Untangled: Improve Efficiency with Modern Cable Choices

Dennis Martin

President, Demartek

Agenda

- About Demartek
- Why Discuss Cables and Connectors?
- Cables
  - Copper
  - Fiber-Optic
- Connectors
- Demartek Free Resources

Demartek Video

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Demartek YouTube Channel:
http://www.youtube.com/user/Demartek/videos

http://www.demartek.com/Demartek_Video_Library.html

About Demartek

- Industry Analysis and ISO 17025 accredited test lab
- Lab includes servers, networking & storage
  - Ethernet: 1, 10 & 40 Gbps: NFS, SMB (CIFS), iSCSI, FCoE and SR-IOV
  - Fibre Channel: 4, 8 & 16 Gbps
  - Servers: 8+ cores, large RAM
  - Virtualization: VMware, Hyper-V, Xen, KVM
- We prefer to run real-world applications to test servers and storage solutions (databases, Hadoop, etc.)
- Website: www.demartek.com/TestLab

Why Discuss Cables and Connectors?

- Cabling is not as well known among IT staff
- Some jurisdictions have cable-related ordinances
  - Often related to fire prevention
- How long do you keep the following in service?
  - Servers
  - Storage systems
  - Network switches
  - Network cables

Many examples in this presentation show Ethernet but can be and often are applied to other interfaces

Cable Life

- Laying of network cables can be labor-intensive
  - Cable trays, inside walls, etc.
- Fiber optic cabling service life: 15 – 20 years
- Cable choices must meet existing needs and future technology needs
  - What speeds of Ethernet, Fibre Channel, Infiniband, SAS/SCSI & USB were you running 5, 10, 15 years ago?

Cable Options - Copper

- Good for short distances
  - Same rack or nearby rack
- Usually heavier and stiffer than fiber-optic cables
- Transceiver or connector usually mounted on cable
- Less expensive than equivalent fiber-optic solutions
- Theft concern?

Cable Options – Fiber-Optic

- Good for short, medium and long distances
- Light weight
- Thin
- Use optical transceivers (optics)
  - Separate from cable
- Generally better Bit Error Rates (BER) than copper cables
  - Important for high speeds and long distances

Types of Copper Cables - DAC

- Direct Attach Copper (DAC)
  - Multiple connector styles (CX, SFP, QSFP, etc.)
  - Passive
    - No additional power
    - Short lengths
  - Active
    - Additional power
    - Longer lengths
  - Used for Ethernet, Infiniband, SAS

Types of Copper Cables – BASE-T

- Familiar RJ45 twisted-pair cables used for general Ethernet at home and in the office
- Different "categories" for different speeds
  - Cat5 – 100MbE and short-distance 1GbE*
  - Cat5e – 1GbE
  - Cat6 – 1GbE and short-distance 10GbE*
  - Cat6a – 10GbE
  - Cat7 – 10GbE
  - Cat8 – 40GbE (proposed standard)

* May not always work at this speed, YMMV

Types of Cables – Fiber-Optic

- Mode: multi-mode and single mode
- 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

Connectors Today

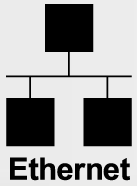
- **Connector speeds: Today**
  - Ethernet: 10Gbps per lane
  - Fibre-Channel: 16Gbps per lane
  - Infiniband: 14Gbps per lane
- **Higher speeds achieved in parallel**
  - Ethernet: 40Gbps = 4 x 10Gbps, 100Gbps = 10 x 10Gbps
  - Infiniband: 56Gbps = 4 x 14Gbps (FDR)
  - Parallel speeds are sometimes known as “channel bonded” solutions

Connectors - Future

- **New 25/28G connectors**
  - 28 Gigabaud signaling rates
  - Ethernet – 25Gbps per lane (1, 2, 4 and 10 lanes)
  - Fibre Channel – 32Gbps per lane (1 and 4 lanes)
  - Infiniband – 25Gbps per lane (4 lanes)

