



IP / DWDM Innovations for Ethernet Services Delivery



Cisco Expo Alger – May '08

Louis-Vincent Perrinel, Consulting System Engineer

Agenda

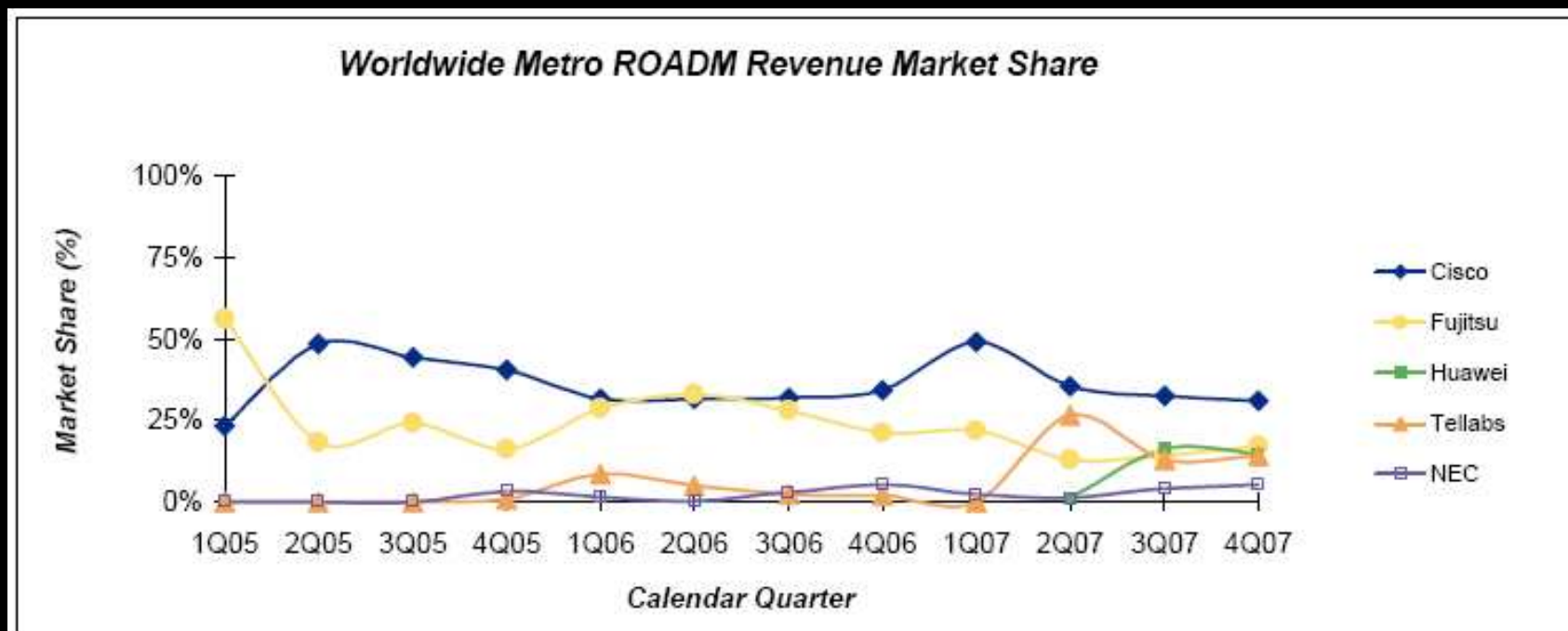
- Cisco in the Optical Market
- IP over DWDM
- Reconfigurable Optical Add-Drop
- Integrated Switching Capability
- References

Cisco in the Optical Market

- SONET and DWDM Player since 1999
- Development based on Innovation:
 - Multi Service SONET / SDH since 1999
 - Reconfigurable Optical Add-Drop since 2004
 - Integration of DWDM Optics with G.709 in Routers since 2005
 - Ethernet Aggregation integrated in DWDM since 2007
 - Multi-Degree Optical Add-Drop Available NOW

Consistent Market Leadership

- Reconfigurable Optical Add-Drop



Infonetics, 4QCY07 Market Data, revised Feb. 08

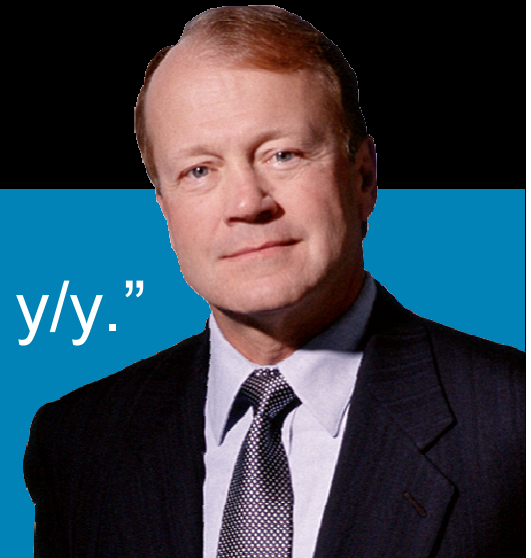
Cisco IP NGN Transport Momentum and Customers

- 75,000+ systems shipped/in-service
- 5,000+ ROADMs sold—market leader
- 1,000+ MSPP and 500+ MSTP customers

Q2 FY 2007
Quarterly
Update

“Optical business grew 40% y/y.”

