MEF Standard

MEF 82

MEF Services Model:

Information Model for SD-WAN Services

July 2020

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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.

- *CenturyLink*

- *Cisco*

- *Verizon*

2   Abstract

The MEF Services Model (MSM) is an information model representation of the constructs used to define MEF services (e.g., Carrier Ethernet, IP, Layer 1 and SD-WAN service). The object definitions, object attributes and relationships specified in the MSM are based on MEF standards that define the given services. This document defines the MSM as well as the UML classes, data types and enumerations for representing SD-WAN Services, as defined in MEF 70[1], as part of the MSM.

This document normatively includes the content of the following Papyrus [2] UML files as if they were contained within this document (pull request **#144,** GitHub Repository [3]):

- SD_WAN.di
- SD_WAN.notation
- SD_WAN.uml

3   Terminology and Abbreviations

This section defines the terms used in this document. In many cases, the normative definitions to terms are found in other documents. In these cases, the third column is used to provide the reference that is controlling, in other MEF or external documents. In addition, terms defined in MEF 70[1] are included in this document by reference and are not repeated in the table below.

Term	Definition	Reference
Information Model	Models managed objects at a conceptual level, independent of any specific implementations or protocols used to transport the data. MEF uses UML Class Diagrams to model Information Models.	IETF RFC 3444 [4]
MEF Services Model	The MEF Services Model (MSM) is an information model representation of the constructs used to define the following services: Carrier Ethernet, IP, Layer 1 and SD-WAN.	This document
MSM	MEF Services Model	This document
Unified Modeling Language	The Unified Modeling Language (UML) is a unified model for object-oriented analysis and design	OMG [5]
UML	Unified Modeling Language	OMG [5]

Table 1-Terminology and Abbreviations

4 Introduction

The MEF Services Model: SD-WAN is a service model intended to support management of SD-WAN services. The model is derived from MEF 70[1] SD-WAN Service Attributes and Services.

The MSM includes common classes and type definitions from MEF-Common and MEF-Types models that can be used by other MEF models. Figure 1 illustrates the model relationships.
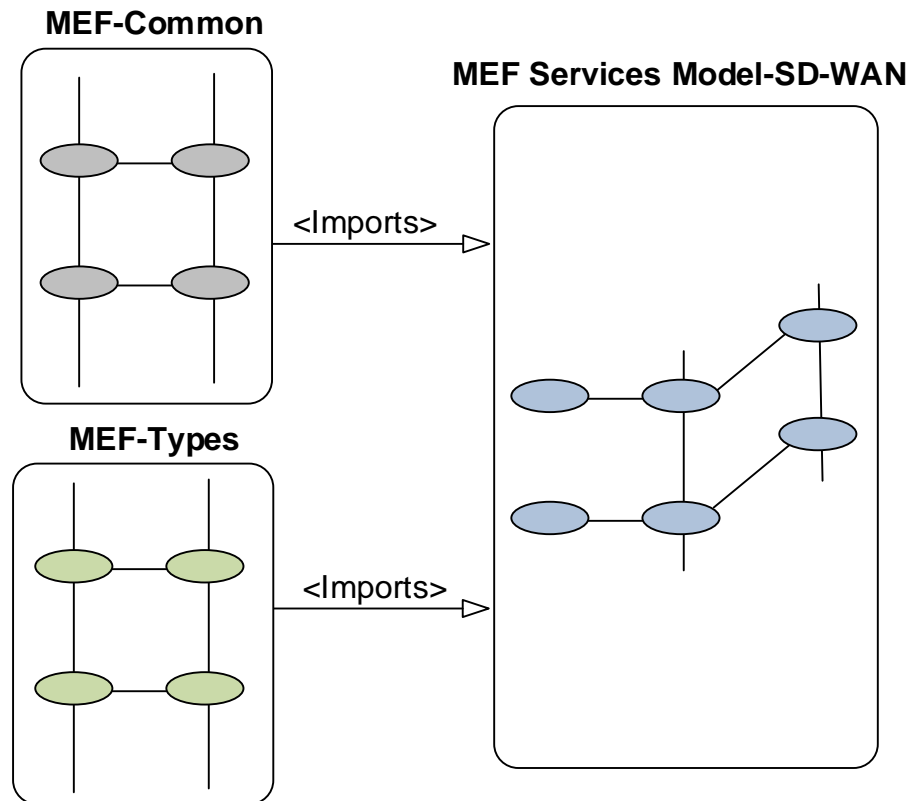
Figure 1-MSM and other model associations

The MSM is intended to be used at multiple LSO interface reference points for multiple API development efforts. Relevant interface reference points include: Sonata, Cantata, Allegro, Interlude and Legato. Each of these interfaces can use the common objects, attributes and relationships defined in the MSM.

The MSM can be used with TM Forum APIs where the JSON payload is derived from the MSM, by YANG-based APIs (via NETCONF or RESTCONF) where the YANG model is derived from the MSM or by OpenAPI based APIs where the OpenAPI specification is derived from the MSM.

5   SD-WAN Service

An SD-WAN Service provides a virtual overlay network that enables application-aware, policy-driven and orchestrated connectivity between SD-WAN User Network Interfaces (UNIs) and provides the logical construct of a L3 Virtual Private Router Network for a Subscriber that conveys IP Packets between Subscriber locations as defined in MEF 70[1].

An SD-WAN Service is described in terms of SD-WAN UNIs, SD-WAN Virtual Connections (SWVCs) between those SD-WAN UNIs, and SWVC End Points (SWVC EPs) at the SD-WAN UNIs. The SD-WAN Service is an overlay service that operates over one or more Underlay Connectivity Services (UCSs). However, modeling of the UCSs is outside the scope of this document.

Traffic is forwarded within an SD-WAN Service based on Application Flows. IP Packets received by the Service Provider at an SD-WAN UNI are mapped to Application Flows based on a set of criteria, and Policies can then be applied to the Application Flow to describe rules and constraints on how the traffic for that Application Flow is forwarded.

Further details on these constructs can be found in MEF 70[1]. The information model described in this document is based on the attributes of SD-WAN UNIs, SWVCs, SWVC EPs, Application Flows and Policies described in MEF 70[1].

6 MEF-Types

This section details the data types imported from MEF-Types that are used by the SD-WAN model.

6.1 AdminState

Data type enumeration for Administrative states. Values are LOCKED and UNLOCKED.

6.2 Identifier45

Data type attribute unique by network administrative domain, containing no more than 45 characters and non-null RFC Display String but not contain the characters 0x00 through 0x1F.

6.3 PositiveInteger

Data type with single attribute, positiveint, which is an Integer > 0.

6.4 OperationalState

Data type enumeration for Operational states. Values are DISABLED and ENABLED.