Ethernet

➢ 25GigE



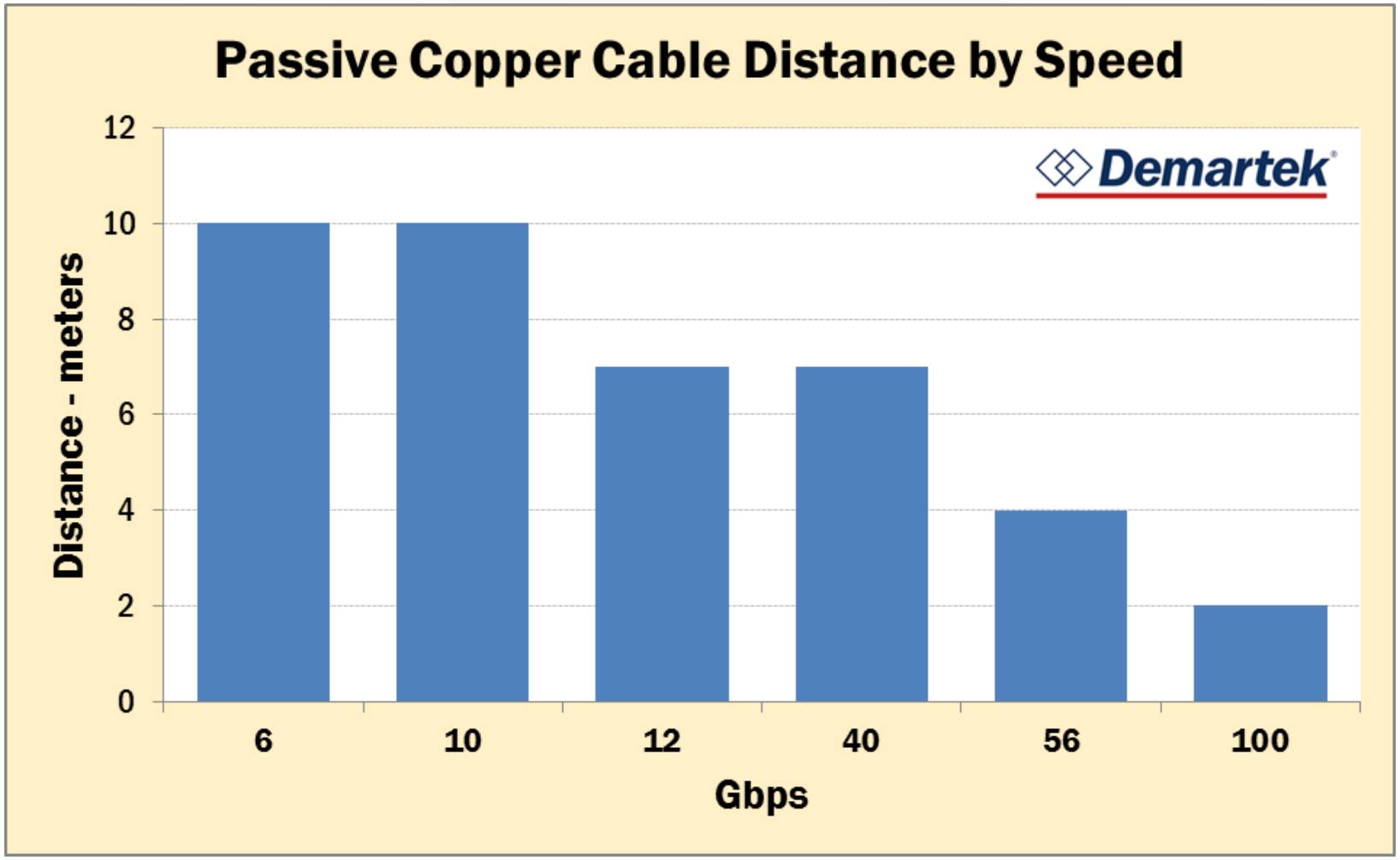
- 25Gb PHYs are beginning to appear
- Why not 25GbE over single-lane connection?
- 25G Ethernet Consortium Announcement – July 1, 2014
  - Arista Networks, Broadcom, Google, Mellanox and Microsoft
  - 25GbE and 50GbE specifications, Draft 1.4 – Sept. 2014
  - www.25GEthernet.org
- IEEE has announced a 25GbE study group – July 2014
  - Server interconnects – backplane, copper cable, multimode fiber
  - http://www.ieee802.org/3/by/index.html
  - Standard completion target date: Sept. 2016

