



# **CE 2.0 Ethernet Access Services**

**MEF Informational and Technical Paper**

**October, 2013**

## Table of Contents

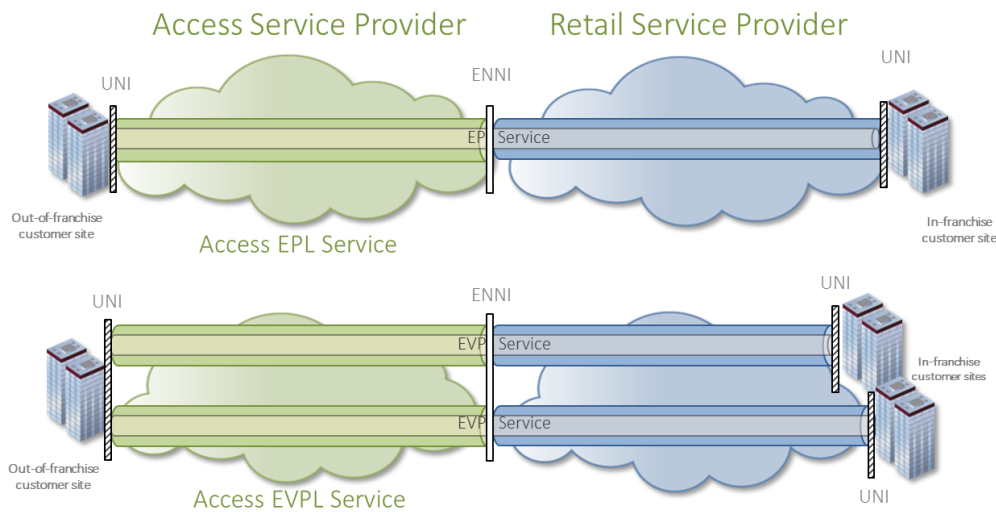
1	Introduction .....	3
1.1	Background and Scope .....	3
1.2	Audience and Purpose .....	3
1.3	Terminology Note .....	3
2	CE 2.0 E-Access Benefits .....	4
3	CE 2.0 E-Access Services Technical Specifications .....	5
4	E-Access Service Attributes .....	5
4.1	ENNI and OVC .....	5
4.2	Color Mode.....	6
4.3	Color Forwarding.....	6
4.4	OVC Multiplexing at the ENNI.....	6
4.5	Classes of Service.....	6
5	Implementation Basics and Use Cases.....	7
5.1	Implementation Basics.....	7
5.2	Use Case 1: EPL service constructed using an Access EPL service. ....	7
5.3	Use Case 2: EVPL services constructed using Access EVPL services. ....	8
6	Recommended Actions and Conclusion.....	9
6.1	Recommended Actions.....	9
6.2	Conclusion.....	9
7	About the MEF .....	9
8	Terms and References .....	9
9	Editors and Contributors .....	9

## 1 Introduction

### 1.1 Background and Scope

Carrier Ethernet 2.0 provides a new global standard making it simpler and faster for service providers to interconnect and meet the growing demand for Carrier Ethernet services at locations that are not on a service provider's own network. Such locations are commonly referred to as 'out-of-franchise' or 'off-net' locations.

CE 2.0 E-Access services allow service providers to carry customer traffic across network boundaries through connections designed to preserve the characteristics of end-to-end services delivered on a single network. This transparency and the need to provide a single industry-sanctioned method for service providers to establish external network network interfaces (ENNI) and implement services across them led the MEF to define two CE 2.0 E-Access services: Access EPL, a port-based service used to extend EPL and EP-LAN services, and Access EVPL, a VLAN-based service used to extend EVPL and EVP-LAN services as shown below:



This new MEF service standard is a deliberately simple design that service providers can immediately adopt to replace the scores of different and cumbersome ad hoc arrangements that are currently in place. A rapid transition to the new CE 2.0 E-Access standard will lower the cost of doing business in the wholesale marketplace, result in faster times to revenue for Carrier Ethernet access services, and finally, fuel the growth of Carrier Ethernet services in markets across the globe.

This paper provides a technical overview of the CE 2.0 E-Access services standard, provides implementation guidelines, sample use cases and a discussion of the benefits service providers can expect when adopting the new CE 2.0 E-Access service standard.

### 1.2 Audience and Purpose

This white paper is primarily intended for service providers that plan to replace the scores of ad-hoc arrangements currently in use to extend services to out-of-franchise locations with the new and simple CE 2.0 E-Access services standard.

