40GbE SMF for Carrier Applications
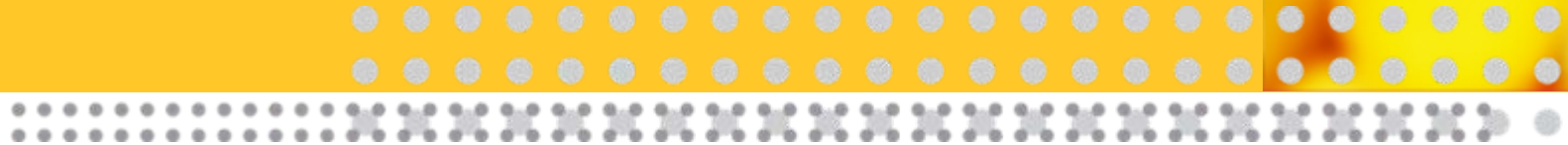
Jesse Simsarian and Terrance Rosadiuk

March, 2008

802.3ba Task Force Objectives

	40 GbE	100 GbE
Backplane, 1m	✓	✗
Cu, 10m	✓	✓
MMF, 100m	✓	✓
SMF, 10km	✗	✓
SMF, 40km	✗	✓

- 100m multi-mode fiber (MMF) is supported for both 40 GbE and 100 GbE
- The longer-reach single-mode fiber (SMF) interfaces are not supported for 40 GbE
  - Attempt to confine 40GbE to the data center
- 40GbE SMF is needed for inter-switch connections
  - Switch-to-switch connections within the data center
 - Link from the data center LAN to WAN

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How did we end up with 40 GbE and 100 GbE?
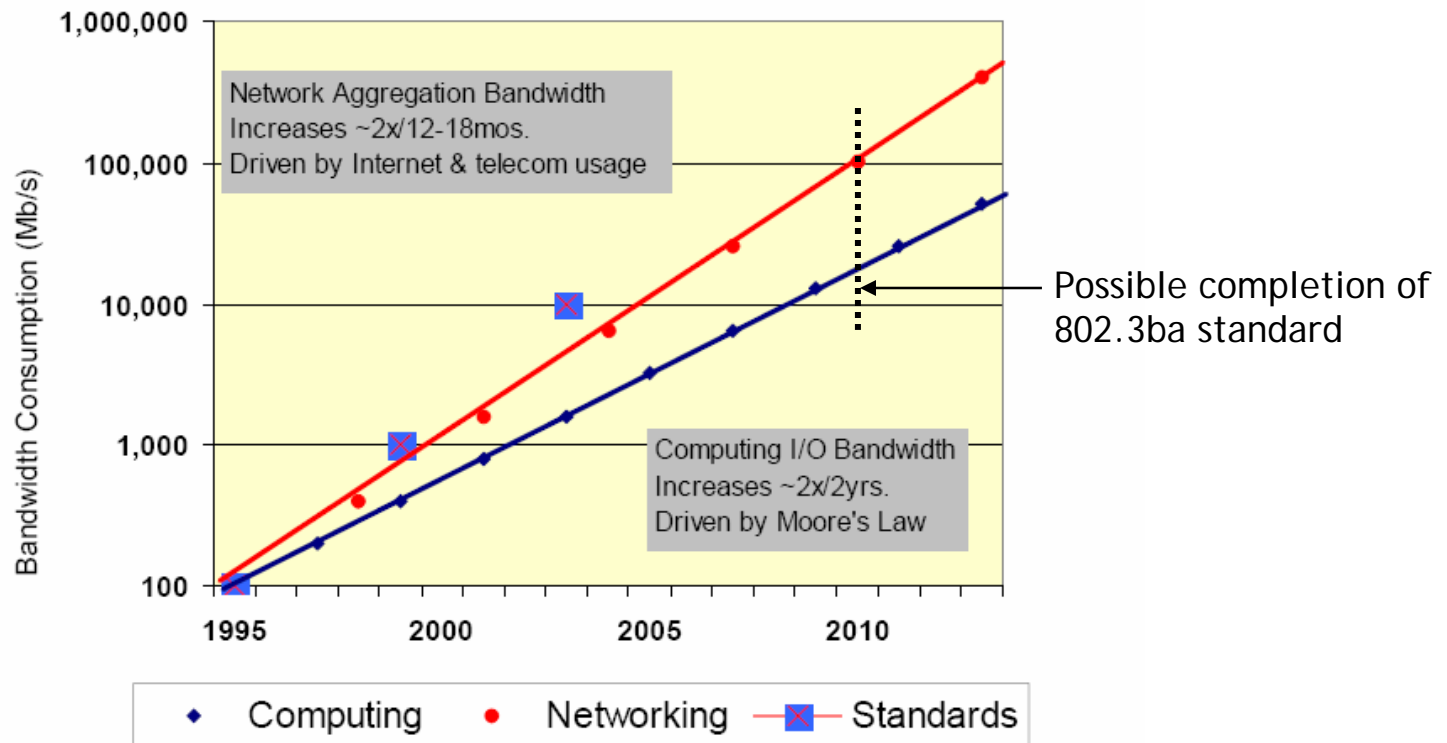
- "Bandwidth requirements for computing and networking applications are growing at different rates... which necessitates two distinct data rates, 40 Gb/s and 100 Gb/s.", 802.3ba Distinct Identity
- This is still true, however, the networking bandwidth consumption shown above is applicable to high-end applications such as video on demand
- Computer traffic aggregation applications will require 40GbE SMF
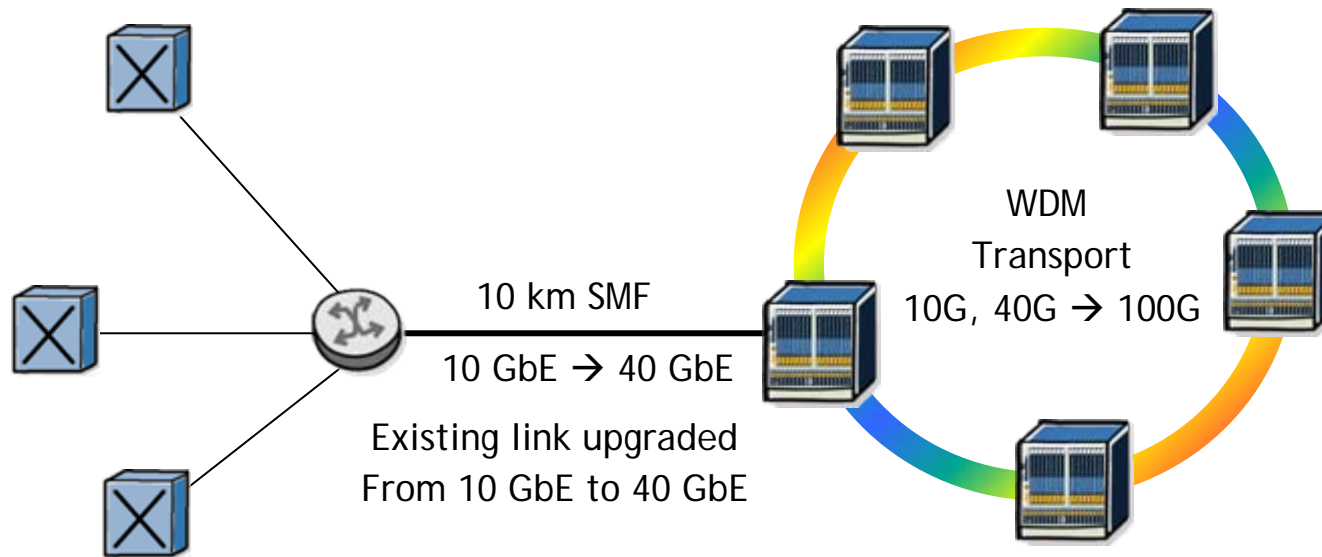 - Higher-speed switch port deployments lag the networking bandwidth curve (see barbieri_01_0108.pdf)

