description
staticPrefix	Ipv4OrIpv6Prefix	0..1	IPv4 or IPv6 Prefix that is advertised.
administrativeDistance	integer	0..1	Administrative distance, an integer > 0.
forwardingInformation	ForwardingInformation	0..1	Forwarding information with either Next Hop IP address or UNI Access Link identifier.

1640   **Table 90 StaticIpEntry**

1641   **14.11.3   ForwardingInformation**

1642   File: \ip\common\ipCommon.yaml

1643   Forwarding information, consisting of either a nexthop IP address in the Subscriber Network (if
1644   the access medium is multipoint capable, e.g., Ethernet), or a specific UNI Access Link (if the
1645   access medium is strictly point-to-point, e.g., HDLC, PPP over DSL).

Name	Type	Multiplicity	Description
nextHopIpAddress	Ipv4OrIpv6Address	0..1	Next hop IP address.
uniAccessLink	IpUniAccessLinkIdentifier	0..1	UNI Access Link unique identifier.

1646   **Table 91 ForwardingInformation**

1647   oneOf:

1648   - required: [nextHopIpAddress]

1649   - required: [uniAccessLink]

1650   **14.11.4   IpUniAccessLinkIdentifier**

1651   File: \ip\common\ipCommon.yaml

1652 Ip Uni Access Link identifier as described in MEF 61.1 Section 11.1. Note - It points to the value
1653 of IpUniAccessLink.identifier Service Attribute. It is not intended to point to the potential Product
1654 identifier if IpUniAccessLink is an instance of a Product.

1655 maxLength: 53

1656 pattern: "[\x20-\x7F]+"

1657 **14.12   IPVC Endpoint Bandwidth Profile Envelope**

1658
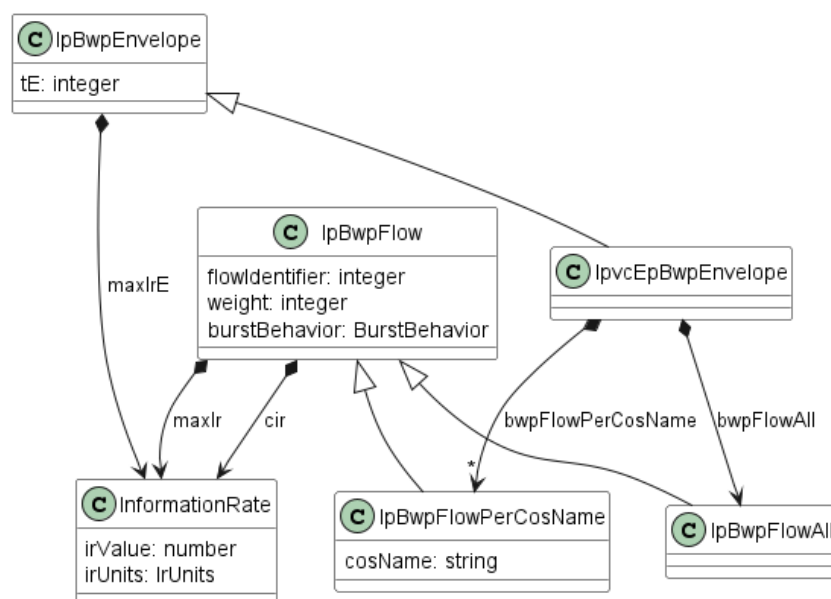
1659 **Figure 27 IpvcEpBwpEnvelope**

1660 Figure 27 IPVC End Point Bandwith Profile Envelope exiends the IpBwpEnvelope to specify
1661 possiblies of Flow configurations that can be applied at the IPVC End Point.

1662 **14.12.1   IpBwpEnvelope**

1663 File: \ip\common\ipCommon.yaml

1664 A BWP Envelope is a list of Bandwidth Profile Flows, plus additional parameters for the BWP as
1665 a whole. A BWP Envelope is a set of one or more BWP Flows that are associated such that the
1666 amount of traffic for one flow can affect the amount that is permitted for another flow. This is an
1667 abstract superclass. There subclasses of IPVC Endpoint, IP UNI and IP NI Access Link Envelopes.
1668 Reference MEF 61.1 Section 17.3 Bandwidth Profile Envelopes.