6.5 TimeAndDate

Data type defined for Time and Date in UTC.

6.6 VlanId

Data type with single attribute, vlanId which is defined as a PostiveInteger. Value 1 to 4094.

7 SD-WAN Model

This section details the SD-WAN UML model with objects, attributes and relationships. The main SD-WAN objects are SdWanUni, SwVcEndPoint and SwVc. Figure 2 illustrates the main SD-WAN objects, relationships and attributes. The following subsections describe each of these classes in more details.
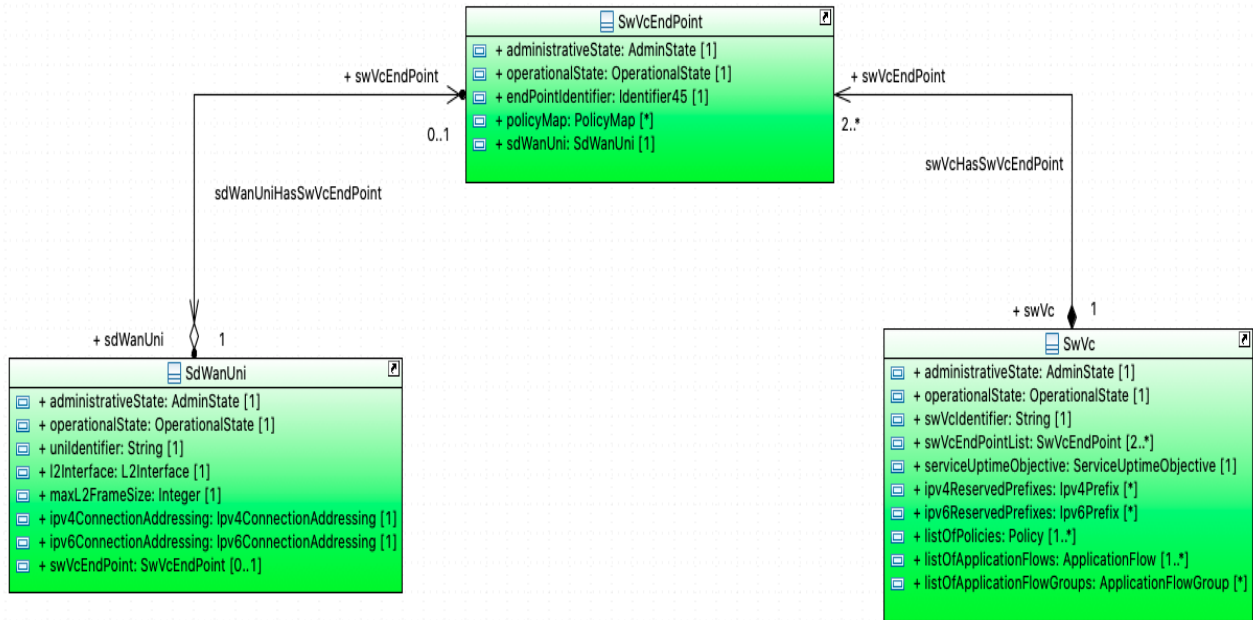

Figure 2-SD-WAN Model Overview

7.1 SdWanUni

SdWanUni is a class that represents the boundary between the responsibility of the Subscriber and the responsibility of the Service Provider. Reference MEF 70[1], Section 6.4 SD-WAN UNI. The attributes of the SdWanUni are described in Table 2.
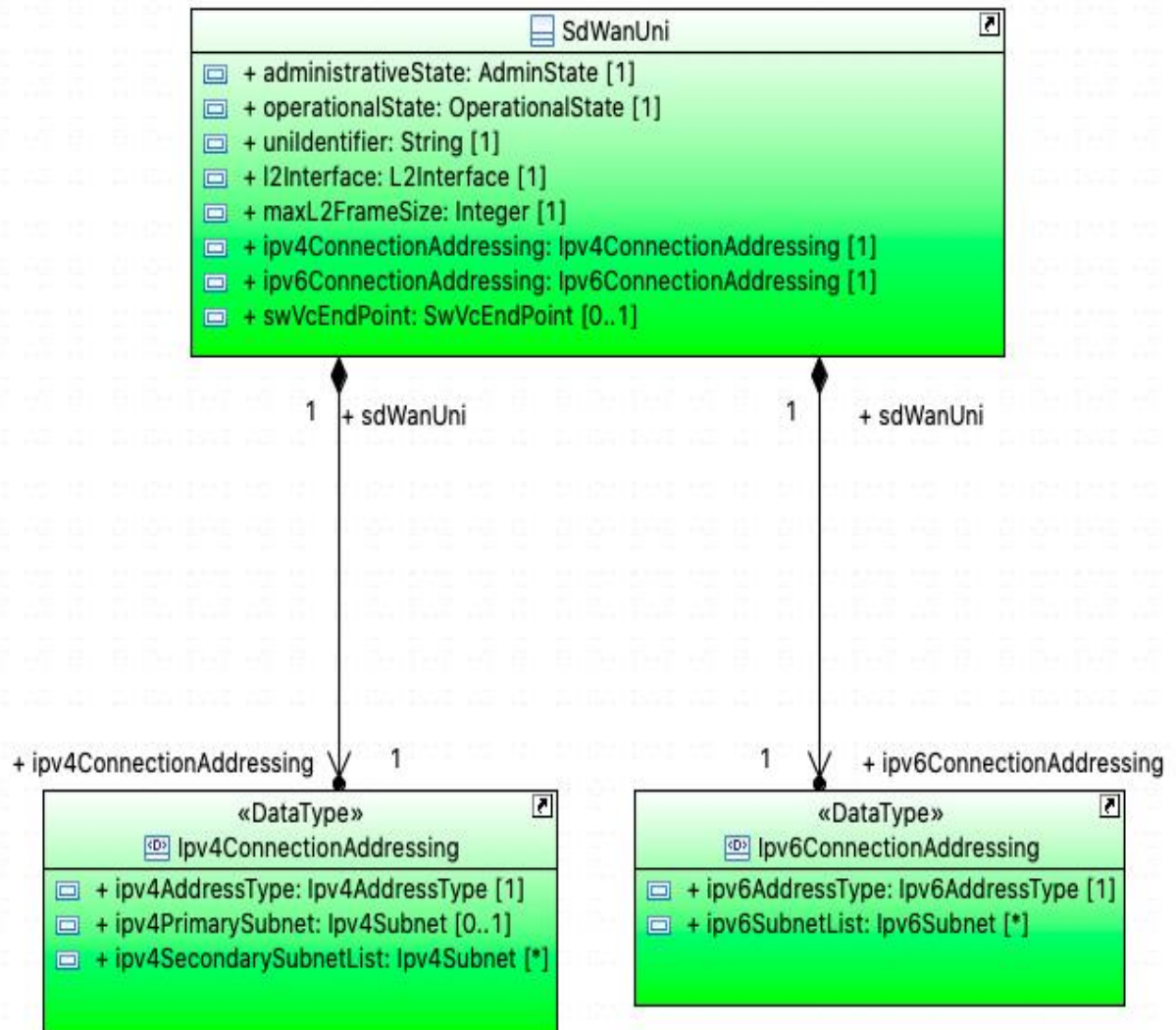
Figure 3-SD-WAN UNI Model

