Standardized Carrier Ethernet Services for Optical Transport Networks

Carsten Rossenhövel

MEF EMEA Marketing Co-Chair
Managing Director, European Advanced Networking Test Center (EANTC)
Developing, Marketing and Certifying Standards for Carrier Ethernet Services since 2001

- Standards
- Operations
- Education
- Compliance

213 Members - 119 Service Providers - 40 Standards

689 Certified Products (54 CE 2.0) - 854 MEF CECPs
Ethernet Services Growth

- Total worldwide bandwidth purchased for Ethernet Services exceeds legacy since 2012
Carrier Ethernet Defined

The MEF has defined Carrier Ethernet as

A ubiquitous, standardized, carrier-class Service and Network defined by five attributes that distinguish it from familiar LAN based Ethernet.

Carrier Ethernet is often referred to in Enterprise circles as Ethernet Business Services.

The MEF is the industry’s defining body for Carrier Ethernet.
Retail and Wholesale Interconnect Business Services

• New Service Attributes Geared for Next Gen Applications

CE 2.0 for Mobile Backhaul

• Blueprint for 4G/LTE, Small Cell

Carrier Ethernet as Cloud Carrier

• Business-Class Cloud Services

... Driving Market Growth
Carrier Ethernet Service Types

Each Service Type Has a Port-Based and a Virtual Service

**E-Line (Point-to-Point)**
- Ethernet Private Lines (EPL)
- Virtual Private Lines (EVPL)
- Ethernet Internet Access

**E-LAN (Multipoint)**
- Multipoint L2 VPNs
- Transparent LAN Service
- Multicast Networks

**E-Tree**
- Rooted Multi-Point L2 VPNs
- Traffic Segregation
- EP-Tree, EVP-Tree

**E-Access**
- Wholesale Access Services
- Access EPL
- Access EVPL
Ethernet Wholesale Access Services

- Greatly simplifies buying & selling of wholesale Ethernet services
- Reduces time to contract from months to weeks
- Significant market differentiators for providers

Service Provider (buyer)
(Owns the customer relationship)

Access Service Provider (seller)
(Provides Wholesale Access to remote customer location)

Optional: Transit Provider (seller)
(Provides Segmented Wholesale Services)
MEF 33 Ethernet Access Services

E-Access: First Wholesale CE Service Type

Specified in MEF 33 based on ENNI (MEF 26)

Two Service Types:

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Port-Based Service (at the UNI)</th>
<th>VLAN-Aware Service (at the UNI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-Access</td>
<td>Access EPL</td>
<td>Access EVPL</td>
</tr>
</tbody>
</table>

Service Provider (Owns the customer relationship)
Access Service Provider (Provides Wholesale Access to remote customer location)

Ethernet Virtual Connection (EVC)
E-Access Benefits by Target Audience

• Wholesale Ethernet Access Providers
  – Standardizes first/last mile Ethernet access services
  – Leverages investment in existing footprint

• Retail Ethernet Service Providers
  – Minimizes quantity of custom interconnect agreements with Ethernet Access Providers
  – Reduces time to market

• End-Users
  – Makes it easier to reach more office locations using a single consistent Carrier Ethernet service
Carrier Ethernet provides consistent services delivered to users connected over the widest variety of access networks.
Carrier Ethernet Backbone Transport

- Carrier Ethernet services are agnostic to the underlying transport
- Typical Backbone Transports include
  - Carrier Ethernet over Provider (Backbone) Bridging
  - Carrier Ethernet over MPLS or MPLS-TP
  - Carrier Ethernet over SONET/SDH
  - Carrier Ethernet over Direct Fiber

![Diagram of Carrier Ethernet Network](image-url)
Ethernet Over Direct Fiber

**Longest Distance**
- Distance up to 50..80 km (not amplified)

**Highest Bandwidth Capacity**
- Bandwidth Capacity of 100 Mbps, 1 Gbps, 10 Gbps, 40 Gbps, 100 Gbps

**Security**
- Physically secure medium with no EMF emission; high effort required to tap lines

**Service Flexibility**
- High link capacity can be efficiently provisioned with rate limiting tiered services
- Network Interface Devices (NIDs) provide managed demarcation
- **Terabits per second per fiber pair in the optical domain:** Coarse-grain bandwidth (100 Gbit/s, 10 Gbit/s)
- **Gigabits per second in the packet domain:** Fine-grain bandwidth (10/1/0.1 Gbit/s)
- Multiple Ethernet virtual circuits are aggregated at the packet-optical network boundary
- WDM solutions extend to the metro aggregation today, requiring flexible packet-optical integration
MEF Specs Enable Multipoint Services

Point-to-Point Ethernet Services
- Port-based (EPL)
- VLAN-aware (AVPNs)

Multipoint Services
- Supported via tunneling and/or Ethernet-aware packet-optical switches
- E-LAN
- E-Tree (Point-to-Multipoint)

Wholesale Access Services
- Port-based (Access EPL)
- VLAN-aware (Access EVPL)
Manageable Multi-Class of Service Delivery

- MEF 23.1: Class-based performance requirements
- Easy to deliver tighter delay or delay range as well as low loss

<table>
<thead>
<tr>
<th>Performance Attributes</th>
<th>CoS Label H</th>
<th>CoS Label M</th>
<th>CoS Label L</th>
<th>Applicability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame Delay (ms)</td>
<td>≤ 10</td>
<td>≤ 20</td>
<td>≤ 37</td>
<td>At least one of either FD or MFD required</td>
</tr>
<tr>
<td>MFD (ms)</td>
<td>≤ 7</td>
<td>≤ 13</td>
<td>≤ 28</td>
<td></td>
</tr>
<tr>
<td>Inter-Frame Delay Variation (ms)</td>
<td>≤ 3</td>
<td>≤ 8 or N/S</td>
<td>N/S</td>
<td>At least one of either FDR or IFDV required</td>
</tr>
<tr>
<td>Frame Delay Range (ms)</td>
<td>≤ 5</td>
<td>≤ 10 or N/S</td>
<td>N/S</td>
<td></td>
</tr>
<tr>
<td>Frame Loss Ratio</td>
<td>≤ .01% i.e. 10-4</td>
<td>≤ .01% i.e. 10-4</td>
<td>≤ .1% i.e. 10-3</td>
<td></td>
</tr>
</tbody>
</table>
Fault Management, Performance Monitoring

- OTN-level OAM recommended for link monitoring
- Ethernet SOAM recommended for service and customer-level monitoring
- Monitor end-to-end connection per Class of Service

**Customer Premises**

**UNI**

**MSG**

**Operator ME**

**ENNI ME**

**Service Provider ME**

**ENNI**

**Carrier Ethernet Network**

**Retail Service Provider**

** wholesale/Access Provider**

**Carrier Ethernet Network**

**Operator ME**

**RESP**

**Customer Premises**

**UNI**
Summary

• Ethernet Access Services constitute now >50% of worldwide Access bandwidth

• MEF supports deployment
  – Professional education program
  – Equipment/services certification program

• Carrier Ethernet adds value to OTNs
  – Enabling advanced multipoint services
  – Creating a standardized wholesale access model
  – Allowing for strict SLAs through service-level fault management and performance monitoring
More at www.metroethernetforum.org