DPoE Support of Carrier Ethernet Services

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March 2012

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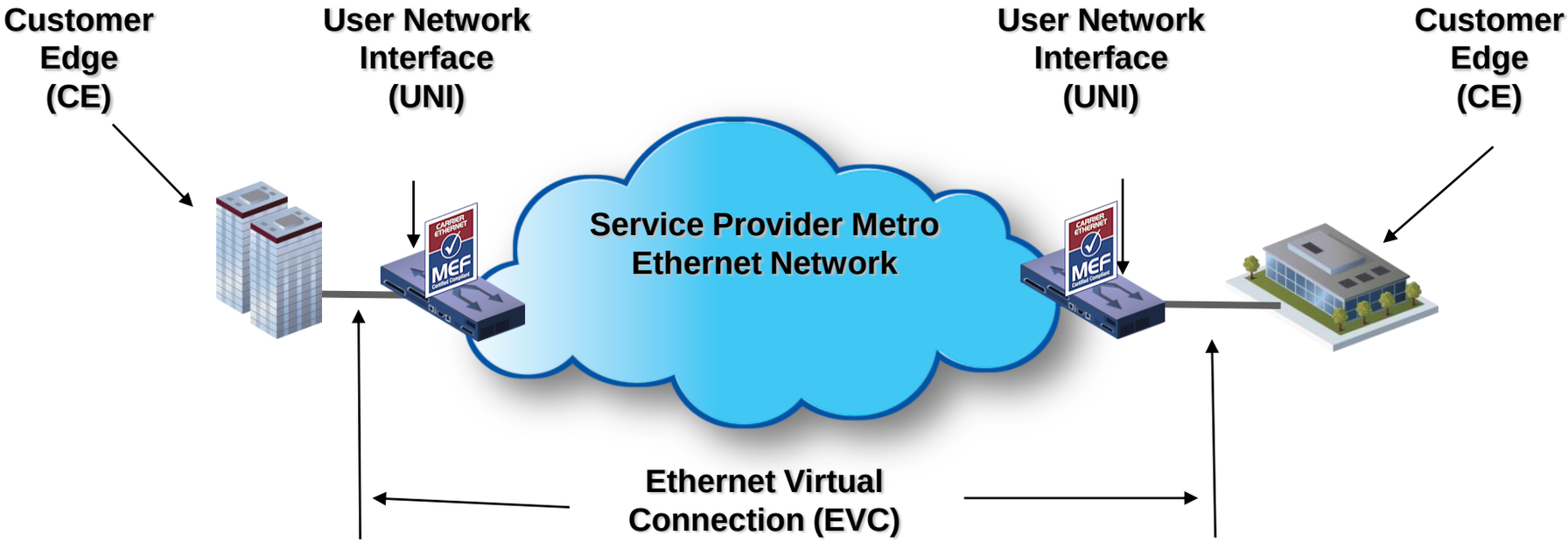
Agenda

- **MEF Carrier Ethernet**
  - Carrier Ethernet Architecture and Service Attributes
  - MEF Carrier Ethernet Services.
- **DPoE (DOCSIS Provisioning of EPON)**
  - Architecture
  - Specifications
- **DPoE 1.0 MEF Specification**
  - Goals and Requirements.
  - QoS support for EPL Service
  - Scenarios
- **EPoC Considerations**

Carrier Ethernet Service - Reference Diagram

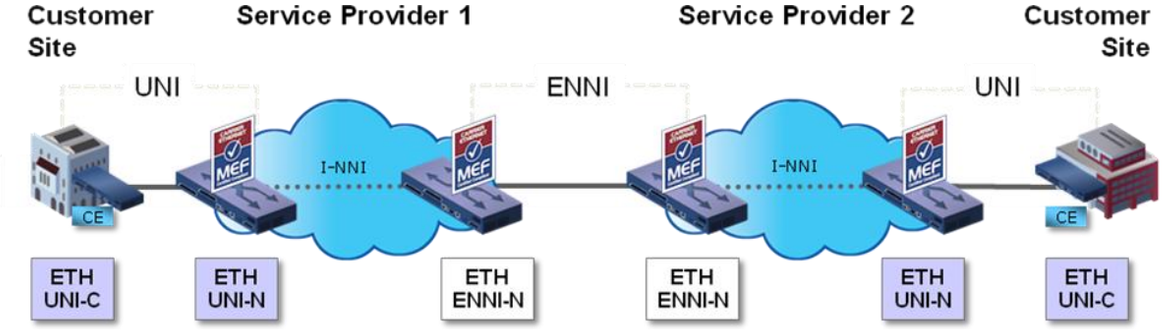
- Ethernet Service extends from one Customer Edge to another
- The Service is called an Ethernet Virtual Connection (EVC)
- Service is handed off at the User Network Interface (UNI)
- MEF 10.2 describes Carrier Ethernet Service attributes.