### 1.3 Terminology Note

The terms 'out-of-franchise location' and 'off-net location' refer to customer sites on Carrier Ethernet Networks that are outside of the direct responsibility of the retail service provider who has the commercial relationship with the end-user or customer. The term 'access provider' is used in this paper to designate a service provider offering wholesale access services that allow a retail provider to reach out-of-franchise customer locations. A provider may both buy and sell access services, acting as retail provider in the former case and as wholesale access provider in the latter.

## 2 CE 2.0 E-Access Benefits

The MEF introduced the CE 2.0 E-Access services standard to create a more efficient wholesale marketplace and fuel the growth of Carrier Ethernet services across the globe. The MEF has also integrated E-Access into its CE 2.0 equipment and services certification programs to speed up the implementation and transition to CE 2.0 E-Access services.

Service providers contending with multiple different ad-hoc arrangements to access out-of-franchise customer locations are seeking to reduce the time, resources and costs associated with the qualification, procurement, and deployment of services provided by local wholesale access providers. At the same time, access providers are seeking more efficient ways to implement, offer and operate wholesale services while benefiting from faster times to revenue. The table below illustrates several of the administrative, commercial and engineering processes the CE 2.0 E-Access service standard helps to simplify:



### Source: The MEF CE 2.0 Certification Registry

- Lists all CE 2.0 certified E-Access services available from wholesale access providers worldwide
- Lists all CE 2.0 E-Access certified equipment that can be deployed at the ENNI and at the UNI
- The registry is consulted by service providers seeking metro, regional, national and international CE 2.0 E-Access services in markets across the globe and is continuously updated

### Qualify: The MEF CE 2.0 Certification Program

- Certification testing based on CE 2.0 Test Plan for Service Attributes and Traffic Management
- Certification program covers both E-Access equipment and E-Access services
- Test Plan comprises 624 test cases & complies with ISO/IEC 17025 standard for conformity assessment

### Procure: CE 2.0 E-Access Requests for Product

- Service providers simplify RFP process by requesting CE 2.0 certified E-Access services
- Access providers complete CE 2.0 certification in one round of testing
- Requests for Product simplified by requiring CE 2.0 certified equipment at the UNI and the ENNI
- CE 2.0 E-Access services comply with MEF 23.1 service level objectives

### Deploy: CE 2.0 E-Access Service Deployment

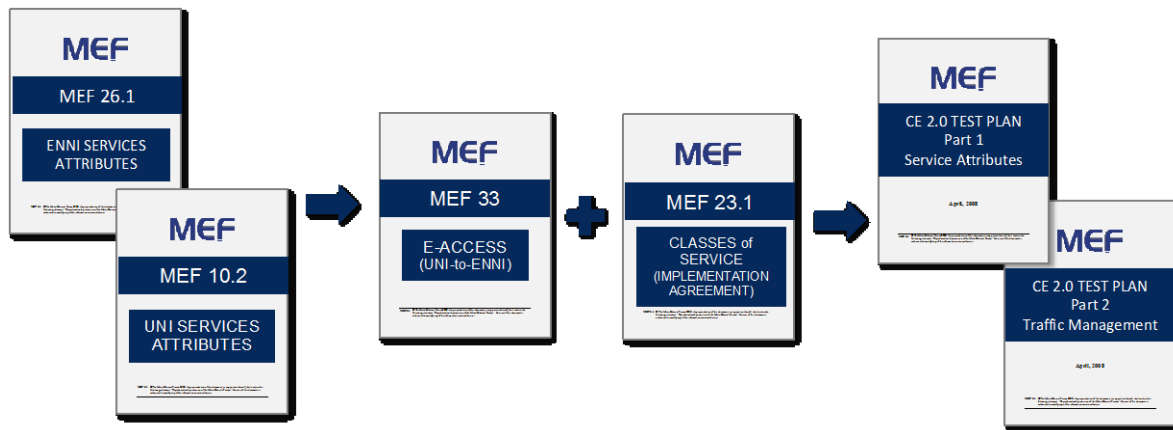
- Service and wholesale providers can routinely establish ENNIs to support the CE 2.0 E-Access service standard
- Simpler and faster deployment by access providers when using CE 2.0 E-Access certified equipment
- Service providers require less time and resources to interconnect to a standard CE 2.0 E-Access service