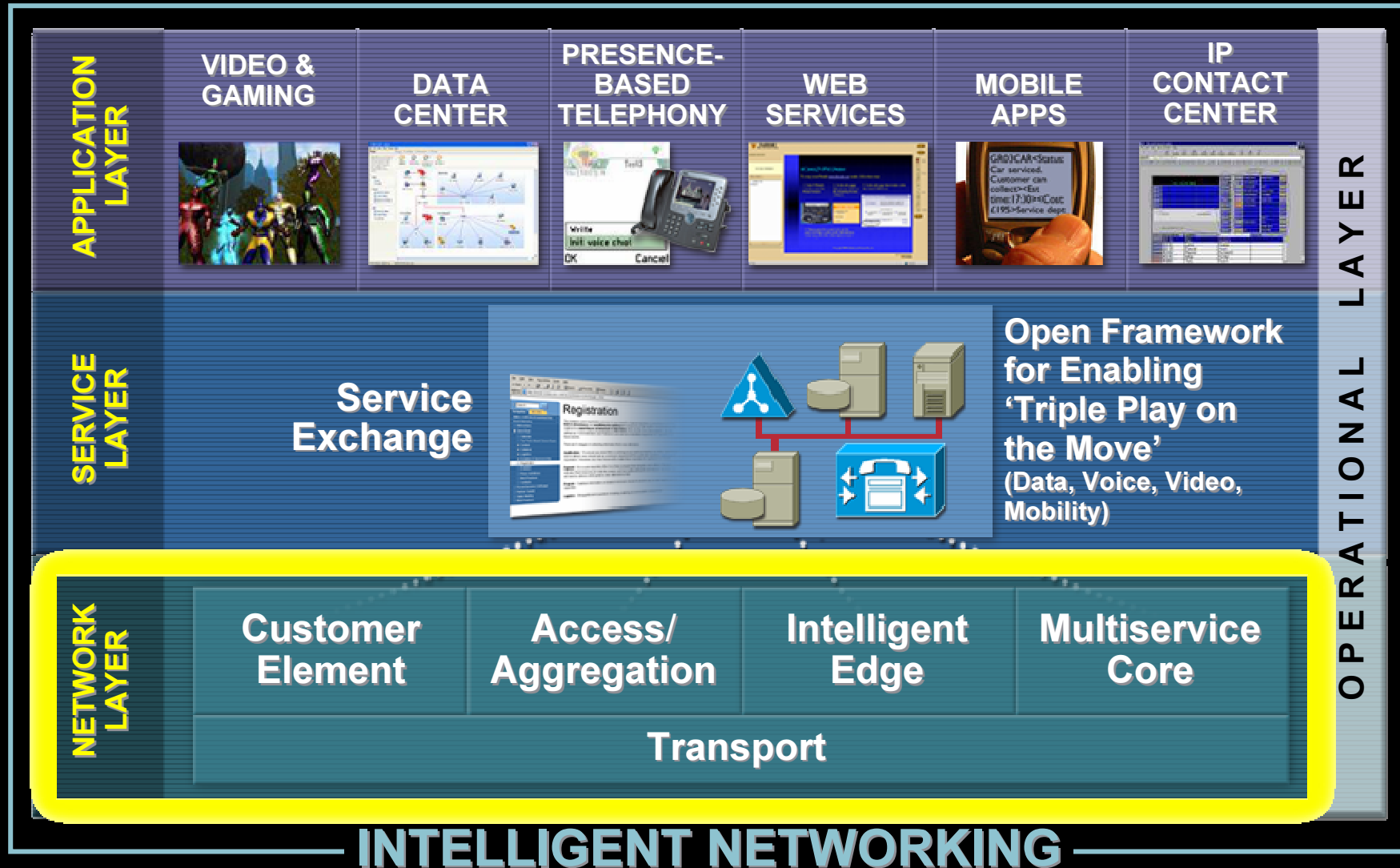
John Chambers
Cisco Systems, CEO



Expanding Global Customer and User Base

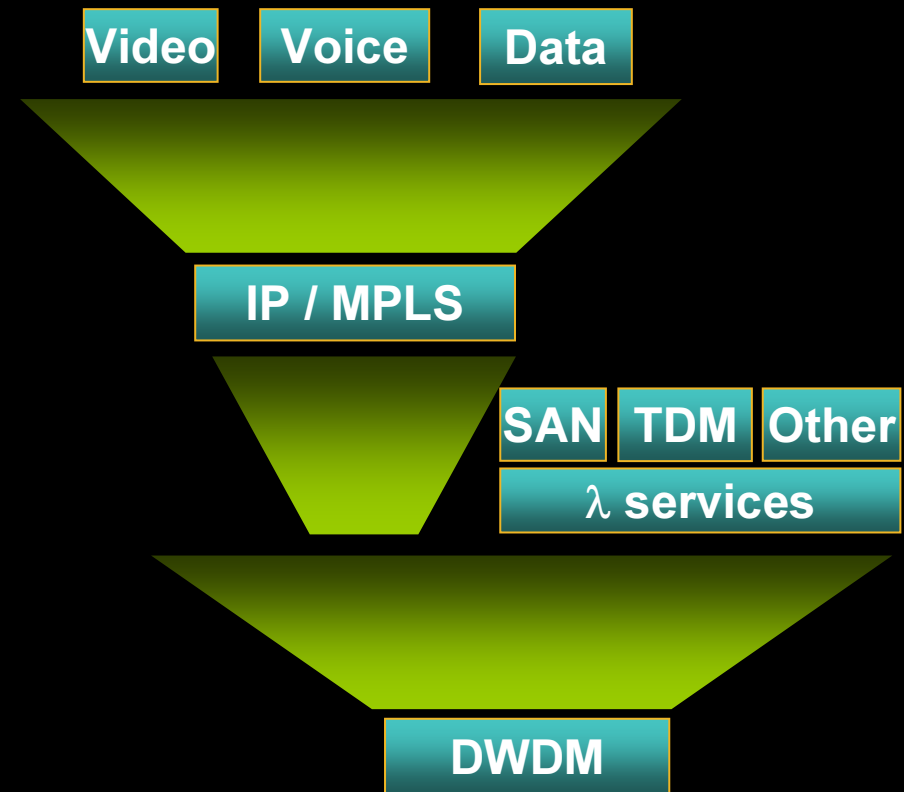


Next-Generation Network Architecture

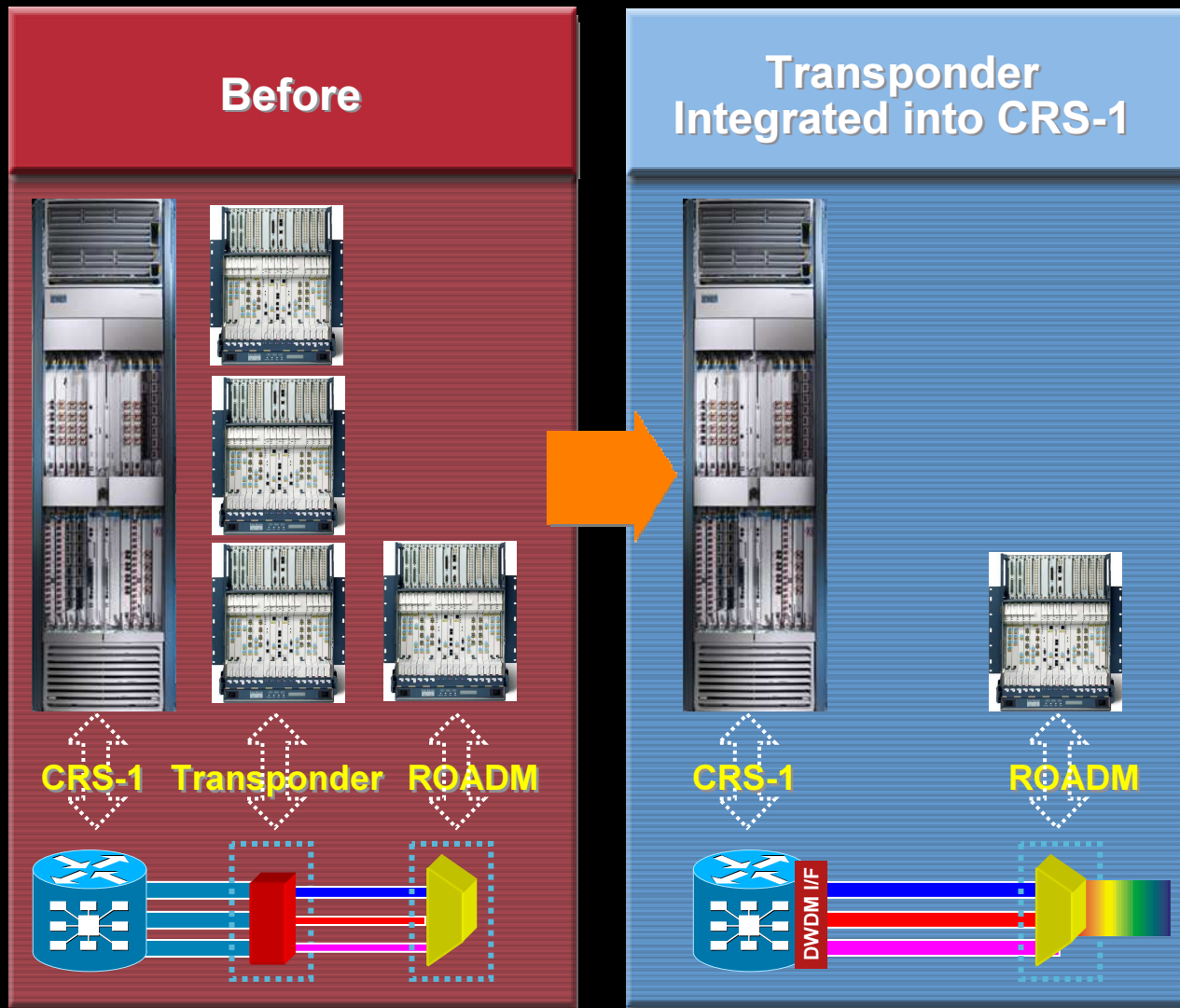


IP-over-DWDM Converged NGN Transport

- Packet layer convergence to IP/MPLS has delivered CapEx & OpEx savings in core networks
- WDM layer convergence has enabled CapEx & OpEx savings in multi-service metro networks
- *Significant additional CapEx/OpEx saving can be delivered by converging the IP and optical layers!*



IPoDWDM - Strategy



- **Increased Performance**
 - 4x increase in throughput for *existing* 10G DWDM systems
- **Lower CapEx**
 - 50% optics reduction
- **Lower OpEx**
 - Fewer shelves (space, cooling, power, management), fewer interconnects
- **Enhanced resiliency**
 - Fewer devices, fewer active components, fewer interconnects

IPoDWDM: ITU Optics on Routers over DWDM

Cisco CRS-1 (16/8/4)

1x OC-768c ITU PLIM

4 x 10GbE ITU PLIM



Cisco 12000

1 x 10GbE ITU SPA



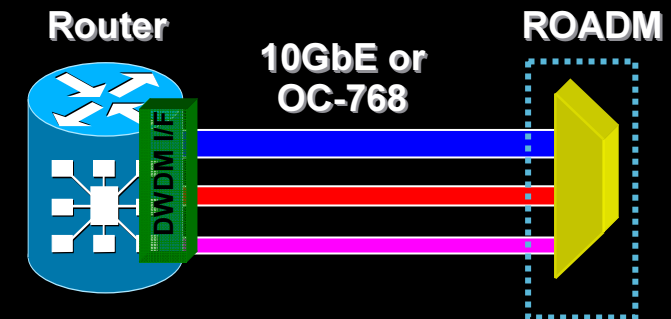
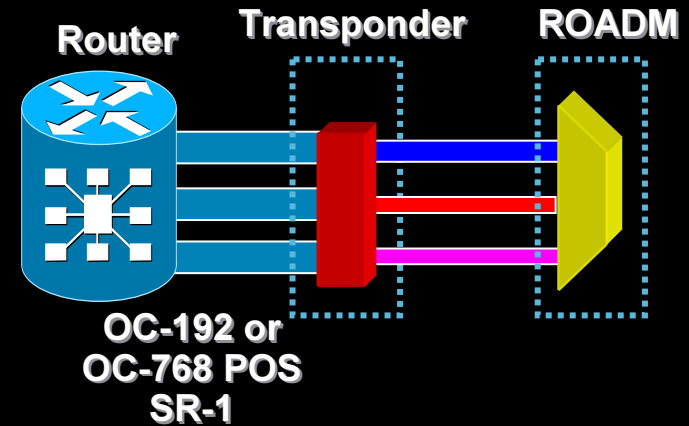
Cisco 7600

4 x 10GbE ITU DWDM XENPAK

DWDM XFP w/EFEC



ONS 15454 MSTP



55% CapEx Reduction due to 10GbE versus 10G POS and no TxPs

70% OpEx Reduction (Less Power, Space, and Fewer Active Devices)

