



10GbE Cable
Questions? We've
got answers!

Webcast



 **EMULEX**

 **Demartek**

Everything you wanted to know about cabling, but were afraid to ask

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June 2012

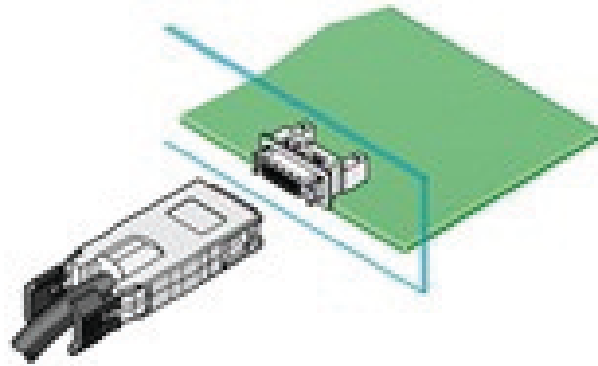


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Welcome!

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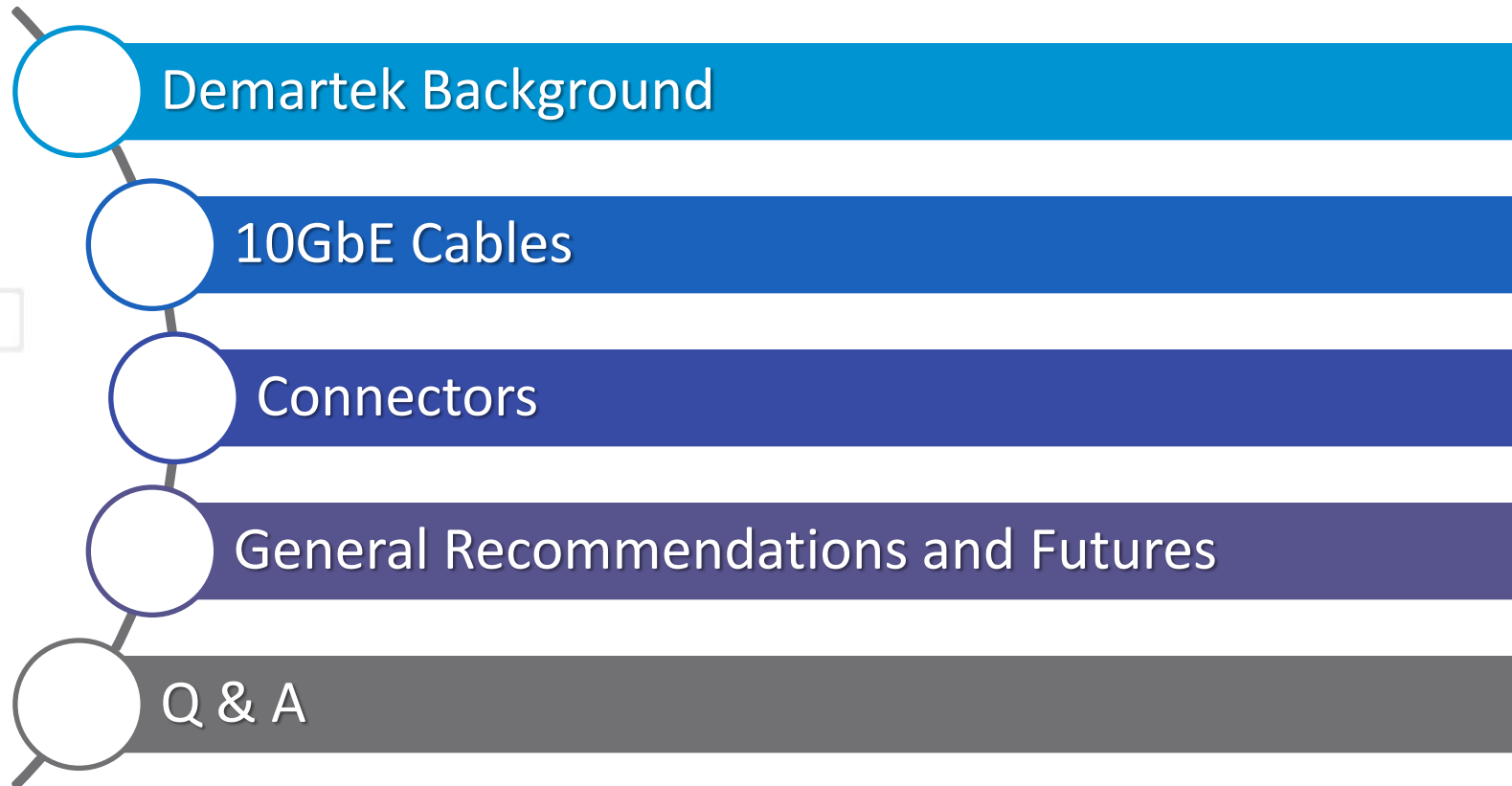
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Agenda





