Cisco PONC 2015

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NCS 4k Use Case

Evolution – Not Revolution!

- Aging SDH Infrastructure
- Packet Traffic is Growing
- OTN is good for Private Line, No Statistical Multiplexing
- SDH Evolution requires Legacy to be accommodated
- Co-Existence of Legacy SDH/PDH, OTN & GreenField Packet Services
- Transport Operational Model – Resiliency, OAM&P
- Next-Gen Transport requires Programmability, Scalability

Touch-less ROADM/DWDM underpinning TDM (SONET/PDH) Circuit Emulation, Packet and OTN with Agnostic switching to enable Network Convergence
Packet Optical architecture can save from 56% to 71% Reliant on static provisioning and legacy services
SP CO SDH Migration
ODU Statistical Multiplexing

**SDH**

**10 GigE**

**DWDM**

**Coherent**

**N x 10 Gig OTN over DWDM**

**ODUFlex**

**ODU1**

**ODU2/2e**

**100 Gig DWDM Coherent**

**Tunably Utilized GigE/10 GigE**

**Tunably Utilized 100 GigE**

**Packet Processing**

**L2/MPLS**

**L2/MPLS**
SDH Mobile Backhaul Migration

- Legacy 2G SDH Switches
- E1, E3, STM1, STM4 Access
- STM16/STM64 Transport
- DWDM Wavelength Services

- Accommodates 2G → LTE
- Recoverable Circuit Emulation
- STM16, STM64 → N x 10 GigE
- Unlock Value from DWDM
- Combine OTN Switch/SDH Agg into 1 NE
ATM Switch Migration

- Legacy ATM Switches
- Frame Relay Applications
- E1, E3, STM1, STM4 Access
- STM16/STM64 Transport
- Leased Dark Fiber
- DWDM Wavelength Services

- Accommodates ATM/FR Transition to Ethernet
- Recoverable Circuit Emulation
- STM16, STM64 → N x 10 GigE
- Unlock Value from Leased Transport
- Combine OTN Switch/SDH Agg into 1 NE
Utility Use Case

- SDH used for Teleprotection
- SCADA aggregated to E1
- E1 Circuit Emulated over MPLS-xx/Carrier Ethernet interface

- Latency/jitter/symmetry for Teleprotection between Teleprotection routers
  - Latency: less than 5ms (RTT less than 10ms)
  - Jitter: less then 0.5ms.
  - Symmetric traffic: |A to B| - |B to A| < 1ms
- Restoration after single link/node failure less than 50ms
- Frequency and time delivered to TPR sites (1588v2)
Packet Optical vs Routing

Packet Optical
- IPv4 / IPv6 / MPLS Forwarding
- Bridging
- L2VPN (VPWS/VPLS)
- OTN/DWDM
- Legacy TDM
- Transport Opex Model
- Converged Transport Edge
- Carrier Class

Router
- MPLS, Bridging
- Subscriber Management (BNG)
- Full L3VPN Provider Edge
- Full Internet Table Routing
- Router Opex Model
- Service Edge
- L3 Scale

Multicast L3VPN
- BNG
- IPv6
- BGP
- SR-TE
- ISIS
- L2VPN
- MPLS
- OSPF
- QoS
- Y.1731
- CFM
- EFM
- OTN
- DWDM

Full Spectrum Routing at Scale
NCS Convergence

NCS 4k Converged Transport Edge – Address Converged POTS Applications, Enable Cloud Computing Infrastructure, Virtualized Service Layer, Accommodate Legacy, Migrate SONET/SDH, MultiLayer Management

- SDN Enabled
- IP/MPLS
- DWDM
- OTN
- Carrier Ethernet
- SDH
- Virtualization
- MPLS-TP

Routing
- ASR 901
- ASR 903
- ASR 9001
- ASR 9000v
- Strong L2/L3
- Depth/Breadth
- CLI

Packet Optical
- NCS 4000v
- NCS 4009
- NCS 4016
- Full L0/L1
- Strong Carrier Class, Mgmt

