Update about the work of the Metro Ethernet Forum

Highlighting the Mobile Backhaul Project and EANTC Interoperability Testing

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Agenda

• MEF & Carrier Ethernet - Global Market Update
• Current and Upcoming MEF Specifications
• Business Drivers for Carrier Ethernet
• Current Project: E-NNI
• Current Project: Mobile Backhaul Initiative
• State of the art revisited – EANTC mobile backhaul interoperability event
Worldwide Business Ethernet Services

Worldwide revenue for Business Ethernet Services mounts steadily to nearly $31 billion by 2012.

- Robust growth of enterprise customer demand worldwide projected
- Regional differences in coverage and predominant type of access (copper, fiber, wireless)
- Service providers committed to Ethernet as the future ubiquitous standard for packet network service *connectivity*

Top challenges:
- Progress of standardization
- Availability of appropriate last mile access
MEF Mission & Key Areas of Work

Accelerate the worldwide adoption of Carrier Ethernet networks and services

Specifications and Liaisons

Marketing Carrier Ethernet

Certification Program
Business Drivers for Carrier Ethernet

• Top Enterprise Market Sectors
  • Healthcare, finance, education, government, media

• Principal Applications
  • Site-to-Site access, server consolidation, business continuity, disaster recovery, software as a service, service orientated architecture, Internet access, converged networking

• Benefits
  • Scalability, ubiquity, unprecedented reach, control, reliability, performance, data center & server consolidation, bandwidth on demand, expedites and enables new applications, predictability and risk reduction

• Cost reduction, revenue acceleration
Carrier Ethernet Defined

Carrier Ethernet is:

A ubiquitous, standardized, carrier-class service

Defined by **five attributes** that distinguish it from familiar LAN based Ethernet
Standardized Services

E-Line
Point-to-point EVC,
Like Duplex Ethernet

E-LAN
Multi-Site
Multipoint EVC,
Like VLAN, Any-to-any

E-TREE
Rooted Multipoint
(proposed)
Point-to-multipoint,
Like EPON Ethernet,
Root-to-Leaf and Leaf-to-Root
Approved MEF Specifications

- MEF 2 Requirements and Framework for Ethernet Service Protection
- MEF 3 Circuit Emulation Service Definitions, Framework and Requirements in Metro Ethernet Networks
- MEF 6 Metro Ethernet Services Definitions Phase I
- MEF 7 EMS-NMS Information Model
- MEF 8 Implementation Agreement for the Emulation of PDH Circuits over Metro Ethernet Networks
- MEF 9 Abstract Test Suite for Ethernet Services at the UNI
- MEF 10.1 Ethernet Services Attributes Phase 2*
- MEF 11 User Network Interface (UNI) Requirements and Framework
- MEF 12 Metro Ethernet Network Architecture Framework Part 2: Ethernet Services Layer
- MEF 13 User Network Interface (UNI) Type 1 Implementation Agreement
- MEF 14 Abstract Test Suite for Traffic Management Phase 1
- MEF 15 Requirements for Management of Metro Ethernet Phase 1 Network Elements
- MEF 16 Ethernet Local Management Interface
- MEF 17 Service OAM Framework and Requirements
- MEF 18 Abstract Test Suite for Circuit Emulation Services
- MEF 19 Abstract Test Suite for UNI Type 1

* MEF 10.1 replaces and enhances MEF 10 Ethernet Services Definition Phase 1 and replaced MEF 1 and MEF 5.
E-NNI Specification

Editor: Steve Holmgren, at&t

- Nobody has footprint everywhere. The interconnection of Carrier Ethernet networks is one of the last hurdles for ubiquitous Ethernet services
- Need a common language for peering
- E-NNI is a reference point representing the boundary between two Carrier Ethernet Networks, each in a different administrative domain
- Draft # 4 is the latest version; many comments pending
Carrier Ethernet for Mobile Backhaul

A new MEF initiative that merges mobile backhaul and wire-line infrastructure into a single network
Mobile Backhaul Has Dynamic Growth …

• New mobile applications and bandwidth growth
  (>100% in 2008 with much more to come)

Legacy TDM

Movies, music, news, more
music, text, web, more content ..
Industry Trends

• Rapidly growing demand for bandwidth:
  – HSDPA
  – Data flat rates
• Search for next-generation backhaul technologies
  – Scalable
  – Reducing operational expenditure
  – Widely available
• Evolution towards Ethernet/IP packet based mobile solutions

Source: Light Reading
Mobile Backhaul Implementation Agreement

- Defines how to apply MEF standards to create next-gen, standards-based mobile backhaul solutions

- **UNI Requirements**
  - Ethernet OAM (Link OAM and Service OAM)
  - Protection and Fault Recovery Requirements

- **Service Requirements**
  - CoS Requirements
  - Service Definitions
  - Synchronization
A view of today

- Legacy = “non-packet RAN” and “non-packet transport”

Scalability and TDM/ATM line cost issues
Migration Step 1 – RAN Dual stack

- RAN nodes are equipped with Ethernet and legacy interfaces
- Overlay legacy network transport voice and delivers sync; MEN is used for bandwidth offloading
Migration Step 2 – TDM/ATM Emulation

- RAN nodes with legacy interfaces transport all traffic over Ethernet services using emulation technologies
Migration Step 3 – Full Ethernet

- New RAN nodes with native Ethernet interfaces
- All traffic is transported over Ethernet services
Wireless Evolution