MEF Carrier Ethernet Network Interfaces

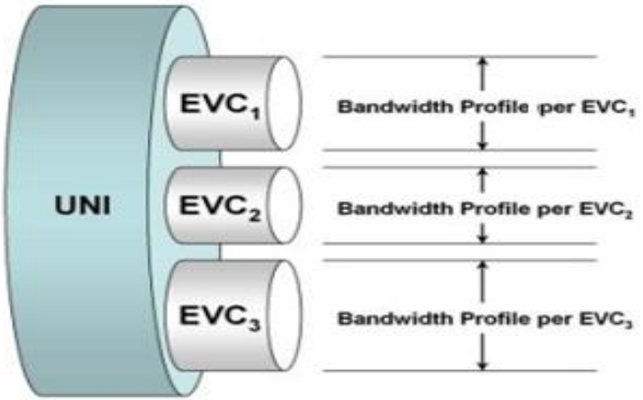
- **The User Network Interface (UNI)**
  - The UNI is the physical Ethernet interface or port that is the demarcation between the customer and the service provider/Cable Operator/Carrier/MSO.
    - It consists of client side (UNI-C) and network side (UNI-N)
  - **UNI Type I**: A UNI compliant with MEF 13.
    - Manually Configurable.
  - **UNI Type II**: A UNI compliant with MEF 20.
    - Automatically Configurable via E-LMI and Manageable via OAM.

- **Network to Network Interface (NNI)**
  - **E-NNI**: Network to Network Interface between distinct MEN operated by one or more carriers. Specified by MEF 26.
  - **I-NNI**: open interface between two network elements in the same MEN.



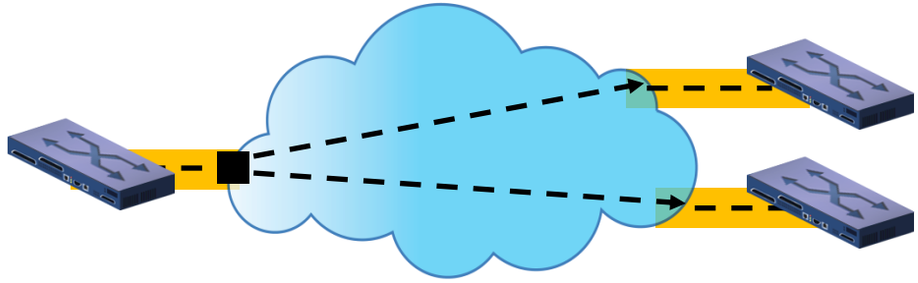
MEF Ethernet Virtual Connection (EVC)

- **EVC is an Ethernet service container**
  - It is defined in MEF 10.2
  - Connects two or more subscriber sites (UNI's)
  - Provides an association between two or more UNIs.
  - EVCs help visualize the Ethernet connections
    - Like Frame Relay and ATM PVCs or SVCs
  - Prevents data transfer between sites that are not part of the same EVC.
- **Can be bundled or multiplexed on the same UNI.**
  - Multiple EVCs accessible at a single UNI allows Service Multiplexing on the UNI.
  - Each EVC may have an ingress/egress bandwidth profile.