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of SD-WAN UNI. The values supported are LOCKED and UNLOCKED. When set to UNLOCKED, the SD-WAN UNI is enabled and ready to forward traffic. When set to LOCKED, the SD-WAN UNI is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState		This attribute denotes the operational state of the SD-WAN UNI, as working ENABLED or not working DISABLED.
uniIdentifier	String	1	Identification of the UNI for management purposes. Reference MEF 70[1], Section 10.1 SD-WAN UNI Identifier Service Attribute.
l2Interface	L2Interface	1	Describes the underlying L2 technology for the UNI. Reference MEF 70[1], Section 10.2 SD-WAN UNI L2 Interface Service Attribute.
maxL2FrameSize	Integer	1	Specifies the maximum length L2 frame that is accepted by the Service Provider. Reference MEF 70[1], Section 10.3 SD-WAN UNI Maximum L2 Frame Size Service Attribute.
ipv4ConnectionAddressing	Ipv4ConnectionAddressing	0..1	Specifies how IPv4 addresses are allocated to the devices on the Subscriber side for the UNI. This attribute is omitted if there is no IPv4 address (i.e., if the Service Attribute is None). Reference MEF 70[1], Section 10.4 SD-WAN UNI IPv4 Connection Addressing Service Attribute.
ipv6ConnectionAddressing	Ipv6ConnectionAddressing	0..1	Specifies how IPv6 addresses are allocated to the devices connected to the UNI. This attribute is omitted if there is no IPv4 address (i.e., if the Service Attribute is None). Reference MEF 70[1] Section 10.5 SD-WAN UNI IPv6 Connection Addressing Service Attribute.
swVcEndPoint	SwVcEndPoint	0..1	Attribute representation association to 0 or 1 SD-WAN VC End Point.

Table 2-SdWanUni Attributes

7.2 SwVcEndPoint

SwVcEndPoint is a class that represents a logical construct at an SD-WAN UNI that partitions Ingress IP Packets into Application Flows, applies Policy to each IP Packet based on the associated Application Flow and selects an appropriate path to transport the IP Packet over the SWVC. Reference MEF 70[1], Section 9 SD-WAN Virtual Connection (SWVC) End Point. The attributes of the SwVcEndPoint are described in Table 3. The PolicyMap is further described in Section 9.
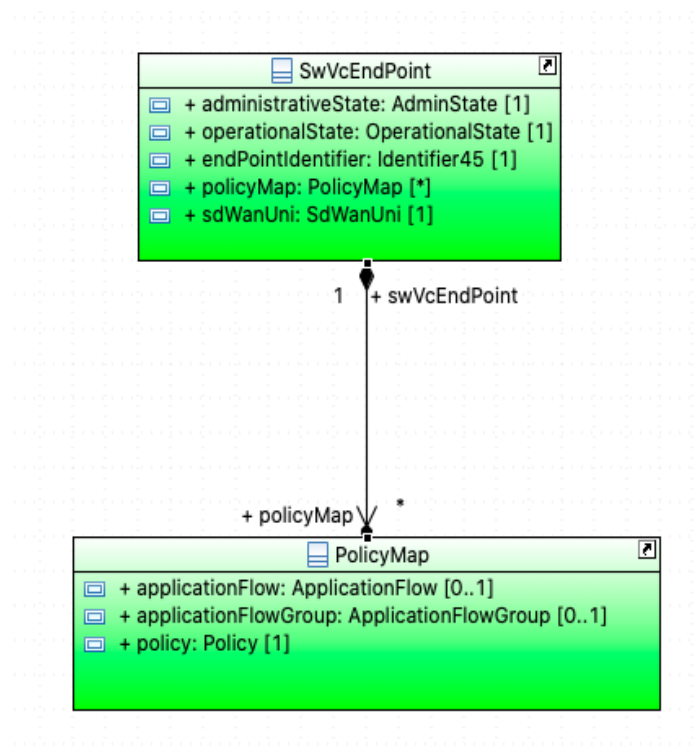
Figure 4-SWVC End Point Model

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of SD-WAN Virtual Circuit End Point. The values supported are LOCKED and UNLOCKED. When set to UNLOCKED, the SD-WAN Virtual Circuit End Point is enabled and ready to forward traffic. When set to LOCKED, the SD-WAN Virtual Circuit End Point is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState	1	This attribute denotes the operational state of the SD-WAN Virtual Circuit End Point, as working ENABLED or not working DISABLED.
endPointIdentifier	Identifier45	1	Identification of the SWVC End Point for management purposes. Reference MEF 70[1] Section 9.1 SWVC End Point Identifier Service Attribute. Reference MEF-Types for Identifier45.
sdWanUni	SdWanUni	1	Reference to SD-WAN UNI (SdWanUni).
policyMap	PolicyMap	0..*	Maps Policies to Application Flows and Application Flow Groups. Reference MEF 70[1] Section 9.3 SWVC End Point Policy Map.

