DPoE Support of Carrier Ethernet Services

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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.

![Diagram of EVCs multiplexed on a UNI](image)
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 jointly 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 service 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
- **E-Line (Point-to-Point EVC)**
- **E-LAN (multipoint-to-multipoint EVC)**
- **E-Tree (rooted multipoint EVC)**

#### Port-Based (All-to-One Bundling)
- E-Line
  - Ethernet Private Line (EPL)
- E-LAN
  - Ethernet Private LAN (EP-LAN)
- E-Tree
  - Ethernet Private Tree (EP-Tree)

#### VLAN-Based (Service Multiplexed)
- E-Line
  - Ethernet Virtual Private Line (EVPL)
- E-LAN
  - Ethernet Virtual Private LAN (EVP-LAN)
- E-Tree
  - Ethernet Virtual Private Tree (EVP-Tree)

#### 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 network
- 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 guidelines for defining marking and BWP and performance parameters for each class of service.

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

- 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-SP-IPNeEv1.0**
  - SSH/Telnet
  - TACACS+
  - RADIUS
  - HTTP
  - NTP
  - FTP/SFTP
  - TFTP
  - RSH
  - SNMP

- **OSS**

- **IP/Transport Network**

- **OLT**

- **DPoE System**

- **DOCSIS 3.0 Equivalent IP Service**

- **eSAFE SNMP**

- **eSAFE EVCs**

- **DPoE-SP-OAMv1.0**
  - EPON OAM + EPON OAM Extensions

- **EPON OAM**

- **Extended EPON OAM**

- **IEEE 802.3 (EPON)**

- **IEEE 802.3 Frame Labels**
  - 802.1 MAC
  - 802.1 q VLAN
  - 802.1ad or q-in-q
  - 802.1ah ISID or MAC-in-MAC

- **IEEE 802.1 Switch**

- **IEEE 802.1 Switch**

- **Mi MEF INNI**

- **S1 LCI**

- **CMCI**

- **MU**

- **MU DEMARC**

- **MN**
  - IEEE 802.3 MEF INNI L2VPN

- **Routing**
  - ARP
  - IS-IS
  - OSPF
  - MP-BGP

- **eSAFE SNMP**

- **External eSAFE SNMP**

- **External eSAFE CEs**

- **KEY**
  - Reference Point (GREEN)
  - Interface (RED)
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
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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