Active Optical Cables for InfiniBand QDR and FDR

SC11 – Seattle, WA

Steffen Koehler
November 16, 2011
World’s Largest Supplier of Fiber Optic Components

Company Highlights

Market leader: Volume and Revenue

Founded in 1988 / IPO in 1999

Headquarters: Sunnyvale, CA (USA)

Global locations with 6000+ employees

1300+ issued patents / 1000+ pending

High performance, best-in-class broad product line

Vertically integrated with low cost manufacturing

Experienced management team

Financially profitable which allows increased R&D and capacity expansion
Finisar – The Optics Industry Leader

- #1 share in Storage optics
- #1 share in Ethernet optics
- #1 share in WDM
- #2 share in SONET
- Broadest product portfolio

Industry leader by revenue and volume

CY 2009 Revenue by Vendor
SONET/SDH, Ethernet, Fibre Channel, WDM, Parallel and FTTx

Finisar 25%

Source: Lightcounting 2010, Ovum-RHK 2010, SEC filings, internal estimates
Broad Product Portfolio and Customer Base

**PRODUCTS**

- **SAN**
  - SFP
  - SFP+

- **LAN**
  - SFP
  - SFP+
  - X2/XENPAK
  - CFP
  - Active Cable

- **PARALLEL**

- **METRO/TELECOM**
  - SFP
  - CML™ Laser
  - XFP
  - WDM passives
  - Interleaver
  - 300-pin

- **ROADM**
  - WSS
  - ROADM line card

- **FTTx and CATV**
  - PON
  - CATV

**CUSTOMERS**

- **SAN**
  - EMC²
  - H3C
  - Brocade
  - LSI
  - Emulex

- **LAN**
  - Intel
  - QLogic
  - IBM
  - Juniper
  - Force10
  - Ericsson
  - Hitachi
  - Infinea
  - NEC
  - Hauwei
  - Ciena
  - Tellabs

- **Telecom**
  - Alcatel-Lucent
  - ZTE
  - Nokia Siemens Networks
  - ADVA
  - Fujitsu
  - TRANSMODE
  - ECI
  - NetApp
  - Cisco
  - Dell

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High-Volume Low Cost Manufacturing

Ipoh, Malaysia

- Acquired in 2001
- 20 acres of land
- 640,000 sq ft facility / 200,000 sq ft clean room
- Ipoh manufactured products
  - All high-volume transceivers / transponders
  - CATV products
  - 16M total units per year (CY10)
- ISO 9001 and 14001 Certified

Shanghai, China

- Began Operations in 2001
- State of the Art facility expansion in 2008
  - Increased from 50,000 to 150,000 sq ft
- Shanghai manufactured products
  - Parallel optics transceivers and active cables
  - WSS ROADM line cards
  - High-end TOSAs / ROSAs
  - Passive optical components
- ISO 9001 Certified

Finisar is one of a few optics companies to own assembly / manufacturing facilities

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What is the Ideal High-Speed Interconnect Solution?

◆ Wish list
  ▪ Optimized for short distances (MMF)
  ▪ Low cost
  ▪ Low power consumption
  ▪ Small cable bend radius
  ▪ Low cable weight
  ▪ High density
  ▪ Low link latency

◆ The solution
  ▪ Finisar active optical cable assemblies
Best of Both Worlds: Copper and Optics

Comparison of Cable Types and Optical Transceivers
Advantages of Active Optical Cables (AOC)

Compared to Optical Transceivers
- Cost-optimized: Not constrained by optical interface specifications driven by longer reach applications
- Datacenter/Consumer friendly: No cleanliness issues in optical connector
- Disadvantage: Cannot be routed through optical patch panels

Compared to Copper Cables
- Longer reach
- Lower weight and tighter bend radius enable simpler cable management
- Thinner cables allows better airflow for cooling
- Lower power consumption
- No need for power-hungry conditioning ICs on the host board
Successfully Deployed in HPC Clusters Today

- Passive copper cables used for very short links and lowest cost
- Active optical cables used for links with
  - Longer distance (> 7 meters)
  - Architectures with challenging cable routing
  - Cooling/Power concerns
    - Copper signal-conditioning ICs add power/heat
    - Thick copper cables block airflow
Active Optical Cables Portfolio