Demartek

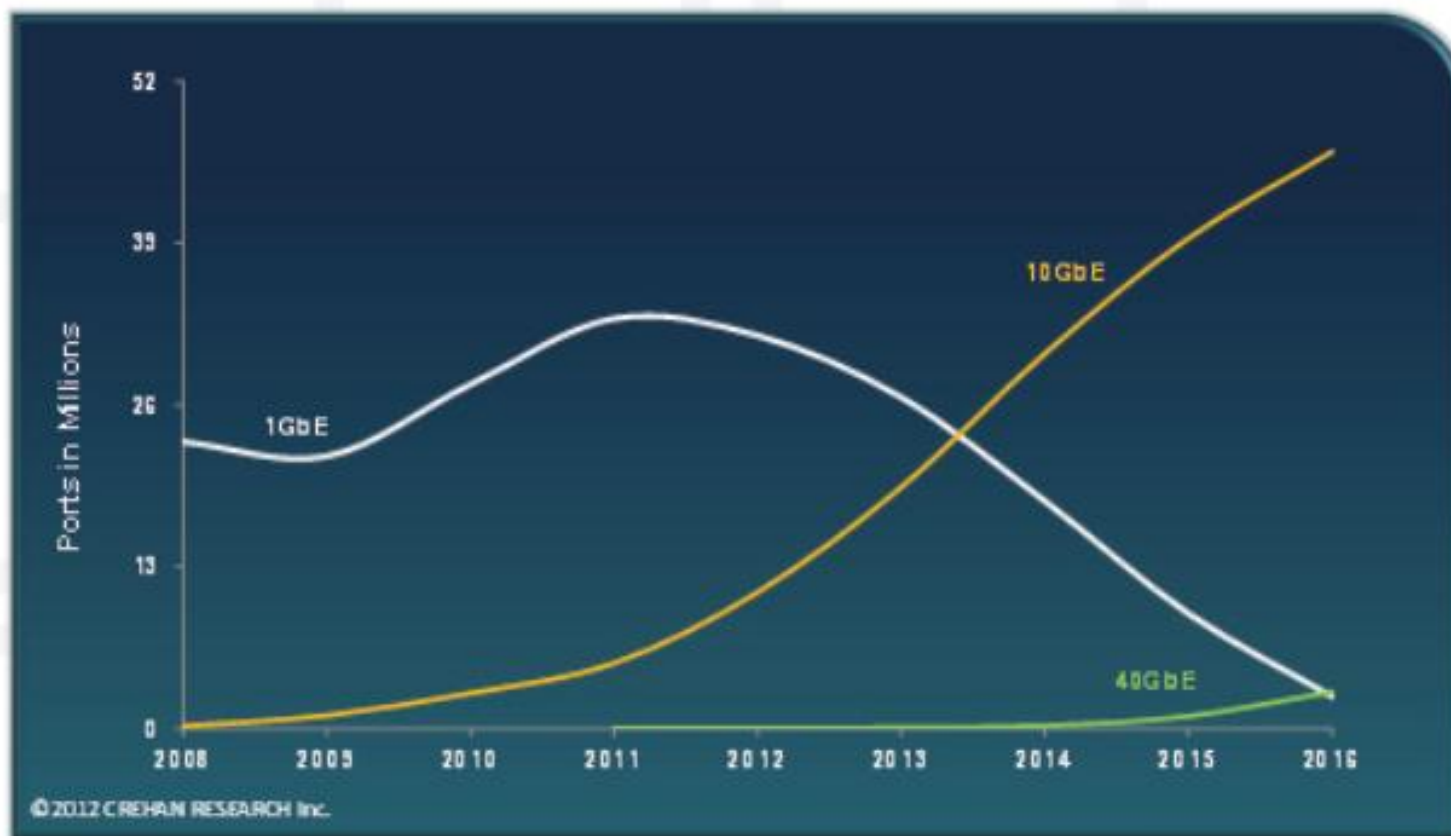
- **Industry analysis with on-site test lab**
- **Lab includes servers, networking and storage infrastructure**
 - Fibre Channel – 4, 8 & 16 Gbps
 - Ethernet – 1 & 10 Gbps
 - NFS, CIFS, iSCSI & FCoE
 - Servers – 8+ cores, large RAM
 - Virtualization – VMware, Hyper-V, Xen
- **We run real-world applications to test server and storage solutions**
 - Currently testing with SSD, 10GbE, 16 GFC and more
- **More information:**
 - www.demartek.com/Newsletter
 - www.youtube.com/Demartek