Connector Types for Ethernet

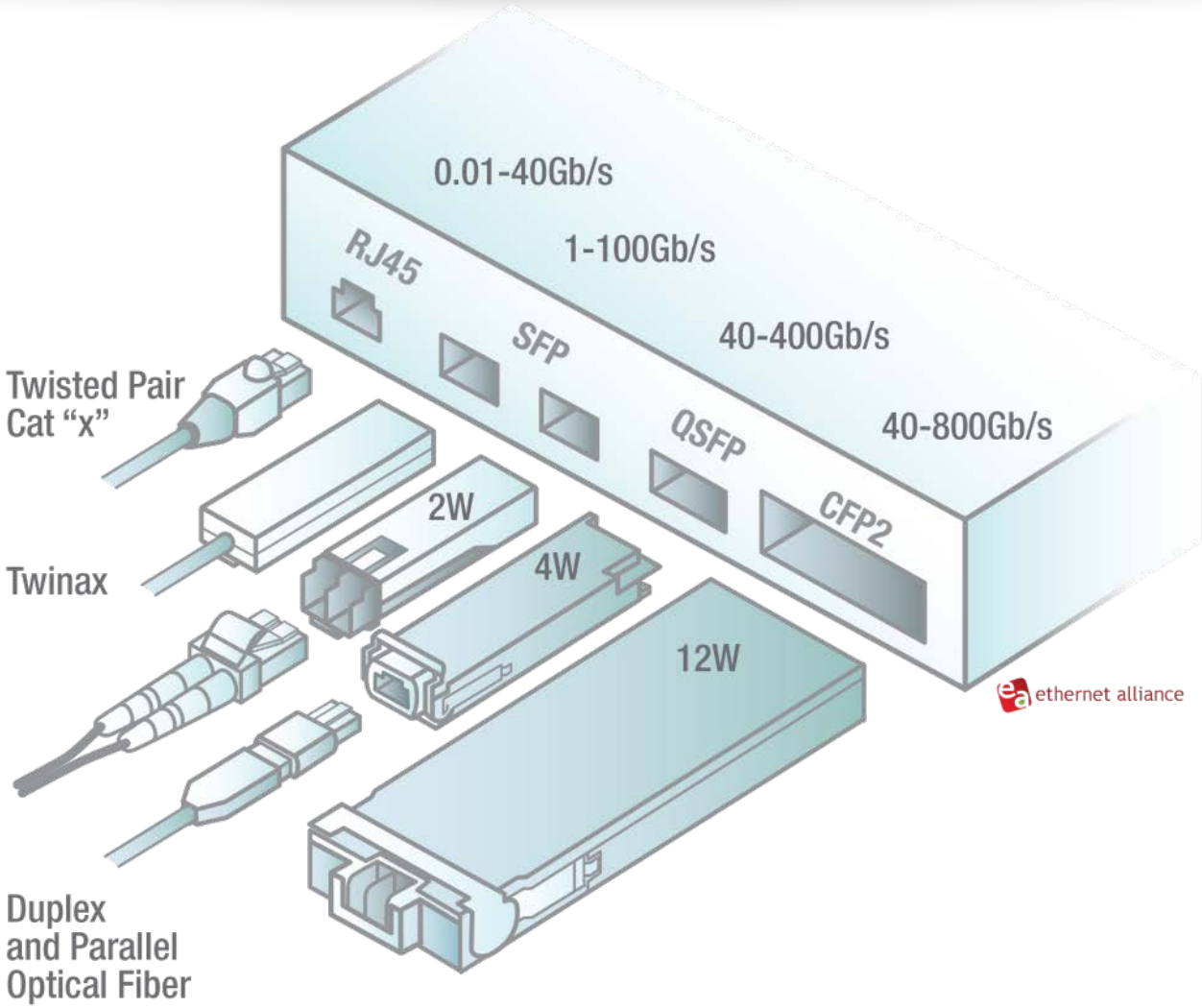
Demartek	Lanes	Max. Speed per lane (Gbps)	Max. Speed total (Gbps)	Cable Type	Usage
CX4	4	2.5, 5	10, 20	Copper	10GbE
RJ45	1	1, 10	1, 10	Copper	1GbE, 10GbE
SFP	1	1	1	Copper, Optical	1GbE
SFP+	1	10	10	Copper, Optical	10GbE
QSFP	4	5	20	Copper, Optical	Various
QSFP+	4	10	40	Copper, Optical	40GbE
CXP	10, 12	10	100, 120	Copper	100GbE
CFP	10	10	100	Optical	100GbE
MTP/MPO	6 or 12	10	120	Optical	40GbE, 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.

