Packet-Optical Evolution
Realizing Practical Control Plane interoperability

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Agile Core Network

Traditional Networks

New Applications

Packet Switching and Optical Transport

- Collapsed networks
- Integrated technologies
- Dynamic and easy to operate

Packets

Time Slots

Wavelengths

Purpose-built platforms
- One technology
- Static

Automated packet and optical transport
A scalable NGN foundation with flexibility and simplified operation
“…Big, fat, dumb pipes…”

For nearly all of the last two decades, IP network architects have been asking the transport layer to provide big, fat dumb pipes.

Transport network architects have had a different vision
Networking Realities

“The industry is poised for strong growth through 2014, when worldwide cloud services revenue is projected to reach $148.8 billion.”
Gartner, June 2010

“Mobile market is booming — we expect 60% backhaul equipment market growth in 2009. ...We see no letup in the market...”
Infonetics Research, November 2009

“IPTV Service Revenue will grow from US$17.5 billion to US$46 billion in 2014.”
Multimedia Research Group, Inc. June 2010

Cloud computing drives ENTERPRISE NETWORKS

Mobile broadband drives ETHERNET ACCESS

Video content drives CARRIER INFRASTRUCTURE

Three solid growth trends drive sustainable demand for our converged Optical+Ethernet transport solutions
Networking Realities

Cloud computing means
HIGHER SPEED CUSTOMER INTERFACES
LOWER LATENCY NETWORKS

Mobile broadband means
MORE DYNAMIC AND STOCHASTIC NETWORKS

Video content means
HIGHER TOTAL NETOWRK BANDWIDTH

It’s time for a new level of integration between IP and transport
Integrating Packet and Optical Networks

Traditional networks
- Management silos enforce operational separation, slowing reaction to traffic changes
- Layer interconnection drives interface counts

Operational simplification
- Flexible, reconfigurable optical layer
- Optical interface integration
- Operational integration of control plane and service/network management
Agile Core Network
Market Trends and Requirements

Rapid bandwidth demand increase

Unpredictable traffic patterns
Increasing peak-to-average bandwidth demand

Agile Core Network
• Flexible traffic management at the lowest possible / best suited OSI layer
• Data Center and PoP consolidation support
• Multi-layer awareness

The Agile Optical Core provides more capacity, reach and flexibility; Network resources can be allocated on demand.
Unrestricted Wavelength Connectivity Add-On to Standard ROADM Configurations

Fixed

Directionless

Dir-/Colorless

Contentionless

Contentionless add/drop ...

- ... is a fully non-blocking switch array
- ... is designed to be used together with coherent channel card interfaces

Efficiency and simplicity by new ROADM technologies
Integrated Multi-Layer Control

- Client
  - Clients see port-based EVC interfaces

- Ethernet
  - Ethernet tunnels via control plane signaling, "inner" tunnels

- DWDM
  - Optical tunnels via control plane signaling, "outer" tunnels
GMPLS Interworking

- **Control Plane**
  - Optical tunnels setup via CP; label is Lambda
  - Ethernet tunnels also setup via CP; label is VLAN tag
    - VLAN tag may change along service path, per policy

- GbE 1310nm to transponder
- STM64 DWDM to ROADDM
- RSVP-TE, OSPF-TE
- 10/100 eth (fe0, eth0)
- GRE tunnel
- OSC
“...Big, fat, smart pipes...”

› Create a virtual mesh on DWDM layer
  › PSC layer is realized as a fully meshed one-hop network.

› Eliminate transponders
  › Support DWDM optics directly on router
  › $2500 to $4500 savings for 10Gbps network interface depending on use of core or access cards

› In existing organizations
  › Bring WDM efficiencies to the router teams
    • DWDM interfaces directly on routers give access to the transport “pipes” available in the network
  › Remove intra-company lag to turning up new wavelengths for more efficient peering
    • End-to-end Ethernet services can be provisioned across optical transport network by existing router teams
  › Enable new “on demand” services
Agile Core Evolution

1. Control plane interworking
   - Provisioning & restoration
   - Link state statistics

2. Alien wavelength support
   - Colored interworking
   - Control plane support of alien wavelength

3. Fully integrated packet optical switching solution
   - Maximizes interfaces and operational efficiencies
   - Unified network management and control plane
Thank You

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