Connection-oriented Ethernet (COE)

Combining the Reliability, Performance, and Security of SONET with the Flexibility and Efficiency of Ethernet
Topics

- Just what is connection-oriented Ethernet (COE) anyway?
  - Fundamental attributes
  - Key technologies
  - Basic value proposition

- The value of integrating COE with optical networking
  - Packet Optical Networking

- How is COE creating business opportunities in metro networks?
  - Mobile backhaul
  - DSLAM backhaul
  - Wholesale and retail Ethernet services
Connection-Oriented Ethernet: Carrier Ethernet with Traffic Engineering

- Explicit forwarding of Ethernet connections & tunnels
  - Forward on tags
  - vs. connectionless MAC address learning and flooding
  - vs. Layer 1 forwarding

- Resource reservation and admission control
  - For each CoS instance, EVC, tunnel
  - Per-flow queuing / traffic engineering
  - vs. simple priority queuing

- Connection-oriented Ethernet
  - Explicit data path

- Traditional Ethernet “switching”
  - Plug n’ play

- Connection-oriented Ethernet
  - Per flow queuing
    - Scheduler sees each EVC
    - Deterministic performance

- Traditional Ethernet “switching”
  - Priority queuing
    - Scheduler sees the Queue
    - Statistical performance
Attributes of Connection-oriented Ethernet

Standardized Services
- MEF 6.1 EPL, EVPL Services
- MEF 10.2 Service Attributes

Deterministic QoS
- Lowest Delay, Delay Variation, Loss
- Bandwidth Resource Reservation
- Connection Admission Control

Ethernet OAM
- 802.3ah Link Fault Management
- Y.1731 Service Fault Management

Scalability
- Layer 2 Aggregation
- Statistical Multiplexing
- Tag Swapping/Reuse

Network Protection
- G.8031 50ms EVC Protection
- 802.3ad UNI & ENNI Protection

Security
- Bridging disabled-MAC DoS attacks mitigated
- Completely Layer 2 - no IP vulnerabilities

Connection-oriented Ethernet: More than just a protocol…
The Best of Both Worlds

**Connectionless 802.1 Ethernet Bridging**
- Good Aggregation / Stat Muxing
- Non-deterministic QoS
- Long (>200ms) protection times

**Ethernet over SONET/WDM**
- No Aggregation /Stat Muxing
- Deterministic QoS
- Short (<50ms) protection times
- Security

**Connection-Oriented Ethernet**
- Ethernet aggregation and stat muxing
- Highest EVC quality
- 50ms protection speed
- Precision OAM
- Security

**SONET quality, security, availability – Ethernet flexibility and efficiency**
Connection-Oriented Ethernet (COE) NGN Metro Infrastructure and Ethernet Services

- First general purpose Ethernet Infrastructure
  - A single investment for all applications
  - Deterministic foundation
  - Ethernet aggregation for efficiency

- High-value Ethernet connectivity and backhaul services

- Key applications
  - Mobile Backhaul
  - Enterprise site to site services
  - Retail Ethernet access services
  - Wholesale interconnection services
  - DSLAM Backhaul

COE does for Ethernet what SONET did for DS1/DS3

COE is the foundation of Metro NGN Networks / Services
Ethernet-Centric COE
Simplest COE for Metro

- **One Layer to manage**
  - Ethernet
- **Scalable through reusable tags**
- **One OAM method** (802.1ag/Y.1731)
- **One protection method** (G.8031)
- **Management plane approach**

- **Three Layers to manage**
  - Ethernet, MPLS PW, MPLS LSP
- **Multiple OAM methods**
- **Complex protection**

*Ethernet-centric COE results in simplest and lowest cost metro operations*
Packet Optical Networking: Integrating COE and Layer 1 Optical Networking

- "Open Platform" implementation
  - Pluggable open /interworking environment
  - Vs. discrete functions that live under a specific technology “roof”
    - Like packet on a blade in a ROADM
- Widest range of application and flexibility in network evolution

- COE + complete layer 1 networking
  - SONET, PDH, OTN, Lambda, Ethernet
  - Provisioned connections vs. dynamic IP control plane

- Brownfield optical network is an asset
  - ~100,000 nodes can feed COE services

- Builds the NGN network

Joining the Existing Network and the Next Generation Network
Backhaul Provider Challenges

- **COE is required for 3G and 4G backhaul**
  - Ethernet for economical bandwidth
  - Connection-oriented Ethernet for loss, latency, jitter performance
    - Performance is too stringent for connectionless Ethernet

- **T1 transport is required**
  - ¾ of cell sites have 2G, 3G, 4G mix

- **Leveraging existing assets**
  - Many sites served by MSPP equipment now
  - T1 over SONET is tariffed and operationalized

- **Minimizing access costs**
  - Serving multiple operators with a single solution
  - Keep backhaul simple and familiar

**Mobile Operator Ethernet Performance Requirements**
- < 5ms latency
- < 1ms jitter
- < 10-6 packet loss

**Cell Sites by RAN (Worldwide 2010-2012)**
- Multi-Ran - 73%
- 3G-only - 11%
- 2G-only - 13%
- 4G-only - 3%

Source: Infonetics. August 2009
Case Study: Full Service Mobile Backhaul

- COE uniquely addresses emerging 3G/4G Ethernet needs
  - Connection performance with Ethernet aggregation

- SONET integration for existing T1 backhaul
  - Native TDM backhaul for multi-provider, multi-RAN sites
  - No new sync technology, no staff retraining, no new SLAs, no new troubleshooting

- Maximizes use of existing assets
  - Existing MSPPs with EoS
  - Add COE units to existing MSPP chassis – Micro Packet ONP
  - Packet ONP is a flexible anchor point to build out new fiber to greenfield sites

Single architecture for emerging and existing services
Case Study: DSLAM Backhaul and Wholesale Access

- Mix of DSLAM backhaul required
  - Legacy DSLAMs - ATM over DS3
    - Requires SONET backhaul
  - New EoCu DSLAM deployments
    - Requires Ethernet Backhaul

- Packet Optical COE Infrastructure
  - Single network for all needs
  - High quality Connection-oriented Ethernet backhaul connections
    - Underpins all services
    - Provides broad-scale aggregation vs. EoS
    - Presents a standard ENNI to partners

Evolve to new EoCu DSL services while cost effectively servicing existing subscribers
Wholesale and Retail Ethernet Services

- **Decouples Ethernet service from the underlying network technology**
  - One COE service – any access
  - One end user, one service, different access

- **Increases the addressable end-users**
  - Embedded networks / off-net can get COE services

- **Increases the service velocity**
  - No specialized overlay

- **Enables wholesale interconnection services**
  - Delivers standard R-UNI and ENNI

- **Simplifies Ethernet access network**
  - Single elements at hub and access sites

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One Ethernet Service Description over any type of Access Network
COE + Packet Optical for Next Generation Networks

- **COE = Carrier Ethernet + Traffic Engineering**
  - SONET reliability, performance, security
  - Ethernet flexibility and efficiency

- **Packet Optical Networking integrates COE and Layer 1 optical networking**
  - Joins existing assets (networks, people, IT) with next generation services
  - Increases velocity, addressable customers, lowers cost

- **Unique applications being deployed now**
  - Full Service Mobile backhaul
  - DSLAM backhaul
  - Wholesale and retail Ethernet services