Examining the Practicality of Ethernet for Mobile Backhaul Through Interoperability Testing

Carsten Rossenhövel, Managing Director

European Advanced Networking Test Center
EANTC Introduction

Providing independent network quality assurance since 1991

- Test and certification of network components for manufacturers
- Network design consultancy and proof of concept tests for service providers
- Request for Proposal (RFP) support and life cycle testing for large enterprises and government organizations

EANTC Berlin, Germany
Agenda

- Opportunities and challenges
- Gauging the state of the art
- Mobile backhaul relevant interop test areas
  - ATM pseudowires, TDM circuit emulation
  - Clock synchronization – packet- and network-based
  - Inter-carrier connectivity
  - IPv6 VPNs
- Outlook
“Average cell site traffic will be 25 Mbit/s by 2012 ... legacy technology can’t scale”

Michael Howard, principal analyst at Infonetics Research
Projected Cell Site Migration Towards Ethernet

Source: New Paradigm Resources Group
The Converged Network Vision

Consumer triple play
+ business services
+ mobile backhaul

Across a single,
converged network

Additional revenue
opportunity for fixed
network operators (?) (!)
Mobile Backhaul Migration to MPLS and Carrier Ethernet – Coverage

Carrier Ethernet services available virtually anywhere using diverse access technologies

- User to Network Interface (UNI)
- ATM, TDM Tunnel Termination (where required)
Ethernet Backhaul Challenges

Operational experience
- Can I rapidly isolate a fault?

Clock Synchronization
- How do I accurately time my Radio interface?
- How do I ensure seamless call handover?

Reliability and availability
- Are the network controller connections highly available?

Support for legacy and future generations
- How will I support multiple generations of radio technology?
Ethernet Backhaul Test Areas

Operational experience
- Ethernet OAM (IEEE 802.1ag, 802.3ah; ITU-T Y.1731)

Clock Synchronization
- Packet-based sync (adaptive clock, IEEE 1588, NTP?)
- Network-based sync (Sync Ethernet, NTR, microwave)

Reliability and availability
- Global protection using backup paths; MPLS fast reroute

Support for legacy and future generations
- ATM pseudowires, TDM circuit emulation (legacy)
- E-Line (pseudowires), E-Tree (VPLS) (future backhaul)
Packet Backhaul Technologies Mapped To Gartner Hype Cycle – Personal View

- LTE Backhaul
- Sync Ethernet
- IEEE 1588v2
- Performance Monitoring Y.1731
- OAM IEEE 802.1ag
- TDM Circuit Emulation
- E-NNI
- ATM Pseudowires

Technology Trigger, Peak of Inflated Expectations, Trough of Disillusionment, Slope of Enlightenment, Plateau of Productivity
MPLS and Ethernet World 2009 Interop
Event: Participating Vendors

- Alcatel-Lucent
- Corrigent Systems
- SPIRENT Communications
- BROCADE
- ERICSSON
- Telco Systems
- Calnex Solutions
- HUAWEI
- RAD
- IXIA
- NEC
- celtro
- MRV
- Redback Networks
- UTSTARCOM

European Advanced Networking Test Center
Y.1731 Performance Monitoring Tests at MPLS World Congress 2009

- Important when outsourcing the mobile backhaul network; validates SLAs
- Growing number of implementations (10 tested)
- Artificial loss, delay, delay variation inserted by impairment generators
- Generally, high degree of accuracy – much improved since last test
Test Area: Mobile Backhaul – TDM Circuit Emulation

Used for E1 connections between GSM base stations and controllers

Five alternative solutions tested:
1. IETF MPLS SAToP (4 vendors)
2. IETF IP SAToP (2 vendors)
3. MEF 8 Structure Agnostic (4 vendors)
4. MEF 8 Structure Aware (3 vendors)
5. IETF MPLS Structure Aware (3 vendors)

Adaptive clock synchronization tested (one combination under emulated network conditions, back-to-back otherwise)
Test Area: Mobile Backhaul – ATM Pseudowires

Used for E1 connections between 3G base stations and network controllers
- ATM transport over MPLS (RFC 4717)
- Clock sync external (IEEE 1588v2)
Findings:

- Twelve multi-vendor test combinations
- Standard defines a number of options; some interop issues in option support:
  - Cell concatenation mode (multiple cells per PDU)
  - “N-to-1” mapping of ATM channels into a single pseudowire
  - Penultimate Hop Popping (PHP, one MPLS label)
- 100% interoperability successfully achieved on minimum subset support level
State of the art and challenges of clock synchronization over Carrier Ethernet

Packet based solutions:
- Multiple technologies (adaptive clocking, IEEE 1588v2) developed – extensive lab testing activities going on
- Performance threat: Network delay and delay variation at the same order of magnitude as clock wander and jitter
- Control end-to-end packet network QoS - finally use differentiated quality for clock, voice, data

Network synchronous solutions:
- Synchronous Ethernet support slowly growing
- Not influenced by network load conditions
- Hop-by-hop support required

Combination of methods expected in the future, using transparent boundary clocks
Test Area: Clock Synchronization (Precision Time Protocol IEEE 1588-2008)

Several implementations – option support varies:

- Some vendors support multicast, some unicast transport of clock messages
- Two clock options: one-step and two-step
- Sync messages rate range support varied: 1-32, 32-128, 100-1000 per second
- Limited interoperability already achieved in our early tests
Test Area: Synchronous Ethernet

- First time successful public multi-vendor testing at this year’s interop event
- Test system measured wander of sync messages
- Requirements for frequency synchronization quality met by all vendors
Inter-Provider Peering Solutions – Important For Mobile Backhaul?

- Base station to network controller connections are regional!
- NNI will improve coverage, open market to small local SPs
- Mobile operators benefit by centralizing services
Inter-Provider Peering Solutions

State of the art:
- Carrier Ethernet E-NNI stuck in standardization
- Provider Briding-based interconnection ("Q-in-Q") are standard today

Growing SP interest in advanced MPLS interconnections, improving service and reducing provisioning effort
- Multi-segment pseudowires
- End-to-end MPLS pseudowires
- Mutual understanding of level of trust required!

QoS awareness required
- Service Level Agreements across service providers
Test Area: Inter-Carrier MPLS Interconnectivity

Three standardized alternatives tested:

- Option A – Treat opposite carrier like a customer
- Option B – Build separate service segment between providers, stitch three segments together
- Option C – Single, dynamic end-to-end service

From A to C: Operational efficiency increases, privacy decreases

Lab facilitated end-to-end testing
Service providers have growing interest in providing IPv6 services:

- Continues to use IPv4 in the backbone
- Implementation similar to standard IP VPN; new IPv6 family defined
- Successfully tested IPv6 service with three router vendors
Summary

Interoperability testing helps to:

- Validate new protocols, create confidence
- Improve quality of individual implementations
  (Majority of SP networks are multi-vendor today)

Outlook

- EANTC will focus interop testing for LTE backhaul and increase coverage of clock sync
- Individual performance & scalability PoC tests (vendor-and service provider-driven) upcoming
Thank you!

For further information, please visit the live interoperability event at the congress or download the white paper: http://www.eantc.com/mplsewc2009

Carsten Rossenhoevel
EANTC AG, Berlin, Germany
Phone: +49.30.318 05 95-0
E-mail: cross@eantc.de