40GbE SMF for Carrier Applications

Jesse Simsarian and Terrance Rosadiuk

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802.3ba Task force objectives

**802.3ba Task Force Objectives**

<table>
<thead>
<tr>
<th></th>
<th>40 GbE</th>
<th>100 GbE</th>
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</thead>
<tbody>
<tr>
<td>Backplane, 1m</td>
<td>✓</td>
<td>✗</td>
</tr>
<tr>
<td>Cu, 10m</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>MMF, 100m</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>SMF, 10km</td>
<td>✗</td>
<td>✓</td>
</tr>
<tr>
<td>SMF, 40km</td>
<td>✗</td>
<td>✓</td>
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</tbody>
</table>

- 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
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)
OIF Carrier Working Group requirement for 40 GbE SMF

- 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.
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)
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
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