Copper Cable Lengths

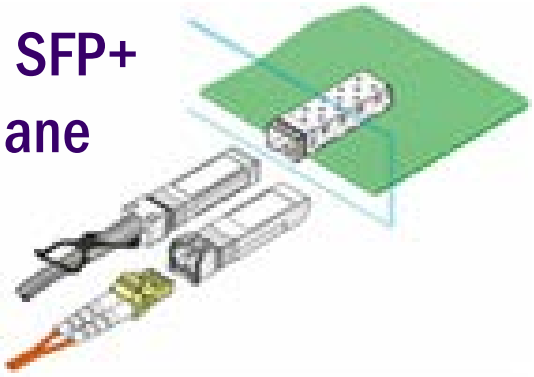


Ethernet Connectors

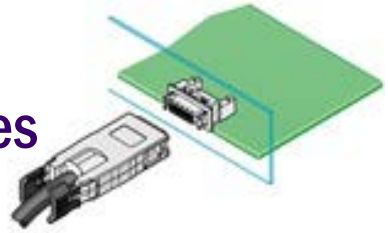


Connector Diagrams

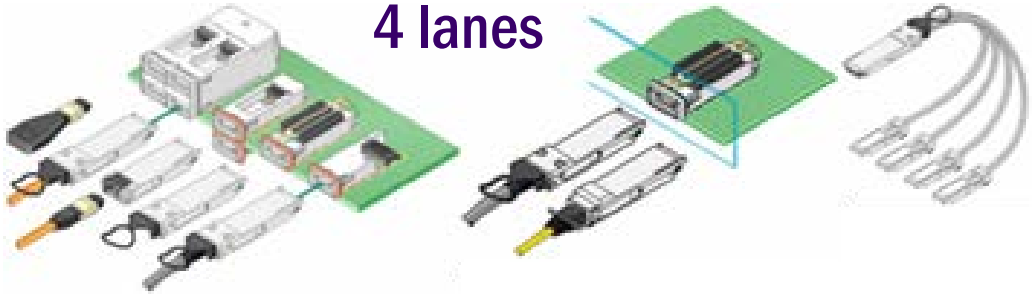
SFP, SFP+
1 lane



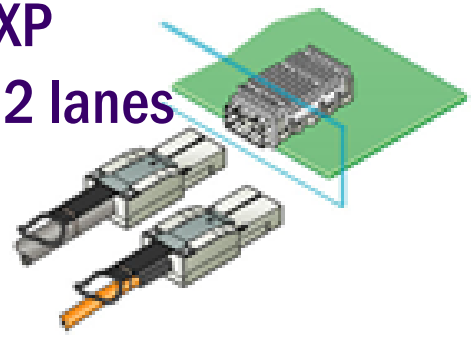
CX4
4 lanes



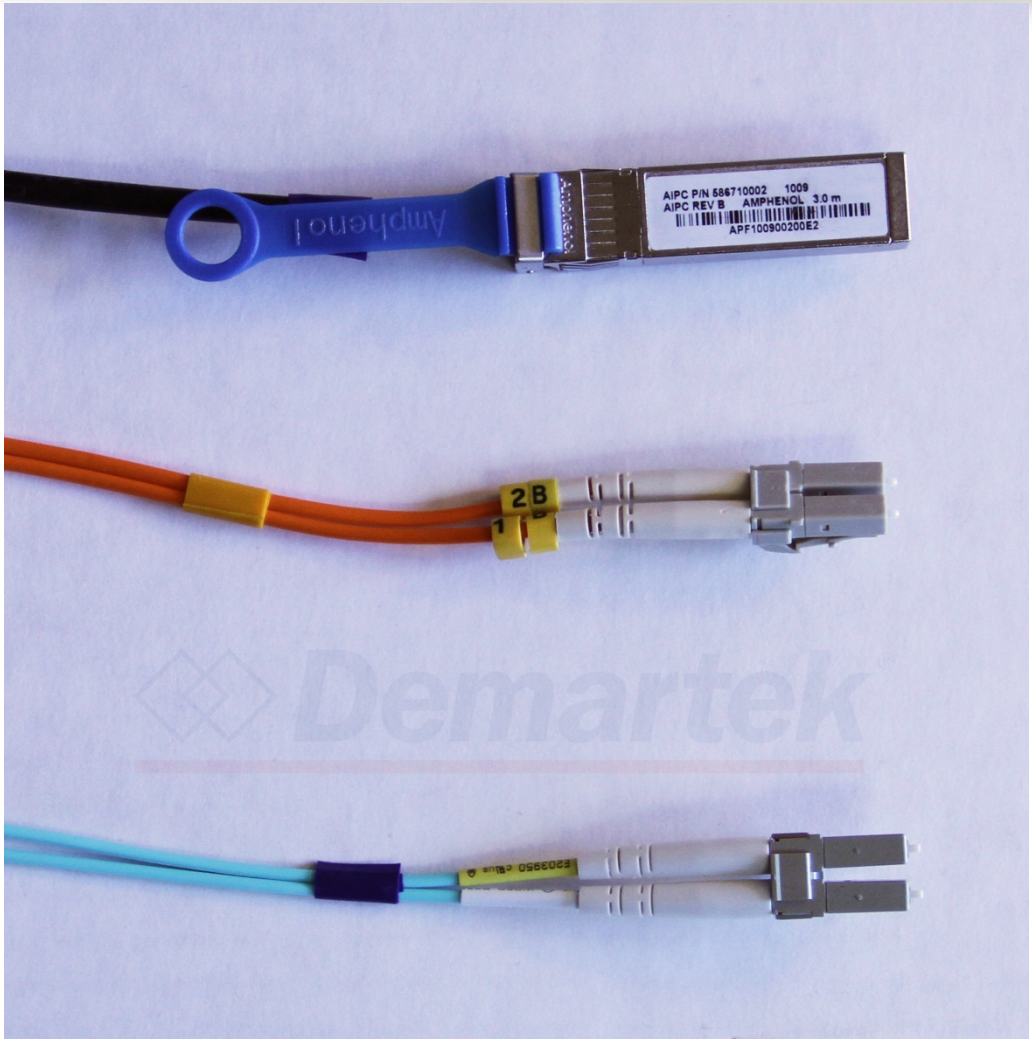
QSFP, QSFP+
4 lanes



CXP
10 or 12 lanes



