MPLS-TP Technology Primer
What is MPLS-TP?

- MPLS-TP = MPLS Transport Profile
- MPLS-TP is a Layer 2 technology
- Combines the benefits of MPLS and removes the complexity of IP networking
- Uses MPLS Label switching mechanism but with static route provisioning (no Label Distribution Protocol LDP or RSVP-TE)
- Supports an advanced set of OAM functions and path protection mechanisms
- In-band OAM traffic on same path as data traffic
MPLS-TP deployments are targeted for the Access and Aggregation networks

MPLS-TP suited for Circuit Switched evolution
- Packet switched network efficiency
- Multi-service capabilities
- Extensive set of OAM tools

MPLS-TP suited for Mobile backhaul deployment
- Handle multiple traffic types (e.g., TDM, ATM, Ethernet, IP)
- Support multiple classes of service
- Operational simplicity with static service provisioning through management
- Fault resiliency with sub-50 ms recovery mechanism
MPLS-TP in the Mobile Backhaul

ACCESS

L2 or MPLS-TP

AGGREGATION

MPLS-TP

CORE

IP/MPLS

Increasing Complexity

Increasing number of nodes
MPLS-TP

- RFC 5654: MPLS-TP Requirements
- RFC 5960: MPLS Transport Profile Data Plane Architecture
- RFC 5921: A Framework for MPLS in Transport Networks

MPLS-TP OAM

- RFC 6427: MPLS Fault Management Operations, Administration, and Maintenance (OAM)
- RFC 5586: MPLS Generic Associated Channel
- ITU-T G.8113.1: Operations, administration and maintenance mechanism for MPLS-TP in packet transport networks
**LER**: Label Edge Router. Entrance/Exit point to the MPLS Cloud. Pushes or Pops MPLS Label

**LSR**: Label Switch Router. Intermediate point in the MPLS Cloud. Swaps MPLS Label

**LSP**: Label Switch Path. Statically configured path from Ingress to Egress LER through LSR network
- **Label:** 20 bits to identify label value
- **Exp:** Experimental bit, used for Class of Service (CoS) indication
- **S:** S=0 indicates there are additional labels, S=1 indicates bottom of stack, no additional label
- **TTL:** Time To Live, decremented by 1 at each hop. Frame is not forwarded after TTL reaches 0.
**CER:** Customer Edge Router. A device where one end of a service originates and/or terminates. The CE is not aware that it is using an emulated service rather than a native service.

**PER:** Provider Edge Router. A device that provides pseudo-wire emulation to the customer edge. It is the interface between customer network and MPLS core.

**PW:** Pseudo-Wire. Service mechanism that carries an emulated service from one PE to another PE over a packet switched network.
MPLS-TP over Ethernet with PW Label

- Ethernet Source/Destination MAC
- LSP Tunnel Label(s) (4 Bytes)
- PW Label (4 Bytes)
- Control Word (4 Bytes)
- Payload Ethernet MAC header
- Payload IP header
- Payload data
- CRC

- Ethernet Transport MAC Header
- LSP Label(s)
- PW Label (S=1)
- Control Word used with PW over Packet Switched network (RFC4385)
- Payload = Service Frame
**LSP and PW Label Examples**

**LER = Pop**  
Label 35

**LSR = Swap**  
Label 53 to 35

**LER = Push**  
Label 53

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**LER**  
35

**LSP**  
53

**LSR**  
35

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**LER**  
22

**LSP**  
22

**LSR**  
53

**PW**  
22
- MPLS-TP OAM follows ITU-T G.8113.1
- MPLS-TP OAM travels on the same path as data traffic
- MPLS-TP OAM uses G-Ach and GAL labels to differentiate from customer traffic per RFC 5586
- OAM format follows Y.1731
- OAM functionalities follow Y.1731
  - CCM Messages
  - Loopback Message/Loopback Response
  - DMM/LMM
  - …
Connectivity Fault Management Functions

