



Understanding the Impact of Ethernet on the Optical Layer

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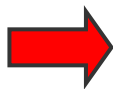


- **The transition to 21st Century Networking**
 - Reference Transport Architecture for NGN
- **Optical Layer Evolution**
- **Ethernet and Optical Convergence**
- **Emergence of Carrier Ethernet Transport**
- **Service Provider Advantages of Ethernet Tunnel Switching (eg. PBT)**
- **Migration to NGN**
- **Summary**

The Transition to 21st Century Networking

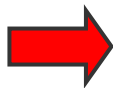
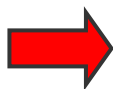
▪ 20th Century

- Transport of bits
- Closed OADM ring
- Separation of Ethernet Aggregation layer and Optical domain



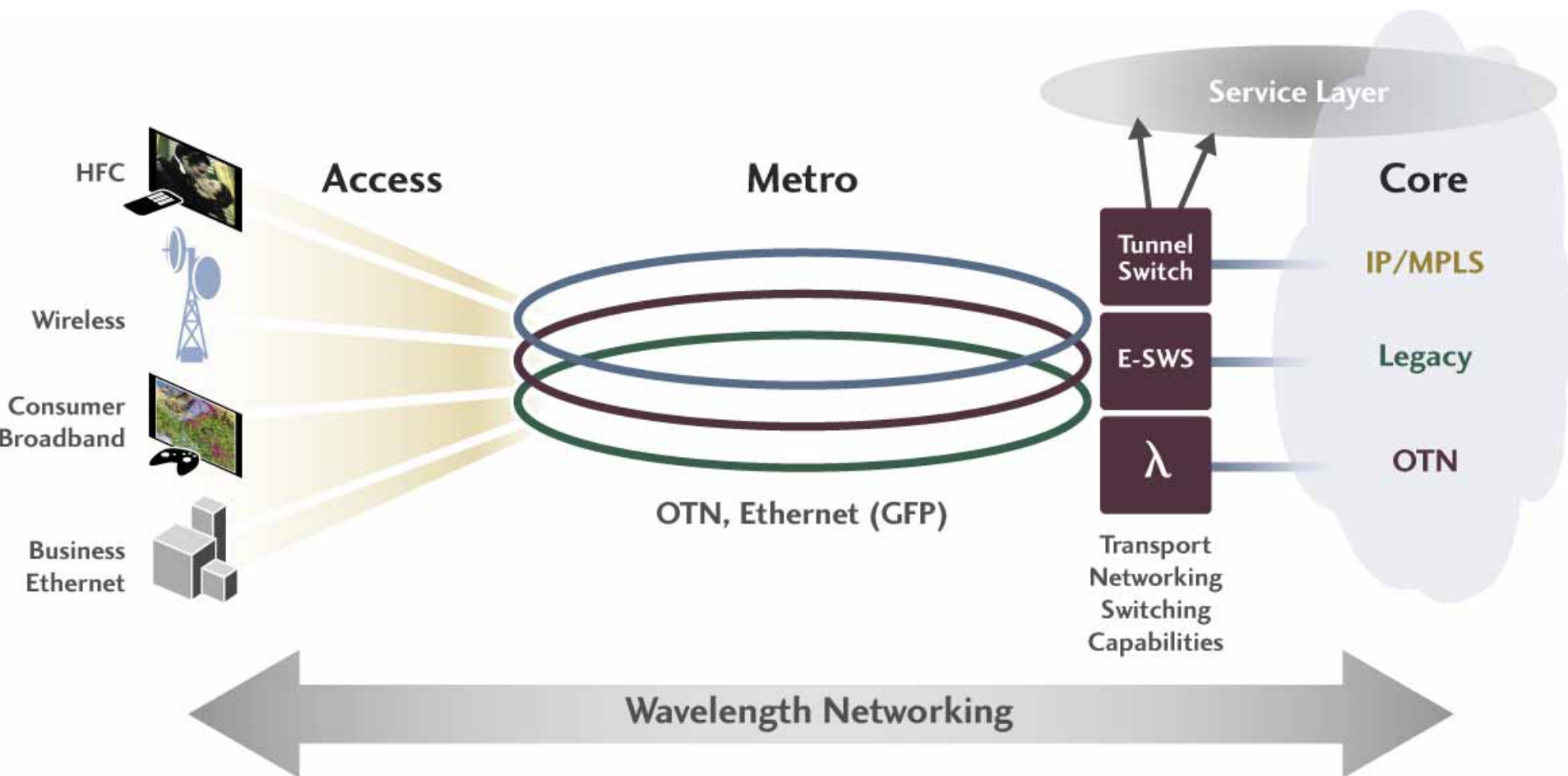
▪ 21st Century

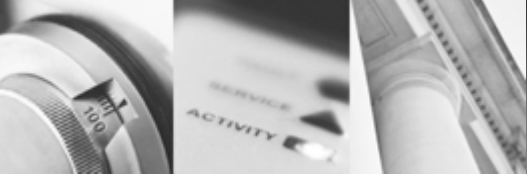
- Switching of connections (Subrate λ paths and full λ s)
- Multi-ring access and multi-degree Metro switching
- Convergence of the Ethernet-Optical layer



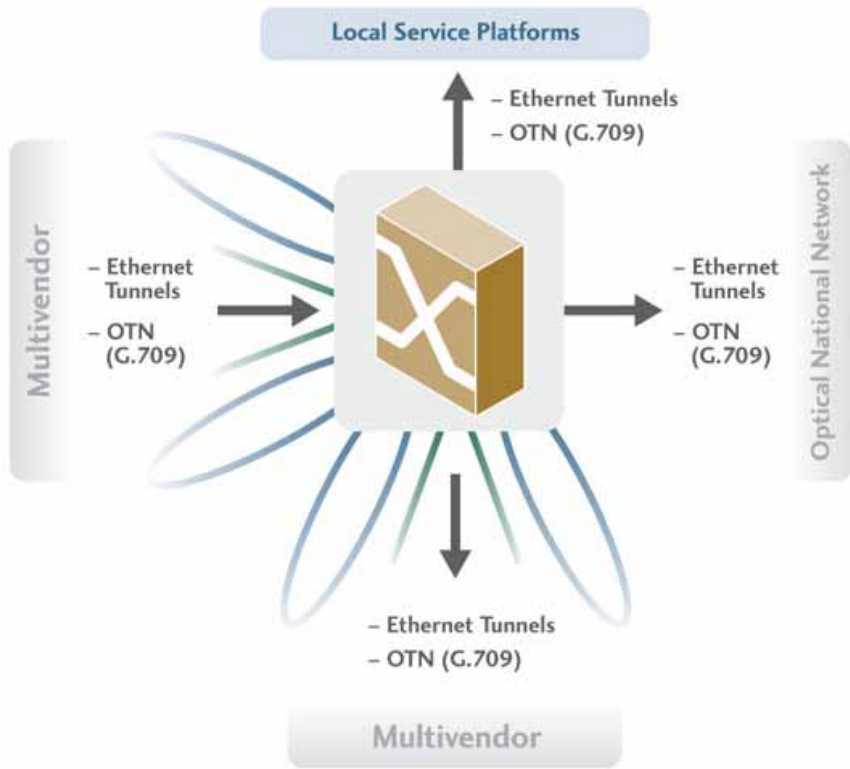
**Fundamentally changing the value model
of the transport infrastructure**

