Technical Specification

MEF 33

Ethernet Access Services Definition

January 2012

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1. Abstract

This document defines Ethernet Access Services, which are OVC-based Ethernet services in contrast to the EVC-based services which are defined in MEF 6.1 Technical Specification "Ethernet Services Definitions"[1]. This document uses the UNI service attributes and parameters options defined in the MEF 6.1 and ENNI and OVC service attributes defined in MEF 26 Technical Specification "External Network Network Interface (ENNI) – Phase 1" [8] and applies them to create new Ethernet access services between a UNI and an ENNI. These new carrier-to-carrier Ethernet access services enable Ethernet Service Providers to reach out-of-franchise customer locations through an Ethernet Access Provider's network, and deliver E-Line and E-LAN service types end to end. This document defines the UNI, OVC, OVC per UNI, OVC End Point per ENNI, and ENNI requirements for point-to-point OVC-based Ethernet services. In addition, an informative appendix is provided showing use cases of some of the defined services.

2. Terminology

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 fourth column is used to provide the reference that is controlling.

Term	Abbrev.	Definition	Ref
Access Ethernet Private Line	**Access EPL**	Access EPL service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support only a single instance of the Access EPL service.	This document
Access Ethernet Virtual Private Line	**Access EVPL**	Access EVPL service uses a Point-to-Point OVC to associate one OVC End Point at a UNI and one OVC End Point at an ENNI. One UNI can support one or more Access EVPL instances.	This document
Access Provider	AP	An Operator MEN that offers the Ethernet Access Service type.	This document
Bandwidth Profile		A Bandwidth Profile is a characterization of the lengths and arrival times for Service Frames at a reference point.	MEF 10.2 [2]
Bandwidth profile per CoS ID		A bandwidth profile applied on a per-Class of Service basis.	[2]
Bandwidth profile per OVC Endpoint		A bandwidth profile applied on a per-OVC Endpoint basis.	MEF 26 [8]
Bandwidth profile per UNI		A bandwidth profile applied on a per-UNI basis.	[2]
Broadcast Service Frame		A Service Frame that has the broadcast destination MAC address.	[2]
CE-VLAN CoS ID		Customer Edge VLAN CoS. Also C-tag PCP.	[2]
CE-VLAN CoS ID Value Preservation (OVC)		CE-VLAN CoS ID Value Preservation describes a relationship between the format and certain field values of the frame at one External Interface and of the corresponding frame at another External Interface	[8]
CE-VLAN ID		Customer Edge VLAN ID	[2]

Term	Abbrev.	Definition	Ref
CE-VLAN ID Preservation (OVC)		CE-VLAN ID Preservation describes a relationship between the format and certain field values of the frame at one External Interface and of the corresponding frame at another External Interface	[8]
OVC End Point Map at the UNI		An association of CE-VLAN IDs with OVCs at a UNI.	[8]
CE-VLAN Tag		Customer Edge VLAN Tag	[2]
Class of Service Frame Set	CoS	A set of Service Frames that have a commitment from the Service Provider subject to a particular set of performance objectives.	MEF 23.1 [16]
Class of Service Identifier for Service Frames (UNI)		The mechanism and/or values of the mechanism to be used to identify the CoS Name that applies to the frame at a given UNI.	[8]
Class of Service Identifier for ENNI Frames (ENNI)		The mechanism and/or values of the parameters in the mechanism to be used to identify the CoS Name that applies to the frame at a given ENNI that maps to an OVC End Point.	[16]
Class of Service Frame Set		A set of Service or ENNI Frames that have a commitment from the Operator or Service Provider subject to a particular set of performance objectives.	[16]
Class of Service Label		A CoS Name that is standardized in MEF 23.1. Each CoS Label identifies four Performance Tiers where each Performance Tier contains a set of performance objectives and associated parameters.	[16]
Class of Service Name		A designation given to one or more sets of performance objectives and associated parameters by the Service Provider or Operator.	[16]
Color Mode	CM	CM is a Bandwidth Profile parameter. The Color Mode parameter indicates whether the color-aware or color-blind property is employed by the Bandwidth Profile. It takes a value of "color-blind" or "color-aware" only.	[2]
Color-aware		A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each Service or ENNI Frame is taken into account when determining the level of compliance for each Service Frame.	[2], [8]
Color-blind		A Bandwidth Profile property where a pre-determined level of Bandwidth Profile compliance for each Service Frame, if present, is ignored when determining the level of compliance for each Service Frame.	[2], [8]
Color Identifier for Service Frame (UNI)		The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the frame at a given UNI. A particular Color ID value may indicate Color instance of Green or Yellow for a Service Frame. PCP and DSCP may indicate both CoS Name and Color. Information derivable from a) a set of one or more C-Tag PCP values or b) a set of one or more DSCP values.	[16]

Term	Abbrev.	Definition	Ref
Color Identifier for ENNI Frames (ENNI)		The mechanism and/or values of the parameters in the mechanism used to identify the Color that applies to the frame at a given ENNI that maps to an OVC End Point. A particular Color ID value may indicate Color instance of Green or Yellow for an ENNI Frame. PCP may indicate both CoS Name and Color. Information derivable from a) a set of one or more S-Tag PCP values or b) DEI value.	[16]
Committed Burst Size	CBS	CBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Frames sent at the EI speed to remain CIR-conformant.	[2]
Committed Information Rate	CIR	CIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Frames at an EI up to which the network delivers Frames, and is committed to meeting the performance objectives defined by the CoS Service Attribute.	[2]
Coupling Flag	CF	CF is a Bandwidth Profile parameter. The Coupling Flag allows the choice between two modes of operation of the rate enforcement algorithm. It takes a value of 0 or 1 only.	[2]
Customer Edge	CE	Equipment on the Subscriber side of the UNI.	[2]
Customer Edge VLAN CoS		The Priority Code Point bits in the IEEE 802.1Q Customer VLAN Tag in a Service Frame that is either tagged or priority tagged.	[2]
Customer Edge VLAN ID		The identifier derivable from the content of a Service Frame that allows the Service Frame to be associated with an EVC at the UNI.	[2]
E-Access Service Type		Ethernet services that use an OVC with at least one UNI OVC End Point and one ENNI OVC End Point.	This document
Egress Bandwidth Profile		A service attribute that specifies the length and arrival time characteristics of egress Frames at the egress EI.	[2]
Egress Service Frame		A Service Frame sent from within a MEN to an EI.	[2]
E-LAN Service		An Ethernet service type that is based on a Multipoint-to-Multipoint EVC.	MEF 6.1 [1]
E-Line Service		An Ethernet service type that is based on a Point-to-Point EVC.	[1]
EPL		Ethernet Private Line	[1]
ENNI		A reference point representing the boundary between two Operator MENs that are operated as separate administrative domains	MEF 4 [6]
ENNI Frame		The first bit of the Destination Address to the last bit of the Frame Check Sequence of the Ethernet Frame transmitted across the ENNI	[8]
ENNI MTU		MTU of an ENNI frame at the ENNI	[8]
E-Tree Service		An Ethernet service type that is based on a Rooted-Multipoint EVC.	[1]
Ethernet Access Provider		Operator of the MEN providing the OVC-based Ethernet service between a UNI and an ENNI.	This document
Ethernet Virtual Connection	EVC	An association of two or more UNIs that limits the exchange of Service Frames to UNIs in the Ethernet Virtual Connection.	[2]
EVC MTU Size		The maximum sized Service Frame allowed for an EVC.	[2]
EVPL		Ethernet Virtual Private Line	[1]

Term	Abbrev.	Definition	Ref
Excess Burst Size	EBS	EBS is a Bandwidth Profile parameter. It limits the maximum number of bytes available for a burst of Frames sent at the EI speed to remain EIR-conformant.	[2]
Excess Information Rate	EIR	EIR is a Bandwidth Profile parameter. It defines the average rate in bits/s of Frames up to which the network may deliver Frames but without any performance objectives.	[2]
External Interface	EI	Either a UNI or an ENNI	[8]
Frame		Short for Ethernet Frame	[2]
Frame Delay	FD	The time elapsed from the reception of the first bit of the ingress frame at EI_1 until the transmission of the last bit of the corresponding egress frame at EI_2.	MEF 26.0.3 [17]
Frame Delay Range	FDR	The difference between the observed percentile of delay at a target percentile and the observed minimum delay for the set of frames in interval T.	[2]
Frame Delay Performance		A measure of the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.	[17]
Frame Delay Range Performance		A measure of the extent of delay variability experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.	[17]
Frame Loss Ratio Performance	FLR	Frame Loss Ratio is a measure of the number of lost frames between the ingress EI_1 and the egress EI_2. Frame Loss Ratio is expressed as a percentage.	[17]
Ingress Bandwidth Profile		A characterization of ingress Frame arrival times and lengths at the ingress EI and a specification of disposition of each Frame based on its level of compliance with the characterization.	[2]
Ingress Service Frame		A Service Frame sent from an EI into the Service Provider network.	[2]
Inter-Frame Delay Variation	IFDV	The difference in delay of two Service or ENNI Frames belonging to the same CoS Frame Set.	[17]
Inter-Frame Delay Variation Performance		A measure of the variation in the delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.	[17]
Layer 2 Control Protocol Service Frame	L2CP Frame	A Service Frame that is used for Layer 2 control, e.g., Spanning Tree Protocol.	[2]
Layer 2 Control Protocol Tunneling		The process by which a Layer 2 Control Protocol Service Frame is passed through the Service Provider network without being processed and is delivered unchanged to the proper UNI(s).	[2]
Maximum Number of OVCs per UNI		The maximum number of OVCs that may be on a UNI.	This document
Maximum Number of CE-VLAN IDs per OVC		An integer that indicates the quantity of CE-VLANs that can be mapped to a single OVC at that UNI. A value = 1 indicates that UNI can only map single CE-VLANs to an OVC. A value > 1 indicates that up to that limit can be mapped to a single OVC.	This document
Mean Frame Delay Performance	MFD	The arithmetic mean, or average of delays experienced by different Service or ENNI Frames belonging to the same CoS Frame Set.	[17]
MEN		Metro Ethernet Network	[6]

