Introduction To Carrier Ethernet

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About EANTC

The European Advanced Networking Test Center offers vendor independent network quality assurance since 1991.

- Test and certification of network components for manufacturers
- Proof of concept evaluation, acceptance tests and network design consultancy for service providers and large enterprises
- Research and development of test methods and analysis tools
Agenda

- What is Carrier Ethernet?
- Current status of the technology
- Recent and future testing
- Q & A
What is Carrier Ethernet?

- Transparent business data service on the Ethernet layer
  - No Internet / IP routers involved
- User-Network Interface (UNI) standardized by the Metro Ethernet Forum (MEF)
- Point-to-point service: E-Line
- Multipoint service: E-LAN
Carrier Ethernet Justification

Carrier Ethernet one of the hottest topics in wireline and wireless backhaul networking in 2006

- Carriers seek for scalable and affordable solutions for Triple Play and business layer 2 services
- Many networks are upgraded after telecom investments were delayed in the early 2000’s
- “Carrier Ethernet” driven by strong marketing efforts
Carrier Ethernet Defined

- Carrier Ethernet is a ubiquitous, standardized, carrier-class SERVICE defined by five attributes that distinguish Carrier Ethernet from familiar LAN based Ethernet
- It brings the compelling business benefit of the Ethernet cost model to achieve significant savings

Carrier Ethernet Attributes:
- Standardized Services
- Scalability
- Service Management
- Reliability
- Quality of Service

Source: Metro Ethernet Forum
Services And Applications

Residential Triple Play:
- Video requires huge bandwidth scalability, multicast replication
- Voice requires application-specific traffic prioritization, low latency, intelligent filters
- Data requires queue-in-queue encapsulation, MAC address scalability

Business applications:
- Multipoint (E-LAN) requires suitable network service
- Multicast, QoS also used
Carrier Ethernet Access Expansion

- Internet
- HD TV
- Gaming, Business
- Voice/Video
- Voice/Video Telephony gateway
- Video Source
- Video Source
- Global/National Carrier Ethernet
- Metro Carrier Ethernet
- Access Carrier Ethernet
- E-Line and E-LAN service
- Business Broadband
- E-Line and E-LAN service
- Metro Carrier Ethernet
- Access Carrier Ethernet
- Copper, Fiber, EPON, Wireless, Coax Cable
- Residential Triple-Play
- Small/Medium Business
- FTTx, DSLAM, Cable Modem
- Broadband mobile data/video
- Source: Metro Ethernet Forum
- Source: Metro Ethernet Forum
- European Advanced Networking Test Center

Source: Metro Ethernet Forum
Status of Standardization

Can standardization keep pace with demand?

- IEEE 802.1 / 802.3 Committees
- Metro Ethernet Forum (MEF)
- ITU NGN Focus Group

Protocols / Services Yet To Be Standardized

- Provider Bridges
- Operation, Administration & Maintenance (OAM)
- Network-Network Interface (E-NNI)
Source: Metro Ethernet Forum
# Ethernet Standards Overview

<table>
<thead>
<tr>
<th>Standards Body</th>
<th>Ethernet Services</th>
<th>Architecture/Control</th>
<th>Ethernet OAM</th>
<th>Ethernet Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>IEEE</td>
<td>-</td>
<td>802.3 – MAC</td>
<td>802.3ah – EFM OAM</td>
<td>802.3 – PHYs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>802.3ar – Congestion Management</td>
<td>802.1aq – CFM</td>
<td>802.3as - Frame Expansion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>802.1D/Q – Bridges/VLAN</td>
<td>802.1AB - Discovery</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>802.17 - RPR</td>
<td>802.1ap – VLAN MIB</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>802.1ad – Provider Bridges</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEF</td>
<td>MEF 10 – Service Attributes</td>
<td>MEF 4 – Generic Architecture</td>
<td>MEF 7 – EMS-NMS Info Model</td>
<td>MEF 13 - UNI Type 1</td>
</tr>
<tr>
<td></td>
<td>MEF 3 – Circuit Emulation</td>
<td>MEF 2 – Protection Req &amp; Framework</td>
<td>MEF 15 – NE Management Req</td>
<td>MEF 16 – ELMI</td>
</tr>
<tr>
<td></td>
<td>MEF 6 – Service Definition</td>
<td>MEF 11 – UNI Req &amp; Framework</td>
<td>OAM Req &amp; Framework</td>
<td>E-NNI</td>
</tr>
<tr>
<td></td>
<td>MEF 8 – PDH Emulation</td>
<td>MEF 12 - Layer Architecture</td>
<td>OAM Protocol – Phase 1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>MEF 9 – Test Suites</td>
<td></td>
<td>Performance Monitoring</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Services Phase 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G.8011.2 – EVPL Service</td>
<td>G.8010v2 – Layer Architecture</td>
<td>G.8031 – Protection</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G.asm – Service Mgmt Arch</td>
<td>G.8021v2 – Equipment model</td>
<td>Y.17ethqos – QoS</td>
<td></td>
</tr>
<tr>
<td></td>
<td>G.smc – Service Mgmt Chnl</td>
<td>Y.17ethmpls - ETH-MPLS Interwork</td>
<td>Y.ethperf - Performance</td>
<td></td>
</tr>
<tr>
<td>TMF</td>
<td>-</td>
<td>-</td>
<td>TMF814 – EMS to NMS Model</td>
<td>-</td>
</tr>
</tbody>
</table>