- Fault Detection – Continuity Check
  - CCM “heartbeat” messages transmitted at a configurable periodic interval by MEPs

- Fault Notification – RDI
  - Upon detection of fault condition, MEP encodes RDI flag in CCM message

- Network/Path Discovery – Link trace message
  - Equivalent to “traceroute” test. MIPs and MEPs along the path send a response

- Fault verification and isolation – Loopback
  - Verify connectivity to a specific point in the message. Equivalent to “ping” test

Performance Monitoring Functions

- Packet Loss Measurement - LMM
- Delay Measurement - DMM
For Pseudo-wires, the G-ACh uses the first four bits of the PW control word to provide the initial discrimination between data packets and packets belonging to the associated channel, as described in RFC4385.
For LSP, it is necessary to provide an indication in the packet that the payload is something other than a client data packet. This is achieved by including a reserved label with a value of 13 at the bottom of the label stack. This reserved label is referred to as the G-ACh Label (GAL) and is defined in RFC5586.
MPLS-TP Option for the TX300
- MPLS-TP line rate traffic generation on any test port from 10BT to 10GE
- Fully configurable MPLS-TP header fields, LSP and PW
- Dual Port MPLS-TP traffic generation
- MPLS-TP traffic analysis, including all SLA key parameters (frame loss, delay, jitter, …)
- MPLS-TP support for all Ethernet tests: RFC2544, V-SAM (Y.1564), Multi-stream throughput test and BERT
- OAM support per ITU-T G.8113.1 including G-ACH and GAL support per RFC 4385 and RFC 5586

- Y.1731 Connectivity Fault Management and Performance Monitoring functions:
  - CCM, Loop Back, Link Trace, Loss Measurement and Delay Measurement OAM frames support

- OAM functions can be enabled simultaneously with MPLS-TP traffic generation

- OAM support in Dual Port mode
MPLS-TP encapsulation requires MPLS-TP option

Tap on graph to configure MPLS-TP header
Configure MPLS-TP Header and Ethernet Frame payload independently.
### MPLS-TP Header Configuration

**Configurable MPLS-TP VLAN** can be enabled/disabled.

**Configurable LSP** with configurable Label, CoS/EXP and TTL.

**Optional PW** with configurable Label, CoS/EXP and TTL.

**CW automatically enabled when PW selected.**

<table>
<thead>
<tr>
<th>Configuration</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPLS-TP VLAN</td>
<td>Enabled/disabled</td>
</tr>
<tr>
<td>LSP</td>
<td>Label 428, S=0, CoS=5, TTL=128</td>
</tr>
<tr>
<td>PW</td>
<td>Label 10, S=1, CoS=0, TTL=128</td>
</tr>
<tr>
<td>CW</td>
<td>Flags=0000, Len=000000000000, Seq#=0000</td>
</tr>
</tbody>
</table>
MPLS-TP Traffic Statistics

Per-Stream detailed Test Statistics

Additional counters detecting MPLS-TP LSP/PW frames
MPLS-TP Traffic Statistics

Per-Stream detailed Test Statistics

Additional counters detecting MPLS-TP LSP/PW frames
Requires MPLS-TP option and Y.1731 option

Configure Y.1731 MEP parameters

Refer to Ethernet OAM training presentation for details on Y.1731 Configuration
Copy LSP/PW from existing Stream

Configurable LSP/PW parameters

GAL and ACH label automatically added as needed
After Configuration add checkmark to enable G.8113.1 functions
Refer to Ethernet OAM training presentation for details on CCM
OAM Functions

OAM Loopback and Linktrace

OAM Loss Measurement and Delay Measurement
- **499-05-304**: MPLS-TP Tags
  - Includes MPLS-TP Traffic Generation/Analysis on all TX300 Test ports, including 10GE ports

- **499-05-305**: MPLS-TP OAM ITU-T G.8113.1 (requires 499-05-199)

- OAM option requires MPLS-TP option and Y.1731 option
Thank you.

Any questions?