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OIF Carrier Working Group requirement for 40 GbE SMF

OIF Carrier Working Group Reference Architecture
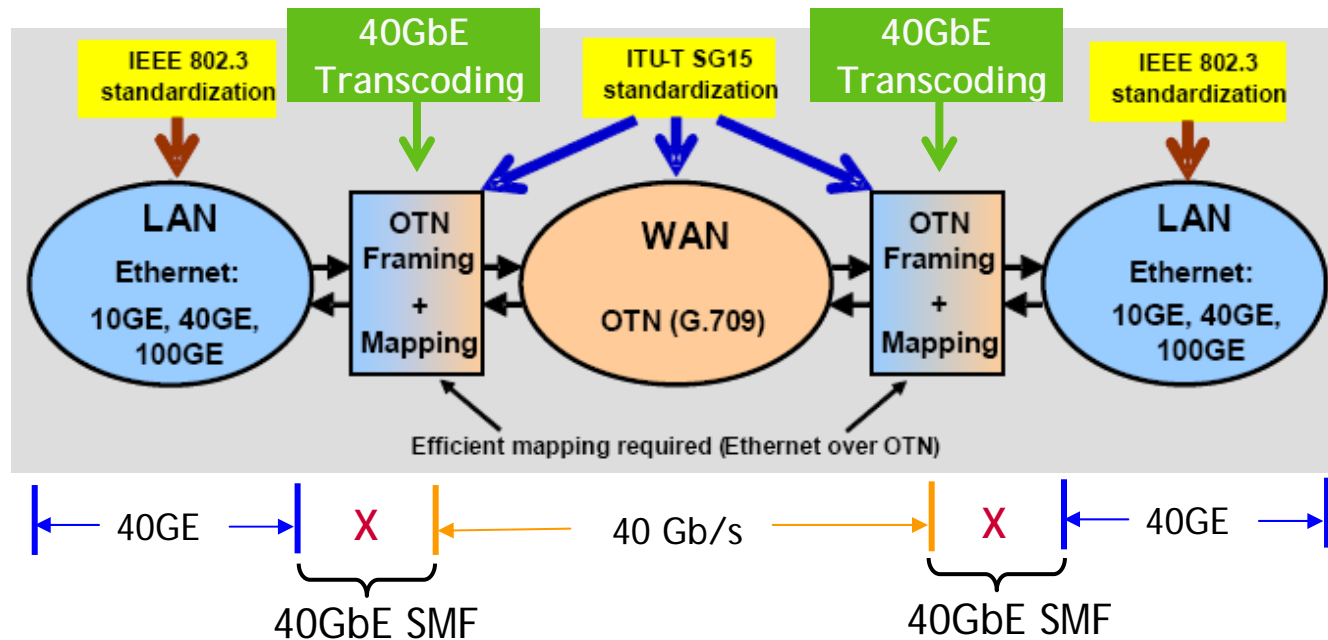
- 40 Gb/s exists in OTN WAN
- One objective of 802.3ba: Provide appropriate support for OTN
  - Transcoding at the LAN/WAN interface (see, e.g., trowbridge_01_0907)
  - Connection from LAN to WAN is missing from current objectives
  - 40GbE SMF objective fills this gap
- OIF carrier working group liaison letter sent to ITU-T and IEEE 802.3ba with the requirement:
  - R 17 Physical layer interface specifications for 40 and 100 GB Ethernet shall include an option for SMF minimum 2 km. The interface architecture should support an evolution to a single wavelength serial interface.