Table 3-SwVcEndPoint Attributes

7.3 SwVc

SwVc is a class that represents a SD-WAN Virtual Connection. Reference MEF 70[1] Section 6.8 SD-WAN Virtual Connection. The attributes of the SwVc are described in Table 4. The Policy, ApplicationFlow and ApplicationFlowGroup are further described in Section 9.
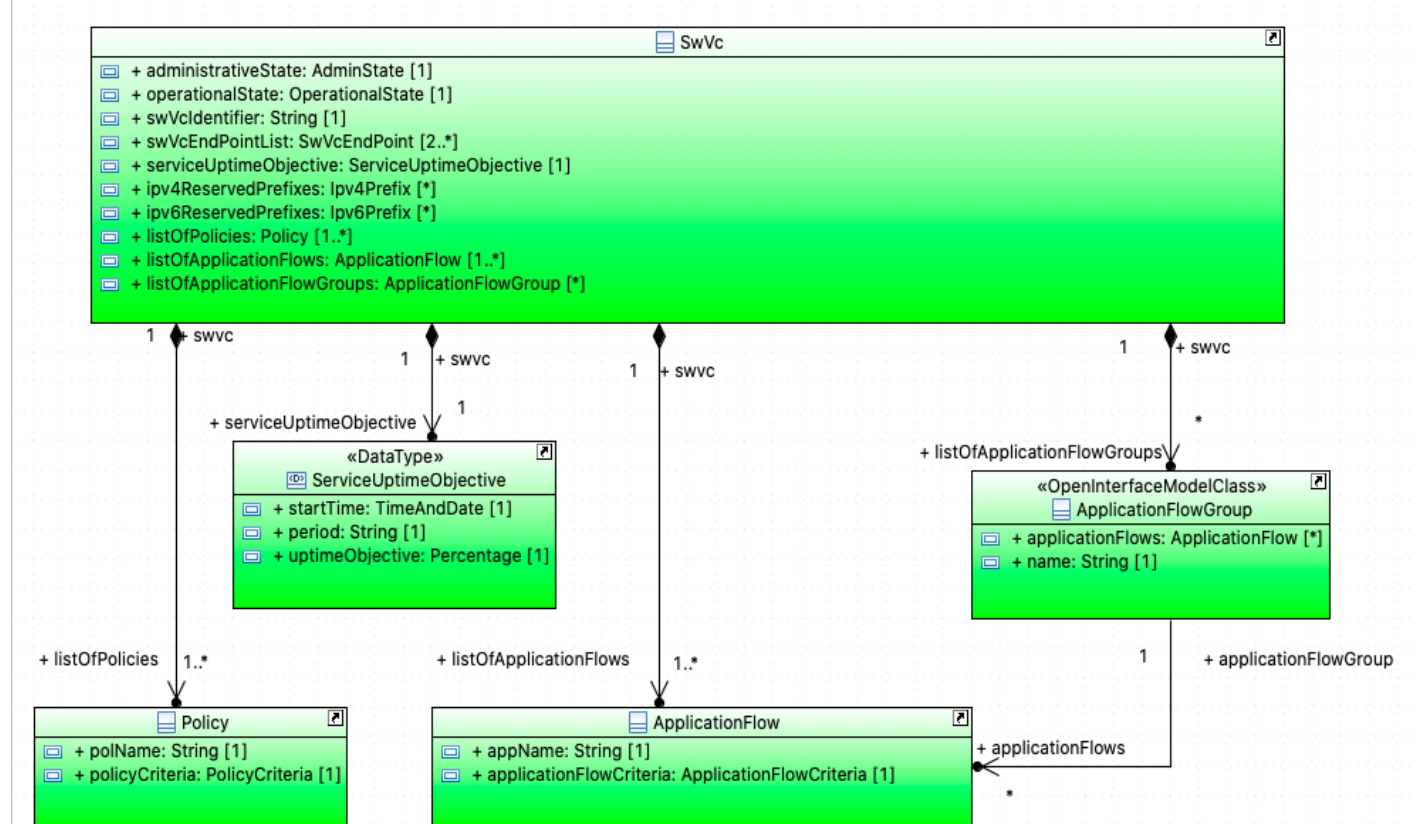
Figure 5-SWVC Model

Attribute Name	Type	Mult.	Description
administrativeState	AdminState	1	This attribute denotes the administrative state of SD-WAN Virtual Circuit. The values supported are LOCKED and UNLOCKED. When set to UNLOCKED, the SD-WAN Virtual Circuit is enabled and ready to forward traffic. When set to LOCKED, the SD-WAN Virtual Circuit is disabled and will block (i.e., not forward) traffic.
operationalState	OperationalState	1	This attribute denotes the operational state of the SD-WAN Virtual Circuit, as working ENABLED or not working DISABLED.
swvcIdentifier	String	1	Identification of the SWVC for management purposes. Reference MEF 70[1], Section 8.1.
swVcEndPointList	SwVcEndPoint	2.*	The SWVC End Point that are connected by the SWVC. Reference MEF 70[1] Section 8.2 SWVC End Point List Service Attribute.
serviceUptimeObjective	ServiceUptimeObjective	1	Attribute representing the proportion of time, during a given time period that

			the service is working from the perspective of the Subscriber, excluding any pre-agreed exceptions. Reference MEF 70[1] Section 8.3 SWVC Service Uptime Object Service Attribute.
ipv4ReservedPrefixes	Ipv4Prefix	0..*	Specifies a list of IPv4 Prefixes that the Service Provider reserves for use for the SWVC within their own network or for distribution to the Subscriber via DHCP. Reference MEF 70[1] Section 8.4 SWVC Reserved Prefixes Service Attribute.
ipv6ReservedPrefixes	Ipv6Prefix	0..*	Specifies a list of IPv6 Prefixes that the Service Provider reserves for use for the SWVC within their own network or for distribution to the Subscriber via DHCP or SLAAC. Reference MEF 70[1] Section 8.4 SWVC Reserved Prefixes Service Attribute.
listOfPolicies	Policy	1..*	A list of the Policies that can be applied to Application Flows carried by the SWVC End Points. Reference MEF 10.4 Section 8.5 SWVC List of Policies Service Attribute.
listOfApplicationFlowGroups	ApplicationFlowGroup	0..*	A list (possibly empty) of Application Flow Group names. Reference MEF 70[1] Section 8.6 SWVC List of Application Flow Groups Service Attribute.
listOfApplicationFlows	ApplicationFlow	1..*	Specifies the Application Flows that can be recognized by the SD-WAN service and information about how to identify IP packets in each Application Flow. Reference MEF 70[1] Section 8.7 SWVC List of Application Flows Service Attribute.