Term	Abbrev.	Definition	Ref
Metro Ethernet Network	MEN	The Service Provider's network providing Ethernet services.	[6]
Maximum Transmission Unit	MTU	The maximum sized Service Frame allowed for an Ethernet service.	[1]
Multicast Service Frame		A Service Frame that has a multicast destination MAC address.	[2]
Multipoint-to-Multipoint EVC		An EVC with two or more UNIs. A Multipoint-to-Multipoint EVC with two UNIs is different from a Point-to-Point EVC because one or more additional UNIs can be added to it.	[2]
Operator Virtual Connection	OVC	Operator Virtual Connection, an association of OVC End Points	[8]
OVC End Point		An association of an OVC with a specific External Interface i.e., UNI, ENNI	[8]
OVC Identifier		string that is unique among all OVCs in the Operator MEN	[8]
N/A		Not Applicable	
N/S		Not Specified	
Point-to-Point EVC		An EVC with exactly 2 UNIs.	[2]
Rooted-Multipoint EVC		A multipoint EVC in which each UNI is designated as either a Root or a Leaf. Ingress Service Frames at a Root UNI can be delivered to one or more of any of the other UNIs in the EVC. Ingress Service Frames at a Leaf UNI can only be delivered to one or more Root UNIs in the EVC.	[2]
Service Frame		An Ethernet frame transmitted across the UNI toward the Service Provider or an Ethernet frame transmitted across the UNI toward the Subscriber.	[2]
Service Level Agreement	SLA	The contract between the Subscriber or Operator and Service Provider specifying the agreed to service level commitments and related business agreements.	Adopted from [2] and [8]
Service Level Specification	SLS	The technical specification of the service level being offered by the Service Provider to the Subscriber or Operator.	Adopted from [2] and [8]
Service Multiplexing		A UNI service attribute in which the UNI can be in more than one EVC instance.	[2]
Service Provider		The organization providing UNI to UNI Ethernet Service(s).	[2]
Subscriber		The organization purchasing and/or using Ethernet Services.	[2]
S-Tag		Service VLAN Tag.	IEEE Std 802.1ad [5]
S-VLAN ID		The 12 bit VLAN ID field in the S-Tag of an ENNI Frame	[8]
Tag		An optional field in a frame header. In this document it is the 4-byte field that, when present in an Ethernet frame, appears immediately after the Source Address, or another tag in an Ethernet frame header and which consists of the 2-byte Tag Protocol Identification Field (TPID) which indicates S-Tag or C-Tag, and the 2-byte Tag Control Information field (TCI) which contains the 3-bit Priority Code Point, and the 12-bit VLAN ID field	IEEE Std 802.1ad [5]
UNI MTU Size		The maximum sized Service Frame allowed at the UNI.	[2]

Term	Abbrev.	Definition	Ref
Unicast Service Frame		A Service Frame that has a unicast destination MAC address.	[2]
User Network Interface	UNI	The physical demarcation point between the responsibility of the Service Provider and the responsibility of the Subscriber.	[2]
VLAN		Virtual LAN	IEEE 802.3-2008 [3]

Table 1: Terminology and Definitions Table

3. Scope

This document defines a new Ethernet Service Type, Ethernet Access, and corresponding OVC-based Ethernet services between a UNI and an ENNI. These services are typically in the form of a Ethernet access service offered by an Ethernet Access Provider. The Ethernet Access Provider operates the access network to reach the Service Provider's out-of-franchise Subscriber locations as part of providing an end to end service to a Subscriber. Figure 1 describes the scope of the service definitions included in this document.

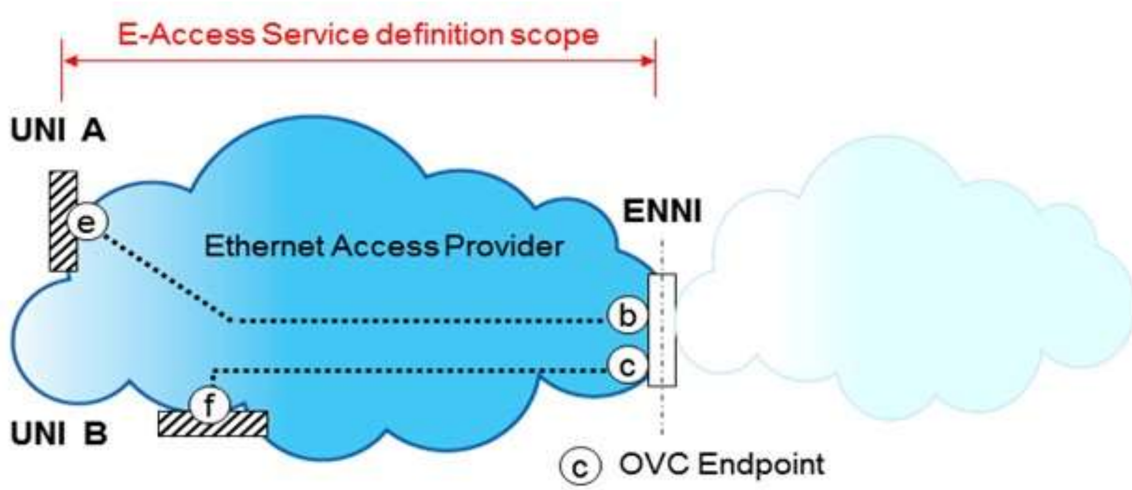

Figure 1. Scope of the E-Access Services Definition.

This document defines Ethernet Access services using point-to-point OVCs consisting of one UNI and one ENNI. These services may be augmented in the future by other Ethernet Access services.

4. Compliance Levels

The key words "**MUST**", "**MUST NOT**", "**REQUIRED**", "**SHALL**", "**SHALL NOT**", "**SHOULD**", "**SHOULD NOT**", "**RECOMMENDED**", "**MAY**", and "**OPTIONAL**" in this document are to be interpreted as described in RFC 2119 [4]. All key words use upper case, bold text.

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

5. Ethernet Service Definition Framework (Normative)

The Ethernet Service Definition Framework defined in MEF 6.1 [1] provides a model for specifying Ethernet services. Each Ethernet Service type has a set of Ethernet service attributes that define the service characteristics. These Ethernet Service Attributes in turn have a set of parameters associated with them that provide various options for the different service attributes. Refer to Figure 2.

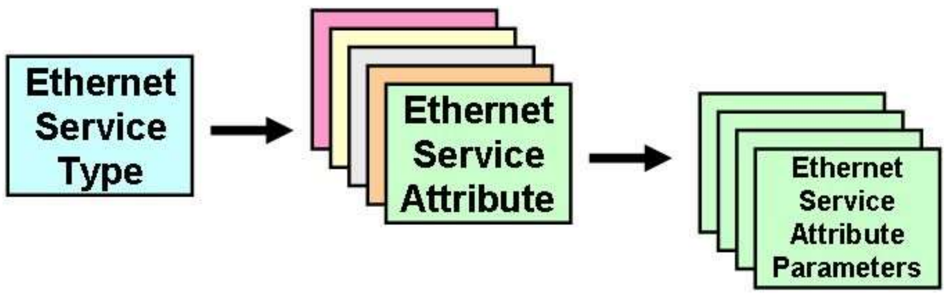

Figure 2: Ethernet Service Definition Framework

MEF 6.1 defines three generic Ethernet Service type constructs based on EVCs, namely, Ethernet Line (E-Line) Service type, Ethernet LAN (E-LAN) Service type and Ethernet Tree (E-Tree) Service type, and their associated service attributes and parameters. The key differentiator is the type of connectivity provided, as indicated by the 'EVC Type' service attribute. MEF 6.1 provides constraints to the UNI and EVC service attributes and parameters specific to each of these EVC-based service types.

This document defines a new Ethernet Service type called Ethernet Access (E-Access) and its associated service attributes and parameters. Ethernet services defined using this general Ethernet Access service type use an OVC that associates at least one UNI OVC End Point and one ENNI OVC End Point. This first specification under the Ethernet Access Service Type defines services that use a point-to-point OVC which has one OVC End Point at an ENNI and one at a UNI. The service attributes and parameters for the UNI, OVC per UNI, OVC End Point per ENNI, OVC, and ENNI are normatively defined in Section 6.

Two Ethernet Services are defined in this document for the E-Access Service type. These are differentiated by the ability to support one or more service instances at the UNI. Services where Service Frames at the UNI can be mapped to only a single OVC End Point are referred to as 'Private' or Port-based services. Services where Service Frames at the UNI can be mapped to one member of a set of OVC End Points, or to one member of a set of OVC End Points and EVCs, are referred to as "Virtual Private" or VLAN-based services. This relationship is shown in Table 2 below.

Service Type	Port-Based	VLAN-Based
E-Access		
(point-to-point OVC)	Access Ethernet Private Line (Access EPL)	Access Ethernet Virtual Private Line (Access EVPL)

Table 2: Services defined based on E-Access Service type

5.1 Ethernet Access (E-Access) Service Type

Any Ethernet service that is based on a Operator Virtual Connection (OVC) that associates at least one OVC End Point at a UNI, and at least one OVC End Point at an ENNI, is designated as an Ethernet Access (E-Access) Service type. The Ethernet services defined in the scope of this specification use a point-to-point OVC which associates one OVC End Point at an ENNI and one at a UNI.

A point-to-point example of an E-Access Service type is illustrated in Figure 3. An E-Access Service type can be used to create a broad range of Ethernet access services.

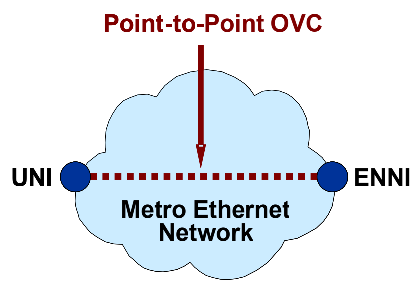

Figure 3: A point-to-point example of an E-Access Service type using OVC with UNI and ENNI OVC End Points

1. The services attributes used in Section 6 to specify the parameters of E-Access services are taken from the noted sections of the following specifications: UNI Service Attributes (defined in MEF 10.2 [2], Section 7)
2. OVC per UNI Service Attributes (defined in MEF 26 [8] Section 7.5)
3. OVC End Point per ENNI Service Attributes (defined in MEF 26 [8] Section 7.3)
4. OVC Service Attributes (defined in MEF 26 [8], Section 7.2)
5. ENNI Service Attributes (defined in MEF 26 [8], Section 7.1)

In each of these tables, if that service description makes no restrictions on an attribute it is noted in the table cell.

An example of how E-Access Service types may be used as a component of a Service Provider's end-to-end service is shown in Table 3 below. The Access Services defined in this document allow use of S-VLAN multiplexing of multiple E-Access Services at one ENNI, permitting efficient aggregation while maintaining CE-VLAN ID preservation for all Subscribers' traffic.

		Supported by Access Provider's Wholesale Service:	
Service Provider Offers MEF 6.1 Service:		Access-EPL (Port-Based)	Access-EVPL (VLAN-Based)
Port-based	EPL	X	
	EP-LAN	X	
VLAN-based	EVPL		X
	EVP-LAN		X

Table 3. Example of typical pairings of Service Provider's end to end services with supporting services from an Access Provider.

Use Cases illustrating more specifically how Access EPL and Access EVPL Services can be combined to form end to end services are shown in Appendix B.