10GbE SFP-style Cable Comparison



10GbE Copper DAC

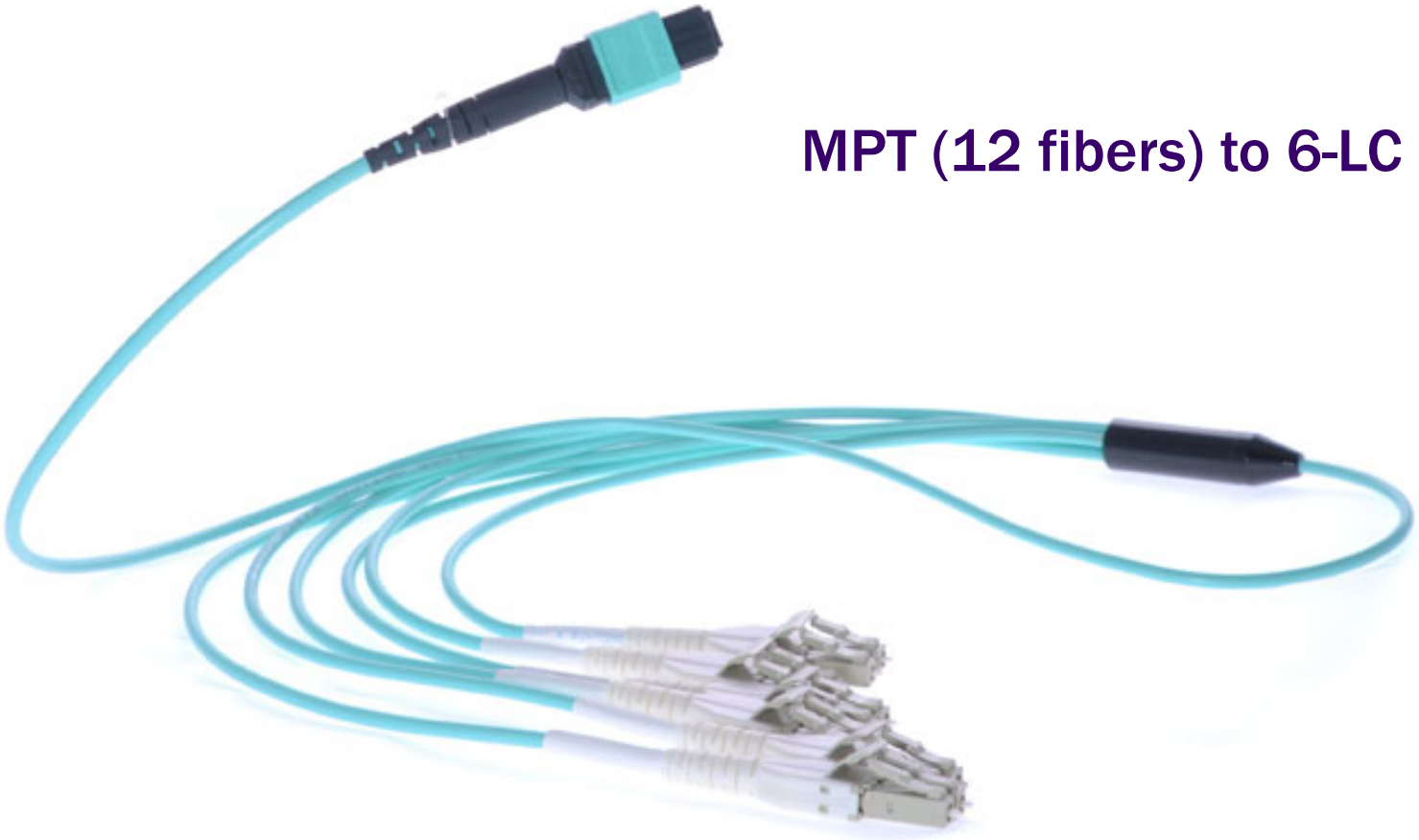
OM1 with LC connector

OM3 with LC connector

QSFP/QSFP+ Example

QSFP+ to 4-SFP+ breakout

MPT Example



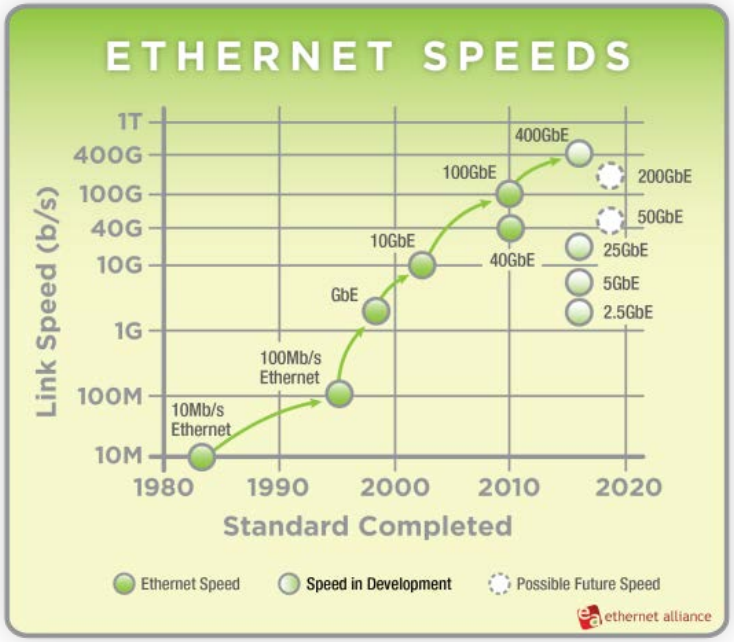
MPT (12 fibers) to 6-LC breakout

Various Designations – 10GbE

- 10GBASE-T – 10GbE with RJ45
- 10GBASE-CX4 – 10GbE with DAC (4-lane CX)
- 10GBASE-CR – 10GbE with DAC (SFP+)
- 10GBASE-SR – 10GbE with short range optics
  - Up to a few hundred meters
- 10GBASE-LR – 10GbE with long range optics
  - Up to 10KM
- 10GBASE-ER – 10GbE with extended range optics
  - Up to 40KM
- 10GBASE-ZR – 10GbE with long range optics
  - Up to 80KM – not an official standard

