Optical PMD Overview

Tutorial T1A:
40/100 GbE: What's Happening?
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## Overview Summary

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* 40GE-LR, 1x40G, is now also being standardized to interoperate with legacy telecom interfaces (CFP form factor, XLAUI 4x10G I/O)
40GBase-LR4

Lane Coding

TX3  TX2  TX1  TX0
  CDR  CDR  CDR  CDR
  10G  10G  10G  10G

LD    LD    LD    LD
DML  DML  DML  DML

4:1 CWDM Mux

SMF

RX3  RX2  RX1  RX0
  CDR  CDR  CDR  CDR
  10G  10G  10G  10G

TIA  TIA  TIA  TIA
PIN  PIN  PIN  PIN

1:4 CWDM DeMux

SMF

PCS MLD  XLAUI  XLPPPI  (IEEE 802.3ba)  40GE-LR4
40GBase-SR4

Diagram:

- TX3, TX2, TX1, TX0
- RX3, RX2, RX1, RX0
- CDR, 10G
- LD, VCSEL
- MPO 12 MMF
- PCS MLD, XLAUI, XLPPI (IEEE 802.3ba) 40GE-SR4
• 40GE (and 100GE) SMF and MMF transceivers
• CFP MSA specified: 82mm x 145mm x 13.6mm (w x l x h)
• SC optical connector shown (LC, MPO alternatives)
• 148-pin electrical plug connector with 12x10G I/O
• 40GE MMF and SMF transceivers
• 40GE MMF (and SMF) active cables (no optical connector)
• QSFP MSA specified: 18.5mm x 72.5mm x 8.5mm (w x l x h)
• MPO optical connector shown (LC alternative)
• 38-pad electrical PCB connection with 4x10G I/O
100GBase-LR4, -ER4

San Jose, CA  USA
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Finisar
100GBase-SR10
• 100GE MMF transceivers
• 100GE MMF active cables (no optical connector)
• InfiniBand Association specified: 24mm x 51mm x 14mm (w x l x h)
• 2x12 MPO optical connector
• 84-pad electrical dual stacked PCB connection with 12x10G I/O
Future 100GBase-LR4
High yield Photonic Integrated Circuit (PIC) technology is required for low power, cost and size 40GE and 100GE transceivers.

Ex. monolithic InP TX PIC with four O-band DMLs (lasers) and an AWG with 24.5nm $\Delta\lambda$, 1.1 x 2.4 mm, CyOptics Inc.
Future 100GBase-SR4
Future 100GE Electrical Interface

- 25GBaud adopted by all mainstream datacom standards as the next electrical signaling rate
  - Ethernet: 26GBaud (4x26Gb/s → 103Gb/s)
  - Telecom: 28GBaud (4x28Gb/s → 112Gb/s)
  - Infiniband: 25Gbaud (4 x 25Gb/s, 12 x 25Gb/s)
  - FiberChannel: 28Gbaud (28Gb/s)
- Standardization project approved in OIF: CEI-28G-VSR
- Critical to maintain liaison between all concerned to maximize development efficiency
- Critical to share technology
  - Connectors
  - I/O
Future 100GE Modules

- **CFP2**
  - 100GE SMF and MMF transceivers
  - Future MSA specified size: >2x CFP density
  - SC optical connector (LC and MPO alternatives)
  - New two piece electrical connector with dense 4x25G I/O

- **QSFP2**
  - 100GE MMF transceivers and active cables
  - Future MSA specified size: ~ QSFP
  - 1x12 MPO optical connector
  - New two piece electrical connector with dense 4x25G I/O

- **QSFP2 SMF**
  - 100GE SMF transceiver requires 2\textsuperscript{nd} Gen PIC technology
  - LC optical connector
100GE Roadmap Summary
Chris Cole is a director at Finisar Corp., Sunnyvale, Calif. He received a B.S. in Aeronautics and Astronautics, and B.S. and M.S. in Electrical Engineering from the Massachusetts Institute of Technology. At Hughes Aircraft Co. (now Boeing SDC,) and then M.I.T. Lincoln Laboratory, Chris contributed to multiple imaging and communication satellite programs. Later, he consulted on telecom ICs for Texas Instruments’ DSP Group and Silicon Systems Inc. (now Teridian.) At Acuson Corp. (now Siemens Ultrasound,) Chris was one of the architects of the Sequoia coherent imaging ultrasound platform, where he was also director of hardware and software development groups. As a principal consultant with the Parallax Group, he carried out signal processing analysis and product definition for several imaging and communication systems. Chris is now managing the development of 40-Gb/s and 100-Gb/s LAN and WAN optical transceivers at Finisar (which acquired his previous company, Big Bear Networks.) He is a Senior Member of the IEEE.
Finisar Corp.

Finisar is a global technology leader in optical communication subsystems and components that enable high-speed voice, video and data communications for networking, storage, wireless, and cable TV applications. Finisar provides system manufacturers with critical breakthroughs in optics technologies, and the production volumes needed to meet the exploding demand for network bandwidth and storage.

Finisar delivers the industry's broadest optical product portfolio backed by world-class quality and reliability, including transceivers/transponders, ROADM and passive and active components for enterprise networking and storage, telecom and CATV applications.

With more than 5,000 employees, Finisar has sales, channel, and support offices worldwide. Corporate headquarters are located in Sunnyvale, California (USA), with product development and manufacturing facilities located in California, Pennsylvania, and Texas (USA), Australia, China, Israel, Malaysia, and Singapore.