6. Service Definitions (Normative)

An Ethernet service is defined by specifying service attribute parameter values for a given Ethernet Access Service type. This section defines the required service attributes and related parameter values for the Ethernet services specified in this Technical Specification. If any of the Ethernet services in this section are offered, the normative text for each service attribute is applied. Note that other variations of these Ethernet services are also possible, but beyond the scope of this document.

6.1 Access Ethernet Private Line Service (Access EPL)

An Access Ethernet Private Line (Access EPL) service is specified using an E-Access Service type.

[R1] An Access EPL service **MUST** use a Point-to-Point OVC that associates one OVC End Point at a UNI and one OVC End Point at an ENNI

This service can provide a high degree of transparency for Frames between the EIs it interconnects such that the Frame's header and payload upon ingress at the UNI is delivered unchanged to the ENNI, with the addition of an S-VLAN tag. The Frame's header and payload upon ingress at the ENNI is delivered unchanged to the UNI except for the removal of the S-VLAN tag. (These actions presume that the FCS for the frame is recalculated when an S-VLAN tag is inserted or removed.) Figure 4 below shows the basic structure and scope of Access EPL service.

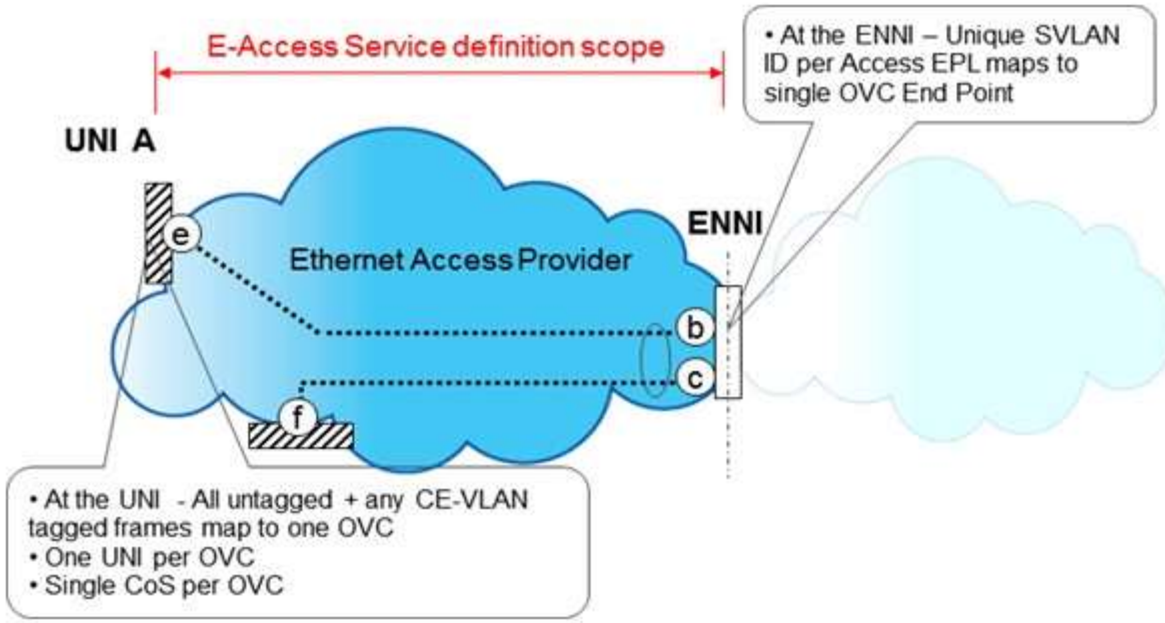

Figure 4: Overview of Access EPL Service

A Service Provider can use the Access EPL service from an Access Provider to deliver the port-based Ethernet services defined in MEF 6.1 and supported by the ENNI defined in MEF 26: Ethernet Private Line (EPL), and Ethernet Private LAN (EP-LAN). Ethernet Private Tree (EP-Tree) services are not supported by MEF 26 (Phase 1), so the suitability of Access EPL to support EP-Tree is outside the scope of this document.

Because of the high degree of transparency of this service, there is no need for coordination between the Subscriber and Service Provider on a detailed CE-VLAN ID/EVC Map for each UNI because all Service Frames at the UNI are mapped to a single OVC End Point, as indicated by the OVC End Point Map attribute in Table 5 below. However, the Service Provider and Access Provider need to coordinate the value of the S-VLAN ID at the ENNI and other service attributes as specified below.

The CE is expected to shape traffic to the Ingress Bandwidth Profile of the service such that all of its traffic, including certain L2CPs that require delivery for proper operation, is accepted by the service.

6.1.1 UNI Service Attributes and Parameter Values

Table 4 provides the UNI service attributes, parameters, and values for the Access EPL service. Note that there are some differences between UNI attributes for OVC-based services and those for EVC-based services. Some attributes, such as Service Multiplexing, Bundling, and All-to-One-Bundling, are not relevant to the agreement between the Access Provider and the Service Provider, and therefore are omitted from this table.

[R2] An Access EPL Service instance **MUST** assign UNI Service Attributes and values according to Table 4.

UNI Service Attribute	Service Attribute Parameters and Values
UNI Identifier	*No additional constraints from definition in MEF 10.2 [2]*
Physical Medium	*No additional constraints from definition in MEF 10.2 [2]*
Speed	*No additional constraints from definition in MEF 10.2 [2]*
Mode	*No additional constraints from definition in MEF 10.2 [2]*
MAC Layer	*No additional constraints from definition in MEF 10.2 [2]*
UNI MTU Size	*No additional constraints from definition in MEF 10.2 [2]*
CE-VLAN ID for untagged and priority tagged Frames	**MUST** be a value from 1 – 4094.
Maximum number of OVCs per UNI	**MUST** be 1 [new attribute defined below in Section 6.1.1.1]
Ingress Bandwidth Profile Per UNI	**MUST NOT** specify[1]
Egress Bandwidth Profile Per UNI	**MUST NOT** specify

Table 4: UNI service attributes and parameters for the Access EPL service

6.1.1.1 Maximum Number of OVCs per UNI Attribute

This attribute is the maximum number of OVC End Points that can be at the UNI. This is a new UNI attribute, (see Table 4 above and Table 9) modeled after the similar Maximum Number of EVCs per UNI, and is used, for example, to differentiate between the Access EPL service where this must = 1, and the Access EVPL service where this can be ≥ 1.

6.1.2 OVC per UNI Service Attributes and Parameter Values

There are service attributes for each instance of an OVC at a specific UNI. Since an OVC can only associate one OVC End Point that is at a UNI (see MEF 26 [8]), these service attributes can be equivalently viewed as OVC End Point per UNI service attributes. These service attributes are presented in Table 5. (Editor's Note: Values taken from the MEF 6.1 table for EPL EVC per UNI were used as starting point)

[R3] An Access EPL Service instance **MUST** assign OVC per UNI Service Attributes and values according to Table 5.

[1] See Ingress Bandwidth Profile per OVC End Point at a UNI service attribute in Table 5.

OVC per UNI Service Attribute	Possible Values
UNI OVC Identifier	*No additional constraints from definition in MEF* 26 [8].
OVC End Point Map	**MUST** contain all CE-VLAN ID values {1, 2, …4095} mapped to a single OVC End Point.
Class of Service Identifier for Service Frames	The CoS Identifier for Service Frames **MUST** be the OVC End Point; that OVC **MUST** have a single CoS Name.
Ingress Bandwidth Profile Per OVC End Point at a UNI	Required, **MUST** specify <CIR, CBS, EIR, EBS, CM, CF>; **MUST** allow configuration to support CIR values[2] up to 70% of the UNI speed, in the following increments: 1 – 10 Mb/s, increments of 1 Mb/s 10 – 100 Mb/s, increments of 10 Mb/s 100 – 1000 Mb/s, increments of 100 Mb/s 1 – 10 Gb/s, increments of 1 Gb/s. These required CIR increments are subject to the limit imposed by the UNI speed. For example, a 100 Mb/s UNI **MUST** support CIR values of 1 – 10 Mb/s in increments of 1 Mb/s, and 10 – 70 Mb/s in increments of 10 Mb/s. **MAY** support other values of CIR. **MUST** allow configuration of EIR = 0, EBS = 0, CF = 0, Color Mode = “color blind” **MAY** support other values of EIR, EBS, CF, and Color Mode. **MUST** have CBS >= 12176 bytes **MUST NOT** be combined with any other type of ingress bandwidth profile. When the ingress Bandwidth Profile of the OVC End Point at the UNI has CIR > 0 and EIR = 0, each egress ENNI Frame **MUST** be marked Green via the S-Tag as per [MEF 23].
Ingress Bandwidth Profile Per Class of Service Identifier at a UNI	Not used.
Egress Bandwidth Profile Per OVC End Point at a UNI	**MUST NOT** specify
Egress Bandwidth Profile Per Class of Service Identifier at a UNI	**MUST NOT** specify

Table 5: OVC per UNI Service Attributes for Access EPL service.

6.1.3 OVC Service Attributes

Table 6 provides the OVC service attributes, parameters, and values for the Access EPL service.

[R4] An Access EPL Service instance **MUST** assign OVC Service Attributes and values according to Table 6.

[2] MEF Bandwidth Profile traffic parameters such as CIR count only Service Frame bits, not interframe gap or preamble bits. Setting CIR above 76% of the physical layer speed of the EI has consequences, which are discussed in more detail in Appendix A.

OVC Service Attribute	Possible Values
OVC Identifier	*No additional constraints from definition in MEF* 26 [8]
OVC Type	**MUST** be Point-to-Point
OVC End Point List	Exactly 2, one OVC End Point at the UNI, one at the ENNI.
Maximum Number of UNI OVC End Points	**MUST** be 1
Maximum Number ENNI OVC End Points	**MUST** be 1
OVC Maximum Transmission Unit Size	**MUST** be an integer number of bytes > or = to 1526; see Section 7.2.9 in [8].
CE-VLAN ID Preservation	**MUST** be Yes
CE-VLAN CoS ID Value Preservation	**MUST** be Yes
S-VLAN ID Preservation	N/A as only one ENNI in the service instance
S-VLAN CoS ID Value Preservation	N/A as only one ENNI in the service instance
Color Forwarding	**SHOULD be yes**. When Ingress BWP at UNI has EIR = 0 frames egressing at ENNI **MUST** be marked green.
Service Level Specification	**MUST** list values for each of the following attributes from MEF 26.0.3 [17]: { One-way Frame Delay, One-way Frame Delay Range, One-way Mean Frame Delay, Inter Frame Delay Variation, One-way Frame Loss Ratio, One-way Availability, One-way High Loss Intervals, One-way Consecutive High Loss Intervals} where **Not Specified** (N/S) is an acceptable value. **MAY** specify additional attributes and values.
Unicast Frame Delivery	**MUST** Deliver Unconditionally
Multicast Frame Delivery	**MUST** Deliver Unconditionally
Broadcast Frame Delivery	**MUST** Deliver Unconditionally

Table 6: OVC service attributes and parameters for the Access EPL service

6.1.4 OVC End Point per ENNI Service Attributes

The OVC End Point per ENNI attribute values associated with the Access EPL service are shown in Table 7.