Name	Type	Multiplicity	Description
tE	integer	0..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.
maxIrE	InformationRate	0..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.

1669   **Table 92 IpBwpEnvelope**

1670   **14.12.2   IpBwpFlow**

1671   File: \ip\common\ipCommon.yaml

1672   A Bandwidth Profile Flow is a stream of IP Packets meeting certain criteria. This is an abstract
1673   superclass. It has subclasses depending on the criteria used. The criteria than can be used depends
1674   on which BWP Envelope the BWP Flow is a part of. Reference MEF 61.1 Section 17.2 Bandwidth
1675   Profile Flows.

Name	Type	Multiplicity	Description
maxIr	InformationRate	0..1	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.
flowIdentifier	integer	0..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.
weight	integer	0..1	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	0..1	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.
cir	InformationRate	0..1	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.

1676   **Table 93 IpBwpFlow**

1677 **14.12.3 IpvcEpBwpEnvelope**

1678 File: \ip\common\ipCommon.yaml

1679 A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile
1680 specifications. A Bandwidth Profile Envelope can be specified for one of a UNI, a UNI Access
1681 Link and ENNI Link or an IPVC End Point. Reference MEF 61.1 Section 11.11 IPVC EP Egress
1682 Bandwidth Profile Envelope Service Attribute. 11.12 IPVC EP Ingress Bandwidth Profile
1683 Envelope Service Attribute.

1684 Inherits from: IpBwpEnvelope

Name	Type	Multiplicity	Description
bwpFlowAll	IpBwpFlowAll	0..1	Pointer to IpvcEpBwpAll
bwpFlowPerCosName	IpBwpFlowPerCosName[]	1..*	List of BWP flows matching given CoS Name

1685 **Table 94 IpvcEpBwpEnvelope**

1686 oneOf:

1687   - required: [bwpFlowPerCosName]

1688   - required: [bwpFlowAll]

1689 **14.12.4 IpBwpFlowAll**

1690 File: \ip\common\ipCommon.yaml

1691 All IP Data Packets. NOTE: No attributes are needed.

1692 Inherits from: IpBwpFlow

1693 **14.12.5 IpBwpFlowPerCosName**

1694 File: \ip\common\ipCommon.yaml

1695 A Bandwidth for and IPVC End Point with an associated Class of Service identifier.

1696 Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
cosName	string[]	1..*	List of Class of Service names.

1697 **Table 95 IpBwpFlowPerCosName**

1698 **14.12.6   BurstBehavior**

1699 File: \ip\common\ipCommon.yaml

1700 Enumeration used to select the Bandwidth Profile Flow Burst Behavior
1701 attribute. Reference MEF 61.1 Section 17.3 Table 29 Bandwidth Profile
1702 Parameters for a Bandwidth Profile Flow.

1703 • OPTIMIZE_DELAY: Enumeration representing the Burst Behavior of optimization of
1704   delay.

1705 • OPTIMIZE_THROUGHPUT: Enumeration representing the Burst Behavior of
1706   optimization of throughput.

Value
OPTIMIZE_DELAY
OPTIMIZE_THROUGHPUT

1707 **Table 96 BurstBehavior**

1708 **14.13   IP UNI Bandwidth Profile Envelope**

1709
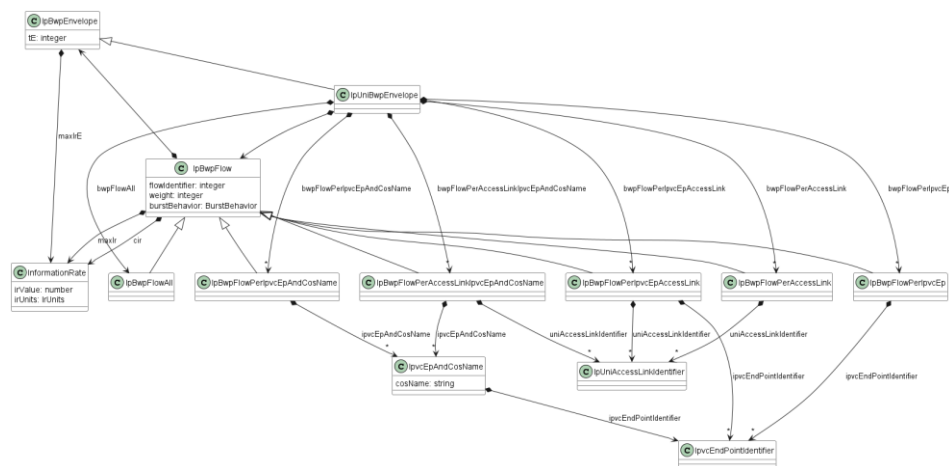
1710   **Figure 28 IpUniBwpEnvelope**

