Why Operators Need Optical Transport SDN

Not Just Another SDN Presentation.

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Optical Transport SDN:
Why is it important?

OpenFlow controlled Optical Transport multiplies the value of packet only SDN: Service Provisioning

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An open control plane including the transport layer reduces risk of dreaded Vendor Lock-in.

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Why is it important?

Scale multi-vendor, multi-domain networks.

Optical Transport SDN:
Packet Optical Convergence

- Provides more flexibility for migration between TDM and IP services.
  - PTN: MPLS, PBB, VLAN, Carrier Ethernet
  - OTN: Combines TDM and packet, FEC for extended reach,
  - WDM: highly flexible ROADM layer eliminates unnecessary OEO conversions
- Line Interface Standardization
  - Coherent Optics, flexible modulation
  - FEC

Transport SDN Use Case:
Data Center

Dynamic Configuration

- Network Slicing
- Network as a Service

Automated Link Provisioning (BoD)

Transport SDN will enable business service turn-up with dynamic, hitless L1 capacity changes using ODUFlex

Transport SDN Use Case:
Dynamic Adjustment of Adjacencies

- Assumes overcapacity built in via unsaturated links, production advance, shared restoration resources
- Assumes a ROADM Mesh topology
- Important Mouse flows maintain priority, but Elephant flows can be orchestrated to automatically "borrow" resources.

Transport SDN Use Case:
Elephant Flow without Transport SDN

VM migration initiated at DC A. Flow marking indicates elephant flow, and traffic shaping begins.

Transport SDN Use Case:
Elephant Flow Transport SDN

Network is aware of additional capacity (λ) availability and will utilize it to avoid trampling the high priority mouse flows.

Beyond the Use Case:
Vendor Lock-in

- Vendor Lock-in
  - When the IP and the optical layers do not share a common control plane, the operator is forced to maintain two disparate systems. A single proprietary system locks the operator into a single vendor, impacting the evolution of the carrier's network.

So How Does Transport SDN Work?

No Packet Header

- While the packet switching technologies identify a signal by fields in the packet header, circuit switching technologies identify a signal by its position in time or frequency-space, similar to GMPLS.
- the *Match* portion of a circuit-switching flow entry uses the signal-type (e.g. ODU1,ODU2, OCH) and location in time (e.g. array of tributary slots) or location in frequency-spectrum (e.g. channel number, width) to identify the ingress signal.

What about OAM and Protection Switching?

Special Considerations

- Time sensitive and repetitive, complex functions don't play well in a centralized control environment:
  - OAM (Y.1731 MEP/MIP)
  - Protection switching
  - OF is lacking in tools to accomplish these functions (no timers, response issue from controller, may not match ITU specified SNCP behavior)
- Proposal for Autonomous Functions:
  - Well defined function that is referenced in a MAT (Match Action Table)

Autonomous Functions
a Monolithic Entity

- Goals for OAM (ONF CMWG OAM Specification 0.5)
  - Not to reinvent OAM protocols, leverage what exists
  - Ability to support multiple OAM methods to go inline with OAM layering
  - The OAM support needs to be extensible
  - AF needs to be very well defined, no minor differences will be accepted.
  - Does not define an implementation

Autonomous Functions

Autonomous Processes

- Configure OAM or APS object outside of OF switch (via NETCONF/YANG, RESTCONF, etc)
- Associate OF AF with externally configured objects
- Internal processes are not addressable individually

SDN vs. GMPLS

Is Transport SDN just GMPLS repackaged?

- GMPLS:
  - facilitates LSPs through LSRs, autonomously, but
    - in practice is usually single layer Implementation, and there is no higher level awareness of the network.
  - is typically not available across different vendors
  - consists of three models: Peer, Overlay and Augmented.
- (Transport) SDN is:
  - Multi Domain
  - Multi vendor
  - Multi layer
  - Programmable

GMPLS is predominately implemented as an overlay model, with separate control of IP and Transport

SDN makes use of distributed network OS coordination between multiple servers

What are Optical Operators are Doing now?

How can Transport SDN help?

- Many large Datacenter operators track router-transport connections with spreadsheets!
- LLDP is a possible solution but requires MAC termination which may be unnecessary on the transport gear.
- SDN controller will have knowledge of both packet layer and transport layer to simplify network organization.

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What are Optical Operators are Doing now?

Bandwidth on Demand

- Customer features
  - Ability to control the network assets and services they 'use'
  - Ability to change the characteristics of the IP services assigned
- Service Provider features
  - No "nailed-up" connections allow optimization of BW allocation: stat muxing
  - Ability to assign assets to individual Customers

Network Topology → **Capacity Planning** → **On-Demand Service Provisioning** → **Performance Monitoring**

Summary

Why do Operators Need Transport SDN?

- Lowers OPEX through reduced operational procedures, with a unified multi-layer control plane
- Lowers CAPEX by homogenizing physical network resources and introducing SW control.
- Network slicing and visualization opens revenue opportunities.
- Simplifies: No more spreadsheets mapping router ports to transport ports, and hoping you got it right.