[R5] An Access EPL Service instance **MUST** assign OVC End Point at an ENNI Service Attributes and values according to Table 7.

OVC End Point per ENNI Service Attribute Name	Possible Values
OVC End Point Identifier	*No additional constraints from definition in MEF* 26 [8]
Class of Service Identifier for ENNI Frames	The CoS Identifier for ENNI Frames **MUST** be the OVC End Point to which the ENNI Frame is mapped; that OVC **MUST** have a single CoS Name which is associated with the entire set of S-Tag PCP values {0 – 7}.
Ingress Bandwidth Profile Per OVC End Point [3]	Required, **MUST** specify <CIR, CBS, EIR, EBS, CM, CF>; **MUST** allow configuration to support CIR[2] values up to 70% of the ENNI speed, in the following increments: 1 – 10 Mb/s, increments of 1 Mb/s 10 – 100 Mb/s, increments of 10 Mb/s 100 – 1000 Mb/s, increments of 100 Mb/s 1 – 10 Gb/s, increments of 1 Gb/s. These required CIR increments are subject to the limit imposed by the ENNI speed. For example, a 100 Mb/s ENNI **MUST** support CIR values of 1 – 10 Mb/s in increments of 1 Mb/s, and 10 – 70 Mb/s in increments of 10 Mb/s. **MAY** support other values of CIR. **MUST** allow configuration of EIR = 0, EBS = 0, CF = 0, Color Mode = "color aware" **MAY** support other values of EIR, EBS, CF, and Color Mode. **MUST** have CBS >= 12176 bytes **MUST NOT** be combined with any other type of ingress bandwidth profile.
Ingress Bandwidth Profile Per ENNI Class of Service Identifier	Not used.
Egress Bandwidth Profile Per End Point	**MUST NOT** specify.
Egress Bandwidth Profile Per ENNI Class of Service Identifier	**MUST NOT** specify.

Table 7: ENNI OVC End Point Service Attributes for the Access EPL service.

6.1.5 ENNI Service Attributes

The following table specifies the ENNI Service Attributes for the Access EPL service. The Maximum Number of OVC End Points per OVC is required to be exactly 1 for Access EPL as this service does not support "hairpin switching" of traffic (see definition and discussion of hairpin switching in Section 7.2.2 of MEF 26 [8]) by the Operator providing the Access EPL service.

[3] The ingress CIR for an OVC at the ENNI should be greater than the corresponding ingress CIR at the UNI due to the presence of the added SVLAN tag (4 bytes) at the ENNI. As an example, if the average frame size was 200 bytes, the CIR should be increased by 2%.

[R6] An Access EPL Service instance **MUST** assign ENNI Service Attributes and values according to Table 8.

ENNI Service Attribute Name	Possible Values
Operator ENNI Identifier	*No additional constraints from definition in MEF* 26 [8]
Physical Layer	*No additional constraints from definition in MEF* 26 [8]
Frame Format	*No additional constraints from definition in MEF* 26 [8]
Number of Links	*No additional constraints from definition in MEF* 26 [8]
Protection Mechanism	*No additional constraints from definition in MEF* 26 [8]
ENNI Maximum Transmission Unit Size	*No additional constraints from definition in MEF* 26 [8]
End Point Map	Each S-VLAN ID value associated with an instance of Access EPL Service **MUST** map to a distinct End Point, of Type = "OVC"
Maximum Number of OVCs	*No additional constraints from definition in MEF* 26 [8]
Maximum Number of OVC End Points per OVC	*No additional constraints from definition in MEF* 26 [8]

Table 8: ENNI Service Attributes for Access EPL Service.

Note that the combination of the End Point Map attribute constraint above and the requirement that the Access EPL OVC is point to point only, implies a single Subscriber UNI.

6.2 Access Ethernet Virtual Private Line (Access EVPL) Service Definition (Normative)

An Access Ethernet Virtual Private Line (Access EVPL) service is specified using an E-Access Service type.

[R7] An Access EVPL service **MUST** use a Point-to-Point OVC that associates a UNI OVC End Point and an ENNI OVC End Point.

An Access EVPL can be used to create services similar to the Ethernet Access Private Line (Access EPL) with some notable exceptions. First, with Access EVPL a UNI can support multiple service instances, including a mix of Access and EVC Services (see Figure 5, UNIs A & B). Such configurations are not possible if Access EPL is offered at the UNI. Second, an Access EVPL need not provide as much transparency of Service Frames as with an Access EPL, as the OVC End Point map determines which CE-VLANs are mapped to OVCs or dropped. Because multiple instances of EVCs and Access EVPLs are permitted, not all ingress Service Frames at the UNI need be sent to the same destination.

This service can provide a high degree of transparency for Frames between the EIs it interconnects such that the Frame's header and payload upon ingress at the UNI is delivered unchanged to the ENNI, with the addition of an S-VLAN tag. The Frame's header and payload upon ingress at the ENNI is delivered unchanged to the UNI except for the removal of the S-VLAN tag. These actions presume that the FCS for the frame is recalculated when an S-VLAN tag is inserted or removed. Figure 5 below shows the basic structure and scope of Access EVPL service.

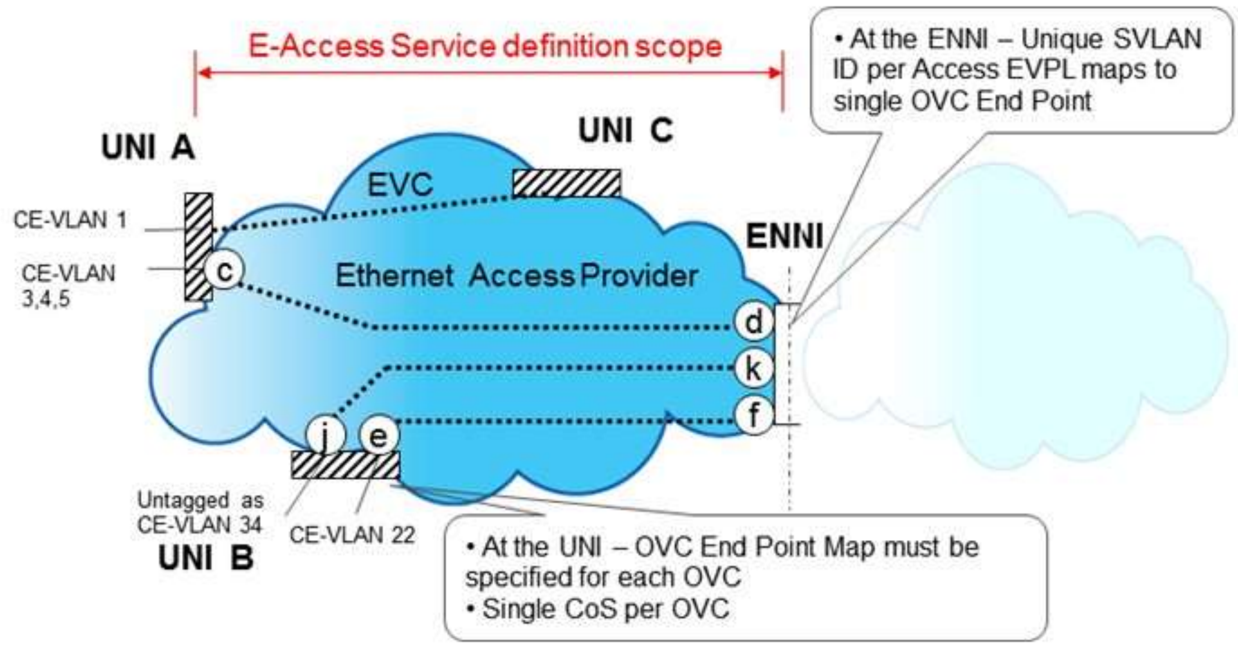

Figure 5: Overview of Access EVPL Service

With Access EVPL, the UNI can support multiple service instances, as shown for UNI A in Figure 5, where CE-VLAN ID 1 is mapped to the EVC that associates UNI A and UNI C. CE-VLAN IDs 3, 4, 5 are mapped to OVC End Point **c,** and associated via the Access EVPL with OVC End Point **d** at the ENNI. UNI B illustrates two instances of Access EVPL connecting it to the ENNI. A Service Provider can use the Access EVPL service from an Access Provider to deliver the two VLAN-based Ethernet services defined in MEF 6.1 and supported by the ENNI defined in MEF 26: Ethernet Virtual Private Line (EVPL), and Ethernet Virtual Private LAN (EVP-LAN). Ethernet Virtual Private Tree (EVP-Tree) services are not supported by MEF 26 (Phase 1), so they are not intended for support by Access EVPL in this document.

The CE is expected to shape traffic to the Ingress Bandwidth Profile to minimize frame loss by the service.

The Subscriber and Service Provider coordinate an OVC End Point Map for each OVC to specify what Service Frames at the UNI are mapped to each OVC. In addition, the Service Provider and Access Provider must coordinate the value of the S-VLAN ID value that maps to each OVC End Point at the ENNI, and other service attributes as specified below.

6.2.1 Maximum CE-VLAN IDs per OVC Attribute

For the Access EVPL Service, a new attribute is defined which indicates how many CE-VLAN IDs can be mapped into a single OVC at the UNI. By default the value of 1 **MUST** be supported by any OVC End Point Map, but a value N > 1 indicates that up to N CE-VLAN IDs can be mapped to an OVC (see Table 9 below).

6.2.2 UNI Service Attributes

Table 9 provides the UNI service attributes, parameters, and values for the Access EVPL Service. Note that there are some differences between UNI attributes for OVC-based services and those for EVC-based services. Some attributes, such as Service Multiplexing, Bundling, and All-to-One-Bundling, are not relevant to the agreement between the Access Provider and the Service Provider, and therefore are omitted from this table.

[R8] An Access EVPL Service instance **MUST** assign UNI Service Attributes and values according to Table 9.

