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Future Market Potential for 100G Ethernet, An MSO Perspective by Time Warner Cable

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Topics of Discussion

- => **Generalized Multi System Operator (MSO) Perspective**
 - Brief follow up from Comcast's presentation (Monterrey meeting)
- => **Data Points Describing Upward Bandwidth Trends**
 - Access / HFC / Deep Fiber
 - Metro Networks
 - Regional Networks
 - National Networks
- => **Primary Application Drivers** (ca 2009-2011)
 - Symmetry of HD-Video over Broadband (STB, DOCSIS, FTTN)
 - Virtual Storage ("... the network is the computer")
- => **Observations and Suggestions**
 - Incremental Change vs. Wholesale Replacement
 - 100G PHY Cost Requirements and Containment
 - Operational Concerns and Market Timing

Time Warner Cable

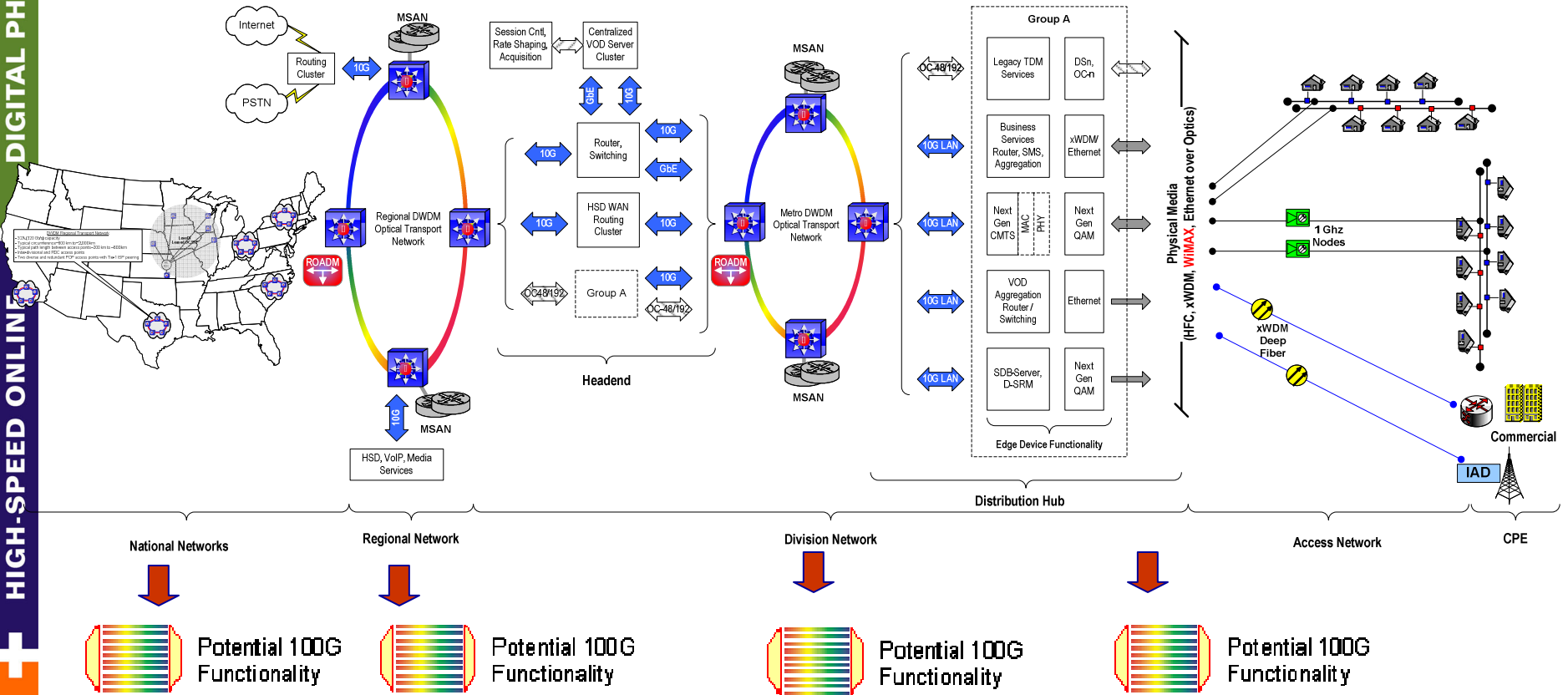
- Time Warner Cable service passes more than 26 million U.S. homes, and serves 13.5 million basic video customers, 7 million being digital customers and 6.4 million HSD and over 2 million voice customers in 33 states, grouped in five 'clusters' or regions in the North East, South East, Midwest, Texas and Southern California
- Have been in the cable business for over 30 years.
- Industry innovation contributors in technology areas including hybrid fiber coax (HFC), Video on Demand (VoD), addressable digital set top boxes, cable modem (DOCSIS), network-based digital video recording (nDVR) and open conditional access systems and development platforms
- Time Warner Cable is part of the Time Warner Inc. family that also produces film and print media
- Active participants in standards bodies including the SCTE, CableLabs, IEC, ITU, OIF, IETF and IEEE