Transport Architecture for NGN





Optical Layer Evolution



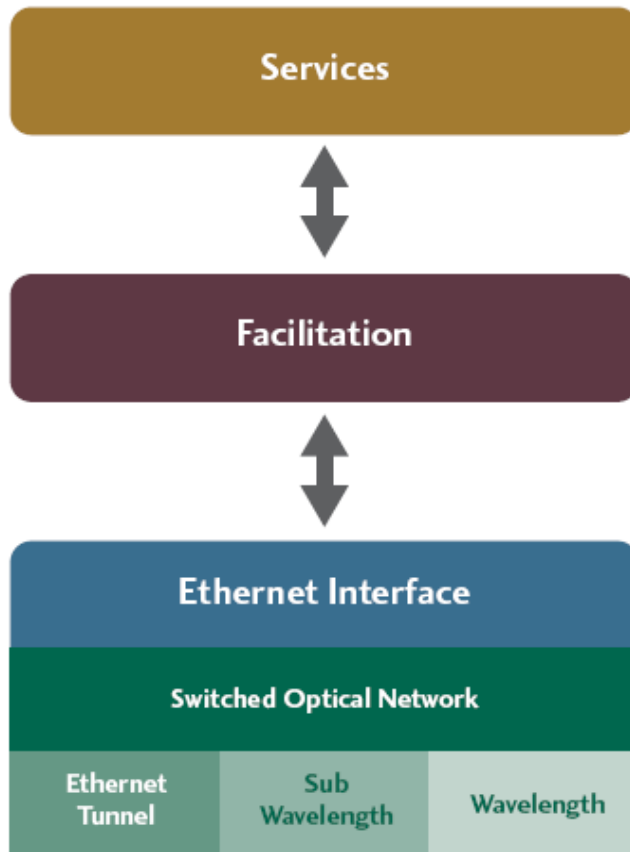
- **All about Ethernet**
 - Gig E bandwidth will be driven deep into the Metro Access Network
 - To each node will be n x GigE....to start
 - Evolution to 10 Gig Wavelength Transport
- **Dramatic Increase in Number of endpoints**
 - Wireless and Wireline service delivery points
- **Optical Wavelength Networking**
 - No single topology (ring, linear, mesh etc)
 - Architectural Flexibility Thru Multi-degree Switching
 - CWDM & DWDM
 - End to end optical path planning and management
- **Evolution Of Optical Layer Intelligence**
 - Ethernet Gateway functions in the optical layer
 - Optimize handoff of Ethernet from Optical layer



Carrier Ethernet Transport

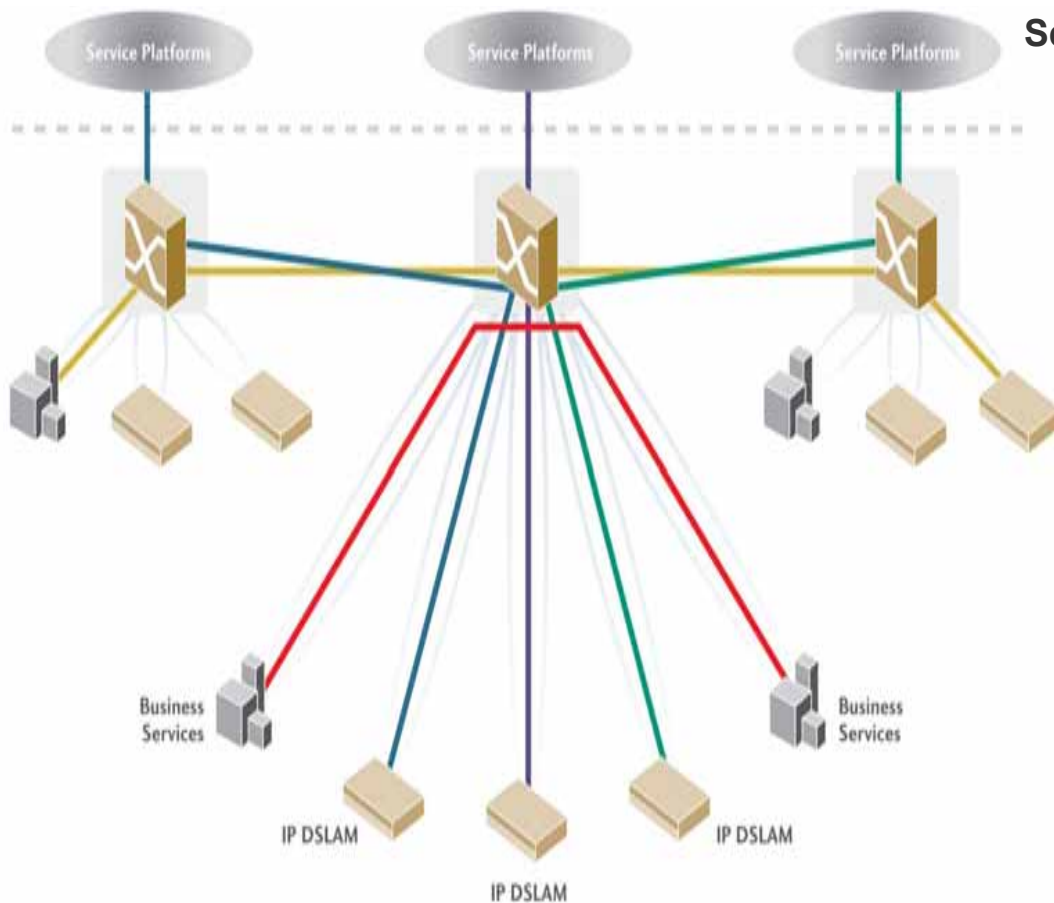
- **Carriers looking to leverage the use of Ethernet in the metro networks**
 - Standardize on Ethernet as an interface
 - Leverage cost advantages of Ethernet
 - “Optimize” Ethernet networking functions for carrier networks
 - Not all Ethernet “Enterprise networking” functions optimal for carriers
- **Use Ethernet as a “Tunnel Support” protocol**
 - Creates “circuit orientated” end to end Ethernet tunnels
 - Precedent set with IP core networks where MPLS is used
- **Range of standards based Tunnel methodologies under discussion**
 - IEEE: Provider Backbone Transport; 802.1ah
 - IETF: Pseudowire; T-MPLS