Source: Metro Ethernet Forum
Ethernet in the First Mile

Maximum Bandwidth (Symmetric)

- **10Gbps**
  - 10GbE
  - 1000BASE-T (Cu Cat5)
  - 1000BASE-PX20
  - 1000BASE-LX (SMF)
  - 1000Base B/L/PX10

- **1Gbps**
  - 1000BASE-T (MMF)
  - 1000BASE-LX (SMF)

- **100Mbps**
  - 100BASE-T (Cu Cat 5)
  - 100BASE-FX (MMF)
  - 100Base-L/BX10 (Single Mode Fiber)

- **10Mbps**
  - 10BASE-T (Cu Cat5)

- **2Mbps**
  - 10Pass-TS (VDSL)
  - 2Base-TL (SHDSL)
  - Bonded Pairs

Minimum Reach

- 100m
- 500m
- 750m
- 2000m
- 2700m
- 5000m
- 10km
- 20km

Source: Actelis

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Metro Ethernet Access
Copper, Fiber and Wireless Access Complement Each Other

- Business HQ
- SME Customer
- ISP
- Branch office
- College
- Elementary School

WAN
Metro Ethernet, SONET/SDH, ATM

Source: Hatteras Networks
**Ethernet OAM Standards**

- **MEF & ITU Y.1731**
  - 802.1aj demarcation device
  - Service Layer OAM (UNI to UNI)

- **IEEE 802.1ag, MEF & ITU Y.1731**
  - Connectivity Layer OAM

- **IEEE 802.3ah**
  - Access Link OAM
  - Access Link OAM

Source: Adva Optical

European Advanced Networking Test Center
First Mile Ethernet OAM Features

- OAM – Operation Administration & Maintenance – tools for:
  - Installation
  - Monitoring
  - Fault Detection
  - Diagnosing Faults
  - Collecting Statistics

- Goal
  - Minimize cost of network operation / ownership
  - Maximize revenue – control / report of SLA

Source: Metro Ethernet Forum
Relevance of Carrier Ethernet Testing

Will implementations be compliant soon?

- Many more vendors than in the router market
- Diverse markets (core, aggregation, DSLAMs, CPEs, …)
- Different service provider architectures

Carrier Ethernet Testing is key to increase product quality and service provider confidence
Current Areas of Testing

Carrier-Specific Ethernet Test Areas:

- L2 Scalability to many 10,000 customers in an Ethernet cloud
- Interfacing with core / aggregation networks (MPLS, IP)
- Protection and High Availability
- Security (Denial of Service attacks)
- User-Network Interface (facing CPEs)
- Multicast performance both for Triple Play and business VPN services
- Service Level Management (QoS, DiffServ)
- Provisioning, Network Management
Multi-Vendor Interop Testing

Organized by

Hosted by

Carrier Ethernet
WORLD CONGRESS 2006

Madrid, Sept 25-29, 2006

- Naturally: Improve Multi-Vendor Interoperability
- Validate New Carrier Ethernet Standards
- Demonstrate Sample Network Design
Hotstaging

- Extensive tests conducted at EANTC in Berlin Sept 6-15
- Verified end-to-end interoperability under NDA
- With on-site support from all participating vendors
- Service provider support
  - T-Systems (on-site)
  - COLT (test plan review)
Some Figures ...

- 50+ devices
- 30 kVA power
- 300 network links from E1 to 10GigE
- 3 months preparation
- 8 days of testing
- 53 engineers
- 3.5 tons of equipment shipped
- 175 liters coffee

See Video at http://www.eantc.de/cewc2006
Network Topology

Transport Technologies
- MPLS
- VLAN-based Ethernet
- Provider Bridges
- Provider Backbone Bridges
- Ethernet over RPR and Wireless (RWPR)
- Ethernet over SDH Rings
- Ethernet over E1
- Ethernet over Copper
Results Highlights

E-Line Service Performance
- Zero packet loss throughout the whole network
- Less than 1 ms end-to-end frame delay (7+ GigE hops)
- Bandwidth Profiles widely implemented, enabling and enforcing service levels at the edge

MPLS Services
- 7 devices implemented point-to-point and multipoint services
- Few issues seen; mature technology
Results Highlights (2)

First Ethernet OAM
Multi-Vendor Tests, Worldwide

1. Physical Layer OAM
   (IEEE 802.3ah)
   ➢ “Dying Gasp” Message

2. VLAN-based OAM
   (IEEE 802.1ag Draft 7)
   ➢ Continuity Check
Carrier Proof of Concept Tests

Carrier Ethernet architectures are complex

- In fact these are “multi-service” networks
- Coexistence of residential / business services with guaranteed service levels is challenging
- Some Ethernet products have an Enterprise heritage

Example: EANTC Ethernet switch proof of concept test
Performance Tests

Carrier Ethernet imposes new scalability, performance, security challenges

Typical issues:
- Cannot learn Ethernet addresses fast enough
- MAC address table too small
- Does not master MAC flooding and hijacking attacks
- Throughput depends on % of mcast/bcast traffic
- QoS implementations not easy to configure, different philosophies / hardware support
- ...
Outlook

- Carrier Ethernet has a great future because it is a service-based idea – not limited to Ethernet transport.

- Stringent Network-Network Interface (NNI) specifications are required to achieve performance and interoperability goals.

- Further scalability, protection and multicast testing required in the future.
Thank you for your interest!

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