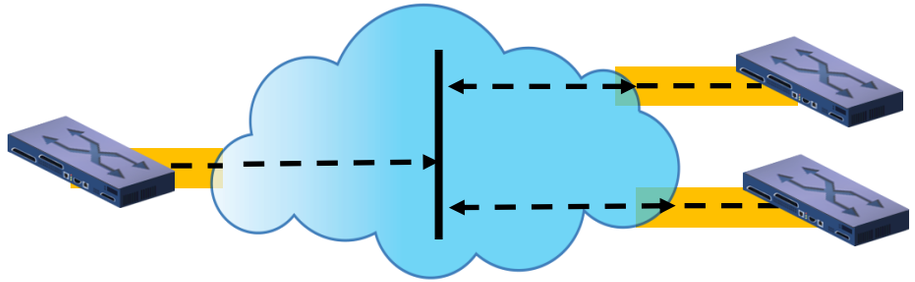


Three Types of EVC's

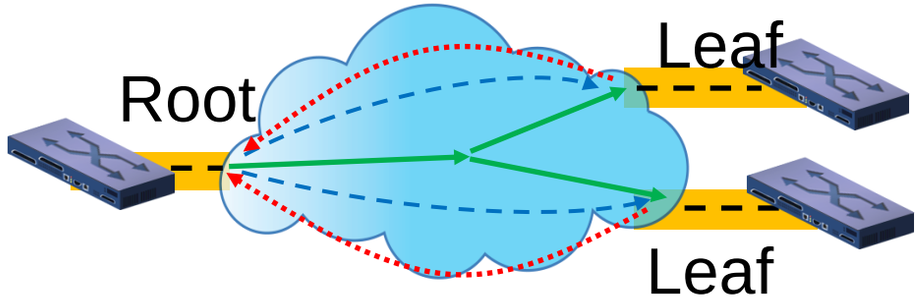
1. **Point to Point EVC – in this diagram one site is separately connected to two other sites with two separate EVCs**



2. **Multipoint EVCs – in this diagram, three sites joint share a multipoint EVC and can freely forward Ethernet frames to each other**



3. **Rooted Multipoint – The root can forward to the leaves, each leaf can only forward to the root**



Broadcast, multicast and unicast

Known unicast

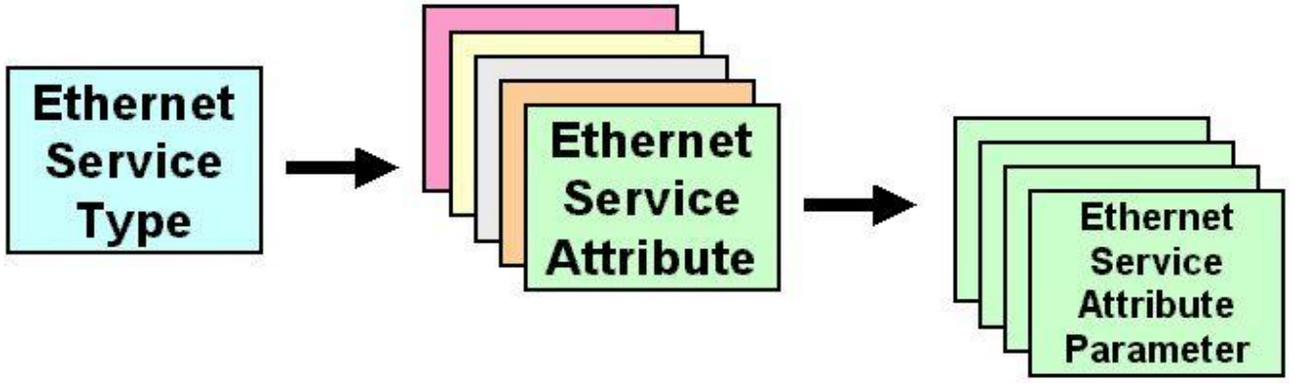
Broadcast, multicast and unicast

MEF Ethernet Service Framework

- Ethernet Service Types can be used to create a broad range of services.
  - The characteristics of these services are defined by the service attributes.
  - These service attributes define the UNI and EVC characteristics
  - Each service attribute has associated with it a set of parameters.

- The Ethernet service framework provides the definition of and relationship between UNI and EVC service attributes and their associated parameters.

- An Ethernet services can be created using this framework by doing the following:
  - Selecting one Ethernet Service Type based on which the service is created,
  - Selecting one or more Ethernet Service Attributes that define the characteristics of the UNI at which the service is offered and the EVC of the service type.
  - Deciding upon one or more parameter values associated with each Ethernet Service Attribute.



MEF 6.1 Carrier Ethernet Services

Service Type	Port-Based (All-to-One Bundling)	VLAN-Based (Service Multiplexed)
E-Line **(Point-to-Point EVC)**	Ethernet Private Line **(EPL)**	Ethernet Virtual Private Line **(EVPL)**
E-LAN **(multipoint-to-multipoint EVC)**	Ethernet Private LAN **(EP-LAN)**	Ethernet Virtual Private LAN **(EVP-LAN)**
E-Tree **(rooted multipoint EVC)**	Ethernet Private Tree **(EP-Tree)**	Ethernet Virtual Private Tree **(EVP-Tree)**

