The Role of
MPLS-TP in
Evolved packet transport

John Volkering
Consulting Engineer
Ericsson Product Area IP& Broadband
Today’s transport architectures
the layered approach

ACCESS | AGGREGATION | METRO | EDGE | CORE

10,000s | 1,000s | 100s | 10s | 10s

OPTICAL | Ethernet | Sonet SDH | IP | OPTICAL
evolved transport network
A prospective view

Transport characteristics
› Long term statically provisioned bi-directional paths
› Support for different transport types, such as packet and TDM
› Pre-determined backup paths (predictability)
› Highly automated operations environment
› Strong reliance on automated OAM and fault management systems
Network LAYER evolution

Technology consolidation

- IP
- Ethernet, ATM, FR
- MPLS
- TDM
- SDH
- xWDM

IP/Ethernet

MPLS

OTN/xWDM

Technology and System Consolidation for Network Simplification
MPLS-TP objectives:

- Enable MPLS to be deployed in a transport network and *operated in a similar manner* to existing transport technologies (SONET/SDH)
- Enable MPLS to support packet *transport services with a similar degree of predictability and reliability* to that found in existing transport networks

MPLS-TP extensions are fully compatible with existing MPLS specifications and newly defined protocols are included in IETF MPLS set
MPLS-TP Additional Functionality
Based on Transport Requirements

Transport-like OAM
› In-band OAM
› Performance monitoring for SLA verification
› Alarms and Fault Notification

Transport-like Operations
› Static Provisioning
› Operation through NMS
› Bi-directional paths

Transport-like Resilience
› Sub-50 ms OAM driven protection switching
› Linear protection (1+1, 1:1, 1:N)
› Ring protection
MPLS-TP Fundamentals

› RFC 5654 specifies the general MPLS-TP fundamentals

- **Standard MPLS Data Paths**
  Same forwarding mechanisms (label push/pop/swap)

- **Transport Optimized OAM**
  Operations, Administration, Maintenance

- **Connection-Oriented**
  Must also support Bi-directional Paths

- **Transport Centric Operational Model**
  Not dependent on distributed Control Plane

- **Protection Switching Triggered by OAM**
  No dependencies on Signaling or Control Plane
Transport-Like OAM

Transport Optimized OAM
Definition of a comprehensive set of in-band OAM tools

1. To monitor and manage the transport network itself
2. To monitor the services delivered to customers

› All OAM functionality needs to be in-band
  – OAM packets are sent over the data plane
    › Takes same path as the user payload
  – No out-band signaling component
  – OAM functionality must not depend on IP forwarding
A dedicated channel associated with the data path is created for the OAM packets
  – Known as an Associated Channel (ACh)

ACh is used for OAM on all levels
  – Using the PW-ACh for Pseudowires
    › RFC 4385
  – Using a Generic ACh (G-ACh) for LSPs
    › RFC 5586
### PW Ach & Generic ACh

#### PW ACH
- Between PW Label and OAM payload
- Channel Type indicates type of OAM packets

<table>
<thead>
<tr>
<th>PW ACH</th>
<th>Version</th>
<th>Reserved</th>
<th>Channel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pseudowire</td>
<td>PW Label</td>
<td>TC 1</td>
<td>TTL</td>
</tr>
<tr>
<td>LSP</td>
<td>LSP Label</td>
<td>TC 0</td>
<td>TTL</td>
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PW-ACh according to RFC 4385

#### Generic ACH
- Reusing structure from PW ACH
- G-ACh Label (GAL) provides alert based mechanism to identify presence of the ACH

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G-ACh according to RFC 5586
Similar **OAM** Features on all Levels

- Pseudowires
- Paths (LSPs)
- Sections
- Portion of LSP

› **OAM Features**
  - Continuity Check (CC)
    › Proactive liveliness monitoring
  - Connectivity Verification (CV)
    › Verifying end-point
  - Delay and Loss Measurements
  - Fault Notification, Fault Isolation and Diagnostics
Secure Connection-Oriented Paths

Connection-Oriented
Must also support bi-directional paths

› MPLS-TP excludes some MPLS options to ensure connection-oriented paths and consistent OAM operation
  › Equal Cost Multi Path (ECMP) – excluded
  › MultiPoint to Point (MP2P) LSPs – excluded
  › Penultimate Hop Popping (PHP) – disabled by default

› MPLS-TP supports the following LSP types:
  › Uni-directional Point-to-Point (P2P)
  › Uni-directional Point-to-Multipoint (P2MP)
  › Bi-directional P2P
    › Associated and co-routed
### Transport-Like Operations

- Possibility to use a centralized control plane

- Provisioning through NMS system
  - Topology discovery
  - Path computation
  - Static assignment of labels
  - Static service provisioning

- No need for distributed control plane
  - Node layer simplification
**Communication on the DCN**

- DCN can be out-of-band or in-band
- For in-band communication the following is defined
  - *Management Communication Channel (MCC)*
  - *Signaling Communication Channel (SCC)*
- To be used for topology discovery, provisioning, etc

- **MCC/SCC** is using the G-ACh structure defined in *RFC 5586*
  - Channel type is set to **MCC/SCC**
  - In addition a protocol ID field is used
- No restriction on protocol to be used for managing an MPLS-TP network
Transport-Like Resilience

Protection Switching Triggered by OAM
No dependencies on Signaling or Control Plane

› Comprehensive set of recovery mechanisms
  – OAM triggered protection mechanisms are standardized within MPLS-TP
  – Existing MPLS & GMPLS mechanisms may also be used

› Similar functionality across PWs, LSPs, SPMEs, and sections
Protection

Protection Switching Triggered by OAM
No dependencies on Signaling or Control Plane

› Protection triggered by data plane OAM
  – Linear protection
    › Dedicated 1+1 (2 concurrent traffic paths)
    › Dedicated 1:1 (one active and one standby path)
    › Shared 1:N (many active paths share one standby)
  – Additional Ring Protection mechanisms

Example: Dedicated 1:1

› Protection State Coordination (PSC) to sync the nodes
Evolved Transport Network
Technology Fit

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- ACCESS: 10,000s
- AGGREGATION: 1,000s
- METRO: 100s
- EDGE: 10s
- CORE: 10s

Optical Networking
- SONET
- SDH
- Ethernet
- IP
- MTU
- Enterprise
- Residential

Evolved Transport Network Technology Fit
Evolved Transport Network
Service Segmentation

**ACCESS**
- E-Line
- E-Tree
- E-LAN
- IPVPN

**AGGREGATION**
- P2P/P2MP PWE
- Ethernet

**METRO**
- L2 Edge
- L3 Edge

**EDGE**
- E-Line
- E-Tree
- E-LAN
- IPVPN

**CORE**
- E-Line
- E-Tree
- E-LAN
- IPVPN

**End 2 End Service**

**Service Topology**

**Fiber Topology**

Aggregation: 1000s of sites

Edge/Core: 10s of sites
MPLS-TP and IP/MPLS Interworking

- End-to-End Pseudo-wire can provide end-to-end OAM across different domains.

MPLS-TP and IP/MPLS interworking can take place anywhere in the transport network.
Evolved packet transport

summary

› Transport networks are under transformation

› MPLS-TP, OTN and P-OTP will enable the transport evolution with simplicity, efficiency and scalability

› MPLS-TP is MPLS.
   › It is optimized for transport networks paradigm

› MPLS-TP provides a similar degree of predictability, reliability and OAM to that found in existing SONET/SDH transport networks