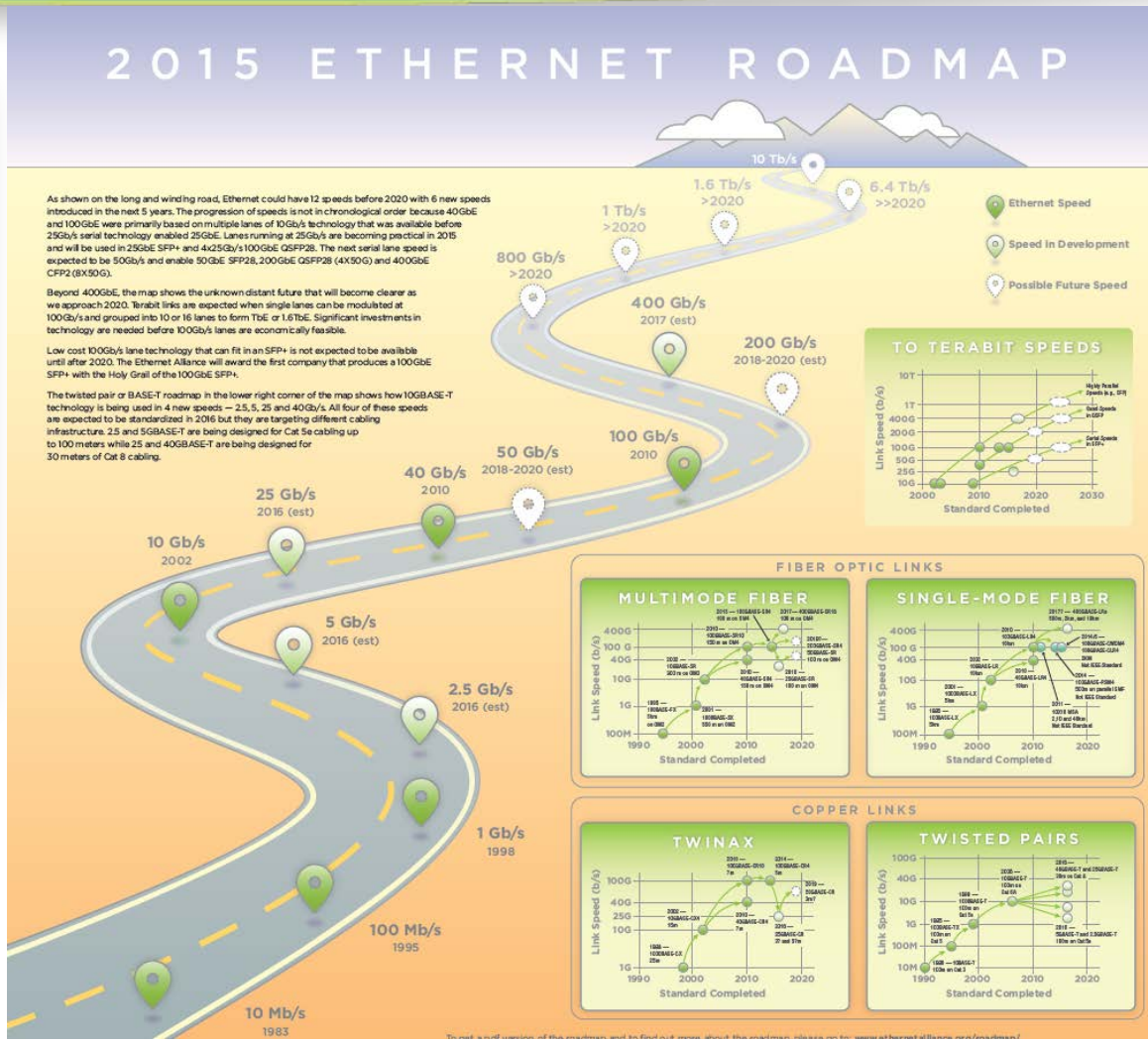
Ethernet

➢ Public Roadmap – March 2015



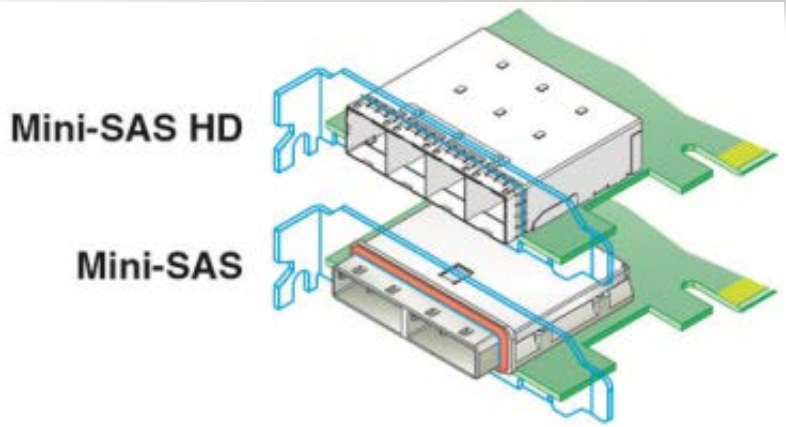
Development of four new speeds began in 2014:
2.5 GbE, 5 GbE, 25 GbE, 400 GbE

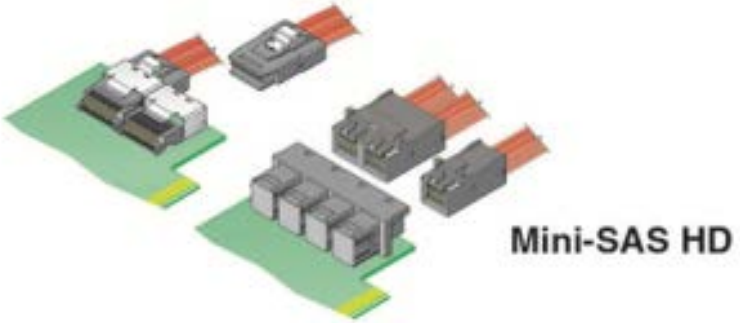
http://www.ethernetalliance.org/roadmap/