No change Modified New

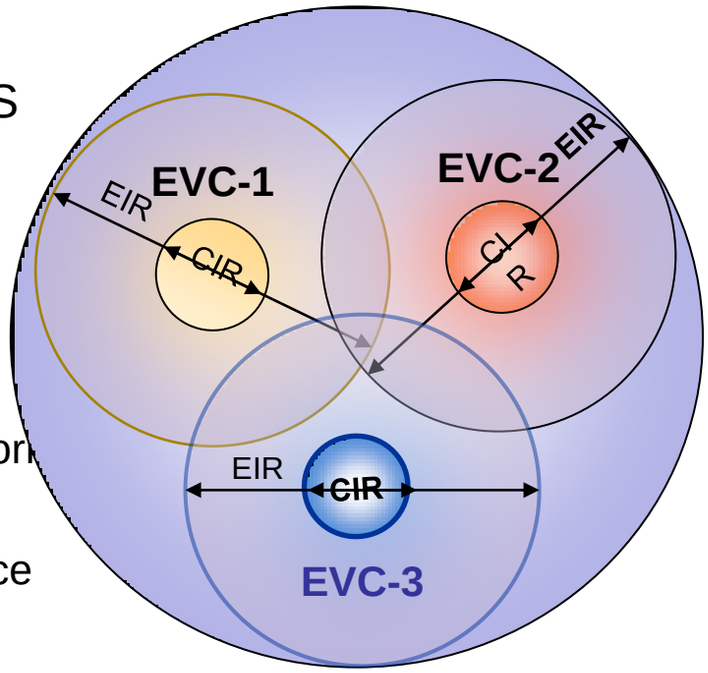
MEF 6.1 Enhancements

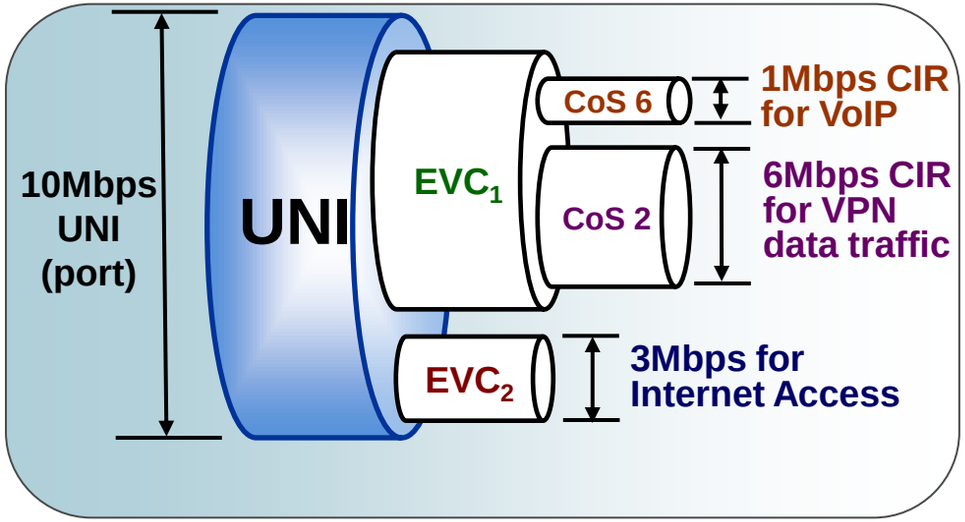
- Defines a new service type (E-Tree) in addition to those defined in MEF 6 (**E-Tree based services are not addressed in this presentation**).
- Adds four new services – two each to E-LAN and E-Tree

Bandwidth Profile Service Attributes

Bandwidth Profiles per EVC (service) and per CoS

- CIR (Committed Information Rate)
  - CIR assured via Bandwidth Reservation and Traffic Engineering
- EIR (Excess Information Rate)
  - EIR bandwidth is considered 'excess'
  - Traffic dropped at congestion points in the networ
- CBS/EBS (Committed/Excess Burst Size)
  - Higher burst size results in improved performance