10Gb Ethernet (10GbE)

10GbE
By the numbers





10GbE Background

■ Specification Ratifications

- 10GbE specification ratified in 2002
- 10GBASE-T specification ratified in 2006

■ Adoption of 10GbE has been noticeably increasing over the last 2-3 years

- New servers announced in 2012 now include 10GbE on the motherboard as an option



Cable Options

■ Fiber-optic

- Good for short, medium and long distances
- Light weight
- Thin
- Use optical transceivers, separate from the cable
- Generally lower latency than copper cables

■ Copper

- Good for short distances
- Heavier than fiber-optic cables
- Less expensive than fiber-optic cables



Fiber-optic

■ 10GBASE-LR – Single-mode fiber (SMF)

- Optical core of 9 microns (μm)
- Very long distances: 10Km (6.2 miles) up to 80-100Km, depending on transceivers, switches, buffer credits, etc.
- Known as OS1
- Single frequency of laser light

■ 10GBASE-SR – Multi-mode fiber (MMF)

- Optical core of 50 or 62.5 μm
- Moderate distances, up to 600m, depending on transmission speed
- Less expensive solution than single-mode
- Four grades of MMF today: OM1, OM2, OM3, OM4 (see upcoming chart)

■ Bend-optimized

- Newer OM2, OM3, OM4 and OS1 have a very small turn or bend radius with minimal signal loss (bending loss)



Fiber-optic cables: Indoor and Outdoor

■ Indoor

- Suitable for indoor applications

■ Outdoor

- Also known as Outside Plant (OSP)
- Water resistant (liquid and frozen)
- Ultraviolet light resistant

■ Indoor/Outdoor

- Similar to Outdoor
- Added fire-retardant jacket, allowing deployment inside building entrance beyond the OSP maximum distance



Fiber-optic Cable Information

	Mode	Core Diameter	Wavelength	Modal Bandwidth	Cable jacket color
OM1	multi-mode	62.5 μm	850 nm 1300 nm	200 MHz	Orange
OM2	multi-mode	50 μm	850 nm 1300 nm	500 MHz	Orange
OM3	multi-mode	50 μm	850 nm 1300 nm	2000 MHz	Aqua
OM4	multi-mode	50 μm	850 nm 1300 nm	4700 MHz	Aqua
OS1	single-mode	9 μm	1310 nm 1550 nm	—	Yellow



Fiber-optic Cable Speed and Distance for Ethernet

	OM1	OM2	OM3	OM4
1 Gb/s	300m	500m	860m	–
10 Gb/s	33m	82m	Up to 300m	Up to 400m

■ Recommendations

- For 10 Gb/s and faster data rates, OM3 and OM4 are recommended
- OM3 and OM4 are the only multi-mode fibers included in the 40G/100G Ethernet standard ratified in June 2010 (IEEE 802.3ba)
- OM4 is the preferred cable for long-term datacenter cabling



Copper

■ Direct Attached Copper (DAC)

- Good for short distances, such as within a rack or to a nearby rack
 - Common lengths are 3m and 5m
- Are generally less expensive than fiber-optic cables for short distances
- Copper cables usually include the connector
- Passive copper cables require no additional power
- Active copper cables require additional power but can transmit data over longer distances (> 7 meters) than passive copper cables