Table 4-SwVc Attributes

8 SD-WAN Policies, Application Flows and Application Flow Groups

This section describes a more detailed UML model for the supporting classes for Policy, Application Flow and Application Flow Group.
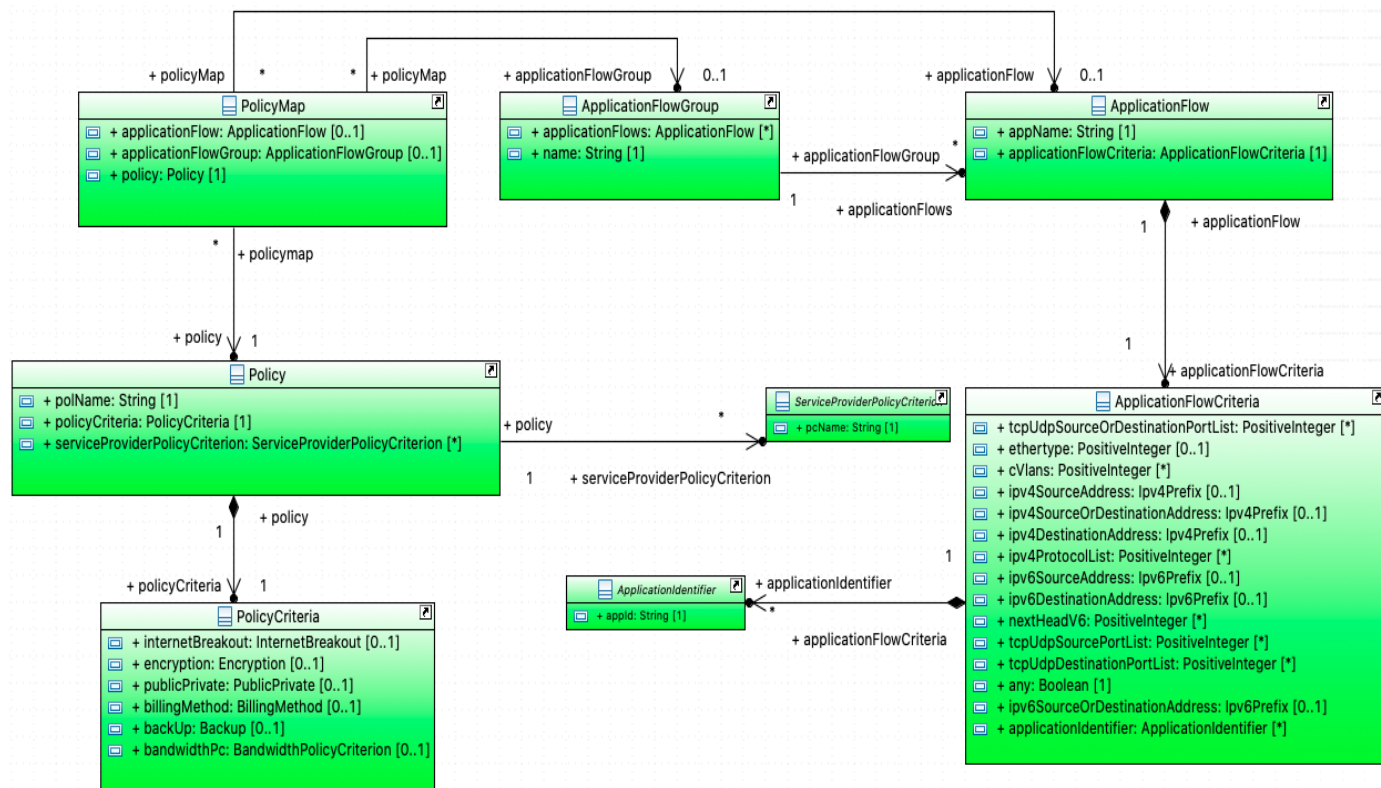
Figure 6-SD-WAN Policies, Application Flows and Application Flow Groups Model

8.1 ApplicationFlow

An ApplicationFlow is subset of the IP packets that arrive at an Ingress SD-WAN UNI, identified by a set of Application Flow Criteria, and distinct from the subset for any other Application Flow at that SD-WAN UNI. Reference MEF 70[1] Section 8.7 SWVC List of Application Flows Service Attribute.

Attribute Name	Type	Mult.	Description
appName	String	1	Identifier String that is used to refer to Application Flow. Reference MEF 70[1] Section 8.7 SWVC List of Application Flows Service Attribute.
applicationFlowCriteria	ApplicationFlowCriteria	1	Pointer to associated ApplicationFlowCriteria. Reference MEF 70[1] Section 8.7 SWVC List of Application Flows Service Attribute.

Table 5-ApplicationFlowAttributes

8.2 **ApplicationFlowCriteria**

The ApplicationFlowCriteria class describes the standard criteria that can be used to describe an Application Flow, as defined in MEF 70[1] Section 8.7. Reference MEF 70[1] Section 8.7 SWVC List of Application Flows Service Attribute.

Attribute Name	Type	Mult.	Description
ethertype	PositiveInteger	0..1	Ethertype. Integer in the range 0x600 to 0xffff. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
cVlans	PositiveInteger	0..*	C-VLAN ID List. Integer in range 0 to 4096. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv4SourceAddress	Ipv4Prefix	0..1	IPv4 Source Address. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv4DestinationAddress	Ipv4Prefix	0..1	IPv4 Destination Address. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv4ProtocolList	PositiveInteger	0..*	IPv4 Protocol List. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv6SourceAddress	Ipv6Prefix	0..1	IPv6 Source Address. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv6DestinationAddress	Ipv6Prefix	0..1	IPv6 Destination Address. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
nextHeadV6	PositiveInteger	0..*	IPv6 Next Header List. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
tcpUdpSourcePortList	PositiveInteger	0..*	TCP/UDP Source Port List. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
tcpUdpDestinationPortList	PositiveInteger	0..*	TCP/UDP Destination Port List. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
any	Boolean	1	Match Any IP Packet. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv4SourceOrDestinationAddress	Ipv4Prefix	0..1	IPv4 Source or Destination Address. Reference MEF

			70[1] Section 8.7 Table-4 Required Application Flow Criteria.
ipv6SourceOrDestinationAddress	Ipv6Prefix	0..1	IPv6 Source or Destination Address. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
tcpUdpSourceOrDestinationPortList	PositiveInteger	0..*	TCP/UDP Source or Destination Port List. Reference MEF 70[1] Section 8.7 Table-4 Required Application Flow Criteria.
applicationIdentifier	ApplicationIdentifier	0..*	Application Identifier as a String. Reference MEF 70[1] Section 8.7 [R47].

Table 6-ApplicationFlowCriteria Attributes

8.3 ApplicationFlowGroup

An aggregation of Application Flows at an SD-WAN UNI that can be used to assign a common Policy to the Application Flows and/or share bandwidth commitments and limitations among Application Flows. Reference MEF 70[1] Table 1-Terminology and Abbreviations.

Attribute Name	Type	Mult.	Description
applicationFlows	ApplicationFlow	0..*	Associated Application Flows.
name	String	1	Application Flow Group name.

Table 7-ApplicationFlowGroup Attributes

8.4 ApplicationIdentifier

Abstract class intended to be extended (subclassed) to Service Provider defined Application Identifier.

Attribute Name	Type	Mult.	Description
appId	String	1	Application Identfier as a String. Reference MEF 70[1] Section 8.7 [R47].

Table 8-ApplicationIdentifier Attributes

8.5 Policy

A Policy is a list of Policy Criteria. Policies are assigned to Application Flows and Application Flow Groups at each SWVC End Point. Reference MEF 70[1] Section 8.5.

Attribute Name	Type	Mult.	Description
polName	String	1	An identifier String that specifies the name of the Policy. polName cannot be "block". Reference MEF 70[1] Section 8.5.
policyCriteria	PolicyCriteria	1	The list of policy criteria values that define the policy. Reference MEF 70[1] Section 8.5.
serviceProviderPolicyCriterion	ServiceProviderPolicyCriterion	0..*	Pointer to ServiceProviderPolicyCriteria list.