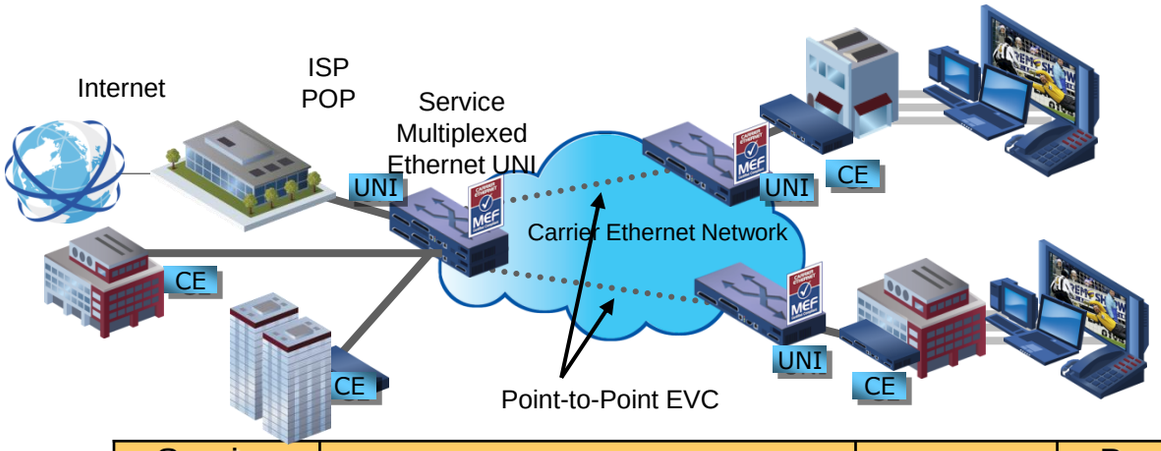


BWPs can divide bandwidth per EVC (service) over a single UNI

- Multiple services over same port (UNI)
- CoS markings enable the network to determine the network QoS to provide

CIR defines the assured bandwidth EIR improves the network's Goodput

Example CoS-based Metro Ethernet SLA



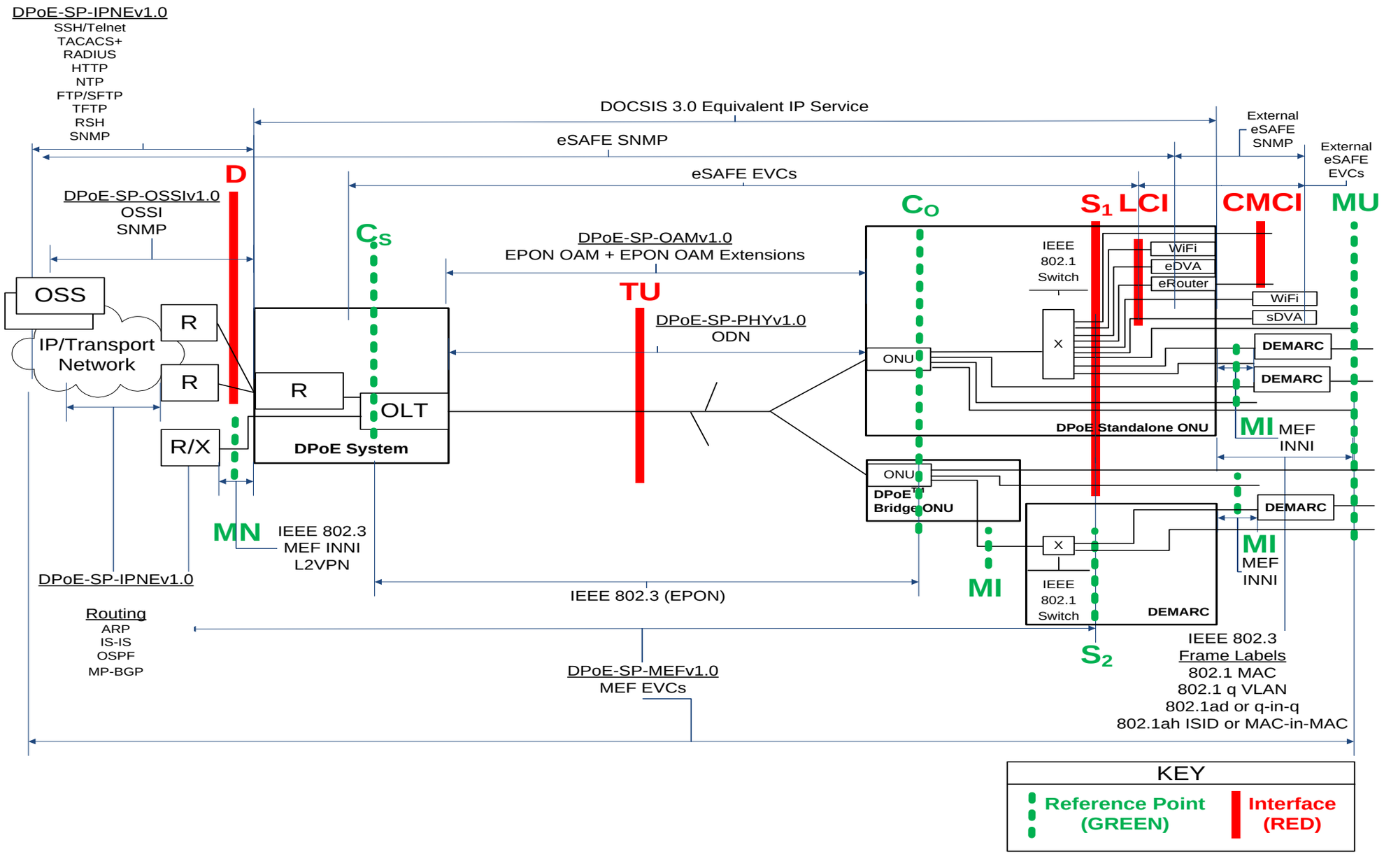
- E-Line Virtual Private Line Service
- 4 Classes of Service
- CoS determined via 802.1p CoS ID
- MEF 23.1 provides guide lines for defining marking and BWP and performance parameters for each class of service.