1711   Figure 28 IP UNI Bandwith Profile Envelope exiends the IpBwpEnvelope to specify possiblies of
1712   Flow configurations that can be applied at the IP UNI.

1713   **14.13.1   IpUniBwpEnvelope**

1714   File: \ip\common\ipCommon.yaml

1715   A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow
1716   specifications. The BWP Flows can be defined per UNI, per IPVC EP, per UNI Access Link, per
1717   CosName, etc. Reference MEF 61.1 Sections 12.4 UNI Ingress Bandwidth Profile Envelope
1718   Service Attribute, 12.5 UNI Egress Bandwidth Profile Envelope Service Attribute.

1719   Inherits from: IpBwpEnvelope

Name	Type	Multiplicity	Description
bwpFlowPerIpvcEp	IpBwpFlowPerIpvcEp[]	1..*	A list of BWP Flows that are mapped to any of a given set of IPVC EPs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.
bwpFlowPerIpvcEpAccessLink	IpBwpFlowPerIpvcEpAccessLink[]	1..*	A list of BWP Flows for IP Packets that are received over one of a given set of UNI Access Links and re mapped to any of a given set of IPVC EPs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.
bwpFlowAll	IpBwpFlowAll	0..1	A BWP Flow for all IP Data Packets at the UNI. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

bwpFlowPerAccessLink	IpBwpFlowPerAccessLink[]	1..*	A list of BWP Flows for IP Packets that are received over one of a given set of UNI Access Links. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.
bwpFlowPerIpvcEpAndCosName	IpBwpFlowPerIpvcEpAndCosName[]	1..*	A list of BWP Flows 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.

bwpFlowPerAccessLinkIpvcEpAndCosName	IpBwpFlowPerAccessLinkIpvcEpAndCosName[]	1..*	A list of BWP Flows that are mapped to the UNI Access Link and any of a given set of (IPVC EP, Cos Name) pairs. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

1720 **Table 97 IpUniBwpEnvelope**

1721 oneOf:

1722 - required: [bwpFlowPerAccessLink]

1723 - required: [bwpFlowPerIpvcEp]

1724 - required: [bwpFlowPerIpvcEpAccessLink]

1725 - required: [bwpFlowPerIpvcEpAndCosName]

1726 - required: [bwpFlowPerAccessLinkIpvcEpAndCosName]

1727 - required: [bwpFlowAll]

1728 **14.13.2   IpBwpFlowPerAccessLink**

1729 File: \ip\common\ipCommon.yaml

1730 All Ingress IP Data Packets at the UNI that are received over one of a give set of UNI Access
1731 Links. Reference MEF 61.1 Section 12.5 UNI Egress BWP Envelope.

1732 Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
uniAccessLinkIdentifier	IpUniAccessLinkIdentifier[]	1..*	List of UNI Access Link Identifiers.

1733   **Table 98 IpBwpFlowPerAccessLink**

1734   **14.13.3   IpBwpFlowPerAccessLinkIpvcEpAndCosName**

1735   File: \ip\common\ipCommon.yaml

1736   All Ingress IP Data Packets at the UNI that are received over one of a given set of UNI Access
1737   Links,and that are mapped to the any of a given set of (IPVC EP, Cos Name) pairs. Reference
1738   MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

1739   Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
ipvcEpAndCosName	IpvcEpAndCosName[]	1..*	List of pairs of IPVC End Point Identifier and Class of Service Name. Reference MEF 61.1 Table 28.
uniAccessLinkIdentifier	IpUniAccessLinkIdentifier[]	1..*	List of UNI Access Link Identifiers.