TWC Architecture, Edge to Core

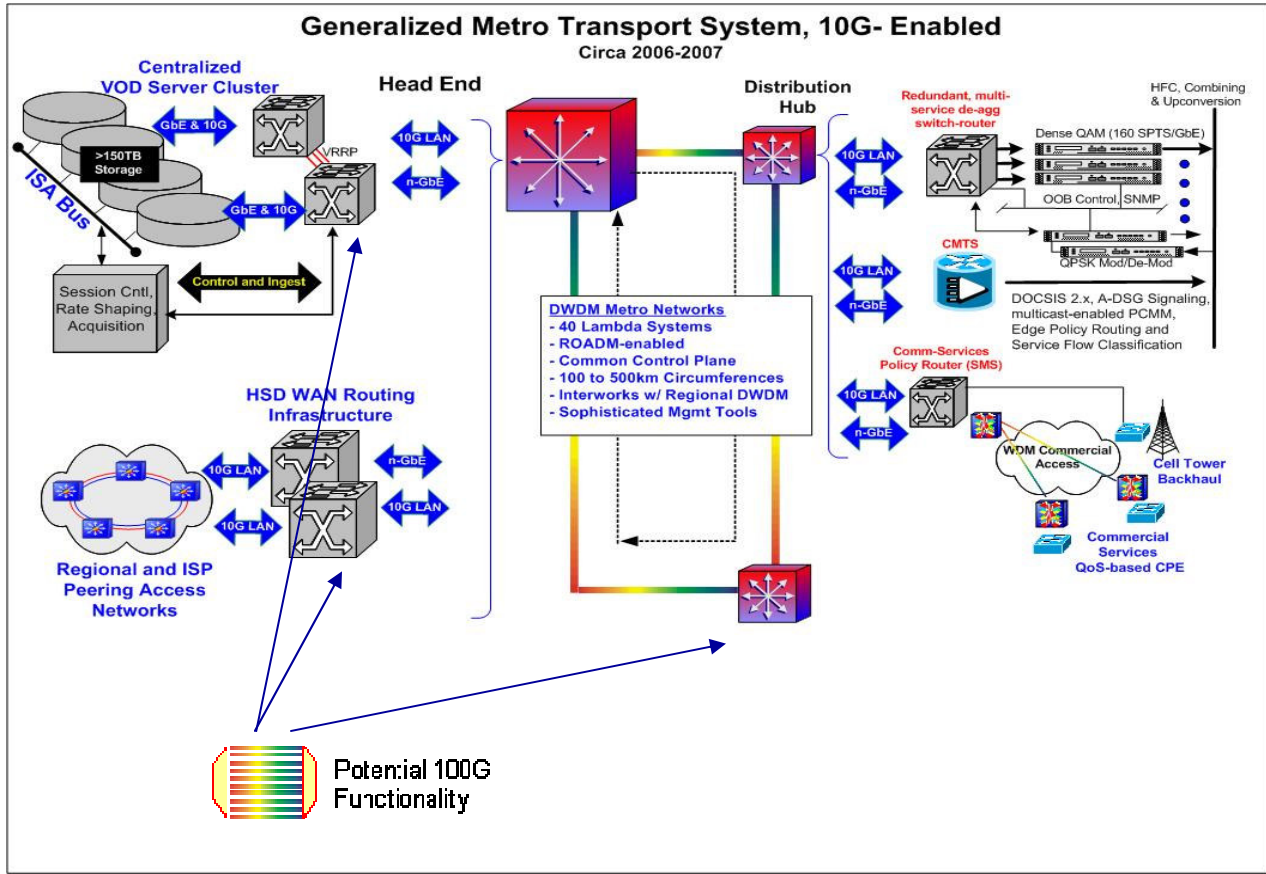
DIGITAL PHONE

HIGH-SPEED ONLINE

CABLE



From edge to core, Ethernet used as the dominant convergence layer



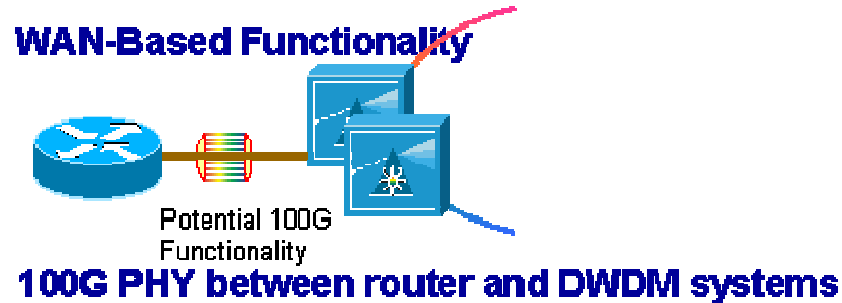
1. Edge aggregation function (SDP, ESLAM, etc.) where we see large number of Ethernet interfaces increasing over time.
2. DWDM wavelength exhaust rectified by interleaving or moving to 40/100G PHY's per λ
3. Using 100G PHY if implemented here must follow the cost trends seen in "commodity" optical and router technologies

Metro networks are a reasonable area to focus 100G development

- => **HD and SD Video (MPEG-2 and AVC-based)**
 - National content and acquisition systems and stores help deliver source material from programmers
 - NG-VOD servers become 10G-enabled, support “switched-unicast”
 - HSD Networks (DOCSIS) merge with MSO’s legacy STB Networks
 - Home content media centers become common place, push technology explodes
- => **Virtual Storage**
 - Consumers require network-based storage as HD-video’s are produced in mass volumes, commodities in content creation both locally (home-based) and via the web portals
 - Solid state storage costs reduced, enabling distributed topologies to foster
 - Upstream bandwidth in carrier networks become critical (high availability a must)
- => **Commercial Services Follow Technology Trends**
 - Cost per carried Mbps is dropping two-fold per year as delivery methodologies become simplified (Ethernet over DWDM-based platforms)
- => **Consumer Mobility Requirements Force Carriers to Merge Networks**
 - Create partnerships- reducing capital outlays in building complementary networks
 - Additional ‘meshing’ occurs at the metro and core, e.g., NNI occurs outside of POP’s

=> Operational Concerns