UNI Service Attribute	Service Attribute Parameters and Values
UNI Identifier	*No additional constraints from definition in MEF 10.2 [2]*
Physical Medium	*No additional constraints from definition in MEF 10.2 [2]*
Speed	*No additional constraints from definition in MEF 10.2 [2]*
Mode	*No additional constraints from definition in MEF 10.2 [2]*
MAC Layer	*No additional constraints from definition in MEF 10.2 [2]*
UNI MTU Size	*No additional constraints from definition in MEF 10.2 [2]*
CE-VLAN ID for untagged and priority tagged Frames	**MUST** be specified if untagged / priority tagged frames are to be supported, and that CE-VLAN ID must be included in the OVC Endpoint Map in Table 10, specifying what OVC these frames are mapped to.
Maximum number of OVCs per UNI	**MUST** be ≥ 1 [attribute defined in Section 6.1.1.1]
Maximum number of CE-VLAN IDs per OVC	**The OVC Endpoint Map MUST** support a value = 1 **The OVC Endpoint Map SHOULD** support a value > 1.
Ingress Bandwidth Profile Per UNI	**MUST NOT** specify[4]
Egress Bandwidth Profile Per UNI	**MUST NOT** specify

Table 9: UNI service attributes and parameters for the Access EVPL service

6.2.3 OVC per UNI Service Attributes and Parameter Values

There are service attributes for each instance of an OVC at a specific UNI. Since an OVC can only associate one OVC End Point that is at a UNI (see MEF 26 [8]), these service attributes can be equivalently viewed as OVC End Point per UNI service attributes. These service attributes are presented in Table 10. (Editor's Note: Values taken from the MEF 6.1 table for EVPL Service, EVC per UNI were used as starting point)

[4] See Ingress Bandwidth Profile per OVC End Point at a UNI service attribute in Table 10.

[R9] An Access EVPL Service instance **MUST** assign OVC per UNI Service Attributes and values according to Table 10.

OVC per UNI Service Attribute	Possible Values
UNI OVC Identifier	*No additional constraints from definition in MEF* 26 [8].
OVC End Point Map	**MUST** specify mapping table of CE-VLAN ID to OVC End Point. **MUST NOT** contain all CE-VLAN ID values mapped to a single OVC End Point. (This configuration is reserved for the Access EPL service)
Class of Service Identifier for Service Frames	The CoS Identifier for Service Frames **MUST** be the OVC End Point to which the Service Frame is mapped; that OVC **MUST** have a single CoS Name.
Ingress Bandwidth Profile Per OVC End Point at a UNI	Required, **MUST** specify <CIR, CBS, EIR, EBS, CM, CF>; **MUST** allow configuration to support CIR values up to 70% of the UNI speed[5], in the following increments: 1 – 10 Mb/s, increments of 1 Mb/s 10 – 100 Mb/s, increments of 10 Mb/s 100 – 1000 Mb/s, increments of 100 Mb/s 1 – 10 Gb/s, increments of 1 Gb/s. These required CIR increments are subject to the limit imposed by the UNI speed. For example, a 100 Mb/s UNI **MUST** support CIR values of 1 – 10 Mb/s in increments of 1 Mb/s, and 10 – 70 Mb/s in increments of 10 Mb/s. **MAY** support other values of CIR. **MUST** allow configuration of EIR = 0, EBS = 0, CF = 0, Color Mode = "color blind" **MAY** support other values of EIR, EBS, CF, and Color Mode. **MUST** have CBS >= 12176 bytes **MUST NOT** be combined with any other type of ingress bandwidth profile. When the ingress Bandwidth Profile of the OVC End Point at the UNI has CIR > 0 and EIR = 0, each egress ENNI Frame **MUST** be marked Green via the S-Tag as per [MEF 23].
Ingress Bandwidth Profile Per Class of Service Identifier at a UNI	Not used.
Egress Bandwidth Profile Per OVC End Point at a UNI	**MUST NOT** specify
Egress Bandwidth Profile Per Class of Service Identifier at a UNI	**MUST NOT** specify

Table 10: OVC per UNI Service Attributes for Access EVPL service.

6.2.4 OVC Service Attributes

Table 11 provides the OVC service attributes, parameters, and values for the Access EVPL service.

[5] MEF Bandwidth Profile traffic parameters such as CIR count only Service Frame bits, not interframe gap or preamble bits. Setting CIR above 76% of the physical layer speed of the EI has consequences, which are discussed in more detail in Appendix A.

[R10] An Access EVPL Service instance **MUST** assign OVC Service Attributes and values according to Table 11.

OVC Service Attribute	Possible Values
OVC Identifier	*No additional constraints from definition in MEF* 26 [8]
OVC Type	**MUST** be Point-to-Point
OVC End Point List	A list of OVC End Point Identifiers, exactly 2, one OVC End Point at the UNI, one at the ENNI.
Maximum Number of UNI OVC End Points	**MUST** be 1
Maximum Number ENNI OVC End Points	**MUST** be 1
OVC Maximum Transmission Unit Size	**MUST** be an integer number of bytes > or = to 1526; see Section 7.2.9 in [8].
CE-VLAN ID Preservation	**MUST** be Yes
CE-VLAN CoS ID Value Preservation	**MUST** be Yes
S-VLAN ID Preservation	N/A as only one ENNI in the service instance
S-VLAN CoS ID Value Preservation	N/A as only one ENNI in the service instance
Color Forwarding	**SHOULD be yes**. When Ingress BWP at UNI has EIR = 0 frames egressing at ENNI **MUST** be marked green.
Service Level Specification	**MUST** list values for each of the following attributes from MEF 26.0.3 [17]: { One-way Frame Delay, One-way Frame Delay Range, One-way Mean Frame Delay, Inter Frame Delay Variation, One-way Frame Loss Ratio, One-way Availability, One-way High Loss Intervals, One-way Consecutive High Loss Intervals} where **Not Specified** (N/S) is an acceptable value. **MAY** specify additional attributes and values.
Unicast Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.
Multicast Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.
Broadcast Frame Delivery	Deliver Unconditionally or Deliver Conditionally. If Delivered Conditionally, **MUST** specify the delivery criteria.

Table 11: OVC service attributes and parameters for the Access EVPL service

6.2.5 OVC End Point per ENNI Service Attributes

The OVC End Point per ENNI attribute values associated with the Access EVPL service are shown in Table 12.

[R11] An Access EVPL Service instance **MUST** assign OVC End Point at an ENNI Service Attributes and values according to Table 12.

OVC End Point per ENNI Service Attribute Name	Possible Values
OVC End Point Identifier	*No additional constraints from definition in MEF* 26 [8]
Class of Service Identifier for ENNI Frames	The CoS Identifier for ENNI Frames **MUST** be the OVC End Point to which the ENNI Frame is mapped; that OVC **MUST** have a single CoS Name which is associated with the entire set of S-Tag PCP values {0 – 7}.
Ingress Bandwidth Profile Per OVC End Point[6]	Required, **MUST** specify <CIR, CBS, EIR, EBS, CM, CF>; **MUST** allow configuration to support CIR values up to 70% of the ENNI speed[7], in the following increments: 1 – 10 Mb/s, increments of 1 Mb/s 10 – 100 Mb/s, increments of 10 Mb/s 100 – 1000 Mb/s, increments of 100 Mb/s 1 – 10 Gb/s, increments of 1 Gb/s. These required CIR increments are subject to the limit imposed by the ENNI speed. For example, a 100 Mb/s ENNI **MUST** support CIR values of 1 – 10 Mb/s in increments of 1 Mb/s, and 10 – 70 Mb/s in increments of 10 Mb/s. **MAY** support other values of CIR. **MUST** allow configuration of EIR = 0, EBS = 0, CF = 0, Color Mode = "color aware" **MAY** support other values of EIR, EBS, CF, and Color Mode. **MUST** have CBS >= 12176 bytes **MUST NOT** be combined with any other type of ingress bandwidth profile.
Ingress Bandwidth Profile Per ENNI Class of Service Identifier	Not used.
Egress Bandwidth Profile Per End Point	**MUST NOT** specify.
Egress Bandwidth Profile Per ENNI Class of Service Identifier	**MUST NOT** specify.

Table 12: ENNI OVC End Point Service Attributes for Access EVPL Service.

6.2.6 ENNI Service Attributes

The following table specifies the ENNI Service Attributes for the Access EVPL service. The Maximum Number of OVC End Points per OVC is required to be exactly 1 for Access EVPL as this service does not support "hairpin switching" of traffic (see definition and discussion of

[6] The ingress CIR for an OVC at the ENNI should be greater than the corresponding ingress CIR at the UNI due to the presence of the added SVLAN tag (4 bytes) at the ENNI. As an example, if the average frame size was 200 bytes, the CIR should be increased by 2%.

[7] MEF Bandwidth Profile traffic parameters such as CIR count only Service Frame bits, not interframe gap or preamble bits. Setting CIR above 76% of the physical layer speed of the EI has consequences, which are discussed in more detail in Appendix A.

hairpin switching in Section 7.2.2 of MEF 26 [8]) by the Operator providing the Access EVPL service.

[R12] An Access EVPL Service instance **MUST** assign ENNI Service Attributes and values according to Table 13.

ENNI Service Attribute Name	Possible Values
Operator ENNI Identifier	*No additional constraints from definition in MEF* 26 [8]
Physical Layer	*No additional constraints from definition in MEF* 26 [8]
Frame Format	*No additional constraints from definition in MEF* 26 [8]
Number of Links	*No additional constraints from definition in MEF* 26 [8]
Protection Mechanism	*No additional constraints from definition in MEF* 26 [8]
ENNI Maximum Transmission Unit Size	*No additional constraints from definition in MEF* 26 [8]
End Point Map	Each S-VLAN ID value associated with an instance of Access EVPL Service **MUST** map to a distinct End Point, of Type = "OVC"
Maximum Number of OVCs	*No additional constraints from definition in MEF* 26 [8]
Maximum Number of OVC End Points per OVC	*No additional constraints from definition in MEF* 26 [8]

Table 13: ENNI Service Attributes for Access EVPL Service.

Note that the combination of the End Point Map attribute constraint above and the requirement that the Access EVPL OVC is point to point only, implies each S-VLAN ID corresponds to a single Subscriber UNI.

6.3 Service OAM Fault Management (SOAM-FM) Requirements for Access EPL and Access EVPL Service

To enable uniform behavior of SOAM-FM for the Access EPL and Access EVPL Services across all Access Providers, the appropriate requirements as detailed in the SOAM FM IA (MEF 30) [10] must be followed. Specifically:

[R13] The Access EPL and Access EVPL Services **MUST** be configurable to tunnel all SOAM frames at the default **Test** and **Subscriber** MEG levels as defined in the SOAM FM IA (MEF 30) [10] document, section 7.1.

If the Access Provider uses SOAM-FM in their network, they have available for their use the Operator, UNI, and ENNI MEG levels as specified in the SOAM-FM IA [10], section 7.1.

6.4 L2CP Requirements For Access EPL And Access EVPL Service

Processing of L2CP frames is for further study. Until defined in a future revision of this document, processing of L2CP frames is agreed to by the two parties involved in the Access Service.