IP Over DWDM Value Proposition



Increase Service Flexibility
Faster service provisioning
New revenue generating services

Increase Reliability
Meet SLAs for customer loyalty

Manage Traffic Growth Efficiently
Video/Rich IP Media growth

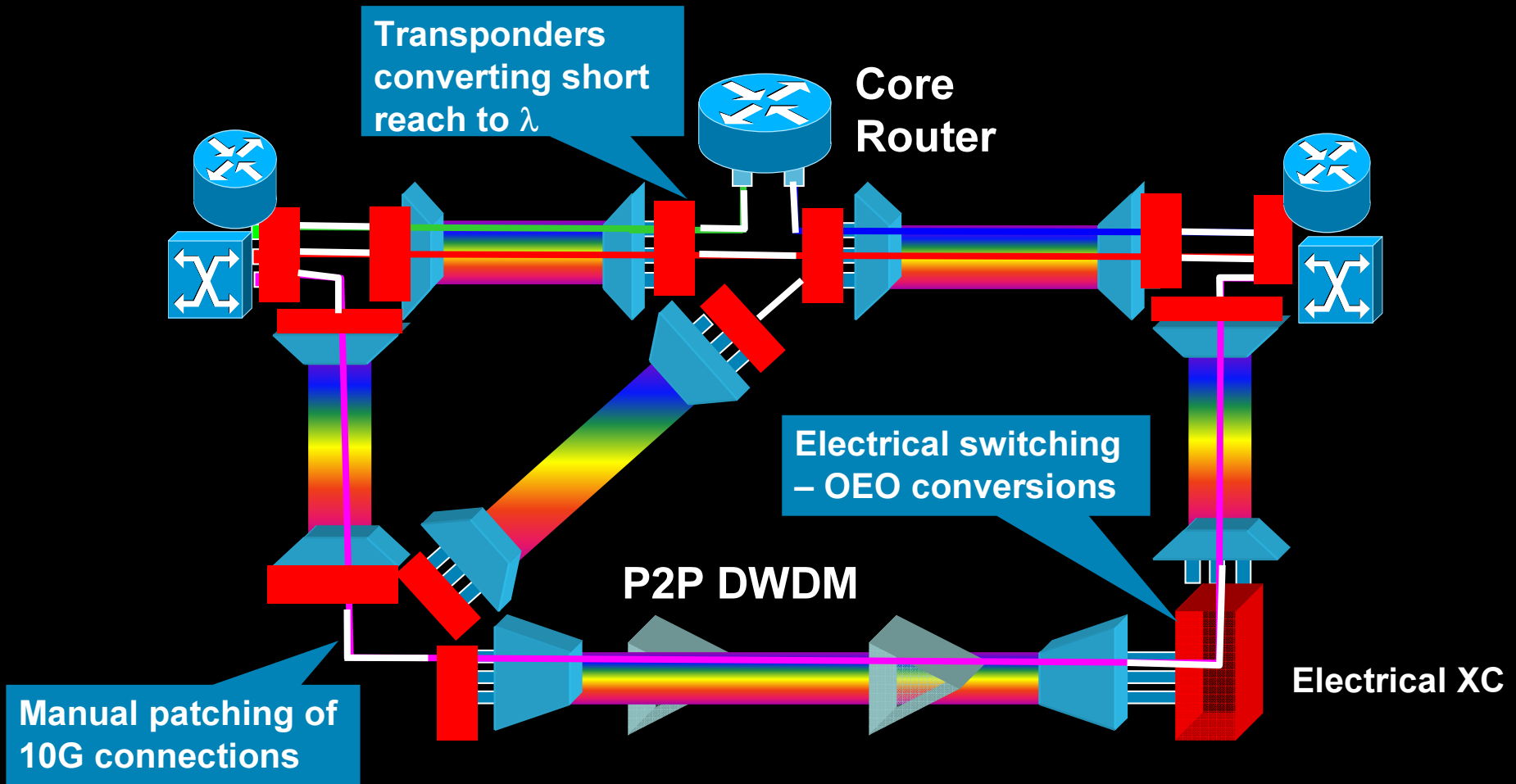
Lower opex
Simplify network & management