Table 9-Policy Attributes

8.6 PolicyCriteria

PolicyCriteria is a class representing listed name Policies that can be applied to Application Flows and Application Flow Groups at SWVC End Points. Reference MEF 70[1] Section 8.5 SWVC List of Policies Service Attribute.

Attribute Name	Type	Mult.	Description
encryption	Encryption	0..1	Represents a Policy Criterion used to specify whether or not encryption is required. Reference MEF 70[1] Section 8.5.2 ENCRYPTION Policy Criterion.
publicPrivate	PublicPrivate	0..1	Represents a Policy Criterion that provides control over whether or not an Application Flow can traverse a public Internet Underlay Connectivity Service. Reference MEF 70[1] Section 8.5.3 PUBLIC-PRIVATE Policy Criterion.
internetBreakout	InternetBreakout	0..1	Represents a Policy Criterion indicating whether the Application Flow should be forwarded directly to the Internet using Internet Breakout. Reference MEF 70[1] Section 8.5.4 INTERNET-BREAKOUT Policy Criterion.
billingMethod	BillingMethod	0..1	Represents a Policy Criterion that provides control over the charge type of the network that can be used to forward an Application Flow. Reference MEF 70[1] Section 8.5.5 BILLING-METHOD Policy Criterion.
backUp	Backup	0..1	Represents a Policy Criterion when at least one non-Backup UCS available at an SD-WAN Edge. Reference MEF 70[1] Section 8.5.6 BACKUP Policy Criterion.
bandwidthPc	BandwidthPolicyCriterion	0..1	Represents a Policy Criterion for bandwidth average and maximum rate. Reference MEF 70[1] Section 8.5.7 BANDWIDTH Policy Criterion.

Table 10-PolicyCriteria Attributes

8.7 PolicyMap

Specifies the Policies that are assigned to Application Flows and Application Flow Groups at the SWVC End Point. Reference MEF 70[1] Section 9.3 SWVC End Point Policy Map.

Attribute Name	Type	Mult.	Description
applicationFlow	ApplicationFlow	0..1	Pointer to Application Flow. Reference MEF 70[1] Section 9.3 SWVC End Point UNI Service Attribute. NOTE: One of applicationFlow and applicationFlowGroup must be specified.
applicationFlowGroup	ApplicationFlowGroup	0..1	Pointer to Application Flow Group.
policy	Policy	1	Pointer to Policy.

Table 11-PolicyMap Attributes

8.8   ServiceProviderPolicyCriterion

Abstract class representing Service Provider defined policy criteria. Reference MEF 70 Section 8.5 SWVC List of Policies Service Attribute.

Attribute Name	Type	Mult.	Description
pcName	String	1	Policy criteria name.

9   SD-WAN Data Type Definitions

This section details the associated set of data types that are used by the SD-WAN model. Figure 7 shows the set of Data Type sand respective Data Type Attributes.

Figure 7-SD-WAN Data Types

9.1   BandwidthPolicyCriterion

BandwidthPolicyCriterion is a data type that specifies a rate (bandwidth) limit on an Application Flow or Application Flow Group. Reference MEF 70[1] Section 8.5.7 BANDWIDTH Policy Criterion.

Attribute Name	Type	Mult.	Access	Description
commit	PositiveInteger	0..1	RW	Average information rate in bits per second that is committed to the Application Flow or none. Reference MEF 70[1] Section 8.5.7.
max	PositiveInteger	0..1	RW	Limit on the average information rate in bits per second that can be used by the Application Flow or none. Reference MEF 70[1] Section 8.5.7.

Table 12-BandwidthPolicyCriterion Attributes

9.2 Ipv4ConnectionAddressing

Ipv4ConnectionAddressing is a data type representing how IPv4 addresses are allocated to the devices on the Subscriber side of the UNI. For DHCP and Static the Primary Subnet and Secondary Subnet List must be included. Reference MEF 70[1] Section 10.4 SD-WAN UNI IPv4 Connection Addressing Service Attribute.

Attribute Name	Type	Mult.	Access	Description
ipv4AddressType	Ipv4AddressType	1	RW	IPv4 Connection Address mechanism. Possible values are Static or DHCP.
ipv4PrimarySubnet	Ipv4Subnet	1	RW	Primary IPv4 Subnet. Includes IPv4 Prefix and Service Provider IPv4 Addresses.
ipv4SecondarySubnetList	Ipv4Subnet	0..*	RW	Secondary IPv4 Subnet List. Includes IPv4 Prefix and Service Provider IPv4 Addresses.

Table 13-Ipv4ConnectionAddressing Attributes

9.3 Ipv4Prefix

Ipv4Prefix is a data type representing an IPv4 prefix using slash notation.

Attribute Name	Type	Mult.	Access	Description
prefixLength	Integer	1	RW	IPv4 prefix length with range 0-31.
ipv4Address	String	1	RW	IPv4 address represented as a string.

Table 14-Ipv4Prefix Attributes

9.4 Ipv4Subnet

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

Attribute Name	Type	Mult.	Access	Description
ipv4Prefix	Ipv4Prefix	1	RW	IPv4 Prefix (IPv4 address prefix and mask length between 0 and 31), in bits.
serviceProviderIpv4Addresses	String	1..*	RW	List of Service Provider IPv4 addresses.

Table 15-Ipv4Subnet Attributes

9.5 Ipv6ConnectionAddressing

IPv6ConnectionAddressing is a data type that specifies how IPv6 addresses are allocated to the devices on the Subscriber side of the UNI. For DHCP, SLAAC and Static, IPv6 Prefix and Service Provider IPv6 Addresses are needed. Reference MEF 70[1] Section 10.5 SD-WAN UNI IPv6 Connection Addressing Service Attribute.

Attribute Name	Type	Mult.	Access	Description
ipv6AddressType	Ipv6AddressType	1	RW	IPv6 Connection Address mechanism. Possible values are DHCP, SLAAC, Static or LL-only.
ipv6SubnetList	Ipv6Subnet	0..*	RW	Primary IPv6 Subnet.

Table 16-Ipv6ConnectionAddressing Attributes

9.6 Ipv6Prefix

Ipv6Prefix is a data type representing an IPv6 prefix using slash notation.

Attribute Name	Type	Mult.	Access	Description
ipv6Address	String	1	RW	IPv6 address represented as a string.
prefixLength	Integer	1	RW	IPv6 prefix length.