7. References

[1] MEF Technical Specification MEF 6.1, "Ethernet Services Definitions - Phase 2", April, 2008.

[2] MEF Technical Specification, MEF 10.2, "Ethernet Services Attributes - Phase 2", October 2009.

[3] IEEE 802.3-2005, "Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications"

[4] RFC 2119, "Key words for use in RFCs to Indicate Requirement Levels", S. Bradner

[5] IEEE 802.1ad-2005, "Virtual Bridged Local Area Networks – Amendment 4: Provider Bridges"

[6] MEF Technical Specification MEF 4, "Metro Ethernet Network Architecture Framework - Part 1: Generic Framework", May 2004

[7] ITU-T Recommendation Y.1731, "OAM functions and mechanisms for Ethernet based networks"

[8] MEF Technical Specification MEF 26, "External Network to Network Interface (ENNI) – Phase 1", January 2010.

[9] MEF Technical Specification MEF 20, "User Network Interface (UNI) Type 2 Implementation Agreement," July 2008.

[10] MEF Technical Specification MEF 30, "Service OAM Fault Management Implementation Agreement," January 2011.

[11] IEEE 802.1ag-2007, "Virtual Bridged Local Area Networks Amendment 5: Connectivity Fault Management."

[12] IEEE 802.1aj-2009. IEEE Standard for Local and metropolitan Area Networks – Virtual Bridged Local Area Networks Amendment 11: Two-Port Media Access Control (MAC) Relay. - December 2009.

[13] IEEE P802.1AB-REV/D6.0-2009. IEEE Standard for Local and metropolitan Area Networks - Station and Media Access Control Connectivity Discovery – June 2009.

[14] IEEE P802.1X-REV/D4.5 IEEE Draft Standard for Local and metropolitan Area Networks. Port-based Network Access Control. – October 2009.

[15] MEF Technical Specification MEF 26.0.2, “OVC Layer 2 Control Protocol Tunneling Amendment to MEF 26”, January 2011.

[16] MEF Technical Specification MEF 23.1, “Carrier Ethernet Class of Service – Phase 2”, (in progress) 2011.

[17] MEF Technical Specification MEF 26.0.3, “Service Level Specification Amendment to MEF 26”, October 2011.

8. Appendix A: Effect of Inter-frame Overhead on CIR (Informative)

MEF Bandwidth Profile algorithms count only Service Frame bits, not interframe gap or preamble bits. Setting CIR too close to the bit rate of the physical layer of the UNI has consequences, which may appear only under certain traffic conditions. Figure 6 shows different ways of counting the length of a frame:

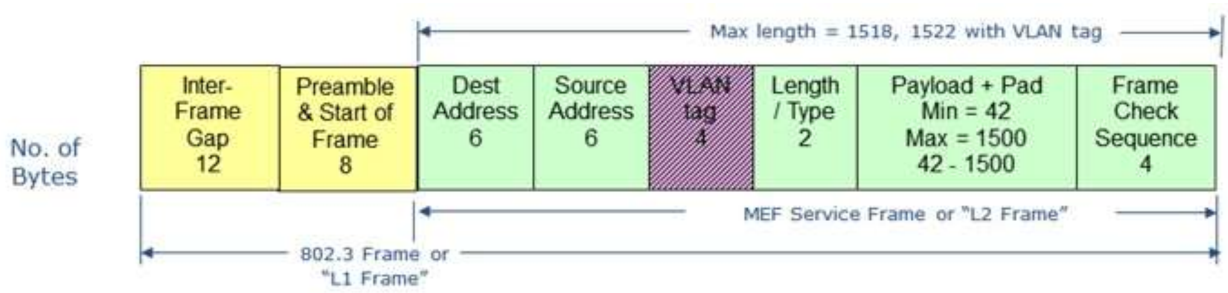

Figure 6. Length of an Ethernet frame as measured with and without the 20 byte inter-frame overhead.

Since Bandwidth Profile traffic parameters such as CIR do not account for interframe gap or preamble bits that are added by the Ethernet physical layer, a policed stream of MEF Service Frames of constant size X, will result in a stream of physical layer frames of size X+20 bytes at a UNI. Clearly the impact of this "overhead inflation" varies directly with frame size, from a low of 1.3% for a 1518 byte frame, to a maximum of 31% for a 64 byte frame. The result of this effect is shown in Figure 7 for a 100 Mb/s interface. The resulting curve shows that as the frame size decreases, an increasing fraction of the line rate is consumed by overhead and the maximum bits/sec of Service Frames transmitted drops sharply as the frame size decreases below 200 bytes.

The resulting caution from these observations is that provisioning a CIR greater than 76% of a physical interface speed, will allow the possiblility that the maximum bits/sec of Service Frames transmitted may be considerably less than the CIR value when traffic is comprised of a high percentage of small frame sizes.

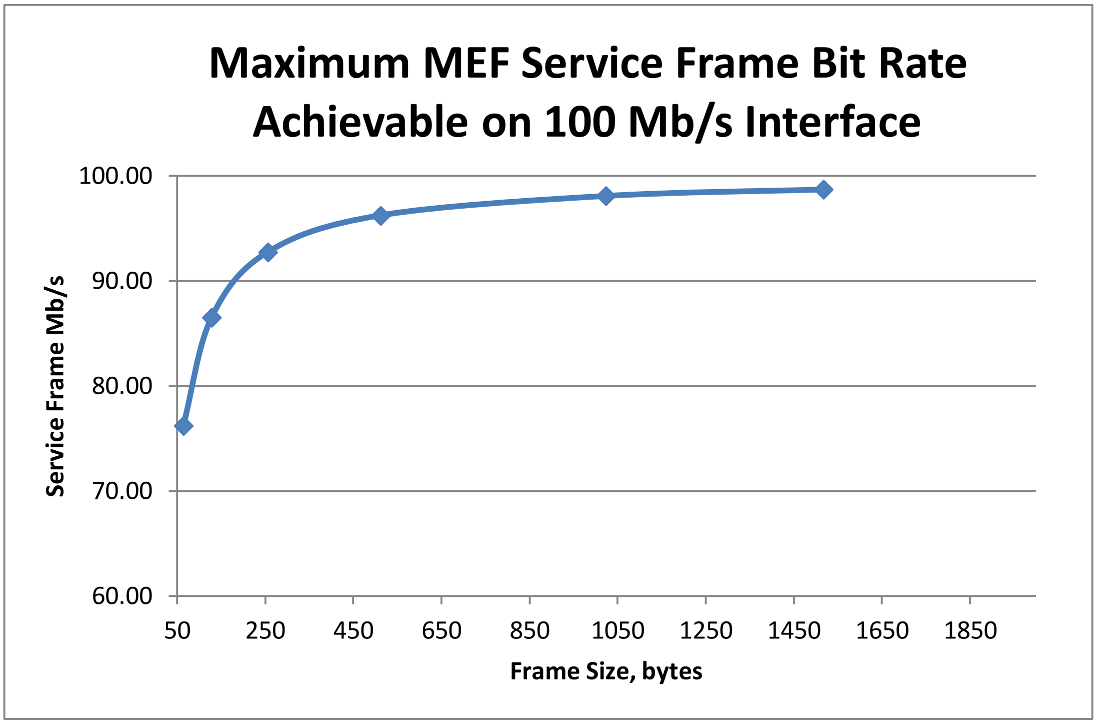

Figure 7. Resulting Layer 1 bit rates for different MEF CIR measured as Service Frames

9. Appendix B: Use Cases (Informative)

The following are non-normative examples of how the E-Access Services defined in this document may be used to provide MEF 6.1 UNI to UNI services. The examples are offered to illustrate some of the applications and show a selective subset of the attributes that would be involved.

9.1 EPL Service

The following figure shows the Subscriber and Service Provider Points of View (POV) for an instance of EPL Service offered by the Service Provider using Access EPL Service in the Access Provider Network.

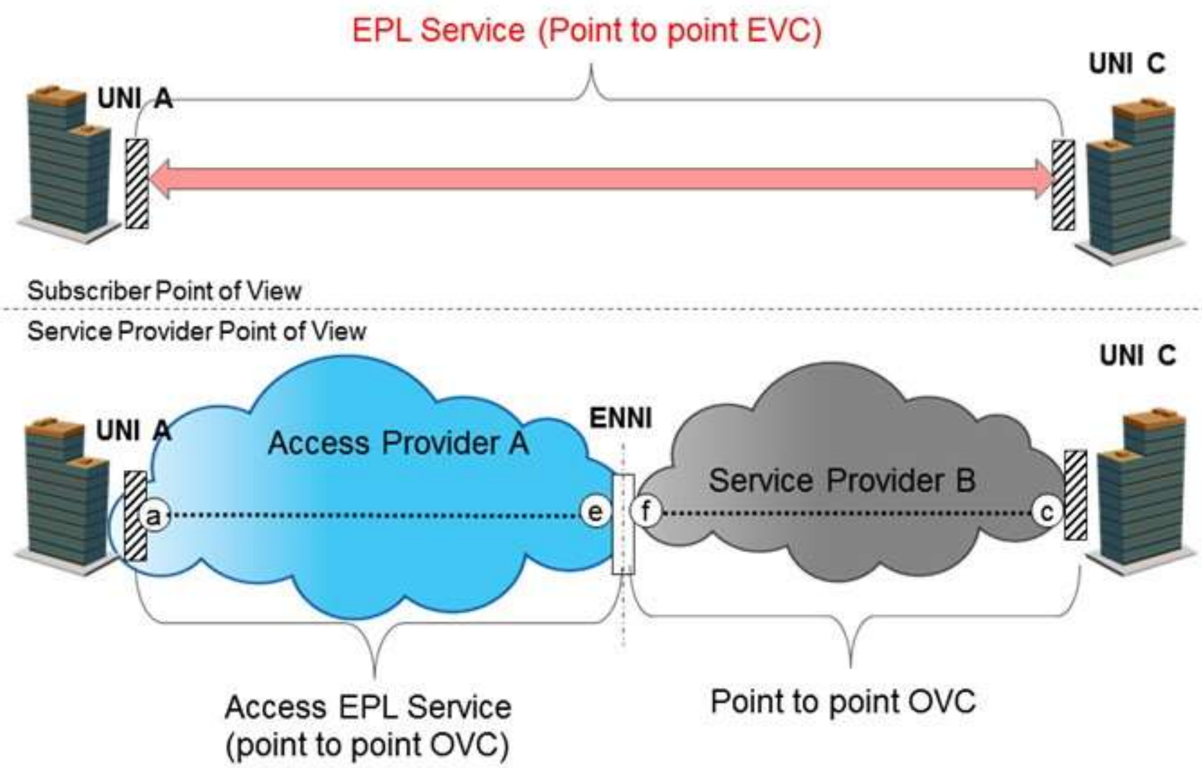

Figure 8. EPL Service as implemented across two networks using Access EPL, showing the Subscriber and Service Provider POVs.