Lower capex
Increase profitability & ROI

Traditional IP Network + Optical Network are not Optimized around IP Transport

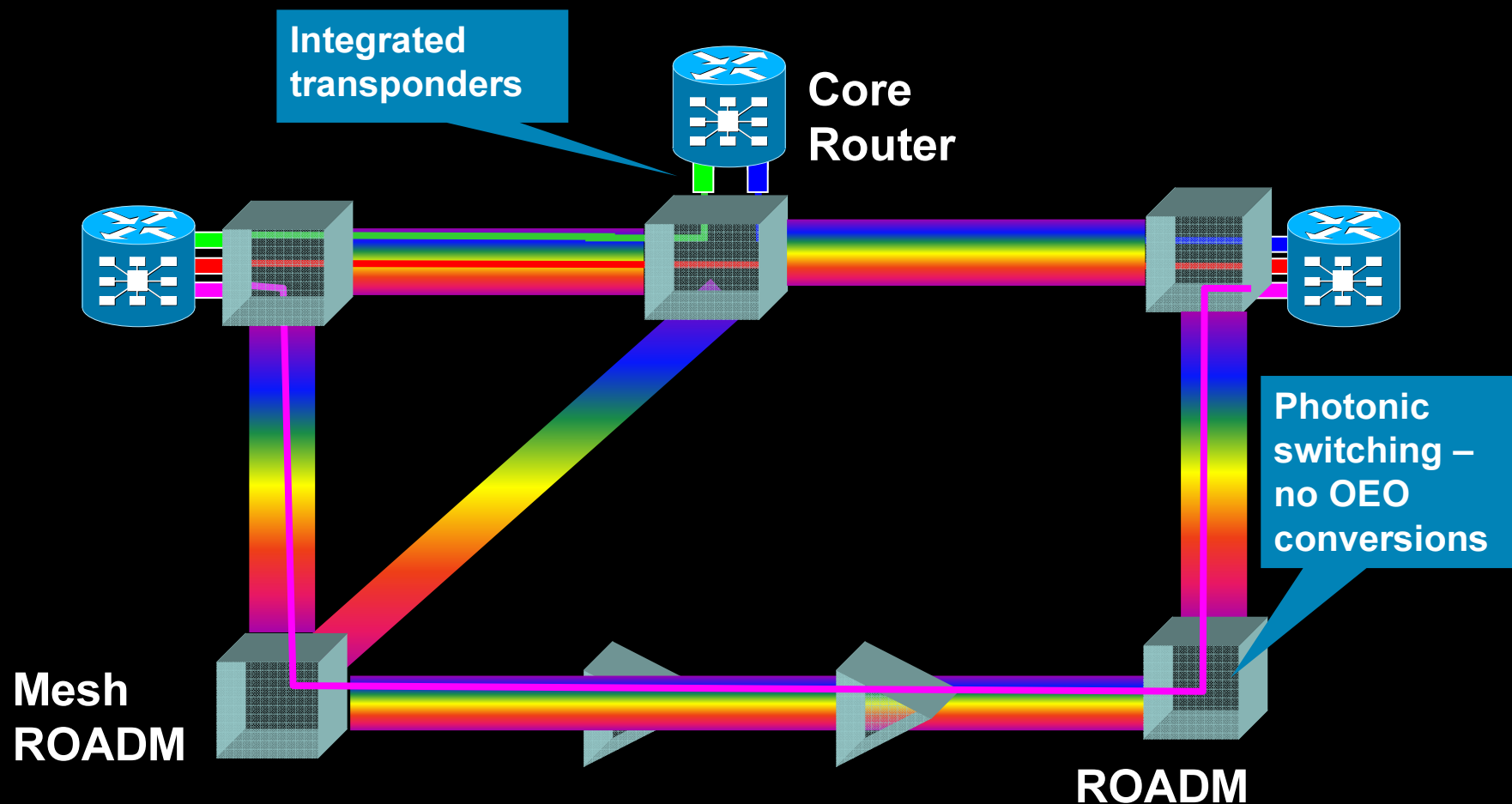
IP Layer Management

Optical Layer Management



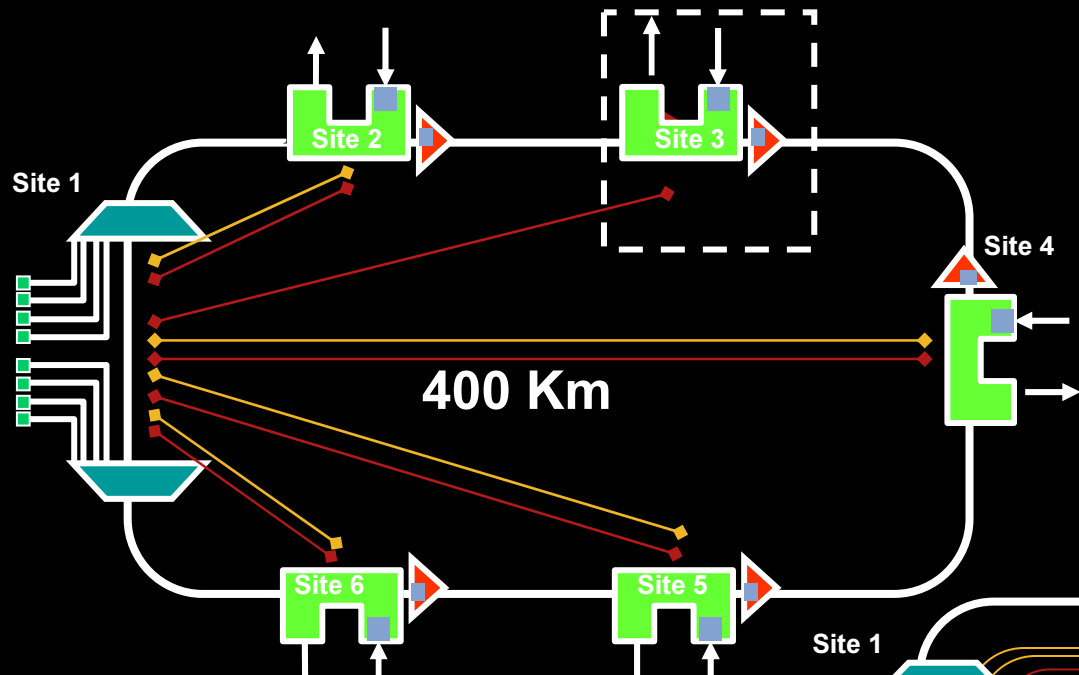
The IP-over-DWDM Architecture Streamlines the Transport of IP packets

Common Network Management and Control



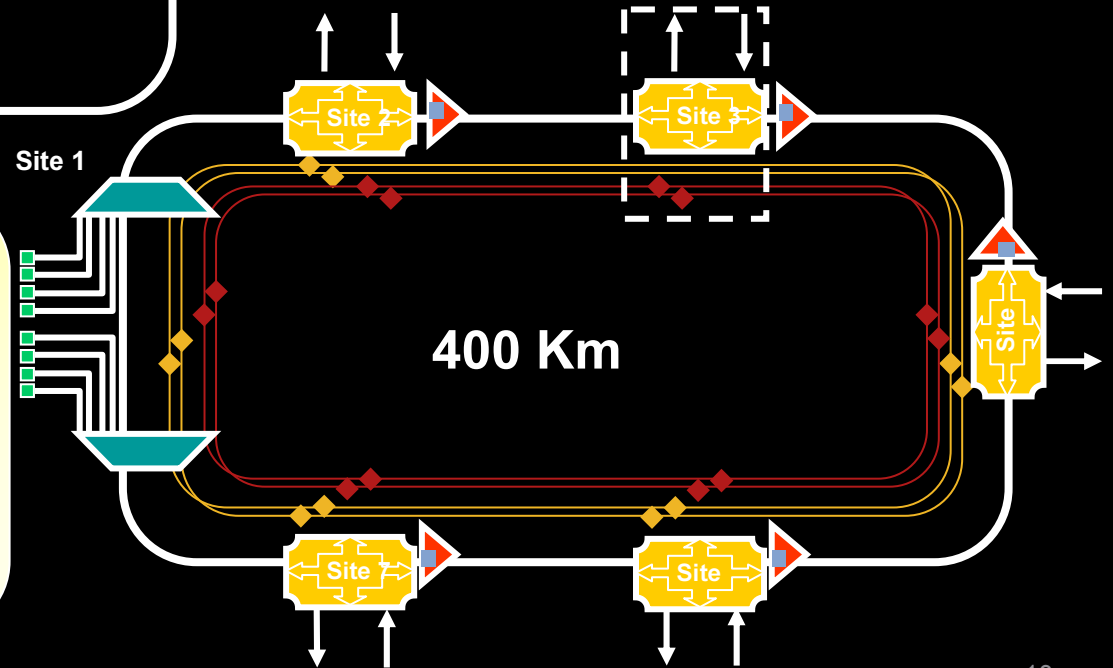
Reconfigurable Networking

Band A	
Band B	



- **Fixed OADM Solutions cause enormous Operational Hurdles which inhibit network growth**
- **TDM / IP / SAN / WDM often from multiple vendors**

- **ROADM - Operational simplicity...**
Single Node scalable from 1-40 ch
Simple cabling
- **...at the right price!**
Price curve to drive toward the elimination of fixed OADMs
- **TDM/IP/WDM Convergence!**



Industry's most comprehensive ROADM Portfolio

- Right-sized ROADM solutions Supports 2° Through 8° Deployments
- Current Metro DWDM customer requirements*
 - 85% 2°
 - 12% 3°–4°
 - 3% 5°–8°
- Mesh will grow over time
- New 8° ROADM Scales in-service from 2°–8°

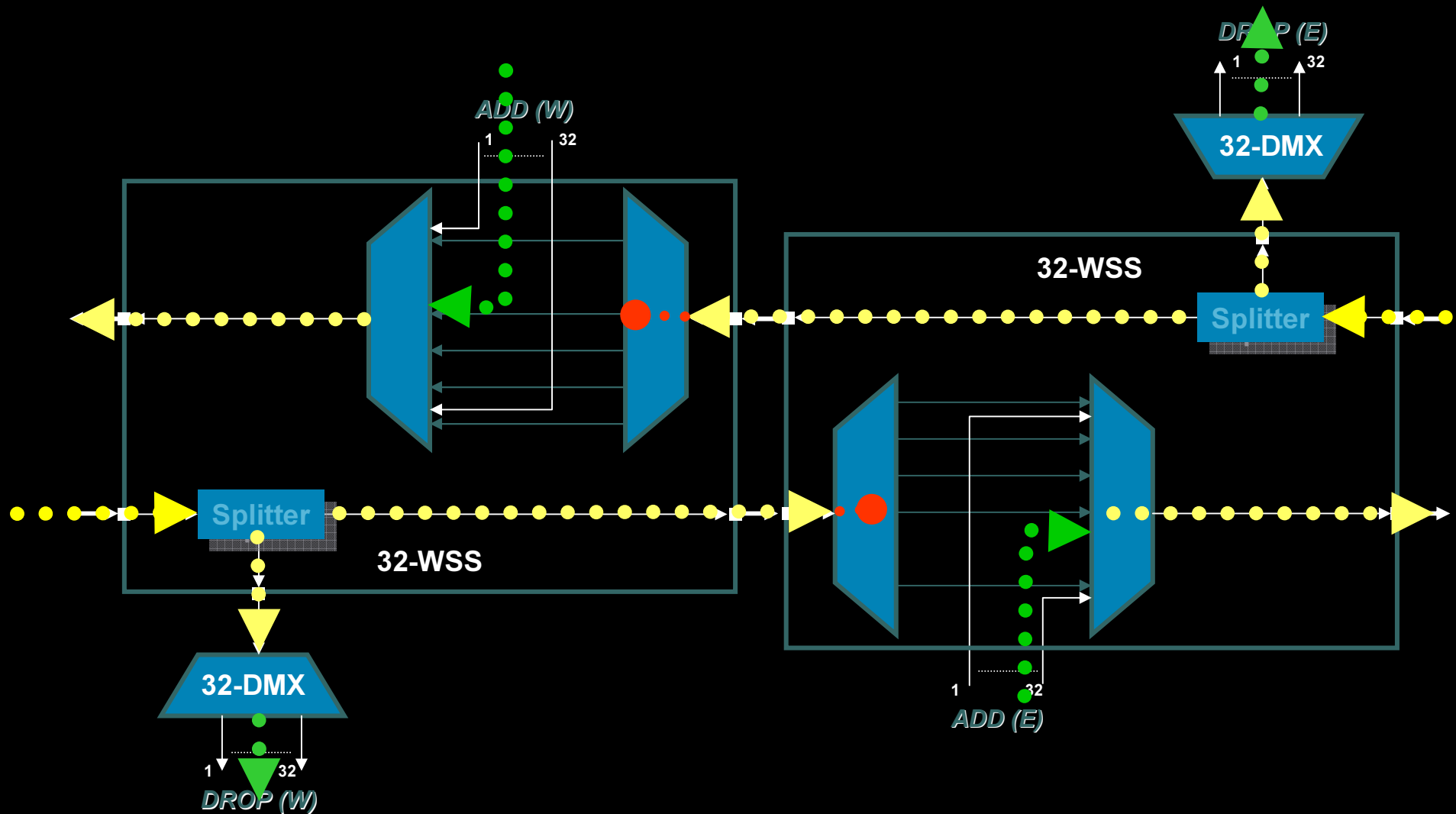
*Based on Cisco Internal Study of Customer Requirements