■ 10GBASE-T

- Uses the familiar RJ45-style connector
- The specification calls for cables certified to at least 500 MHz
- Cat6 (Category 6) can be used up to 55m
- Cat6a (Cat6 augmented) or Cat7 can be used up to 100m



Connector Speeds

■ Connector speeds: Today

- For Ethernet, the fastest generally available connector speeds supported today are **10 Gbps** per channel (or “lane”)
- Higher speeds are achieved by bundling multiple lanes together in parallel, such as 4x10 (40 Gbps), 10x10 (100 Gbps) and 12x10 (120 Gbps)
 - These are known as “channel bonded” solutions
 - 40GbE uses 4x10
 - 100GbE uses 10x10

■ Connector speeds: Future

- The next speed increase for Ethernet connectors will be **25 Gbps** per channel
- When 25 Gbps is available, then 100GbE can use 4x25
- Timeframe:
 - Expected in test labs and components in 2012 or 2013
 - Expected in end-user products in 2013 or 2014



Connector Types for Ethernet

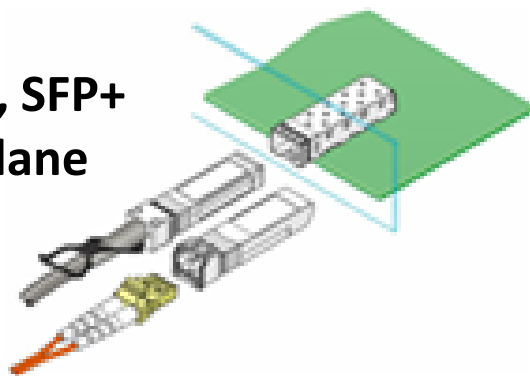
	Lanes	Max. Speed per lane (Gbps)	Max. Speed total (Gbps)	Cable Type	Usage
CX4	4	2.5, 5	10, 20	Copper	10GbE
RJ45	1	1, 10	1, 10	Copper	1GbE, 10GbE
SFP	1	1	1	Copper, Optical	1GbE
SFP+	1	10	10	Copper, Optical	10GbE
QSFP	4	5	20	Copper, Optical	Various
QSFP+	4	10	40	Copper, Optical	40GbE
CXP	10, 12	10	100, 120	Copper	100GbE
CFP	10	10	100	Optical	100GbE

- **Some of these connector types can be used for other interfaces such as Fibre Channel or Infiniband. In those cases, the maximum speed per lane may be different.**