Relative to the use of the PHY when implemented in a WAN configuration (diagram below):



1. Keeping 10G optical physics intact within the DWDM long haul network (invested amplifiers/OTN, 10G test gear, modeling tools) assuming 10 x 10G is used.
2. Graceful failover when one of the multiplexed channels fail
3. Embedded test and measurement points (OAM) per multiplexed channel, if exposed
4. Standard IEEE 802.1ag and ITU Y.1731 OAM integration

=> Cost Concerns: Making the Switch

The cost tradeoff's between 4 x 10G and 40G haven't been compelling of late— try and target an affordable cost point for the PHY (e.g., 4 to 5x current 10G PHY, 2009 costs)

=> Time to Market (36 month target)

⇒ Bandwidth growth in the service provider industry is a known fact. Specific growth curves are showing a 15% per year in the metro strata– and roughly 10% per year in the core strata (conservative estimates) barring disruptive business anomalies

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⇒ Timing for the interface being available is in line with our company’s technology refresh cycles

⇒ Building the interface that targets the WAN via router-DWDM interface is important to our business and industry

⇒ Cost targets of roughly 4 to 5 times the cost of discrete 10G PHY’s (LAN/PHY specifically) is good starting point for the 100G PHY. Keeping the costs as low as possible is critical for the adoption of the technology.

Broad Market Penetration for the 100G PHY in the MSO Market Space Could Be Beneficial in the 2010-2011 Timeframe Based on Conservative Growth and Technology Trends

Thank you for your attention

For more information, please refer to these resources:

(CableLabs) <http://www.cablelabs.org/>

(SCTE) <http://www.scte.org/home.cfm>

(Engineering Trade Pub's) <http://www.cedmagazine.com>