Carrier Ethernet & Metro Service Layer Abstraction



- Common methodology for the delivery of transport services
 - Transparency
 - Scalability
- End to end Ethernet tunnels that are business routable
- Abstract direct connection between services and underlying optical network infrastructure
- Retain value of Ethernet as the common interface to the network infrastructure

Ethernet Applications over Carrier Ethernet Transport



- Separation of Ethernet services from Ethernet transport enabled by carrier Ethernet transport
- Services platform separation from underlying transport infrastructure topology
- Applications: Consumer broadband, business interconnect, wholesale, LLU



Ethernet over Optical layered Vision

Multi-degree wavelength transport and switching via OEO and ROADM

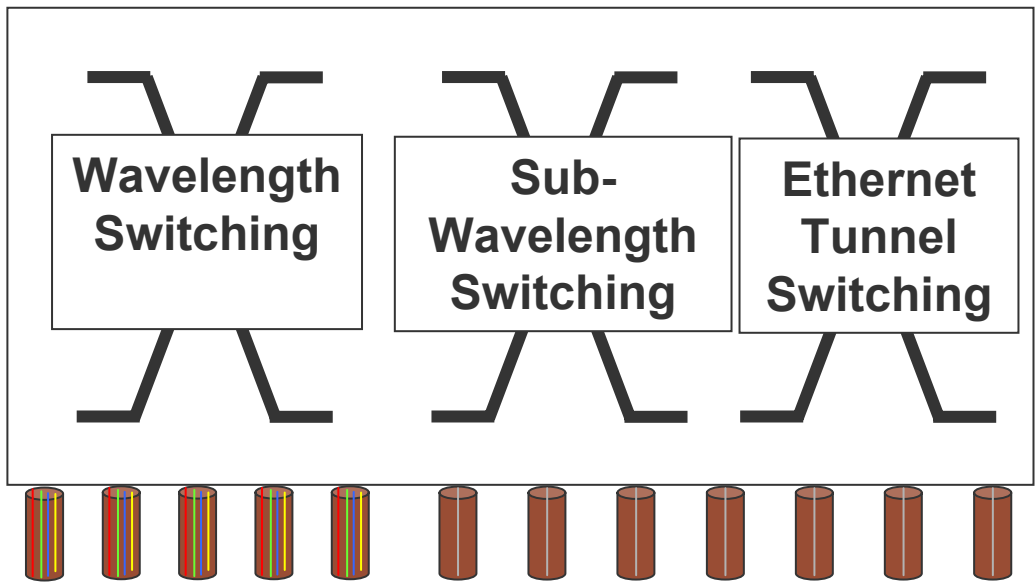
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Layer 1-based Ethernet Sub Wavelength Switching