1740   **Table 99 IpBwpFlowPerAccessLinkIpvcEpAndCosName**

1741   **14.13.4   IpBwpFlowPerIpvcEp**

1742   File: \ip\common\ipCommon.yaml

1743   All Egress/Ingress IP Data Packets at the UNI that are received over the UNI Access Link, and are
1744   mapped to any of a given set of IPVC End Points. Reference MEF 61.1 Section 13.10 UNI Access
1745   Link Ingress BWP Envelope, Section 13.11 UNI Access Link Egress BWP Envelope

1746   Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	IpvcEndPointIdentifier[]	1..*	List of IPVC End Point Identifiers for an IPVC End Point located at the UNI Access Link. Reference MEF 61.1 Table 28.

1747   **Table 100 IpBwpFlowPerIpvcEp**

1748 **14.13.5 IpBwpFlowPerIpvcEpAccessLink**

1749 File: \ip\common\ipCommon.yaml

1750 All Ingress IP Data Packets at the UNI that are received over one of a give set of UNI Access
1751 Links. Reference MEF 61.1 Section 12.4 UNI Ingress BWP Envelope.

1752 Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	IpvcEndPointIdentifier[]	1..*	List of IPVC End Point identifiers as described in MEF 61.1 Section 11.1. Note - It points to the value of IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product identifier if IPVC Endpoint is an instance of a Product.
uniAccessLinkIdentifier	IpUniAccessLinkIdentifier[]	1..*	List of UNI Access Link Identifiers.

1753 **Table 101 IpBwpFlowPerIpvcEpAccessLink**

1754 **14.13.6 IpBwpFlowPerIpvcEpAndCosName**

1755 File: \ip\common\ipCommon.yaml

1756 CoS Name from the IPVC List of Class of Service Names (section 10.8) for the IPVC that has the
1757 IPVC EP.

1758 Inherits from: IpBwpFlow

Name	Type	Multiplicity	Description
ipvcEpAndCosName	IpvcEpAndCosName[]	1..*	List of pairs of IPVC End Point Identifier and Class of Service Name. Reference MEF 61.1 Table 28.

1759 **Table 102 IpBwpFlowPerIpvcEpAndCosName**

1760 **14.13.7 IpvcEpAndCosName**

1761 File: \ip\common\ipCommon.yaml

1762 Data type representing IPVC End Point Identifier and CoS name use for Bandwidth Profiles.

Name	Type	Multiplicity	Description
ipvcEndPointIdentifier	IpvcEndPointIdentifier	0..1	IPVC End Point identifier as described in MEF 61.1 Section 11.1. Note - It points to the value of IpvcEndPoint.identifier Service Attribute. It is not intended to point to the potential Product identifier if IPVC Endpoint is an instance of a Product.
cosName	string	0..1	Class of Service Name.