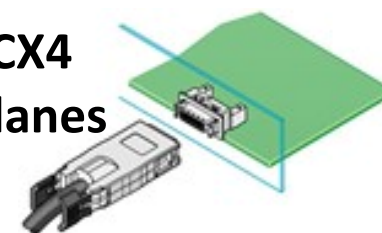


Connector Diagrams for Ethernet

SFP, SFP+
1 lane



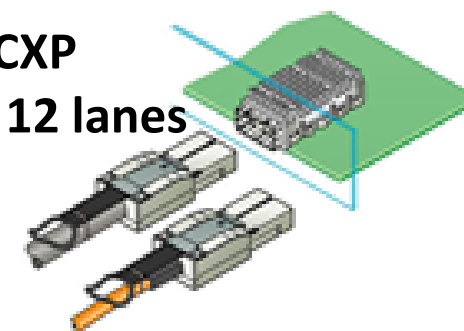
CX4
4 lanes



QSFP, QSFP+
4 lanes

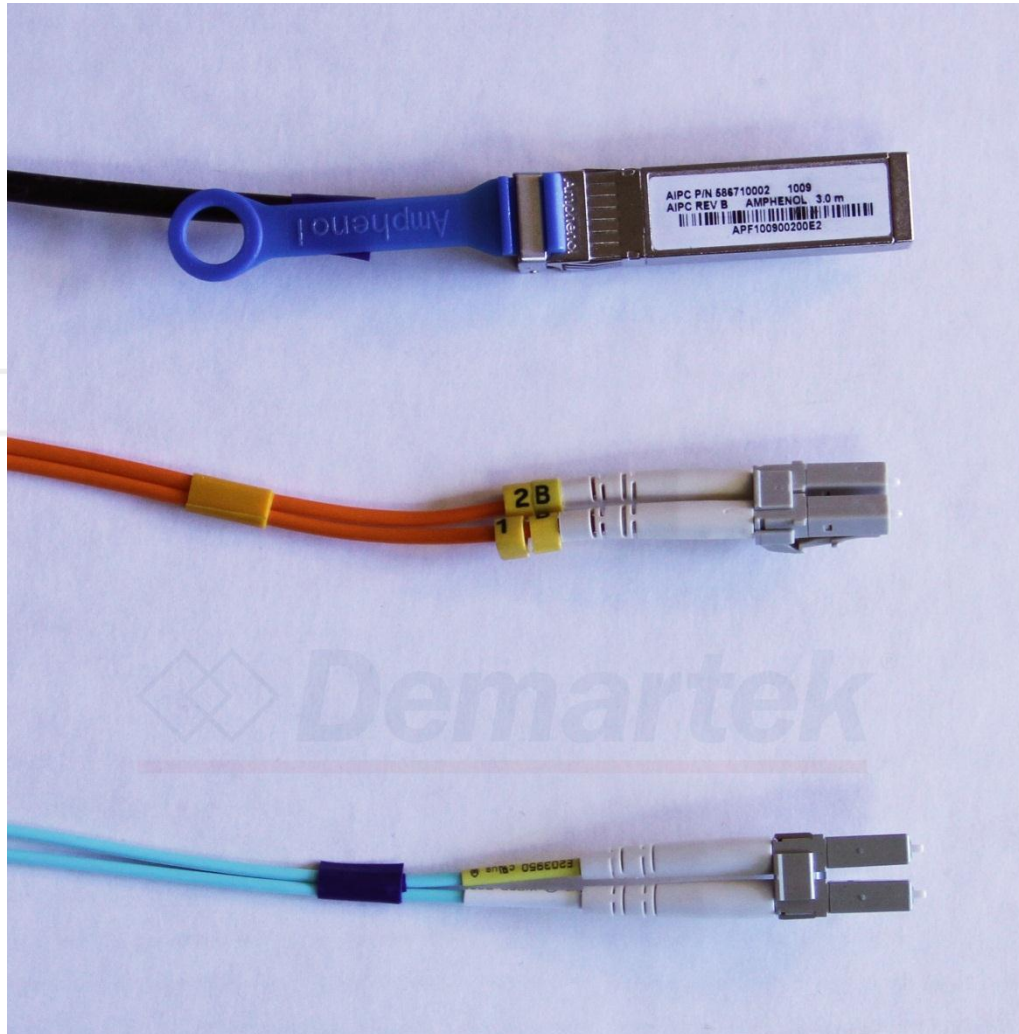


CXP
10 or 12 lanes





10GbE SFP-style Cable Comparison



10GbE Copper DAC

OM1 with LC connector

OM3 with LC connector



Port Type Combinations

- **Different port types are available on 10GbE switches and 10GbE adapters**
 - SFP-style (the most common)
 - Without transceivers for 10GbE copper DAC
 - With transceivers for 10GBASE-SR or 10GBASE-LR
 - RJ45-style
 - For Cat6/Cat6a/Cat7 cables for 10GBASE-T
 - CX4-style
 - Older style connector for twinax cables for 10GBASE-CR
- **Network Interface Cards (NICs) typically have one port type on a card, even if multiple ports**
- **Some 10GbE switches support multiple port types on the same switch**
 - For example: SFP-style and RJ45-style



General Recommendations and Futures

■ Cabling can have very long life

- Fiber-optic cables can remain in place as long as 15 or 20 years
 - Planning should consider legacy, current and future needs
- Laying (and removing) lots of cable is labor-intensive

■ Some jurisdictions have cable-related ordinances

- Often related to fire prevention

■ Future speeds

- As interface speeds increase, expect increased usage of fiber-optic cables and connectors
- At higher gigabit speeds (10Gb/s +), copper cables and interconnects generally lose too much amplitude (signal) as the distance increases



Learning More ...

■ Demartek Cabling Web Pages

- [http://www.demartek.com/Demartek Interface Comparison.html](http://www.demartek.com/Demartek%20Interface%20Comparison.html)

■ Emulex Cabling Guide

- <http://www.emulex.com/blogs/labs/>

■ Call Emulex:

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Questions ...





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