RAN evolves towards IP; Backhaul evolves towards Ethernet
Interoperability Event Goals

Progress Multi-Vendor Interoperability of Carrier Ethernet Services

- Develop confidence that Carrier Ethernet is suitable for mobile backhaul
- Industry-First: Demo converged 2G/3G services across a multi-vendor Carrier Ethernet network, using MEF services
- Showcase a viable (scalable/resilient) migration path from TDM, ATM to Carrier Ethernet backhaul
Challenges

85 devices from 15 vendors – 7 tons of equipment
Challenges

45 Kilowatts of electrical power
Challenges

Some equipment did not survive the forklifting …
Hotstaging

- At EANTC, Berlin, Germany – January 2008
- Extensive end-to-end interoperability tests
- On-site support from all 15 vendors (50+ engineers)
- Supported by T-Systems, UNH-IOL
- Under Non-Disclosure Agreement
“Hot-staging and Showcases”

Joint Hot-staging

Showcases

- **MPLS & Ethernet World Congress, Paris, France**
  Feb 5-8, 2008

- **Mobile World Congress, Barcelona, Spain**
  Feb 11-14, 2008

- **CTIA Wireless Las Vegas, USA**
  Apr 1-3, 2008
Network Topology

MULTI-VENDOR MOBILE BACKHAUL INTEROPERABILITY EVENT 2008
Physical Network Topology
Circuit Emulation Services

- Three deployment scenarios
  - CES in access
  - CES in Metro
  - Inter-Domain CES

- Five interoperability test cases successfully tested, seven single vendor demonstrations
  - TDM (MEF 8)
  - TDM/ATM Circuit Emulation (AToM (RFC4717))
  - SAToP (RFC 4553)
**Synchronization**

Types of sync
- Frequency
- Phase
- Time

Multiple different methods
- Outside of MEN (GPS etc., out of scope)
- Packet based (In scope for Phase 1)
- Synchronous Ethernet (Outside of scope for Phase 1)

Current MEF approach
- References G.8261
- Focus of Phase 1 on packet based timing methods
Clock Synchronisation Tests

- Adaptive Clocking
  - Telco Systems and MRV (derived TDM line timing)
  - Cisco and RAD
- Synchronous Ethernet & Adaptive Clocking
  - Huawei demonstration
- External TDM Reference Clock
  - Nortel and Nokia Siemens Networks
  - Nortel and RAD
- Differential Clocking
  - IEEE 1588v2 (Alcatel-Lucent demo)
- Internet-based, NTPv3 (Ericsson)
- Measured frequency deviation was <16 ppb
Demo – Mobile Applications

- Metro A
- Metro B
- Metro C
- Backhaul
- Aggregation
- Access
- PSTN
- IMS
- Internet
- BTS/Node B
- Internet
Mobile Application Demos

- Nokia Siemens Networks
  - WCDMA packet based mobile backhaul
  - ATM CES on the NSN Base Station and Nortel MSS 15000
  - External Reference Clock
  - Very accurate clock on the base station

- Ericsson
  - GSM packet based mobile backhaul
  - Abis over IP interface
  - NTPv3 clock synchronisation
  - Very accurate clock on the base station
MPLS Aggregation

- Seven vendors participated
- VPLS instance connected to core backbone via Provider Bridges (802.1ad)
- LDP signaling, OSPF and IS-IS dynamic routing
T-MPLS (Transport MPLS)

- Five participants
- 90 TMPs (T-MPLS Paths) established
- 100 TMCs (T-MPLS channels) established
- Manual configuration
- Minor interop issues: Different label ranges used for TMPs/TMPs, corrected by negotiation
PBB-TE (Provider Backbone Bridges – Traffic Engineering)

- Five participants
- 40 trunks established
- Manual configuration
- CFM interoperability issues due to different implementations of the standard; partly resolved
Transport Resiliency Tests

MPLS
- Dual-homed VPLS MTUs
  - Service interruption under 10 ms
- Ring protection with fast reroute extending to access
  - Service interruption under 85 ms

T-MPLS
- 1:1 T-MPLS Path protection with and without APS
- 1+1 Protection
- Service interruption under 40 ms

PBB-TE
- No interoperability achieved
Connecting Administrative Domains

- MPLS in the Core
  - Interconnecting the three metro clouds
- LDP-VPLS, pseudowires
- Separate administrative domains in the three metros and core
- Interfaces to metro clouds:
  - Stitched pseudowires (T-MPLS)
  - 802.1ad Provider Bridging (MEF E-NNI Predecessor)
Ethernet Service OAM

End-to-end OAM verification
- Continuity Check
- Loopback / Ethernet Traceroute
- Y.1731 Performance monitoring (FD, FDV, FLR, Availability)

Interoperability improved
- Same Ethertype supported by all participants
- Configurable CCM intervals
Diverse Access Technologies

Fiber
- Gigabit, Fast Ethernet FTTx attachment circuits

Copper
- Ethernet over concatenated PDH lines (n x E1)

Microwave
- Directional microwave links carrying Ethernet traffic at 500 Mbit/s
Conclusions

- 15 vendors interoperated end-to-end across multiple transport technologies!
- Verified a wide range of TDM/ATM circuit emulation solutions, evaluated clock sync in some combinations
- Resilience showed < 50 ms in all combinations tested
- Great progress in a very complex environment!
More Details?

Detailed, independent EANTC White Paper

→ Download from http://www.eantc.de/mobile_backhaul
Thank You For Your Interest!

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