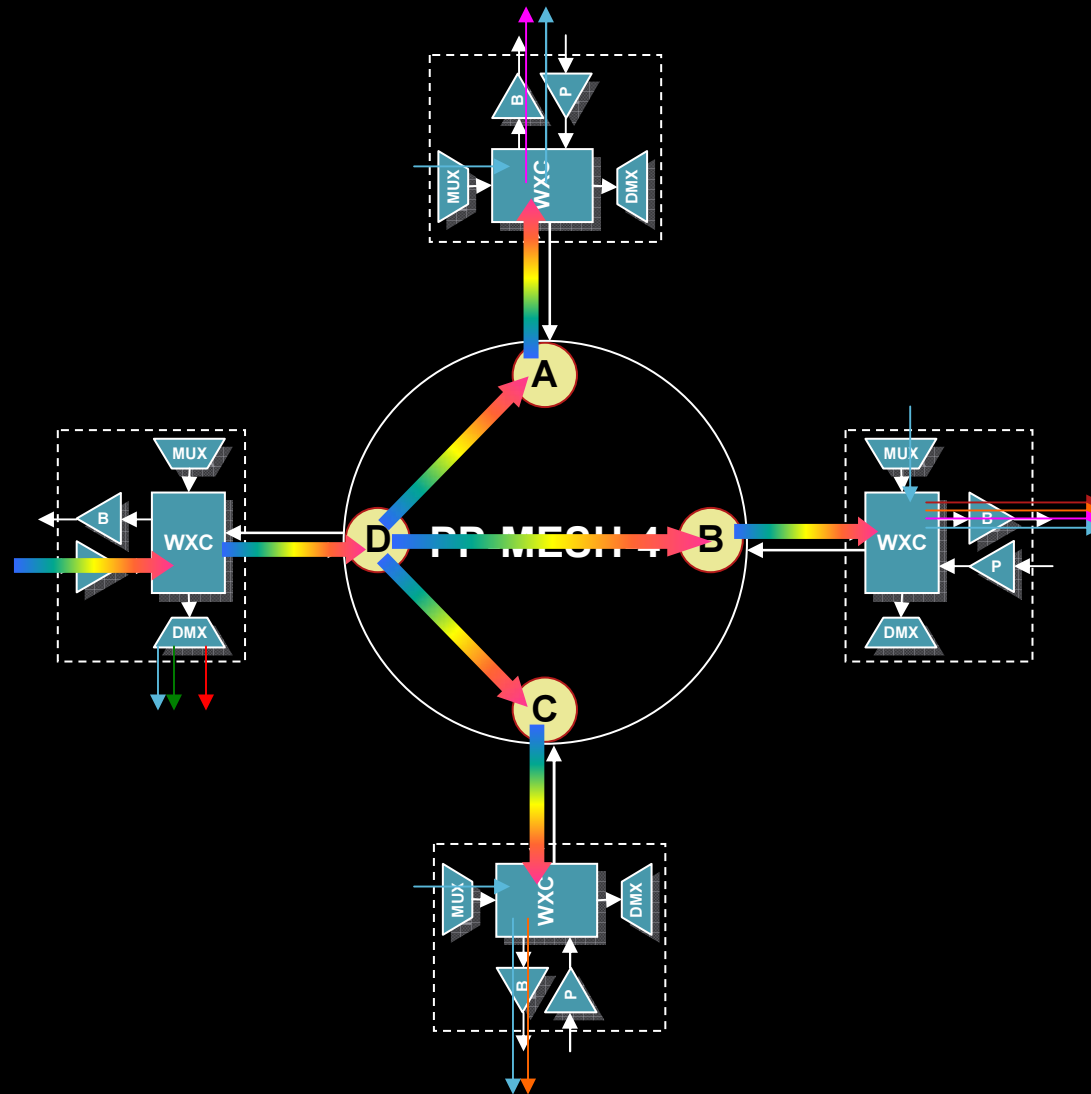
Fully Interoperable

Investment Protection

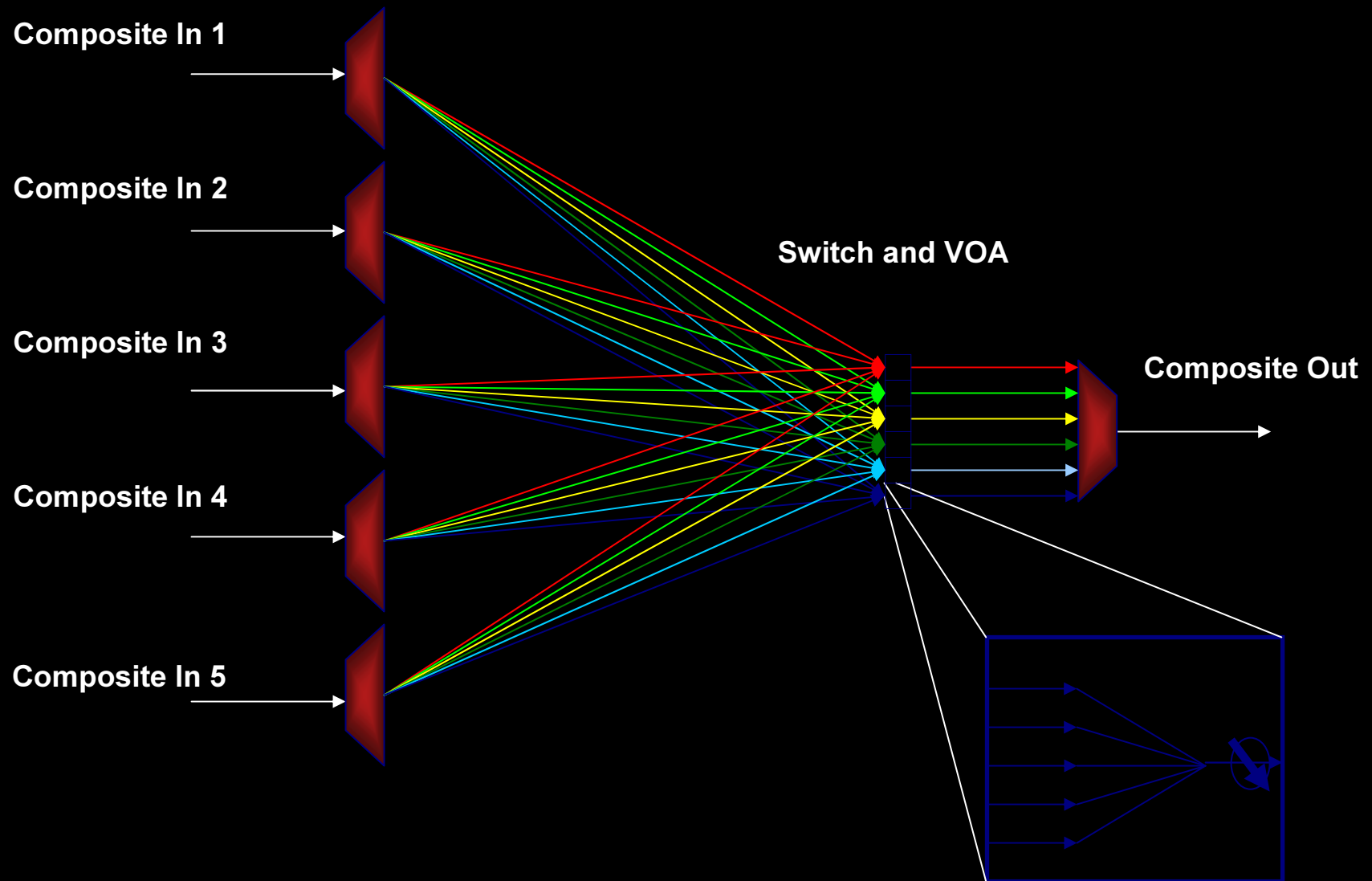
Degree-2 ROADM Node using WSS/DMX



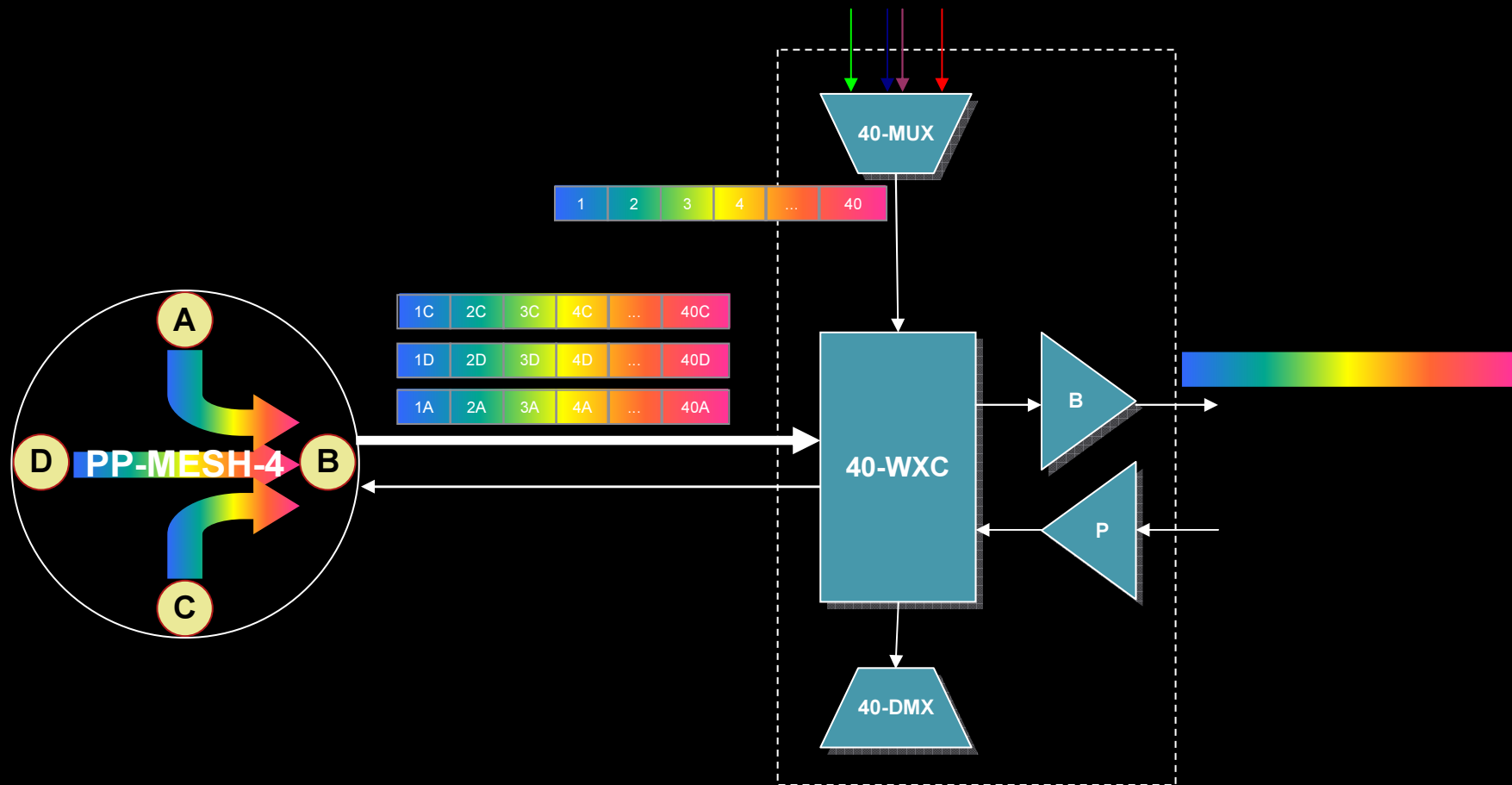
Degree-4 ROADM Optical Signal Flow



40-WXC Functional Block Diagram

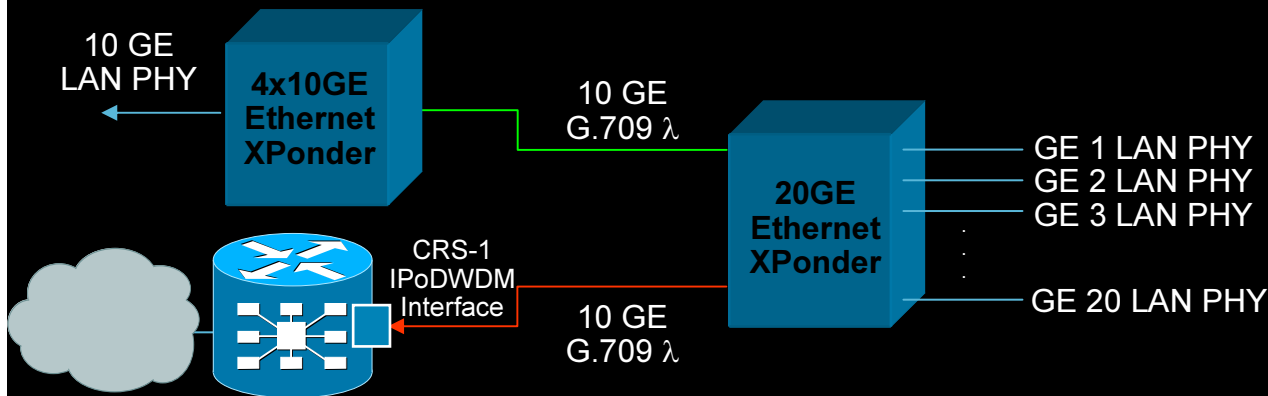


40-WXC Capabilities



Industry First Ethernet Aggregation Integrated into DWDM

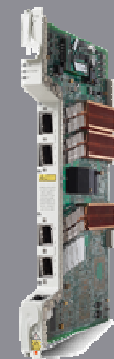
- Introducing Ethernet XPonder (Pronounced Cross-Ponder)
- Single card for Ethernet ADM function, muxponder, transponder
- Innovations:
 - Layer-2 Ethernet aggregation of NxGE into 10GE
 - Sub-wavelength add/drop and drop and continue
 - 50 ms resiliency
 - G.709 (WDMPHY): reach & SONET-like monitoring
 - SONET clocking synchronization over Ethernet



MEF 9 and 14 Certified



20xGbE and 2x10GE XPonder



