Trends in Optical Disaggregation

Presented by:

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Today’s Presenters

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Agenda

• Industry Drivers, Enablers & Activities
• Optical Systems Disaggregation Opportunities
• Industry Goals & Priorities
• Open Line System Vision, Progress & Next Steps
• Q&A
Drivers & Enablers for Optical Disaggregation

• Demand growth & shifts:
  – Rapidly growing user traffic
  – Migration to the cloud
  – Result: Increased demand for network flexibility, agility and optimized cost

• Technology enablers:
  – Increasing use of open source and whitebox approaches (especially in data centers)
  – Multi-layer transport SDN automation & optimization

Source: Cisco VNI Global IP Traffic Forecast, 2015–2020
Enabling Technology: Multi-layer Transport SDN

Service Orchestration

SD-WAN, vCPE...

CORD, vOLT, vEPC...

Transport SDN Control and Applications

DC SDN, NFV...

Premises

Central Office (CO)

Transport Networks

Data Center (DC)

Packet Layers 2-3

OTN Layer 1

DWDM Layer 0

Open APIs
Open/Disaggregated Optical Systems Activities

- Fixed-grid Open Line Systems
  - Separate vendor ("alien") wavelengths over fixed-grid 50 GHz line systems
  - Evolving for 10 years with limited impact

- Flexible Grid Open Line Systems
  - No industry consensus definition yet, some early requirements and RFPs
  - Growing interest and support, limited deployment

- Open ROADM MSA
  - Targeting metro/edge applications
  - Participation from many influential industry members

- Telecom Infra Project (TIP) Initiatives
  - Voyager white box packet-optical system
  - MSA Proposal for point-to-point open line system
  - Strong industry participation
Typical Current Deployment: Integrated Optical System

Single Vendor Control, Integration, Support

Terminal System

Transponder 1

Transponder 2

Transponder n

Line System Control

Mux/Demux

Terminal Amp (TA)

Line Amp (LA) optional

Terminal Amp (TA)

Mux/Demux

80 km

+ ROADMs for optical mesh
Industry Goals

- Enable operators to multi-source critical high value components
- Automate and optimize L0-L3 operations thru software
- Innovate faster by decoupling development cycles for line systems and terminal equipment
Opportunities for Optical Disaggregation

1. Terminal equipment disaggregation
2. Open Line System
3. Open Line System Control/APIs
4. Disaggregated Line System
5. Multi-vendor Transponder Interop
Open Line Systems already exist. Need a common agreement on what that means.
The Telecom Infra Project (TIP) is an engineering-focused initiative driven by operators, infrastructure providers, system integrators, and other technology companies that aim to reimagine the traditional approach to building and deploying telecom network infrastructure.

Open Packet Optical Transport Working Group

http://www.telecominfraproject.com/
TIP Proposal for Point-to-Point Open Line System

- Node-level optical spec (similar to Open ROADM approach) but tailored for point to point OLS configuration.
- Specifications proposed for key optical (filter BW, incremental OSNR contribution, channel powers, gain masks, OSC, monitoring points, line protection, etc.) and control parameters.
- Yang data models proposed for two nodes (Terminal & ILA)
Open ROADM MSA

- Targeted at metro/edge applications (100G QPSK, <500km, highly meshed connectivity).
- Photonic layer (WSS, EDFA) hardware disaggregated from Tx/Rx hardware (lineside and client).
- SDN Controller replaces vendor-specific control plane and Element Management System.
- SDN Controller agnostic to vendor hardware.

“Open ROADM project has at its core the drive towards faster pace innovation and competition, as well as increased volumes through mass adoption, coupled with optical layer flexibility and software control to overcome all the disadvantages of today’s ROADM systems.”
Synergies between Proposed TIP-OLS & Open ROADM MSA

- OSC definition (1511nm, 100Mb -> 1 GE) is aligned
- ALS shutdown logic is aligned
Validated OSNR, end-to-end connectivity, reach and successful error-free data transmission for seamless performance over metro distances.

8QAM 16QAM

19 super-channels
Open Line System Interop Activity (2/2)

Equinix SV3 (NE San Jose) to Equinix SV8 (Palo Alto) connection using 50km Dark Fiber SV3 to SV8 with 4x200G and 8x100G signals. Lumentum Terminal Amps and Voyager Transponders are used. Traffic Generator is connected to the transponders.

Figure 2: Voyager transponder with 12 100G/25G ports and 4 400G/200G /100G line-ports.

Equinix Field Trial 800Gb/s San Jose to Palo Alto BER vs Distance graph showing BER vs distance for different lanes.
Moving Toward Flexible Grid Open Line Systems: Lessons Learned

- Flexible grid open line systems have been an evolving concept with limited adoption

- Early solutions tended to suffer challenges when using alien terminal line cards
  - Not all ‘Native’ functions worked properly
  - Challenges around ownership of network performance commitment

- Many solutions still miss key technical elements for true future proofing
  - Has resulted in OLS primarily using transponders from same vendor
Flexible Grid Open Line System Vision: Controls (part 1)

- Automated amplifier, ROADM WSS & OPM control for native and alien channels
  - Alien channel recognition and power balancing

- Support for variable channel spacing (Flex)
  - 37.5GHz, 50GHz, 62.5Ghz, 35GHz, etc...
  - Allows maximum fiber capacity
  - Allows full flexibility in capacity/reach optimization

- Support for externally muxed sources
  - Industry currently providing single, dual, and multi-carrier solutions. All need to be supported.
Flexible Grid Open Line System Vision: Controls (part 2)

- Support for Network to Network ROADM optical interop
  - Support multiple carriers transmitting between elements
  - Extreme case is full ‘OpenROADM’ concept

- Eliminate customized line module features that exclude operation over alien OLS
  - e.g. special carrier tagging
### Challenges and Next Steps

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| Gaining industry alignment on vision and definition for open line systems | • Converge on OLS component requirements  
• Converge on common control architectures, APIs, YANG data models                                                                 |
| Preserving room for differentiation                                        | Define approaches that maximize benefits of commonality yet allow for customization and innovation of features                               |
| Understanding where to pursue disaggregation with common controls versus  | Define & clarify trade-offs across markets  
• DCI  
• Metro  
• Long haul                                                                 |
| optimized performance                                                      |                                                                                                                                              |
| Network-level integration, service and support for disaggregated elements  | • Multi-vendor testing & integration  
• Commercial service offerings                                                                                                           |
Establishing a Blueprint for Open Line Systems

Infinera Xceed Multi-Layer SDN Controller

Optical Interface Specs

Infinera Transponder

Netconf

APIs

Lumentum Whiteboxes

Infinera FlexILS Open Line System
Enabling an Open Ecosystem

Open-Source SDN Controller (ONOS, ODL, Others)

Controllers

Infinera Transponder

Vendor B Transponder

Vendor C Transponder

Infinera or 3rd Party Open Line System

Lumentum Whiteboxes

Controllers

Netconf

APIs

Line System Control & Management

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Questions and Answers?

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