Table 17-Ipv6Prefix Attributes

9.7 Ipv6Subnet

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

Attribute Name	Type	Mult.	Access	Description
ipv6Prefix	Ipv6Prefix	1	RW	IPv6 Prefix (IPv6 address prefix and mask length between 0 and 127), in bits.
serviceProviderIpv6Addresses	String	1..*	RW	List of IPv6 Service Provider addresses.

Table 18-Ipv6Subnet Attributes

9.8 L2Interface

L2Interface is a data type that describes the underlying network layer that carries IP Packets across the UNI. The possible values are UT/PT and CVLANx. Reference MEF 70[1] Section 10.2 SD-WAN UNI L2 Interface Service Attribute.

Attribute Name	Type	Mult.	Access	Description
l2InterfaceType	L2InterfaceType	1	RW	L2 interface type.
vlanId	VlanId	0..1	RW	VLAN id.

Table 19-L2Interface Attributes

9.9 Period

Period data type with value and specified time unit.

Attribute Name	Type	Mult.	Access	Description
value	PositiveInteger	1	RW	Time value represented as an integer.
units	TimeUnits	1	RW	Time units represented in minutes, hours, days, weeks, months or years.

Table 20-Period Attributes

9.10 Percentage

Percentages as fixed-point, signed decimal values. Represent an interest rate of 19.99% as 19.99. Valid number formats are plain decimal numbers and whole numbers. Unlike a JSON number or JSON schema number type, this value MUST NOT be deserialized in JavaScript into a JavaScript Number object, which is 64-bit floating-point and cannot accurately represent all values transmitted by this type. Likewise, in Java, this type MUST be deserialized into a BigDecimal or other fixed-point numeric type.

Attribute Name	Type	Mult.	Access	Description
value	String	1	RW	"pattern": "^((-?[0-9]+)|(-?([0-9]+)?[.][0-9]+))$"

9.11 ServiceProviderPolicyCriterion

Data type supporting Service Provider defined policy criteria in form of <pcName,pcParam>. Reference MEF 70[1] Section 8.5 SWVC List of Policies Service Attribute.

Attribute Name	Type	Mult.	Access	Description
pcName	String	1	RW	Policy criteria name.
pcParam	String	1	RW	Policy criteria parameter.

Table 21-DerivedPolicyCriteria Attributes

### 9.12 ServiceUptimeObjective

ServiceUptimeObjective is a data type that represents the SWVC service up time objective. It defines that proportion of time that the service is working from the perspective of the Subscriber, excluding any pre-agreed exceptions. Reference MEF 70[1] Section 8.3 SWVC Service Uptime Objective Service Attribute.

Attribute Name	Type	Mult.	Access	Description
startTime	TimeAndDate	1	RW	Represents the data and time that evaluation of Service Uptime starts for the SWVC. Reference MEF 70[1] Section 8.3.
period	Period	1	RW	Time duration, e.g., 1 month or 2 weeks, that is used in conjunction with ts to specify time intervals for determining when the Service Uptime Objective is met. Note the units for T are not constrained; in particular, "1 month" is an allowable value for T. Reference MEF 70[1] Section 8.3.
uptimeObjective	Percentage	1	RW	Objective for Service Uptime expressed as a percentage. Reference MEF 70[1] Section 8.3.

Table 22-ServiceUptimeObjective Attributes

10 SD-WAN Enumerations

The following section details the associated set of enumeration that are used by the SD-WAN model. The figure below shows the set of Data Type sand respective Data Type Attributes.
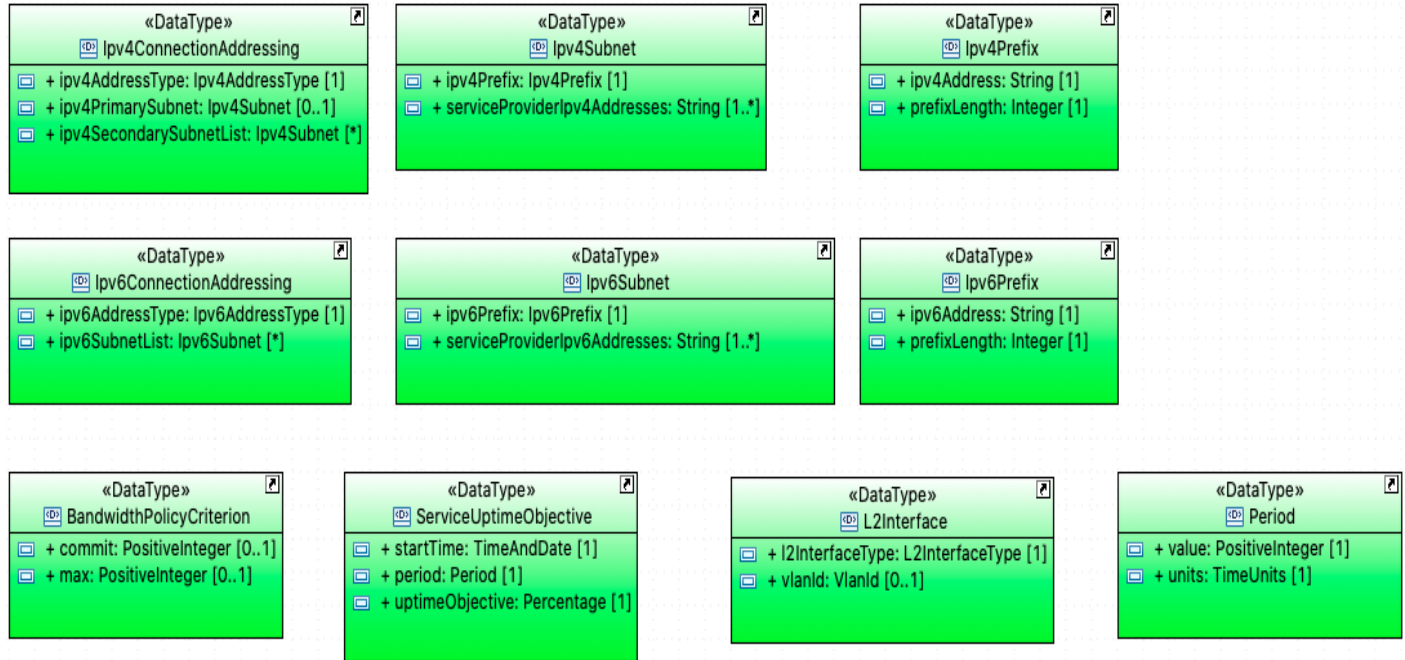
Figure 8-SD-WAN Enumerations

10.1 Backup

Backup is an enumeration that represents a Policy Criterion when at least one non-Backup UCS available at an SD-WAN Edge. Reference MEF 70[1] Section 8.5.6 BACKUP Policy Criterion.