- **10Gb/s Serial Active Optical Cables**
  - High-density form factor, XFP/SFP+ adapters
  - 10G Ethernet
  - 10G Fibre Channel

- **4x10Gb/s and 4x14Gb/s Parallel Active Optical Cables**
  - QSFP+ form factor
  - InfiniBand 4xQDR and 4xFDR
  - 40G Ethernet
  - SAS

- **12x10Gb/s Parallel Active Optical Cables**
  - CXP form factor
  - InfiniBand 12xQDR
  - 100G Ethernet
10Gb/s Serial Active Optical Cable

- Finisar’s first AOC product, introduced in 2007
- 10G serial cable targeting 10GbE LAN on motherboard (LOM)
- Supports distances up to 30 meters
- Enables 48-port 1U switch designs
- Low Power: ~0.5W per port compared to >>5W for 10GBASE-T
- Adaptable to XFP, SFP+ and QSFP+ ports
10Gb/s Copper Cables

10GBASE-CX4 Copper Cables
10GBASE-T Copper Cables

10GbE copper cable solutions are heavier, bulkier and require significantly higher power than active optical cables.
Quadwire®: 40Gb/s Active Optical Cable

- Finisar’s second AOC product, introduced in 2008
- 4 lanes x 10 or 14 Gbit/s (full duplex)
- Based on QSFP+ MSA form factor (SFF-8436)
- Applications
  - 4xQDR InfiniBand; 4xFDR Infiniband, 40G Ethernet; SAS
- Power dissipation ~1W
- Supports links of up to 300 meters
- Utilizes Finisar’s internal VCSEL and PIN arrays
- QSFP+ optical transceiver version also available
  - MTP/MPO12 parallel optical connector
  - Requires the use of 1x12 parallel optics cable assemblies
  - Utilized when routing through patch panels is required
C.wire™: 150Gb/s Active Optical Cables

- Finisar’s third AOC product, introduced in 2009
- 12 lanes x 12.5 Gbit/s (full duplex)
- Based on CXP form factor (IBTA Spec)
- Applications
  - 12xQDR InfiniBand; 100G Ethernet
  - Proprietary interconnections
- Power dissipation ~3W
- Supports links of up to 300 meters
- Utilizes Finisar’s internal VCSEL and PIN arrays
- CXP optical transceiver version also available
  - MTP/MPO24 parallel optical connector
  - Requires the use of 2x12 parallel optics cable assemblies
  - Utilized when routing through patch panels is required
CXP to 3xQSFP Breakout Active Optical Cable

- Application: Switch-to-Node interconnects based on CXP form factor on switch side and QSFP form factor on node
  - Connects three QSFP-based systems to one CXP switch port
InfiniBand Roadmap Drives AOC Development

<table>
<thead>
<tr>
<th>Per 1x Lane Bandwidth (Gb/s)</th>
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<tbody>
<tr>
<td>DDR</td>
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<tr>
<td>5Gb/s</td>
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**Market Demand**

- **60G-IB-DDR**
- **40G-IB-DDR**
- **20G-IB-DDR**
- **10G-IB-QDR**
- **4x**
- **8x**
- **12x**

- **56G-IB-FDR**
- **104G-IB-EDR**
- **112G-IB-FDR**
- **120G-IB-QDR**
- **14G-IB-FDR**
- **26G-IB-EDR**
- **208G-IB-EDR**
- **312G-IB-EDR**

- **NDR**
- **HDR**

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Product Introduction at SC11

4 x 14 Gbit/s Active Optical Cable

- Supports InfiniBand FDR and 16xFC
- QSFP+ MSA form factor
- Power dissipation ~1W
- Supports links of up to 300 meters
- Utilizes Finisar VCSEL and PIN arrays

- See our live demonstration at Finisar Booth #2634
The Finisar Advantage

World’s Largest Supplier of Fiber Optic Components and Subsystems

Market Share Leader
Global Reach
Diverse Customer Base
Broad product portfolio

Technology pioneer
Vertically integrated
Internal manufacturing
Diversifying into new markets

Profitable