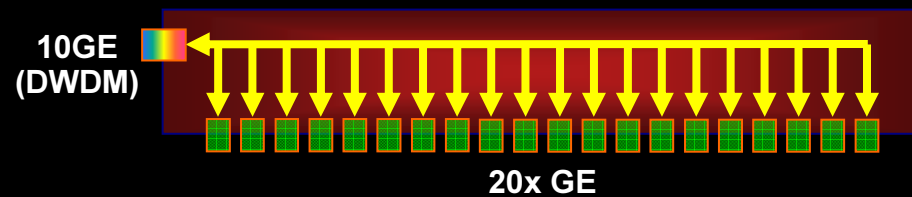
4x10GbE XPonder

GE XPonder Operating Modes

- **Fixed Configurations**

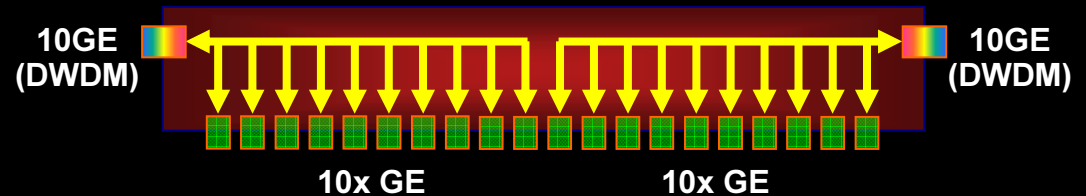
- **20x GE Muxponder**

- Default Per-port Traffic Load is 50% (configurable - w/ or w/o Flow Control)



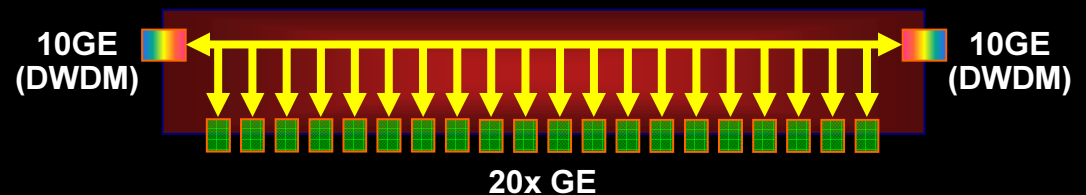
- **2x 10x GE Muxponder**

- Full GE rate multiplexing of Clients to independent Trunks (10th port @ 99%)



- **Layer2 Switch**

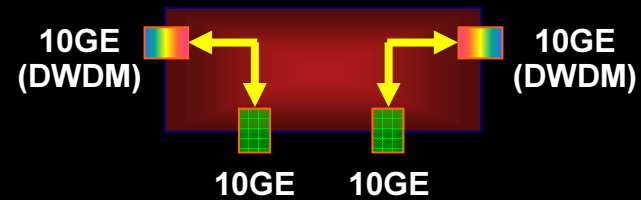
- **Possible to map any port to any port (GE or 10GE) leveraging on Layer2 VLAN**



10GE XPonder Operating Modes

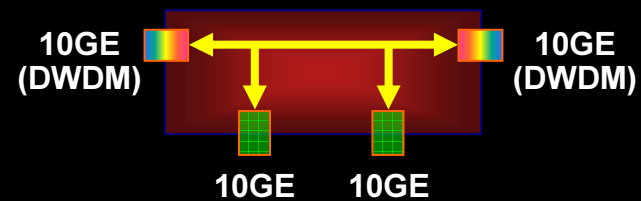
- **Fixed Configuration**

- **2x 10GE Transponder**
Supports 10GE LAN PHY



- **Layer2 Switch**

- Possible to map any port to any port leveraging on Layer2 VLAN



- **10GE LAN PHY DWDM Regenerator**



L2 Switch features (1)