Service Class	Service Characteristics	CoS ID	Bandwidth Profile per EVC per CoS ID	Service Performance
Premium	Real-time IP telephony or IP video applications	6, 7	CIR > 0 EIR = 0	Delay < 5ms Jitter < 1ms Loss < 0.001%
Silver	Bursty mission critical data applications requiring low loss and delay (e.g., Storage)	4, 5	CIR > 0 EIR ≤ UNI Speed	Delay < 5ms Jitter = N/S Loss < 0.01%
Bronze	Bursty data applications requiring bandwidth assurances	3, 4	CIR > 0 EIR ≤ UNI Speed	Delay < 15ms Jitter = N/S Loss < 0.1%
Standard	Best effort service	0, 1, 2	**CIR=0** EIR=UNI speed	Delay < 30ms Jitter = N/S Loss < 0.5%

What is DPoE™ ?

- DOCSIS Provisioning of EPON
- DPoE allows MSO to use DOCSIS back-office provisioning and management system, and DOCSIS service concepts to provision and operate EPON standards based products to deliver IP and Ethernet services.
  - DPoE makes EPON system looks like a DOCSIS system to the back-office management system.
- DPoE Architecture supports interoperability between ONU and OLT of different vendors.
- DPoE Should also be used to provision EPoC systems.

DPoE™ 1.0 Architecture and Reference Points



DPoE™ 1.0 Standards Specifications

Architecture

Specifies fundamental architectural requirements (those that apply to more than one specification). Explains the purpose of each document.

OAM Extensions

Describes OAM Extensions beyond IEEE 802.3ah and 802.3av requirements.

PHY

DPoE uses the EPON PHY. The DPoE EPON PHY specification makes mandatory some options within EPON and adds some additional requirements.

Security

Specifications for support for DOCSIS network and system interfaces to provide transparent support of DOCSIS device authentication, code verification, and additional security for a DPoE implementation.

IPNE

Best practices and operator requirements for IP network element management and operations. This document includes CMTS like IP router requirements.

MULPI

Specifications for support of a subset of DOCSIS 3.0 MULPI functionality for DPoE with additional EPON requirements.

MEF

Specifications for MEF services added to DOCSIS static configuration provisioning model.