Some Feature Overlap at L2/L3
Packet Optical does not require Router scale
# MPLS Transport

## MPLS-TP
- OAM
- Forwarding
- Protection

## FlexLSP
- TP OAM
- Forwarding
- Protection
- SDN Enablement

## Standard IETF MPLS RFC’s

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>MPLS-TP</th>
<th>FlexLSP</th>
<th>IP/MPLS</th>
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<td>L3 Multicast</td>
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<td>Content</td>
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<td><strong>General</strong></td>
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<td>Traffic Engineering</td>
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<td>EMS-Driven</td>
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<td>50ms restoration (1:1 LSP Protection)</td>
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<td>Multiplexing Technology</td>
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<td>Granularity</td>
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<td>Programmable (SDN Enablement)</td>
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<td>EMS-Driven</td>
<td>RSVP-TE Extensions</td>
</tr>
</tbody>
</table>

2011

2013

Standard IETF MPLS RFC’s
Programmable Ethernet Transport

- Predictable, Deterministic Transport-Centric (1:1 LSP Redundancy)
- Resiliency – Sub-50 msec
- Rich OAM
  - Fault Propagation, Connectivity Verification (MPLS-TP)
- Statistical Multiplexing
- Programmable
  - (RSVP-TE Extensions)
- MPLS Scalability

FlexLSP is evolution of MPLS-TP to accommodate Programmability of the MPLS Transport function and full compatibility with existing MPLS implementations
Legacy Evolution

Circuit Emulation

SDH ADM
- E1
- E3
- STMn

OTN Switch
- OTU-1
- OTU-2

L2/MPLS
- GigE
- 10 GigE

SDH ADM
- HO Fabric
- LO Fabric

OTN Switch
- OTN Fabric

L2/MPLS
- MPLS Fabric
- MPLS NNI

NCS
- E1
- E3
- STMn
- OTN
- MPLS

Agnostic Fabric

Per-ODU Statistical Multiplexing
- 100 Gig Coherent
- L2/MPLS
- SONET/SDH
- OTN

100 Gig Coherent
## Circuit Emulation Use-Cases

<table>
<thead>
<tr>
<th>Circuit Emulation Technology</th>
<th>Applicable Standard</th>
<th>TDM Service Support</th>
<th>Encapsulation Options</th>
<th>Emulated Services</th>
<th>Timing Requirements</th>
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<tr>
<td>SAToP</td>
<td>RFC 4553</td>
<td>Unframed</td>
<td>IP/UDP, L2TPv3 and MPLS</td>
<td>Low Order (E1/E1/E3/E3)</td>
<td>None</td>
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<tr>
<td>CESoP</td>
<td>RFC 5086</td>
<td>Framed, Channelized</td>
<td>IP/UDP, L2TPv3 and MPLS</td>
<td>Low order and high Order (OC/STM)</td>
<td>Required</td>
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<tr>
<td>CESoETH</td>
<td>MEF 8.0</td>
<td>Unframed, Framed, Channelized</td>
<td>Native Ethernet</td>
<td>Low Order (E1/E1/E3/E3)</td>
<td>Required for Structure Aware</td>
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</table>
NCS Technology Agility

SDN-Ready Control Plane

Virtualized Service Layer

Service Mapping

Logical Topology

Physical Topology

Single Management Umbrella

L2VPN Ethernet Services

Ethernet Private Line

TDM SDH PDH CEM

Native OTN

SAN FC, ESCON Infiniband

IP + Optical/Wavelength Services

MPLS PWE3, Carrier Ethernet, EPL/ELAN CES

ODUk/ODUFlex

Logical L2+ Topology

O-SNCP, 1+1 APS Topology

Physical Ring, DWDM Mesh 10/40/100 Gig
Summary

- Graceful Transition of Legacy Solutions
- Evolve to Multi-Layer Convergence – Technology Agnostic
- Virtualized Service Layer -
- Converged Packet Optical Transport System – Keep Transport Operational Model
- Agile and Flexible Transport Network
TOMORROW starts here.