Contains Enumeration Literals:
- YES:
    - Enumeration literal for Backup Policy Criterion where Application Flows can be forwarded over a backup path (if there is non-backup path available). Reference MEF 70[1] Section 8.5.6 [R32].
- NO:
    - Enumeration literal for Backup Policy Criterion where Application Flow must be discarded if only Backup UCSs to the destination egress UNI are available. Reference MEF 70[1] Section 8.5.6 BACKUP Policy Criterion. [R32].

10.2 BillingMethod

BillingMethod is an enumeration representing a Policy Criterion that provides control over the charge type of the network that can be used to forward an Application Flow. Reference MEF 70[1] Section 8.5.5 BILLING-METHOD Policy Criterion.

Contains Enumeration Literals:
- FLAT_RATE_ONLY:
    - Enumeration literal for Billing Method Policy Criterion that indicates that traffic must be forwarded over an Underlay Connectivity Service with flat-rate (i.e., time- based) charging. Reference MEF 70[1] Section 8.5.5 [R30].
- EITHER:
    - Enumeration literal for Billing Method Policy Criterion that indicates that the billing method must not be considered in the forwarding decision for the Application Flow. Reference MEF 70[1] Section 8.5.5 [R31].

10.3 Encryption

Encryption is an enumeration that represents a Policy Criterion used to specify whether or not encryption is required. Reference MEF 70[1] Section 8.5.2 ENCRYPTION Policy Criterion.

Contains Enumeration Literals:
- YES:
    - Enumeration literal for Encryption Policy Criterion when Encryption is set and Application Flow must be encrypted before it is forwarded over the Underlay Connectivity Service. Reference MEF 70[1] Section 8.5.2 [R23].
- EITHER:
    - Enumeration literal for Encryption Policy Criterion if Encryption is set to Either and Policy Criterion must not be considered in the forwarding decision for the Application Flow. Reference MEF 70[1] Section 8.5.2 [R24].

10.4   InternetBreakout

InternetBreakout is an enumeration that represents a Policy Criterion that indicates whether the Application Flow should be forwarded directly to the Internet using Internet Breakout. Reference MEF 70[1] Section 8.5.4 INTERNET-BREAKOUT Policy Criterion.

Contains Enumeration Literals:
- YES:
    - Enumeration literal for InternetBreakout Policy Criterion when Application Flow must be forwarded to the Internet over an Internet UCS. Reference MEF 70[1] Section 8.5.4 [R27].
- NO:
    - Enumeration literal for InternetBreakout Policy Criterion when the Application Flow, if it is not blocked or discarded for other reasons, must be forwarded into the SWVC and delivered to another SD-WAN End Point in the SWVC. Reference MEF 70[1] Section 8.5.4 [R28].

10.5   Ipv4AddressType

Ipv4AddressType is an enumeration that represents an IPv4 Connection Address mechanism. Reference MEF 70[1] Section 10.4 SD-WAN UNI IPv4 Connection Addressing Service Attribute.

Contains Enumeration Literals:
- DHCP:
    - Enumeration literal for Ipv4AddressType, indicating that devices in the Subscriber Network request IPv4 addresses from Service Provider hosted DHCP server.
- STATIC:
    - Enumeration literal for Ipv4AddressType, indicating that devices in the Subscriber Network request a statically assigned IPv4 address to the Subscriber.

10.6   Ipv6AddressType

Ipv6AddressType is an enumeration that represents an IPv6 Connection Address mechanism. Reference MEF 70[1] Section 10.5 SD-WAN UNI IPv6 Connection Addressing Service Attribute.

Contains Enumeration Literals:
- DHCP:
    - Enumeration literal for Ipv6AddressType, indicating that devices in the Subscriber Network request IPv6 addresses from Service Provider hosted DHCP server.
- SLAAC:
    - Enumeration literal for Ipv6AddressType, indicating that devices in the Subscriber Network request IPv6 addresses from Service Provider using Stateless Address Autoconfiguration.
- STATIC:
    - Enumeration literal for Ipv6AddressType, indicating that devices in the Subscriber Network request a statically assigned IPv6 address to the Subscriber.
- LL_ONLY:
    - Enumeration literal for Ipv6AddressType is LL_ONLY then only IPv6 Link-Local addressing is used on the UNI.

10.7   L2InterfaceType

L2InterfaceType is an enumeration that describes the underlying network layer that carries IP Packets across the UNI. The possible values are UT/PT and CVLANx. Reference MEF 70[1] Section 10.2.

Contains Enumeration Literals:
- UT_PT:
    - Enumeration literal for L2InterfaceType. If UT/PT, then Untagged and Priority-tagged frames that cross the Ingress UNI MUST be mapped to the SWVC End Point.
- CVLANX:
    - Enumeration literal for L2InterfaceType. If CVLANx, then C-Tagged frames that contain a C-VLAN Tag with a specified C-Tag VLAN ID that cross the Ingress UNI MUST be mapped to the SWVC End Point.

10.8 PublicPrivate

PublicPrivate is an enumeration representing a Policy Criterion provides control over whether or not an Application Flow can traverse a public Internet Underlay Connectivity Service. Reference MEF 70[1] Section 8.5.3 PUBLIC-PRIVATE Policy Criterion.

Contains Enumeration Literals:
- PRIVATE_ONLY:
  - o Enumeration literal for PublicPrivate Policy Criterion set to PrivateOnly and Application Flow must be forwarded over Underlay Connectivity Services that do not traverse the public Internet. Reference MEF 70[1] Section 8.5.3 [R25].
- EITHER:
  - o Enumeration literal for PublicPrivate Policy Criteron when Policy Criterion must not be considered in the forwarding decision for Application Flow. Reference MEF 70[1] Section 8.5.3 [R26].

10.9 TimeUnits

TimeUnits is an enumeration representing time units.

Contains Enumeration Literals:
- MINUTE:
  - o Minute is enumeration literal for TimeUnits.
- HOUR:
  - o Hour is enumeration literal for TimeUnits.
- DAY:
  - o Day is enumeration literal for TimeUnits.
- WEEK:
  - o Week is enumeration literal for TimeUnits.
- MONTH:
  - o Month is enumeration literal for TimeUnits.
- YEAR:
  - o Year is enumeration literal for TimeUnits.

11 References

[1] *MEF 70[1] SD-WAN Service Attributes and Services*, July 2019.

[2] *Papyrus UML Tool* – Version: 2018-09 (4.9.0). Copyright © Eclipse contributors and others 2000, 2017.

[3] *MEF Services Model* GitHub repository: "https://github.com/MEF-GIT/Services-Common-Model.

[4] *IETF RFC 3444, On the Difference between Information Models and Data Models*, January 2003.

[5] *Object Management Group (OMG) Unified Modelling Language,* Version 2.5, May 2015.