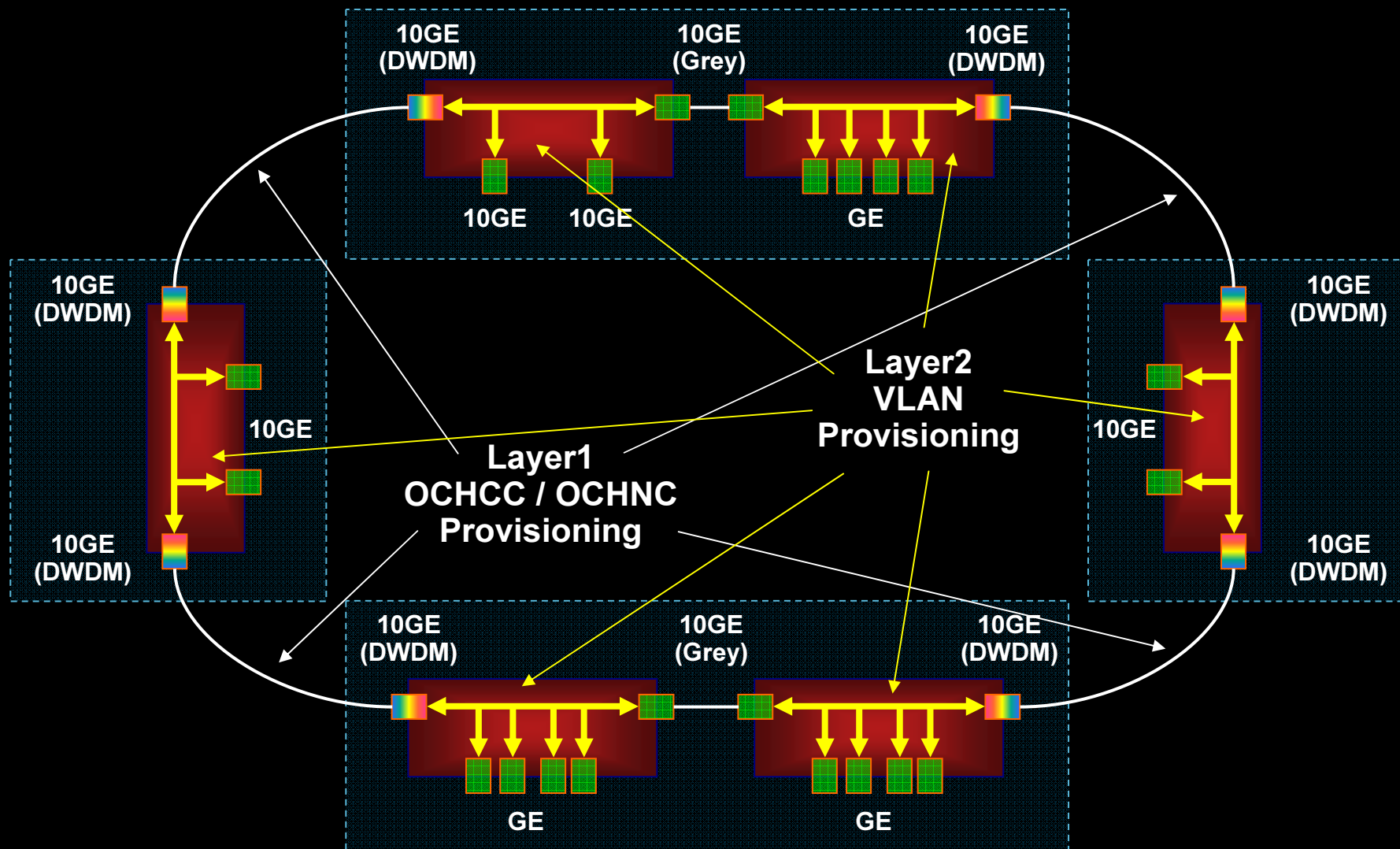
X-Ponder can be configured as a L2 switch supporting following feature set

- **MAC Address**
 - Support a MAC address table with up to 16k entries per card
- **VLAN Management**
 - Virtual Bridged LANs support according to the IEEE 802.1Q
 - VLAN tagging support according to IEEE 802.1Q standard
 - Up to 4096 VLAN-ids on all ports
- **Spanning Tree***
 - Rapid-STP (RSTP) according to IEEE 802.1W standard support
- **Multicast**
 - Multicast replication based on Destination MAC Address. The replication shall happen within the same VLAN
- **Security:**
 - Per-port traffic block for a user provisionable pre-defined set of MAC addresses
 - "L2 Control Protocol Tunnelling" functionality Support
 - User provisioned L2 Control Protocols behaviour (Drop or Tunnel)

L2 Switch features (2)

- Provider bridges support as defined in IEEE 802.1ad standard
 - S-TAG (or Outer tag, or QinQ) support
 - "L2 Control Protocol Tunnelling" functionality Support
 - User provisioned L2 Control Protocols behaviour (Drop or Tunnel)
 - S-VLAN VID translation support through a provisionable VLAN translation table
- QoS
 - 7 egress queues per port scheduled with a Weighted Round Robin (WRR) algorithm.
 - Egress strict priority queue per port
- Policing
 - Single-Rate 3 colour marker (SrTCM). Marking will be based on the following parameters:
 - Committed Information Rate (CIR)
 - Committed Burst Size (CBS)
 - Excess Burst Size (EBS).