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40 GbE and 100 GbE Applications

10 km SMF

10 GbE → 40 GbE

**Existing link upgraded
From 10 GbE to 40 GbE**

**WDM
Transport
10G, 40G → 100G**

- There will be a market for 100 GbE SMF driven by high-end applications – e.g. IPTV video on demand
- Web surfing: bandwidth per user ~ 100 kb/s vs. HD TV: bandwidth per MPEG4 HD stream ~ 8 Mb/s
- Example metropolitan area network with 1 million households and 10% concurrency:
  - Video on demand generates ~800 Gb/s
  - Web surfing generates ~10 Gb/s
- Data applications can often be cost-effectively supported by 40 GbE switch interfaces
  - Connection from enterprise data center to 40 Gb/s WAN transport
- Need for 100GbE and 40 GbE on single-mode fiber comes from the diversity of applications
  - High-end, bandwidth intensive (e.g. entertainment networking) vs. data centric (e.g. server traffic aggregation)
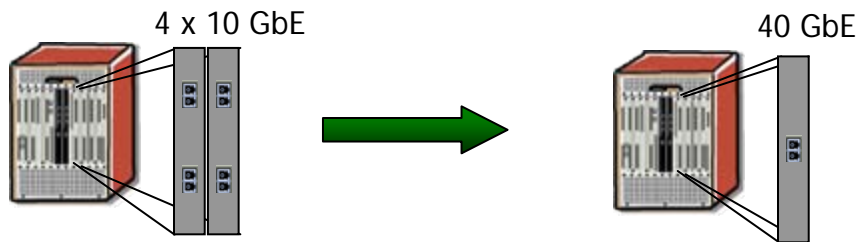
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Problems with 4 x 10 GbE link aggregation

There are several reasons why link aggregation of 4 x 10 GbE is not satisfactory for many customers

- Fiber may not be available:
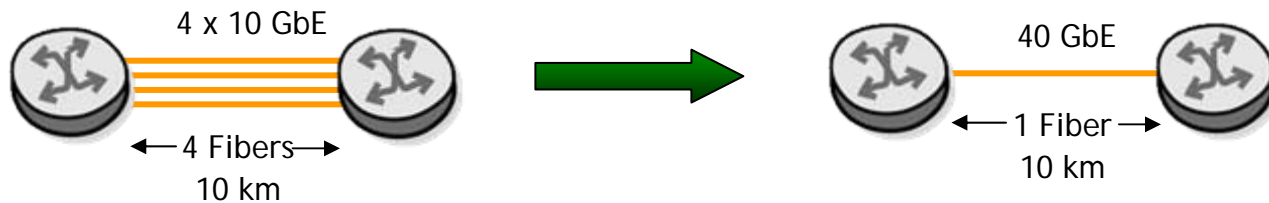
- Lower port density for multiple low-bitrate ports and increased OPEX from a larger number of managed ports

- Flow-based load balancing can be problematic (see trowbridge_01_0906.pdf)
    - E.g., encrypted flows with IPSEC

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Conclusions

- 40 GbE was brought into the standard to support computing applications

- Adding 40 GbE SMF objective allows switch-to-switch connections for server traffic aggregation

- Task force objectives include support for OTN

- OIF Carrier Working Group requirements include 40 GbE SMF for connection from LAN to WAN

- Volume of 100 GbE driven by high-end networking applications, e.g. video on demand

- Support for OTN necessitates the approval of a 40 GbE SMF objective

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