### Grow: CE 2.0 E-Access service standard and Carrier Ethernet Revenue Growth

- CE 2.0 E-Access service standard allows service providers to expand Carrier Ethernet service coverage more quickly and at lower cost
- Improves time to market and time to revenue of service providers delivering Carrier Ethernet services to out-of-franchise locations
- Improves time to market and time to revenue of access providers offering wholesale access services
- Increased availability of CE 2.0 E-Access services supports growth of Carrier Ethernet services

### 3 CE 2.0 E-Access Services Technical Specifications

CE 2.0 E-Access services are defined in MEF 33 *Ethernet Access Services Definition*. E-Access service attributes associated with the UNI are defined in MEF 10.2 *Ethernet Services Attributes Phase 2* and those associated with the ENNI are defined in MEF 26.1 *External Network Network Interface (ENNI) Phase 2*. The Implementation Agreement MEF 23.1 *Carrier Ethernet Class of Service Phase 2* defines the classes of service, performance tiers and performance objectives applicable to Ethernet Access services. The relationship between this set of MEF technical specifications that form the basis of CE 2.0 E-Access and the *CE 2.0 Test Plan Part 1 Service Attributes* and *CE 2.0 Test Plan Part 2 Traffic Management* is illustrated below:



### 4 E-Access Service Attributes

This section describes the attributes that define CE 2.0 E-Access services. Note that E-Access is a *service type* connecting an ENNI and a UNI and Access EPL and Access EVPL are *services*. Access EPL supports a single point-to-point connection at the UNI with all to one bundling while Access EVPL supports multiple point-to-point connections at the UNI with support for the bundling of CE-VLAN IDs 1 to 4094 as well as the non-overlapping mapping of untagged and priority tagged frames.

#### 4.1 ENNI and OVC

The role of an E-Access service is to allow a service provider to construct an Ethernet Virtual Connection (EVC) between two customer sites where one of the sites is located outside of the service provider's own network. In such cases a service provider will use an E-Access service offered by a local wholesale access provider to reach the out-of-franchise UNI. The service provider will connect to the E-Access service at an External Network Network Interface or ENNI, and traffic will be forwarded between the ENNI and the out-of-franchise UNI across an Operator Virtual Connection (OVC).

As with all MEF-defined services, Ethernet Access service definitions include:

- Attributes related to the external interfaces, in this case, the ENNI and the UNI; and
- Attributes related to the virtual Ethernet connection associating these external interfaces. In this case, the term used in MEF technical specifications is Operator Virtual Connection, or OVC.

E-Access services use a point-to-point OVC to associate one OVC End Point at an ENNI and one OVC End Point at a UNI.

At the ENNI, service and access providers are required to append an S-VLAN tag with TPID 88-A8 to transport customer Service Frames originating at the UNI. It is worth noting that all CE 2.0 E-Access certified equipment is verified to support S-VLAN tags as defined in IEEE 802.1Q-2011.

## 4.2 Color Mode

Color mode requires bandwidth profiles to be color aware at the ENNI and support color blind mode at the UNI. Ingress bandwidth profiles per OVC End Point at the ENNI forward ENNI Frames that are indicated as Green at the Committed Information Rate (CIR), and since the bandwidth profile is mandated to support an Excess Information Rate (EIR) = 0, ENNI Frames that are indicated as Yellow will be dropped. The Drop Eligibility Indicator (DEI) field of the S-VLAN tag can be used advantageously to indicate color of ingress frames at the ENNI but PCP values, as indicated in MEF 23.1, can also be used to identify the color of arriving frames at the ENNI. Bandwidth profiles at the UNI, on the other hand, must be color blind and not take account of the color of Service Frames when forwarding at the CIR.

## 4.3 Color Forwarding

Color forwarding, an attribute related to the OVC, prevents the promotion of ingress frames mapped to an OVC End Point from Yellow to Green. MEF 33 stipulates that the color forwarding attribute should be Yes for both Access EPL and Access EVPL services.

## 4.4 OVC Multiplexing at the ENNI

Other important differences exist between UNIs and ENNIs. Whereas a UNI can only support a single instance of port-based EPL or EP-LAN services, an ENNI can support multiple instances of Access EPL and Access EVPL services because each service instance is differentiated through the mapping of a single one of the available 4094 S-VLAN IDs to an OVC.