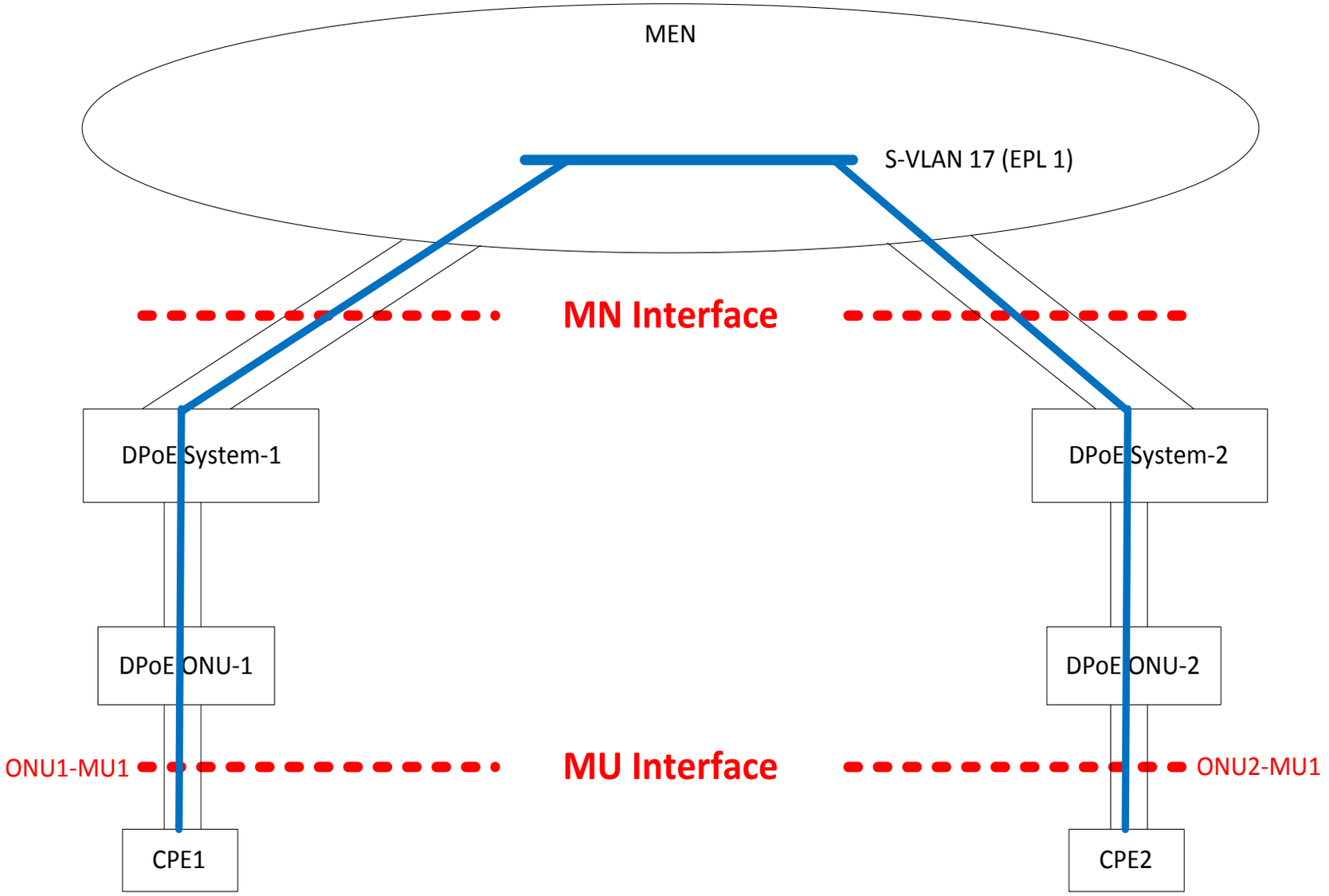
OSSI

Specifications for support of a subset of DOCSIS 3.0 OSSI functionality for DPoE with additional EPON requirements.