1763 **Table 103 IpvcEpAndCosName**

1764   **14.14   IP UNI Access Link Bandwidth Profile Envelope**
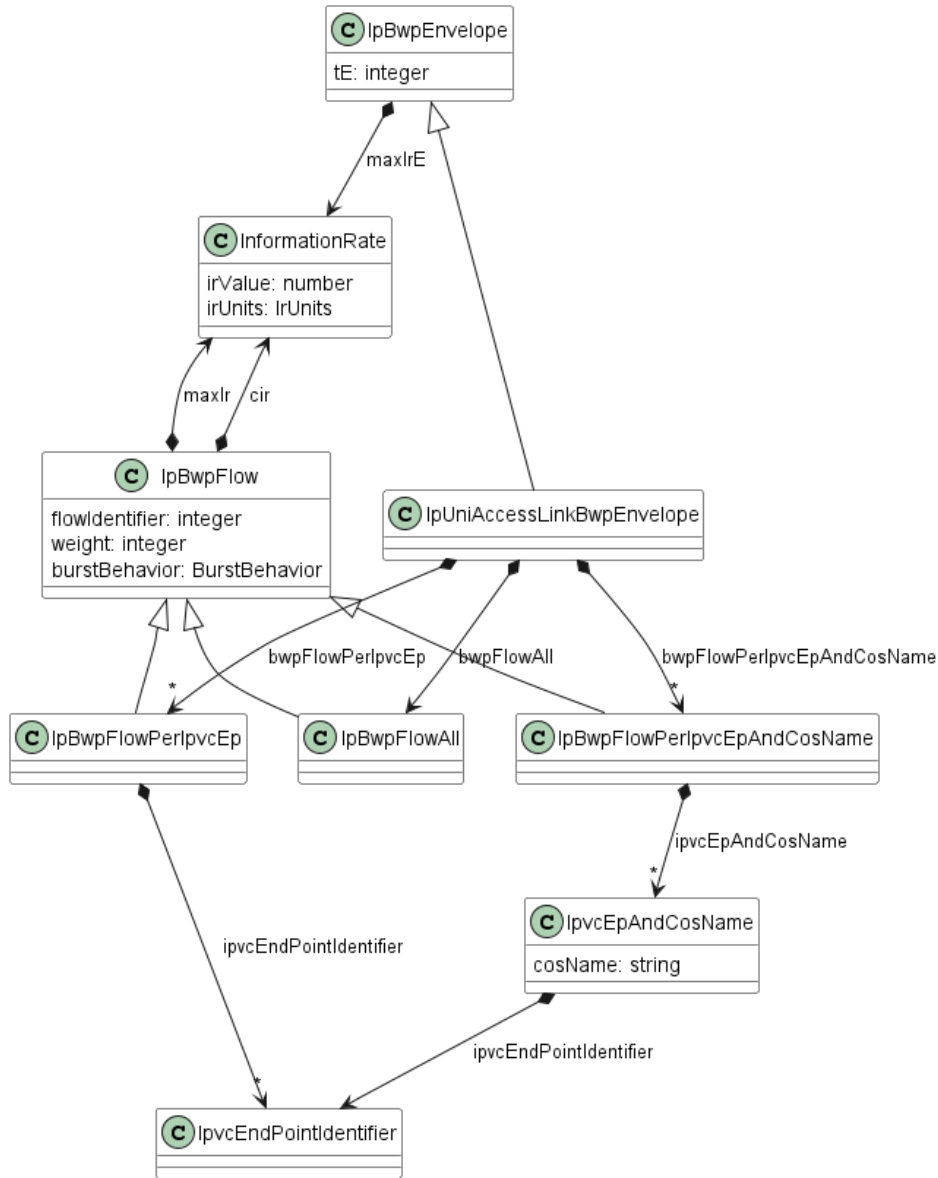
1765

1766   **Figure 29 IpUniAccessLinkBwpEnvelope**

1767 Figure 29 IP UNI Access Link Bandwith Profile Envelope exiends the IpBwpEnvelope to specify
1768 possiblies of Flow configurations that can be applie at the IP UNI Access Link.

1769 **14.14.1 IpUniAccessLinkBwpEnvelope**

1770 File: \ip\common\ipCommon.yaml

1771 A single Bandwidth Profile Envelope consisting of parameters and Bandwidth Profile Flow
1772 specifications. An Ingress Bandwidth Profile Envelope can be specified for one of a UNI, a UNI
1773 Access, or an IPVC EP. Reference MEF 61.1 Section 13.10 UNI Access Link Ingress Bandwidth
1774 Profile Envelope Service Attribute.

1775 Inherits from: IpBwpEnvelope

Name	Type	Multiplicity	Description
bwpFlowPerIpvcEp	IpBwpFlowPerIpvcEp[]	0..*	List of BWP FLows matching IPVC Endpoint Identifier(s) for an IPVC EP located at the UNI.
bwpFlowAll	IpBwpFlowAll	0..1	BWP Flow for all IP Data Packets at the UNI that are transmitted or received over the UNI Access Link.
bwpFlowPerIpvcEpAndCosName	IpBwpFlowPerIpvcEpAndCosName[]	0..*	List of BWP FLows matching pairs of IPVC Endpoint Identifier and CoS Name.

1776   **Table 104 IpUniAccessLinkBwpEnvelope**

1777 oneOf:

1778   - required: [bwpFlowAll]

1779   - required: [bwpFlowPerIpvcEp]

1780   - required: [bwpFlowPerIpvcEpAndCosName]

1781 **14.15   BasicIaBwpEnvelope**

1782
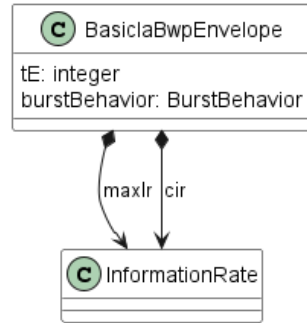
1783   **Figure 30 BasicIaBwpEnvelope**

1784   Figure 30 shows a simple model of BasicIaBwpEnvelope. It leverages MEF 69.1 [10] requirements
1785   to Basic Internet Access and simplifies the model , comaring to the advanced one.