## 4.5 Classes of Service

MEF 23.1 provides service level specifications for CE 2.0 E-Access services based on the service performance metrics frame delay, mean frame delay, inter-frame delay variation, frame delay range and frame loss ratio and four performance tiers for each of three classes of service H (high), M (medium), and L (low). MEF 33 allows only a single class of service to be associated with an OVC. The service performance objectives defined in MEF 23.1 are illustrated in the table below:

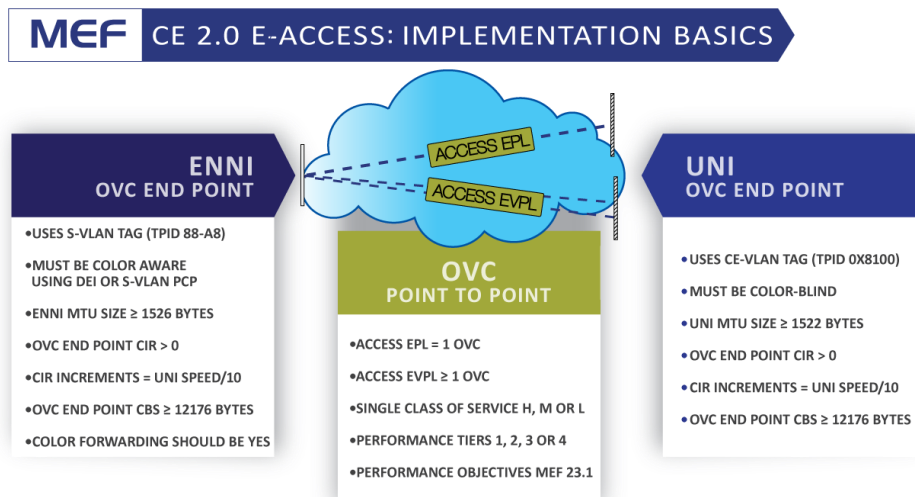
MEF 23.1 PERFORMANCE SPECIFICATIONS FOR CE 2.0 E-ACCESS												
CoS Label	CoS Label H				CoS Label M				CoS Label L			
Performance Tiers	PT1	PT2	PT3	PT4	PT1	PT2	PT3	PT4	PT1	PT2	PT3	PT4
FD (ms)	≤10	≤25	≤77	≤230	≤20	≤75	≤115	≤250	≤37	≤125	≤230	≤390
MFD (ms)	≤7	≤18	≤70	≤200	≤13	≤30	≤80	≤220	≤28	≤50	≤125	≤240
IFDV (ms)	≤3	≤8	≤10	≤32	≤8 or n/s	≤40 or n/s	≤40 or n/s	≤40 or n/s	n/s	n/s	n/s	n/s
FDR (ms)	≤5	≤10	≤12	≤40	≤10 or n/s	≤50 or n/s	≤50 or n/s	≤50 or n/s	n/s	n/s	n/s	n/s
FLR (%)	≤0.01	≤0.01	≤0.025	≤0.05	≤0.01	≤0.01	≤0.025	≤0.05	≤0.1	≤0.1	≤0.1	≤0.1

Although the performance objectives associated with the performance tiers defined in MEF 23.1 align with metropolitan, regional, national and international geographical tiers, service and access providers may align to a performance objective that corresponds to the capabilities of an access method deployed on a network. For example, a metropolitan access service may comply with the performance objectives of performance tier 3 due to the delay characteristics of a specific access method.