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Layer 2 Ethernet Switching

... in a single carrier-class platform



C/DWDM fibre pairs

Grey interfaces: GigE/10GigE, STM-n/OC-n, SAN

From any port, wavelength, or Ethernet tunnel
To any other port, wavelength, or Ethernet tunnel.

Ethernet circuits as tunnels, e.g. using PBT/T-MPLS

- To simplify Ethernet transport
- To reduce explosion of optical ports
- Cost optimal Carrier Ethernet Transport

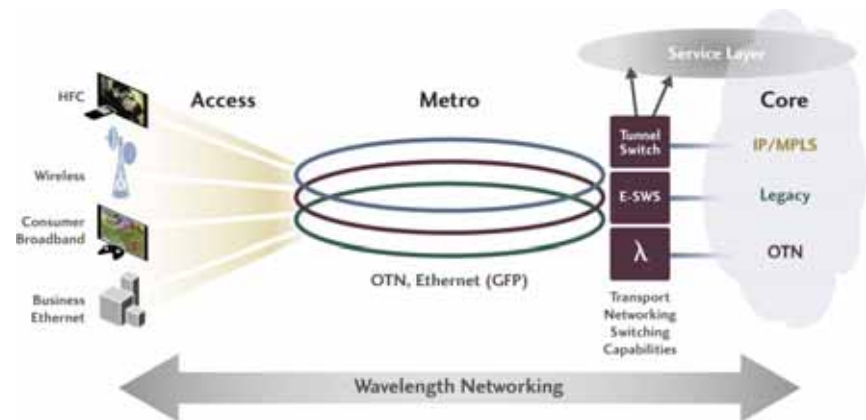
Integrated Service Switching for Optical and Packet Transport

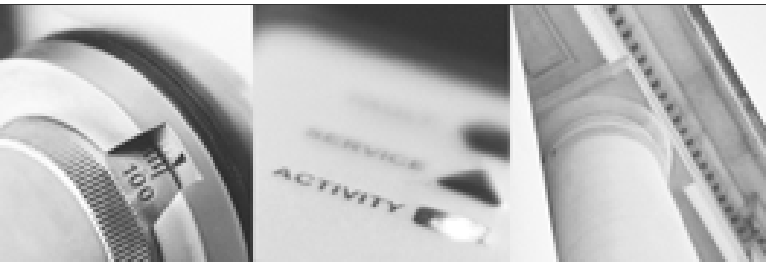
Migration to NGN

Network Mode	Legacy	Current NGN	Future NGN
Connectionless Packet - short messages	IP	IP	IP
Connection-Oriented Packet - Large files or streams	ATM, FR, MPLS, Ethernet	Ethernet/VLAN, MPLS	Ethernet/PBT
Circuit Switched - Aggregates of messages, files or streams	SDH	SDH	OTN

Summary

- Optical wavelength Networking required deep into the Metro Access Network
- Ethernet will be used as a tunnel support technology in conjunction with Optical Switching to deliver Carrier Ethernet Transport
- Value in optical networks will transition to the ability switch (ODU-0/GigE) within the optical domain on an end-to-end basis and provide transparency between packet and Optical layer
- Ensures the abstraction of the Service Delivery architecture from the underlying infrastructure topology
- Three key “Switching” Network capabilities required at strategic points in the optical transport network (integrated or used independently)
 - λ Switching
 - Sub-Wavelength Switching
 - Ethernet Tunnel Switching





Thank you