1786   **14.15.1   BasicIaBwpEnvelope**

1787   File: \ip\common\ipCommon.yaml

1788   A single Bandwidth Profile Envelope simplified for the use of Basic Internet Access. For Basic
1789   Internet Access there must always be exactly one Class of Service Name, exactly one IPVC End
1790   Point at the UNI and exactly one UNI Access Link, none of the other options are needed. There
1791   can also be one flow, so the flowIdentifier and weight are also omitted for the flow. maxIr is omitted
1792   from the Envelope - resulting in flattened BasicIaBwpEnvelope class containing four attributes:
1793   the Envelope IR Time tE, and the cir, maxIr and burstBehavior for the single BWP Flow. This special
1794   case envelope is used for the UNI, IPVC End Point and UNI Access Links cases for Basic Internet
1795   Access. Reference MEF 61.1 Section 11.11 IPVC EP Egress Bandwidth Profile Envelope Service
1796   Attribute.

Name	Type	Multiplicity	Description
maxIr	InformationRate	0..1	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.
tE	integer	0..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.
burstBehavior	BurstBehavior	0..1	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.
cir	InformationRate	0..1	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.

1797   **Table 105 BasicIaBwpEnvelope**

1798   **14.16   IP Addressing**

1799
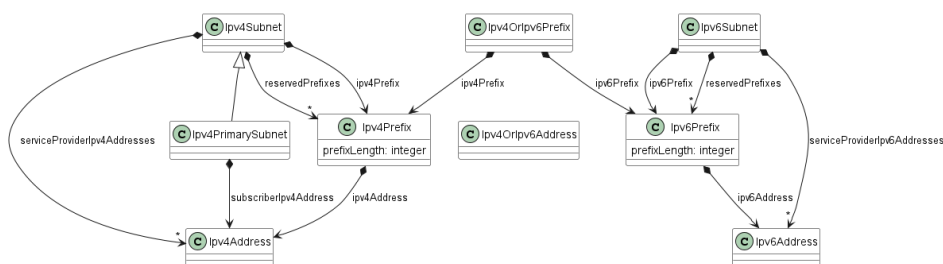
1800   **Figure 31 IP Addressing**

1801   Figure 31 Illustrates the model of IPv4 and IPv6 addressing. Note that the API schema leverages
1802   the OAS embedded *ipv4* and *ipv6* string formats and uses them to specify the *Ipv4Address* and
1803   *Ipv6Address* data types that are uses whenever an address value must be provided.

1804   **14.16.1   Ipv4Address**

1805   File: \ip\common\ipCommon.yaml

1806   Data type representing IPv4 address.

1807   Format: ipv4

1808 **14.16.2   Ipv4Prefix**

1809   File: \ip\common\ipCommon.yaml

1810   Data type representing IPv4 address prefix and mask length between 0 and 31 bits.

Name	Type	Multiplicity	Description
prefixLength	integer	0..1	IPv4 address prefix. Length 0-31.
ipv4Address	Ipv4Address	0..1	IPv4 address.

1811   **Table 106 Ipv4Prefix**

1812   **14.16.3   Ipv4Subnet**

1813   File: \ip\common\ipCommon.yaml

1814   Ipv4Subnet is a data type representing an IPv4 subnet logical partition of an IP network. Included
1815   is list of Service Provider IPv4 addresses.

Name	Type	Multiplicity	Description
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 Provider IPv4 Address. Reference MEF 69.1[1] Section 9.4 Subscriber Internet Access Service: UNI Access Link Requirements
reservedPrefixes	Ipv4Prefix[]	0..*	List of IPv4 Prefixes, possibly empty
ipv4Prefix*	Ipv4Prefix	1	IPv4 address prefix (IPv4 address prefix and mask length between 0 and 31 in bits).