## 5 Implementation Basics and Use Cases

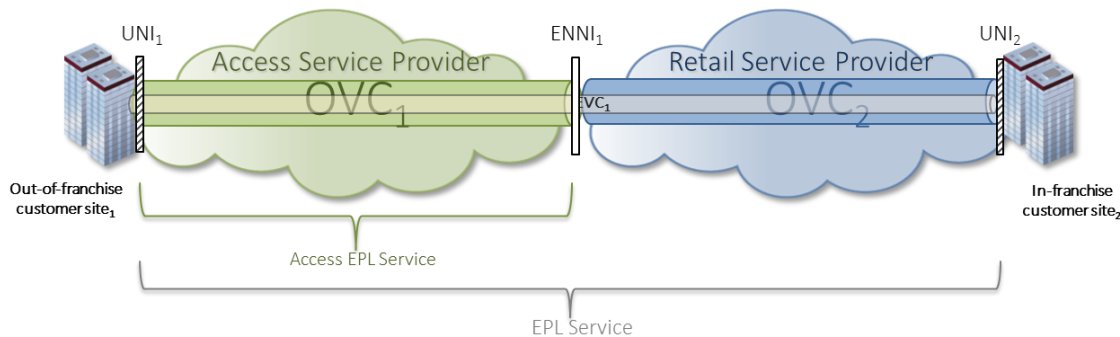
### 5.1 Implementation Basics

The transition to CE 2.0 E-Access services requires the implementation of key attributes and parameters associated with the ENNI, the OVC End Points at the ENNI and UNI, and the OVC. It is important to note that frame formats differ at the ENNI and the UNI, the bandwidth profile algorithm is color aware at the ENNI and color blind at the UNI, and ENNI Frames are 4 bytes longer than Service Frames at the UNI due to the addition of the S-VLAN tag. Both ENNI and UNI OVC End Points, however, must support CIR > 0, CBS ≥ 12176 bytes while the recommended value for EIR and EBS is zero. CIR must be supported in increments of 1 Mbps for ENNI and UNI speeds of 10 Mbps and increments of 10 Mbps, 100 Mbps and 1 Gbps for 100 Mbps, 1000 Mbps and 10 Gbps ENNI and UNI speeds respectively.



### 5.2 Use Case 1: EPL service constructed using an Access EPL service.

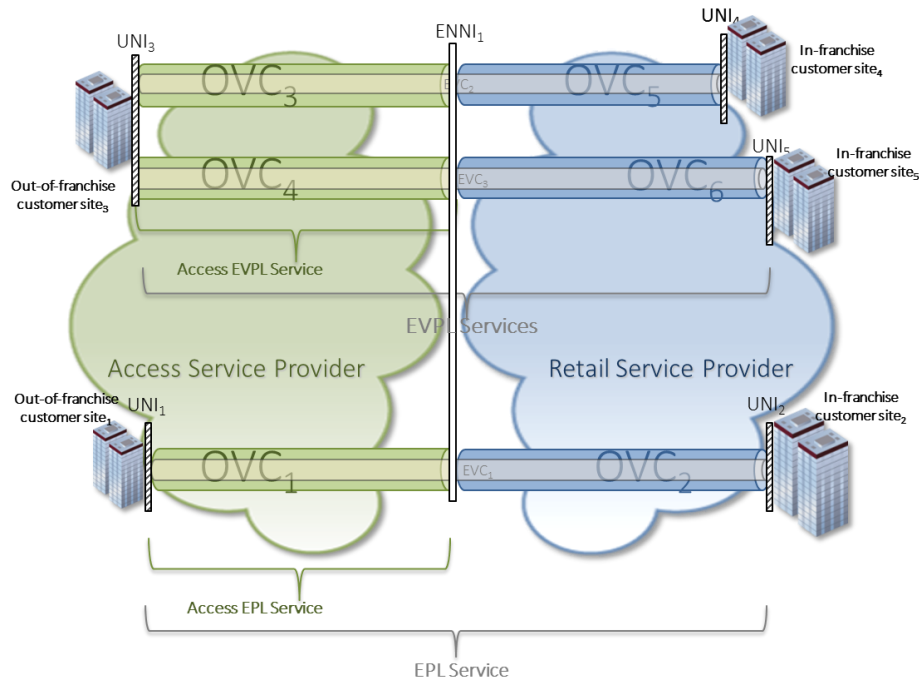
The Illustration below shows a port-based Ethernet Access service forwarding all tagged, untagged and priority-tagged customer Service Frames unchanged between an out-of-franchise UNI<sub>1</sub> and in-franchise customer UNI<sub>2</sub>. Note that OVC<sub>1</sub> and OVC<sub>2</sub> support a single class of service H, M or L and ENNI Frames marked Green must be forwarded across the ENNI. The Access EPL service is expected to meet the class of service performance objectives defined in MEF 23.1 that correspond to the Performance Tier applied to OVC<sub>1</sub>.



- Service Provider and Access Provider establish ENNI<sub>1</sub>
- Service Provider orders a single CE 2.0 Access EPL service from an Access Provider to deliver a port-based end-to-end EPL service where one of the customer sites is out-of-franchise
- Access Provider constructs OVC<sub>1</sub> between OVC End Point<sub>1</sub> at the customer UNI<sub>1</sub> and OVC End Point<sub>2</sub> at ENNI<sub>1</sub>
- Service Provider constructs OVC<sub>2</sub> between OVC End Point<sub>2</sub> at ENNI<sub>1</sub> and OVC End Point<sub>2</sub> at customer UNI<sub>2</sub>
- The concatenation of the two OVCs forms an end-to-end EVC<sub>1</sub> between customer UNI<sub>1</sub> and UNI<sub>2</sub>
- Service Provider delivers EPL service to customer between customer UNI<sub>1</sub> and UNI<sub>2</sub> over point-to-point EVC<sub>1</sub>.