An illustrative table below shows some of the attributes that must be specified as part of the end to end service, color coded to show that they belong to the end to end service (red), the Access Provider (blue), or the Service Provider (gray).

	EPL Service Attribute (End to End)	Value	Access EPL Attribute	Value	SP OVC Attribute	Value
1	EVC Type	Point to Point	OVC Type	Point to Point	OVC Type	Point to Point
2	All to One Bundling	Yes	N/A		N/A	
3	CE-VLAN ID to EVC Map	All Service Frames map to one EVC	OVC Endpoint Map at UNI A	All CE-VLAN ID values map to single OVC	OVC Endpoint Map at UNI C	All CE-VLAN ID values map to single OVC
4	N/A	N/A	ENNI Endpoint Map	OVC Endpoint E = SVLAN ID 158	ENNI Endpoint Map	OVC Endpoint F = SVLAN ID 158
5	Ingress bandwidth profile per EVC	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind;	Ingress bandwidth profile per OVC EP at UNI A	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0	Ingress bandwidth profile per OVC EP at UNI C	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0
6	N/A	N/A	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI
7	CE-VLAN ID, CoS preservation	MUST be yes	CE-VLAN ID, CoS preservation	MUST be yes	CE-VLAN ID, CoS preservation	MUST be yes
8	CoS ID	based on EVC, value=M	CoS ID based S-tag PCP	All PCP values = M	CoS ID based S-tag PCP	All PCP values = M
9	EVC Performance	MFD= 80 ms for Label=M, PT=Continental	OVC Performance	MFD=10	OVC Performance	MFD = 50

Table 14. Sample attributes for an EPL service.

Row 1 shows how the EVC and OVC types all line up as point to point.

Row 2 shows the All to One bundling EVC attribute is Yes.

Row 3 illustrates the CE-VLAN ID to EVC map and the OVC Endpoint Maps with all CE-VLANs mapped to one OVC or EVC.

Row 4 illustrates that the S-VLAN ID value for the OVC must agree for both networks in the ENNI endpoint maps.

Row 5 shows how the ingress bandwidth profile for the EVC is realized in the two OVCs UNI endpoints.

Row 6 shows that the ingress bandwidth profiles at the ENNI should be the same except reflecting a slight CIR increase due to the per-frame S-tag overhead.

Row 7 shows that CE-VLAN and CoS ID Value preservation apply end to end.

Row 8 states the CoS ID for this case is the EVC, with a CoS Label of M level; in the subtending OVCs, this is accomplished by specifying that all PCP values are mapped to the M Class of Service.

Row 9 illustrates that the EVC Mean Frame Delay (MFD) performance for CoS Label = M, and the Continental Performance Tier is 80 ms according to the MEF 23.1 [16]. The individual OVCs have adequate performance to meet the end to end goal.

9.2 EP-LAN Service

The following figure shows the Subscriber and Service Provider Points of View (POV) for an instance of EP-LAN Service offered by the Service Provider using Access EPL Service in the Access Provider Network.

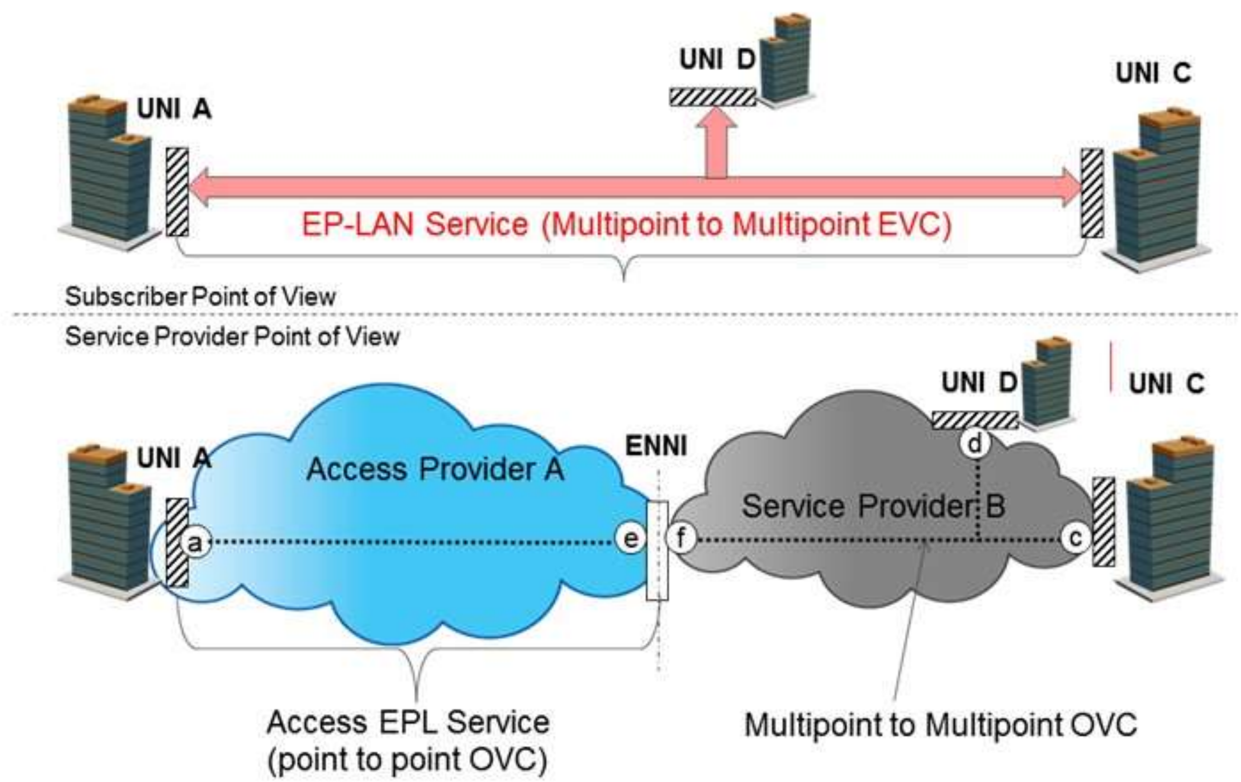

Figure 9. EP-LAN Service as implemented across two networks using Access EPL, showing the Subscriber and Service Provider Points of View.

An illustrative table below shows some of the attributes that must be specified as part of the end to end service, color coded to show that they belong to the end to end service (red), the Access Provider (blue), or the Service Provider (gray).

	EP-LAN Service Attribute (End to End)	Value	Access EPL Attribute	Value	SP OVC Attribute	Value
1	EVC Type	Multipoint to Multipoint	OVC Type	Point to Point	OVC Type	Multipoint to Multipoint
2	All to One Bundling	Yes	N/A		N/A	
3	CE-VLAN ID to EVC Map	All Service Frames map to one EVC	OVC Endpoint Map at UNI A	All CE-VLAN ID values map to single OVC	OVC Endpoint Map at UNIs C & D	All CE-VLAN ID values map to single OVC
4	N/A	N/A	ENNI Endpoint Map	OVC Endpoint E = SVLAN ID 158	ENNI Endpoint Map	OVC Endpoint F = SVLAN ID 158
5	Ingress bandwidth profile per EVC	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind;	Ingress bandwidth profile per OVC EP at UNI A	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0	Ingress bandwidth profile per OVC EP at UNIs C & D	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0
6	N/A	N/A	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI
7	CE-VLAN ID, CoS preservation	MUST be yes	CE-VLAN ID, CoS preservation	MUST be yes	CE-VLAN ID, CoS preservation	MUST be yes
8	CoS ID	based on EVC, value=M	CoS ID based S-tag PCP	All PCP values = M	CoS ID based S-tag PCP	All PCP values = M
9	EVC Performance	MFD= 80 ms for Label=M, PT=Continental, S= {all ordered UNI pairs}	OVC Performance	MFD=10 S= {all ordered OVC EP pairs per OVC}	OVC Performance	MFD = 50 S= {all ordered OVC EP pairs per OVC}

Table 15. Sample attributes for an EP-LAN service.

Row 1 shows how the EVC type of Multipoint to Multipoint can be constructed using the Service Provider's MP2MP OVC and the Access Provider's point to point OVC.

Rows 2-9 are the same as the previous example.

9.3 EP-LAN Service with Hairpin Switching by Service Provider

The following figure illustrates an EP-LAN case with two UNIs in the Access Provider network, which can be connected via hairpin switching from the Service Provider B. Note that two S-VLAN IDs will be needed at the ENNI, one for each OVC End Point (and are indicated in Row 4 of Table 15). For a discussion of hairpin switching, please see MEF 26, Section 7.2.2.

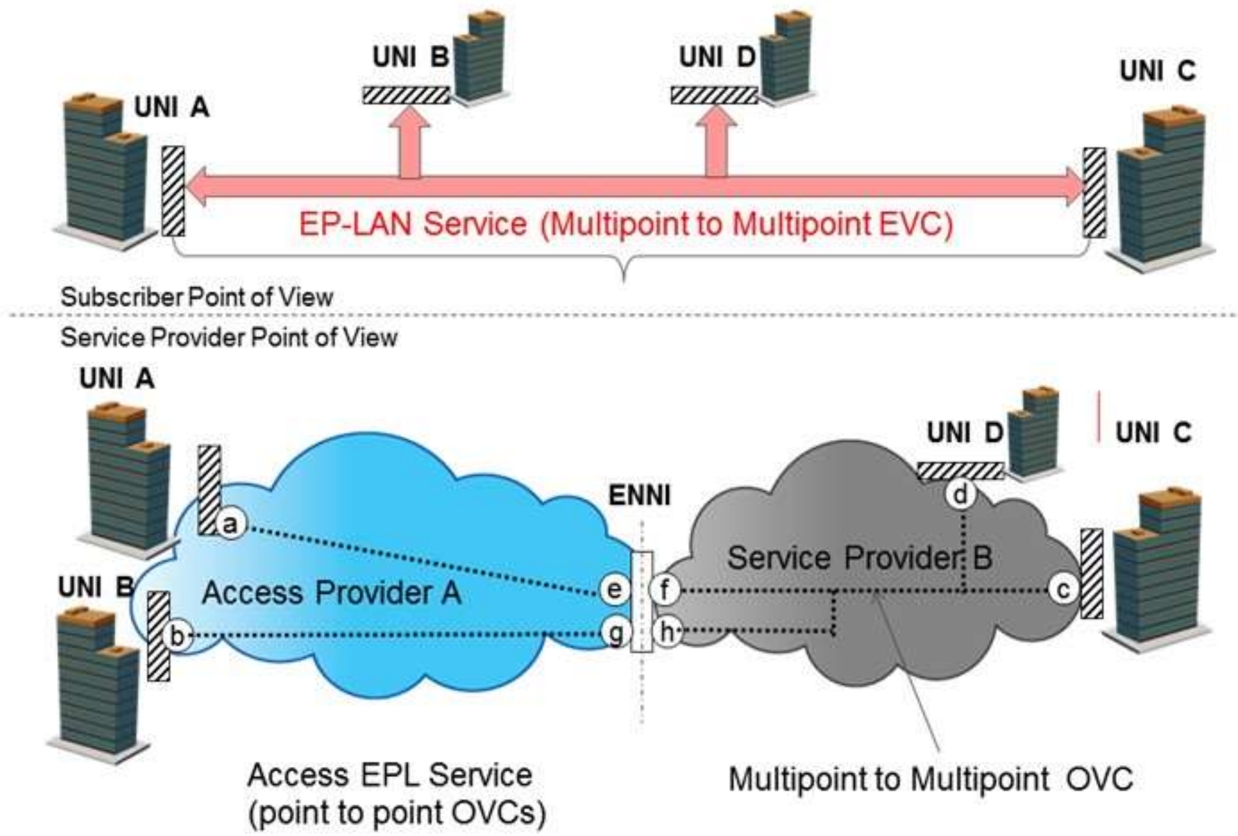

Figure 10. EP-LAN example illustrating a Service Provider using hairpin switching between UNI A & B.