1816   **Table 107 Ipv4Subnet**

1817   **14.16.4   Ipv4PrimarySubnet**

1818   File: \ip\common\ipCommon.yaml

1819   Ipv4Subnet used in context of Primary Ipvc subnet. It adds the subscriberIpv4Address attribute to
1820   the Ipv4Subnet.

1821   Inherits from: Ipv4Subnet

Name	Type	Multiplicity	Description
subscriberIpv4Address	Ipv4Address	0..1	Subscriber IPv4 Address

1822 **Table 108 Ipv4PrimarySubnet**

1823 **14.16.5   Ipv6Address**

1824 File: \ip\common\ipCommon.yaml

1825 Data type representing IPv6 address.

1826 Format: ipv6

1827 **14.16.6   Ipv6Prefix**

1828 File: \ip\common\ipCommon.yaml

1829 Data type representing IPv6 address prefix and mask length between 0 and 127 in bits.

Name	Type	Multiplicity	Description
prefixLength	integer	0..1	IPv6 address prefix. Length 0-127.
ipv6Address	Ipv6Address	0..1	IPv6 address.

1830 **Table 109 Ipv6Prefix**

1831 **14.16.7   Ipv6Subnet**

1832 File: \ip\common\ipCommon.yaml

1833 IPv6Subnet is a data type representing an IPv6 subnet logical partition of an IP network. Included
1834 is list of Service Provider IPv6 addresses.

Name	Type	Multiplicity	Description
reservedPrefixes	Ipv6Prefix[]	0..*	List of IPv6 Prefixes, possibly empty
serviceProviderIpv6Addresses	Ipv6Address[]	1..*	List of IPv6 Service Provider addresses.
ipv6Prefix*	Ipv6Prefix	1	IPv6 Prefix (IPv6 address prefix and mask length between 0 and 127 in bits).

1835   **Table 110 Ipv6Subnet**

1836   **14.16.8   Ipv4OrIpv6Address**

1837   File: \ip\common\ipCommon.yaml

1838   Data type representing IPv4 or IPV6 address.

1839   oneOf:

1840   - format: ipv4

1841   - format: ipv6

1842   **14.16.9   Ipv4OrIpv6Prefix**

1843   File: \ip\common\ipCommon.yaml

1844   IPv4 or IPv6 prefix. Includes subnet address and prefix length.

Name	Type	Multiplicity	Description
ipv6Prefix	Ipv6Prefix	0..1	IPv6 prefix.
ipv4Prefix	Ipv4Prefix	0..1	IPv4 prefix.

1845   **Table 111 Ipv4OrIpv6Prefix**

1846   oneOf:

1847   - required: [ipv4Prefix]

1848   - required: [ipv6Prefix]

14.17 Common IP Classes

This section describes classes that are present in the ipCommon.yaml file, yet are not strictly related to IP technology.

14.17.1 EnabledDisabled

File: \ip\common\ipCommon.yaml

Enumeration to indicate Enabled/Disabled state of an attribute

Value
ENABLED
DISABLED

Table 112 EnabledDisabled

14.17.2 InformationRate

File: \ip\common\ipCommon.yaml

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

Name	Type	Multiplicity	Description
irValue	number	0..1	The value in the information rate. For example if the information rate is 70 kbps this element is 70.
irUnits	IrUnits	0..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 113 InformationRate

14.17.3 IrUnits

File: \ip\common\ipCommon.yaml

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.

Value
BPS
KBPS
MBPS
GBPS
TBPS
PBPS
EBPS
ZBPS
YBPS

1865 **Table 114 IrUnits**

1866 **14.17.4 Percentage**

1867 File: \ip\common\ipCommon.yaml

1868 This is a number of percent - a floating point number between 0 and 100

1869 **14.17.5 TimeDuration**

1870 File: \ip\common\ipCommon.yaml

1871 This class is used to describe durations expressed as a 2-tuple, (value, units). The units from from
1872 nanoseconds to years.

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.

1873   **Table 115 TimeDuration**

1874   **14.17.6   TimeDurationUnits**

1875   File: \ip\common\ipCommon.yaml

1876   The unit of measure in the duration. For example, if an interval is 2ms, this element is MS.

Value
NS
US
MS
SEC
MIN
HOUR
DAY
WEEK
MONTH
YEAR

1877   **Table 116 TimeDurationUnits**

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