Trends in Optical Disaggregation

Presented by:

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LUMENTUM
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...

Open APIs

Premises
Central Office (CO)
Transport Networks
Packet Layers 2-3
OTN Layer 1
DWDM Layer 0
Data Center (DC)

VNFs
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

Mux/ Demux

Terminal Amp (TA)

Line System Control

Line Amp (LA) optional

Terminal Amp (TA)

Mux/ Demux

+ ROADM 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

Transponder 1

Transponder 2

Transponder n

2. Open Line System

Terminal Amp (TA)

Mux/ Demux 80 km Line Amp (LA) optional 80 km Terminal Amp (TA) Mux/ Demux

3. Open Line System Control/APIs

4. Disaggregated Line System

5. Multi-vendor Transponder Interop

Transponder 1

Transponder 2

Transponder n
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)
- Lumentum Terminal Amp
- Voyager Transponder
- Traffic Generator

Equinix SV8 (Palo Alto)
- Lumentum Terminal Amp
- Voyager Transponder

50km Dark Fiber SV3 → SV8
4x200G

Equinix Field Trial 800Gbps San Jose to Palo Alto BER vs Distance

Facebook Voyager Transponder

Lumentum Whitebox

Figure 2: Voyager transponder with 12 OCP4.28 ports and 4 100G CWDM line ports.
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 integration for optimized performance | Define & clarify trade-offs across markets  
• DCI  
• Metro  
• Long haul                                                                 |
| 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
- APIs
- Netconf

Lumentum Whiteboxes

Infinera FlexILS Open Line System

- Infinera Transponder
- Optical Interface Specs
Enabling an Open Ecosystem

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

Controllers

Infinera Transponder

Vendor B Transponder

Vendor C Transponder

Lumentum Whiteboxes

Infinera or 3rd Party Open Line System

Controllers

Infinera Transponder

Vendor B Transponder

Vendor C Transponder

APIs

Line System Control & Management

Netconf

Controllers

Infinera Transponder

Vendor B Transponder

Vendor C Transponder

Optical Interface Specs

Optical Interface Specs

Controllers

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Vendor B Transponder

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Netconf

Optical Interface Specs
Questions and Answers?

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