### 5.3 Use Case 2: EVPL services constructed using Access EVPL services.

The illustration below shows a VLAN-based Ethernet Access service with a UNI associated with multiple point-to-point OVCs. The end-to-end EVPL service allows the customer to map one or more but not overlapping CE-VLAN IDs to each EVC. The illustration also shows that an ENNI can support multiple point-to-point OVCs and multiple instances of both port-based and VLAN-based E-Access services by mapping a single S-VLAN ID to each OVC at the ENNI. Note that each OVC can be assigned a different class of service and that the customer UNIs can support multiple EVCs connecting to other customer UNIs on the same network.



- Service Provider and Access Provider establish ENNI1
- Service Provider orders an Access EVPL service from an Access Provider to connect out-of-franchise Customer UNI3 to ENNI1 with OVC3 and OVC4
- Access Provider constructs OVC3 between OVC End Point3 at ENNI1 and OVC End Point3 at customer UNI3 and OVC4 between OVC End Point4 at ENNI1 and OVC End Point4 at customer UNI3
- Service Provider constructs OVC5 between OVC End Point5 at ENNI1 and OVC End Point5 at customer UNI4 and OVC6 between OVC End Point5 at ENNI1 and OVC End Point6 at customer UNI5
- The concatenation of OVC3 and OVC5 forms an end-to-end EVC2 between customer UNI3 and UNI4 and the concatenation of OVC4 and OVC6 forms an end-to-end EVC3 between customer UNI3 and UNI5
- Service Provider delivers EVPL service to customer between customer UNI3 and customer UNI4 and between customer UNI3 and customer UNI5.



## 6 Recommended Actions and Conclusion

### 6.1 Recommended Actions

For Carrier Ethernet Service Providers intending to offer CE 2.0 E-access services:

- Plan migration to CE 2.0 E-Access services. Consult four key MEF technical specifications: MEF 10.2, MEF 23.1, MEF 26.1 and MEF 33.
- Deploy CE 2.0 certified equipment at the ENNI and the UNI. Refer to MEF Certification Registry for Equipment.
- Certify CE 2.0 E-Access services. Ethernet access providers can achieve CE 2.0 E-Access certification in a single round of testing performed by the official MEF test lab based on the Carrier Ethernet 2.0 Test Plan.
- CE 2.0 certified E-Access services are listed in the MEF Certification Registry for Services.

For Carrier Ethernet Service Providers intending to use CE 2.0 E-Access services:

- Consult MEF Certification Registry for Services. The registry lists all available CE 2.0 E-Access certified services and is continually updated.
- Request CE 2.0 E-Access certified services in RFPs.
- Base Service Level Specifications on MEF 23.1 performance metrics, tiers and objectives.

### 6.2 Conclusion

Carrier Ethernet 2.0 E-Access services provide service providers with a new and simple standard to interconnect and assure the delivery of Carrier Ethernet services wherever there is a demand for them. Service providers motivated by a lower cost of doing business and faster times to revenue are migrating to the new CE 2.0 E-Access service standard to reach out-of-franchise customer locations and deliver Carrier Ethernet services with a global footprint.

## 7 About the MEF

The MEF is a global industry alliance comprising more than 215 organizations including telecommunications service providers, cable MSOs, network equipment/software manufacturers, semiconductor vendors and testing organizations. The MEF's mission is to accelerate the worldwide adoption of Carrier-class Ethernet networks and services. The MEF develops Carrier Ethernet technical specifications and implementation agreements to promote interoperability and deployment of Carrier Ethernet worldwide. For more information about the Forum, including a complete listing of all current MEF members, please visit <http://www.MetroEthernetForum.org>

## 8 Terms and References

Term	Definition
OVC End Point	An association of an OVC with a specific External Interface i.e. UNI, ENNI
S-VLAN ID	The 12 bit VLAN ID field in the S-Tag of an ENNI Frame

A full list of terms may be found at <http://metroethernetforum.org/carrier-ethernet/terms-used-in-mef-specifications>

Reference	The following maybe downloaded at <a href="http://www.metroethernetforum.org">www. metroethernetforum.org</a>
MEF 10.2	Ethernet Services Attributes Phase 2
MEF 26.1	External Network Network Interface (ENNI) Phase 2
MEF 23.1	Carrier Ethernet Class of Service Phase 2
MEF 33	Ethernet Access Services Definition
MEF 34	Abstract Test Suite for Ethernet Access Services

## 9 Editors and Contributors

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