The following table shows what attribute is different in the EP-LAN case with hairpin switching show above:

	EP-LAN Service Attribute (End to End)	Value	Access EPL Attribute	Value	SP OVC Attribute	Value
4	N/A	N/A	ENNI Endpoint Map	OVC Endpoint E = SVLAN ID 158 OVC Endpoint G = SVLAN ID 455	ENNI Endpoint Map	OVC Endpoint F = SVLAN ID 158 OVC Endpoint H = SVLAN ID 455

Table 16. Change in EP-LAN Attributes in hairpin switching example.

9.4 EVPL Service

The following figure shows the Subscriber and Service Provider Points of View (POV) for two instances of EVPL Service offered by the Service Provider using Access EVPL Service in the Access Provider Network.

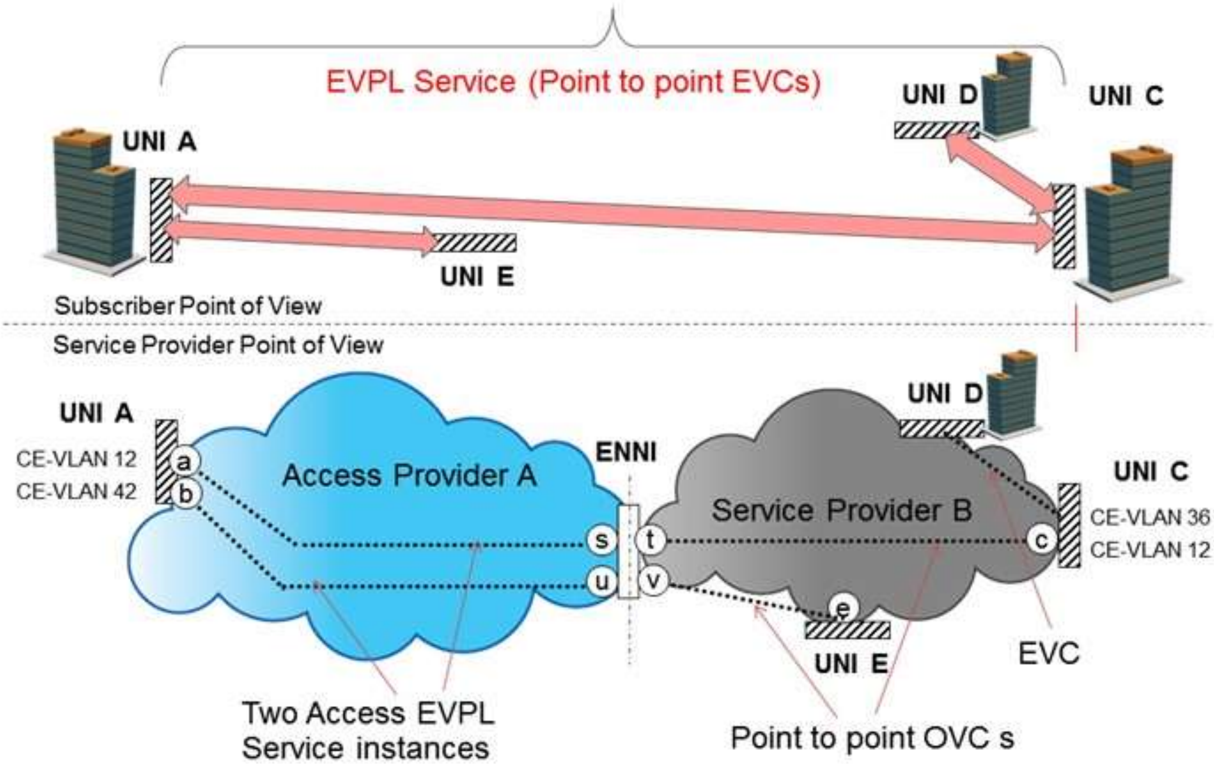

Figure 11. EVPL Service as implemented across two networks using Access EVPL, showing the Subscriber and Service Provider POVs.

An illustrative table below shows some of the attributes that must be specified as part of the end to end EVPL service, color coded to show that they belong to the end to end service (red), the Access Provider (blue), or the Service Provider (gray).

	EVPL Service Attribute (End to End)	Value	Access EVPL Attribute	Value	SP OVC Attribute	Value
1	EVC Type	Point to Point	OVC Type	Point to Point	OVC Type	Point to Point
2	All to One Bundling	No	N/A		N/A	
3	CE-VLAN ID to EVC Map	Specifies what CE-VLAN ID maps to each EVC	OVC Endpoint Map at UNI A	OVC Endpoint a = CE-VLAN ID 12 OVC Endpoint b = CE-VLAN ID 42	OVC Endpoint Map at UNI C & E	OVC Endpoint c = CE-VLAN ID 12 OVC Endpoint e = CE-VLAN ID 42
4	N/A	N/A	ENNI Endpoint Map	OVC Endpoint S = SVLAN ID 158 OVC Endpoint U = SVLAN ID 455	ENNI Endpoint Map	OVC Endpoint T = SVLAN ID 158 OVC Endpoint V = SVLAN ID 455
5	Ingress bandwidth profile per EVC	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind;	Ingress bandwidth profile per OVC EP at UNI A	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0	Ingress bandwidth profile per OVC EP at UNI C	CIR= 100 Mb/s, CBS = 12K, EIR, EBS=0; CM=blind; CF=0
6	N/A	N/A	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI	Ingress bandwidth profile per OVC EP at ENNI	CIR should reflect S-tag overhead, rest same as UNI
7	CE-VLAN ID, CoS preservation	MUST be YES or NO	CE-VLAN ID, CoS preservation	MUST be yes	CE-VLAN ID, CoS preservation	MUST be YES or NO
8	CoS ID	based on EVC, value=M	CoS ID based S-tag PCP	All PCP values = M	CoS ID based S-tag PCP	All PCP values = M
9	EVC Performance	MFD= 80 ms for Label=M, PT=Continental	OVC Performance	MFD=10	OVC Performance	MFD = 50

Table 17. Sample attributes for an EVPL service.

The main difference from EPL in this example is row 2, indicating All to one bundling is No, and the corresponding change in Row 3 indicating which CE-VLANs map to which EVCs, and Row 4 showing there are two SVLAN IDs at the ENNI, corresponding to the two OVCs in this example. Additionally Row 7 shows that the End-to-end EVPL service can have CE-VLAN ID preservation as Yes or No, and since Access EVPL is always Yes for this attribute, it will support both choices.

9.5 Access to Layer 3 Services

The following figure shows how an Internet Service Provider could use Access EPL or Access EVPL Service to aggregate customers in Access Provider A's footprint. Note that there are only OVCs, no EVCs, and the Subscriber seesan IP service, **not** a MEF defined service.

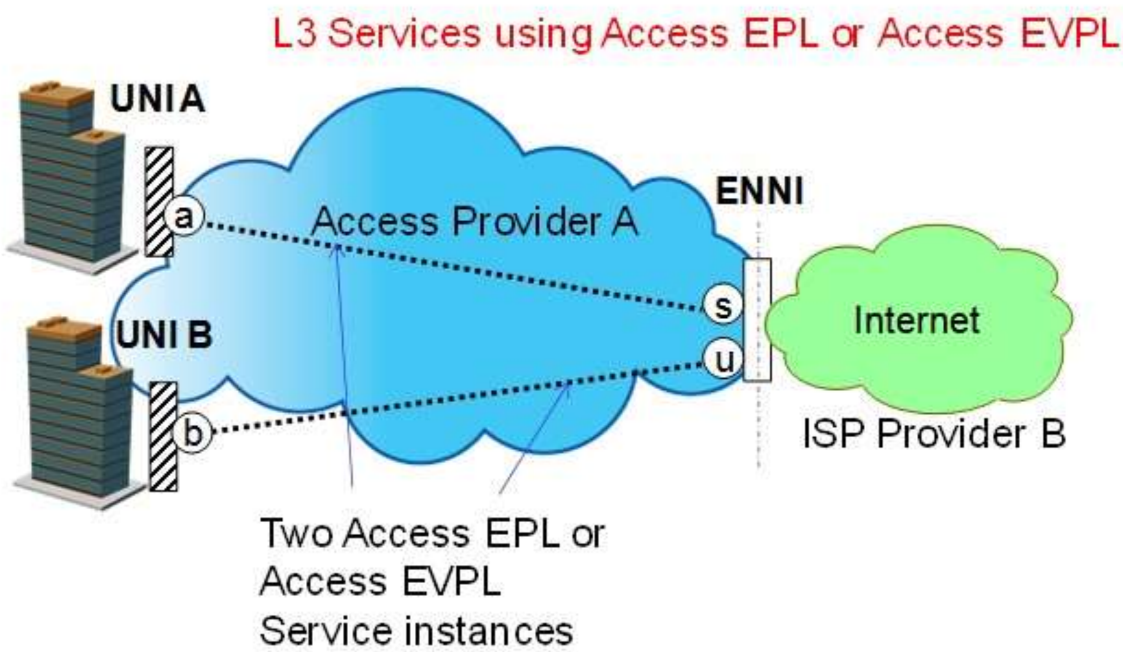

Figure 12. Access aggregation to Layer 3 services using Access EPL or Access EVPL.