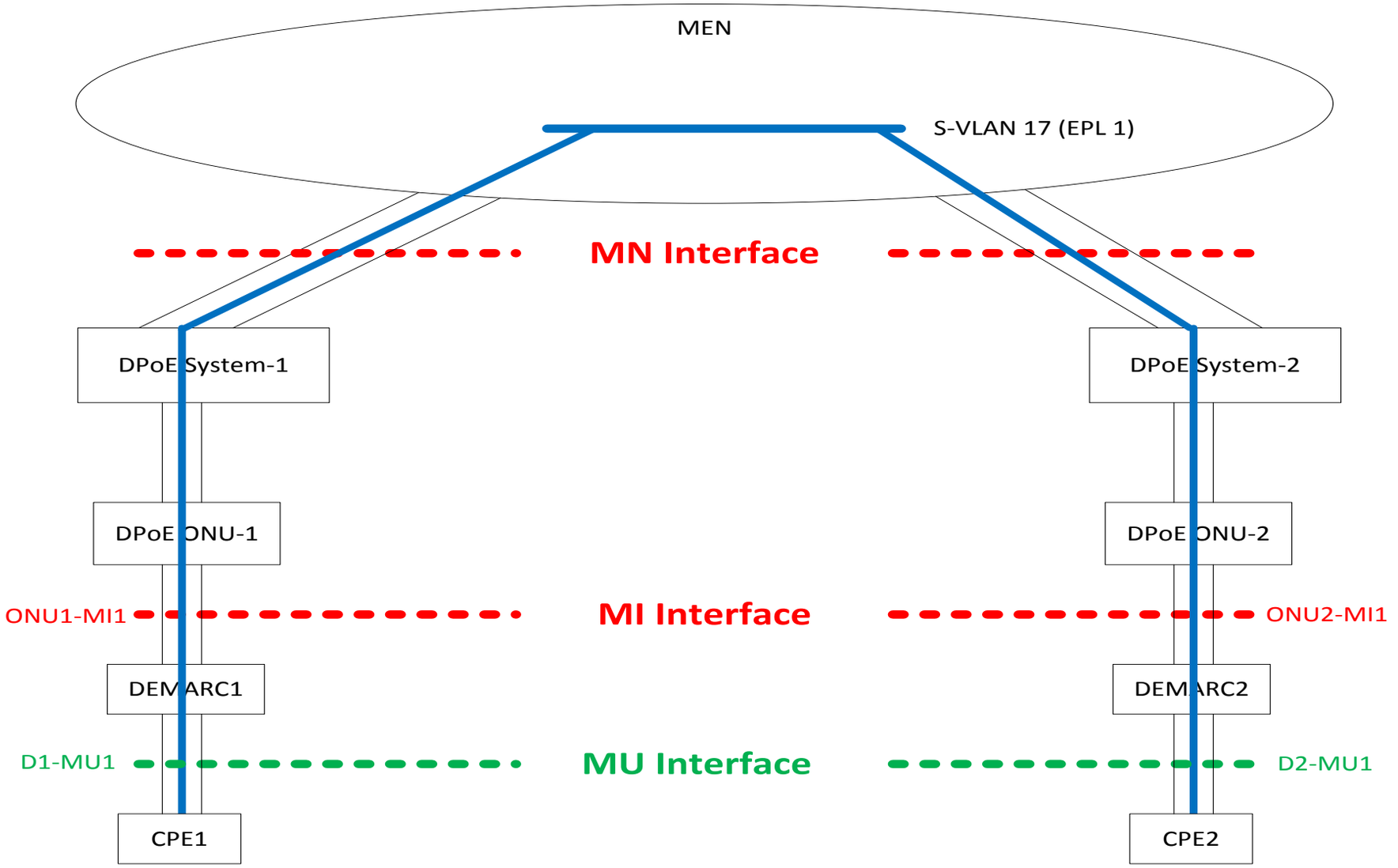
Goals of DPoE™ MEF Specification

- Describe existing DOCSIS [L2VPN] and generic provisioning parameters that can be used to provision MEF Ethernet service attributes and parameters in a DPoE Network.
- Specify additional provisioning parameters that do not exist in DOCSIS, and are required to support MEF EPL Ethernet services in DPoE Network.
  - Specify new TLVs to support the required encapsulation and classification
- Provide common provisioning model to support MEF services in DPoE Elements of various vendors.
- Support of MEF UNI and EVC Service attributes for EPL service.
- Specify DPoE Network (DPoE System and DPoE ONU) behavior to support encapsulation, classification and forwarding for [802.1ad] and [802.1ah] frames.
- Provides mapping of DOCSIS Traffic parameters to MEF BWP service attributes.

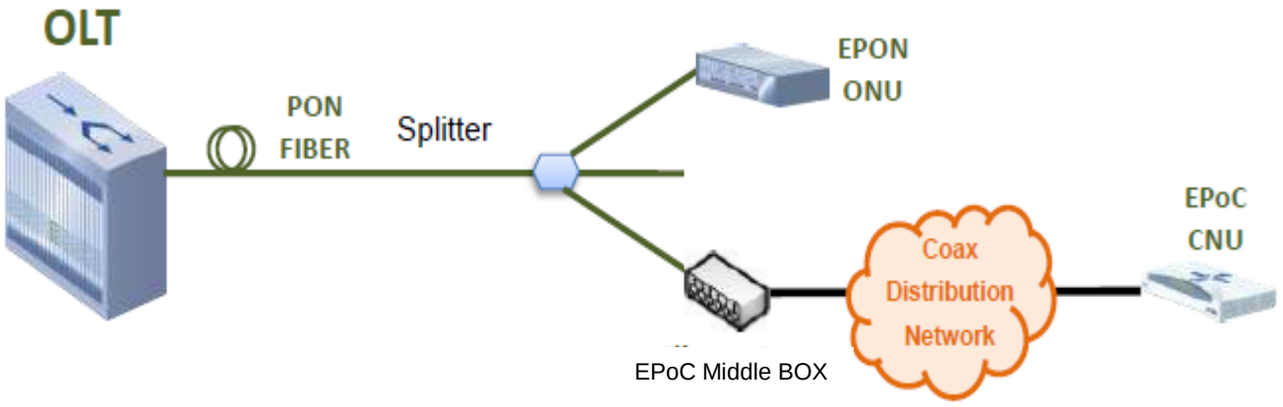
IEEE 802.1ad Support on MU interface



MI Interface in Transport Mode



EPoC Considerations



- CNU should perform the same ONU functions to support Carrier Ethernet Services.
- Based on the definition of EPoC middle “BOX”, future DPoE projects need to explore how EPoC fits into DPoE Architecture.
- Consider the QoS-Cost trade-offs to determine the traffic management features (if any) that this box needs to implement to support the QoS requirements of Carrier Ethernet services.
- Do we need OAM/MPCP extensions to support Carrier Ethernet services ?

Thank You

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