GE/10GE XPonder Layer2 Example

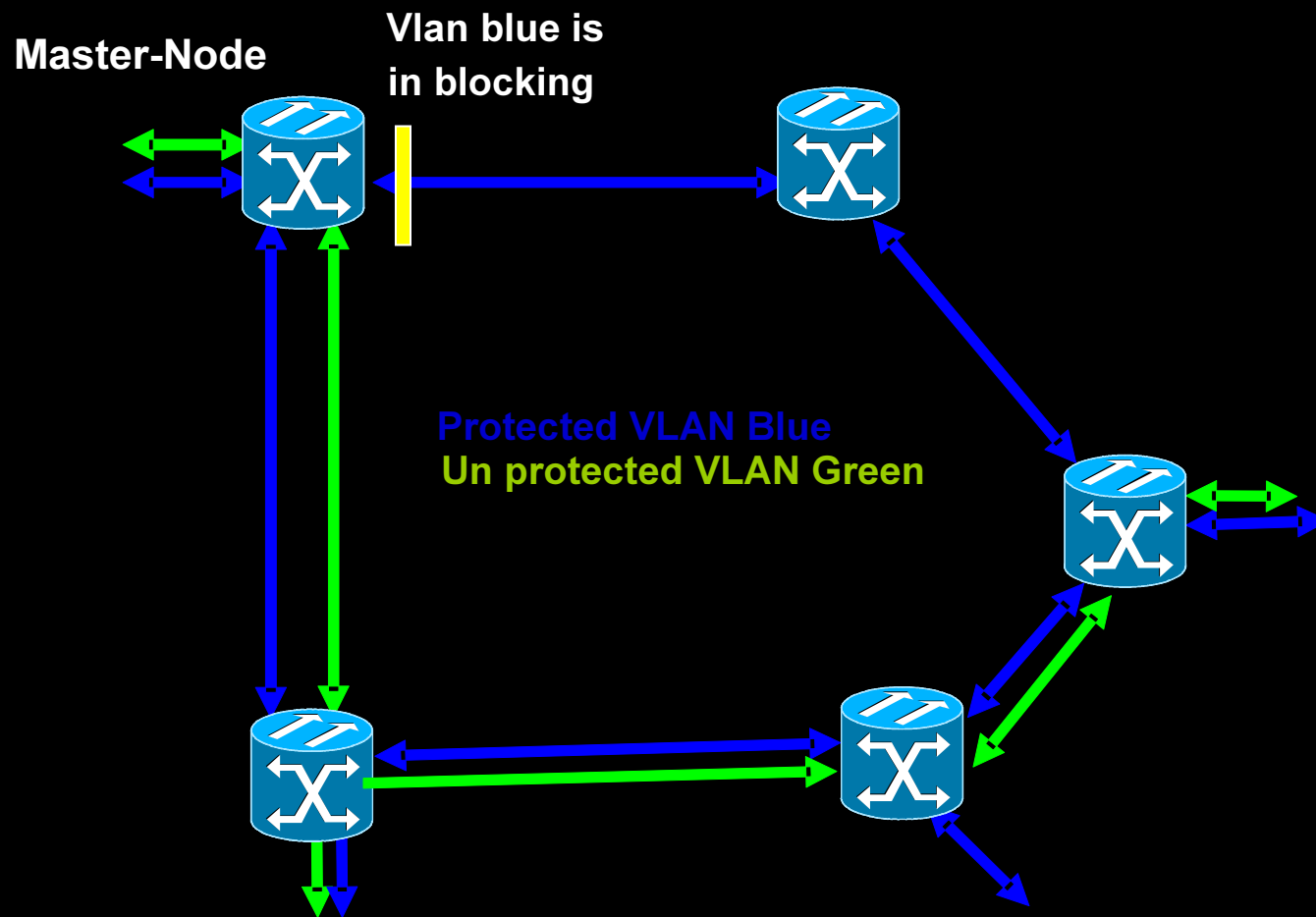


Smart Optical Packet Ring Protection

Basic concept

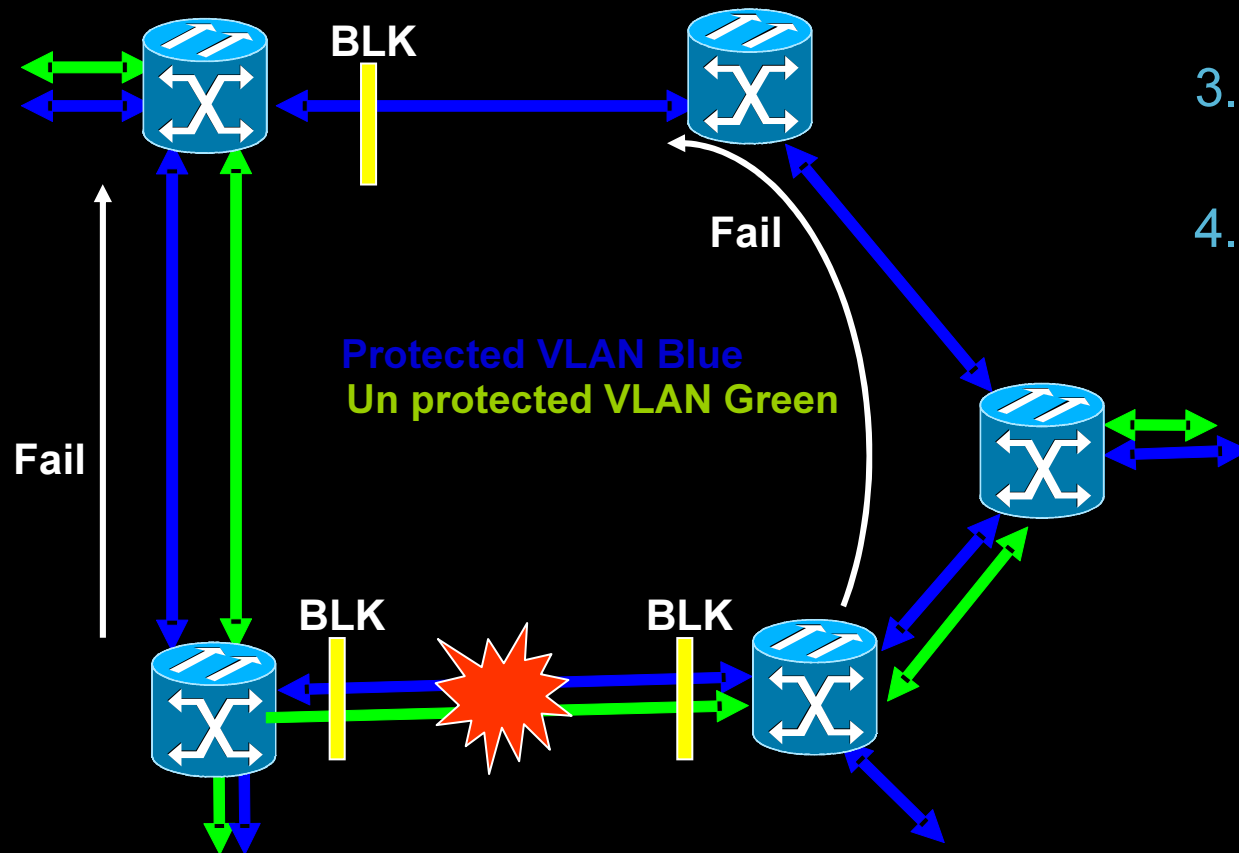
- Revolutionary Protection Mechanism integrating G.709 messaging with Ethernet VLAN mechanism when configured as L2 switches
 - Protection mechanism is achieved using mix of Layer 1 and Layer 2 functionality
 - Fault detection and failure propagation is done via the G.709 bytes. Failure propagation is done at HW level
 - Traffic is flood for each protected VLAN around all 10GE WDM ring.
 - One node is identified (by user config) as master-designated node/port. This node/port is responsible for open-close L2 VLANs loop in case of failure
- Up to 256 protected VLAN can be configured
- Sub 50ms recovery time

Network example



Network example: FAIL

Master-Node

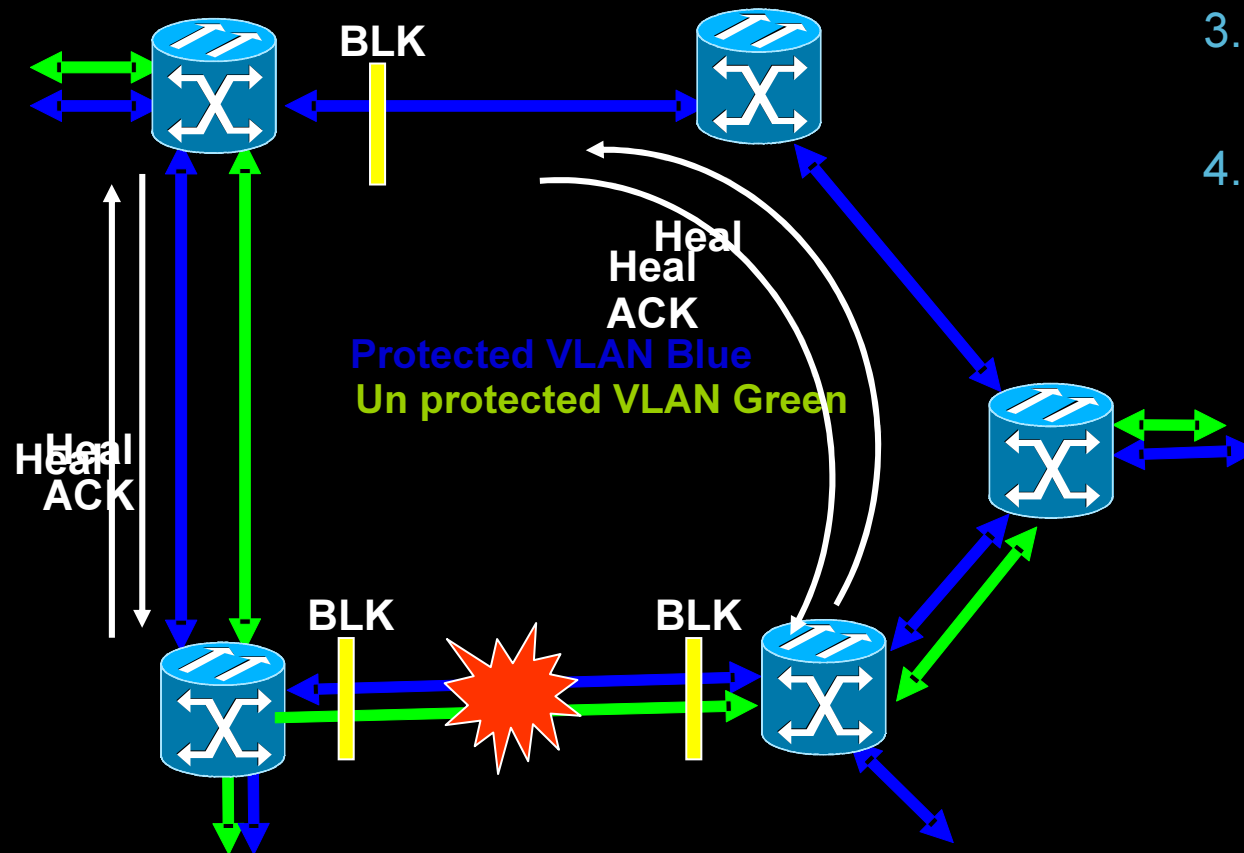


1. Fail detection
2. Port facing the fail in BLK
3. HW fdi/bdi propagation
4. Port on master node in FWD

Network example: Recovery

1. Recovery detection
2. HW Heal propagation
3. Port Port on master node in BLK
4. Heal ack received and BLK removed

Master-Node



Recent Public References

- **Shanghai's Oriental Cable Network Selects Cisco to Deploy First ROADM Optical Networking Technology in Mainland China**
http://newsroom.cisco.com/dlls/2008/prod_011708.html - 17 January 2008, China
- **Saddleback Communications' XPonders Enable World Class Business Services**
http://www.cisco.com/en/US/prod/collateral/optical/ps5724/ps2006/prod_case_study0900aec8073eea2_ps2006_Products_Case_Study.html - 14 January 2008, USA
- **Cisco's MSTP Brings New Benefits to Hong Kong Businesses**
http://newsroom.cisco.com/dlls/global/asiapac/news/2007/pr_07-12.html - 12 July 2007, Hong Kong
- **Ukrtelecom Completes Second Phase of National Fiber Network With Cisco**
http://newsroom.cisco.com/dlls/2007/prod_050707c.html - 7 May 2007, Ukraine
- **Bulgarian Telecommunications Company Expands Cisco IP Next Generation Network for Triple-Play Service Growth**
http://newsroom.cisco.com/dlls/2007/prod_041207b.html - 12 Apr 2007, Bulgaria
- **Charter Communications Enhances Business and Residential Service Delivery with Cisco IP NGN Architecture**
http://newsroom.cisco.com/dlls/2006/prod_101806.html - 18 Oct 2006, USA
- **New Jersey Turnpike Authority Upgrades Network with Cisco Optical Solution**
http://newsroom.cisco.com/dlls/2006/prod_060606.html - 6 Jun 2006, USA
- **MobiCom Deploys State-of-the-Art Optical Network with Cisco Solution**
http://newsroom.cisco.com/dlls/2006/prod_060206c.html - 2 Jun 2006, Mongolia