SAS

➢ Mini-SAS HD connectors





- Cables can be copper or fiber-optic

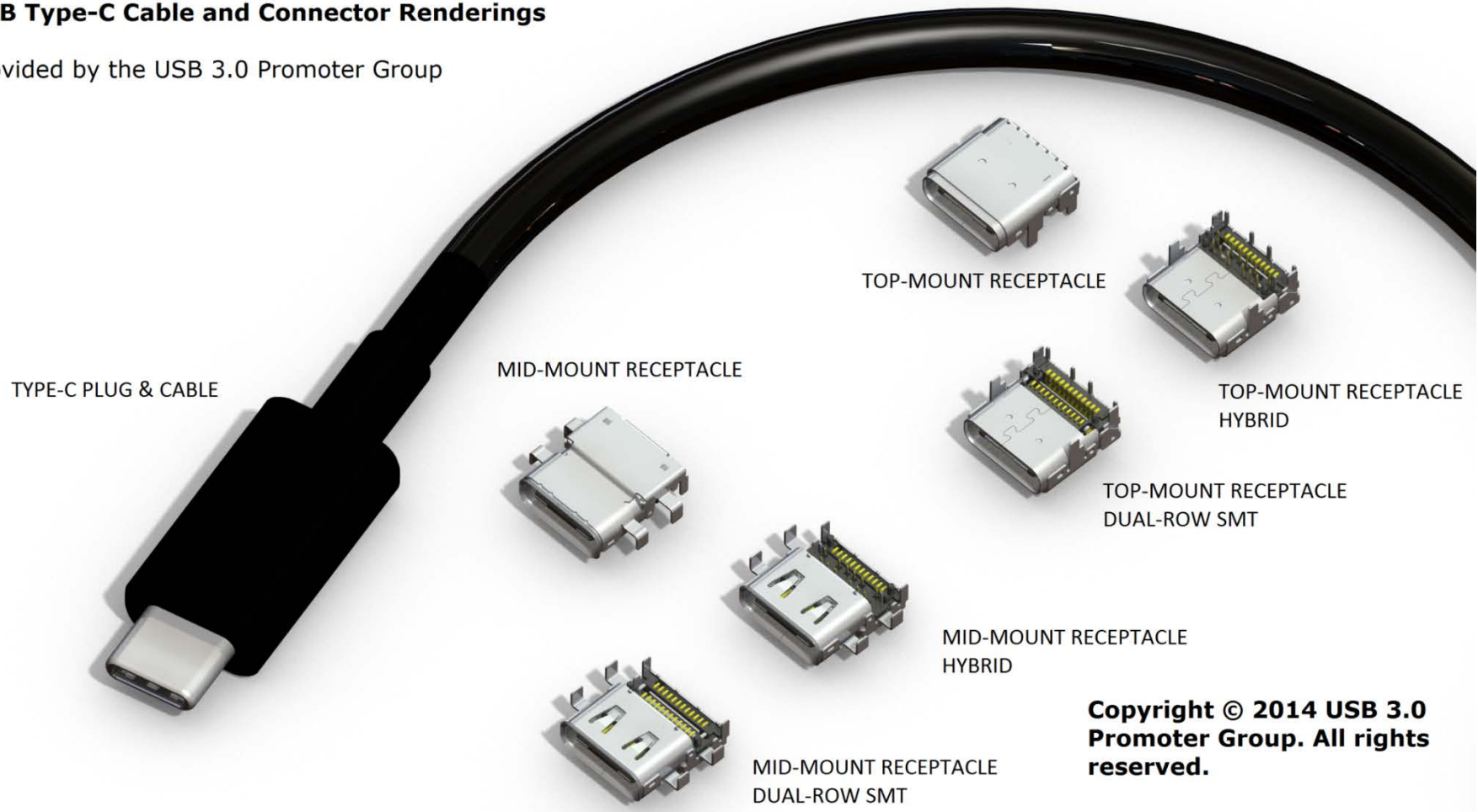
- See larger versions of these diagrams and information for other storage interfaces on the Demartek Storage Interface Comparison page: http://www.demartek.com/Demartek_Interface_Comparison.html

USB 3.1

➢ Type-C Cable & Connector

USB Type-C Cable and Connector Renderings

Provided by the USB 3.0 Promoter Group



Cabling Recommendations

➢ Fiber Optic Cables (data center)

SNIA DSI '15 DATA STORAGE INNOVATION CONFERENCE

- **Recommendation: OM4 cables for current & future**

Demartek	OM1	OM2	OM3	OM4
Jacket color	Orange	Orange	Aqua	Aqua
1 Gb/s	300m	500m	860m	–
2 Gb/s	150m	300m	500m	–
4 Gb/s	70m	150m	380m	400m
8 Gb/s	21m	50m	150m	190m
10 Gb/s	33m	82m	Up to 300m	Up to 400m
16 Gb/s	15m*	35m	100m	125m
40 Gb/s	–	–	100m	150m

* Not recommended

Cabling Recommendations

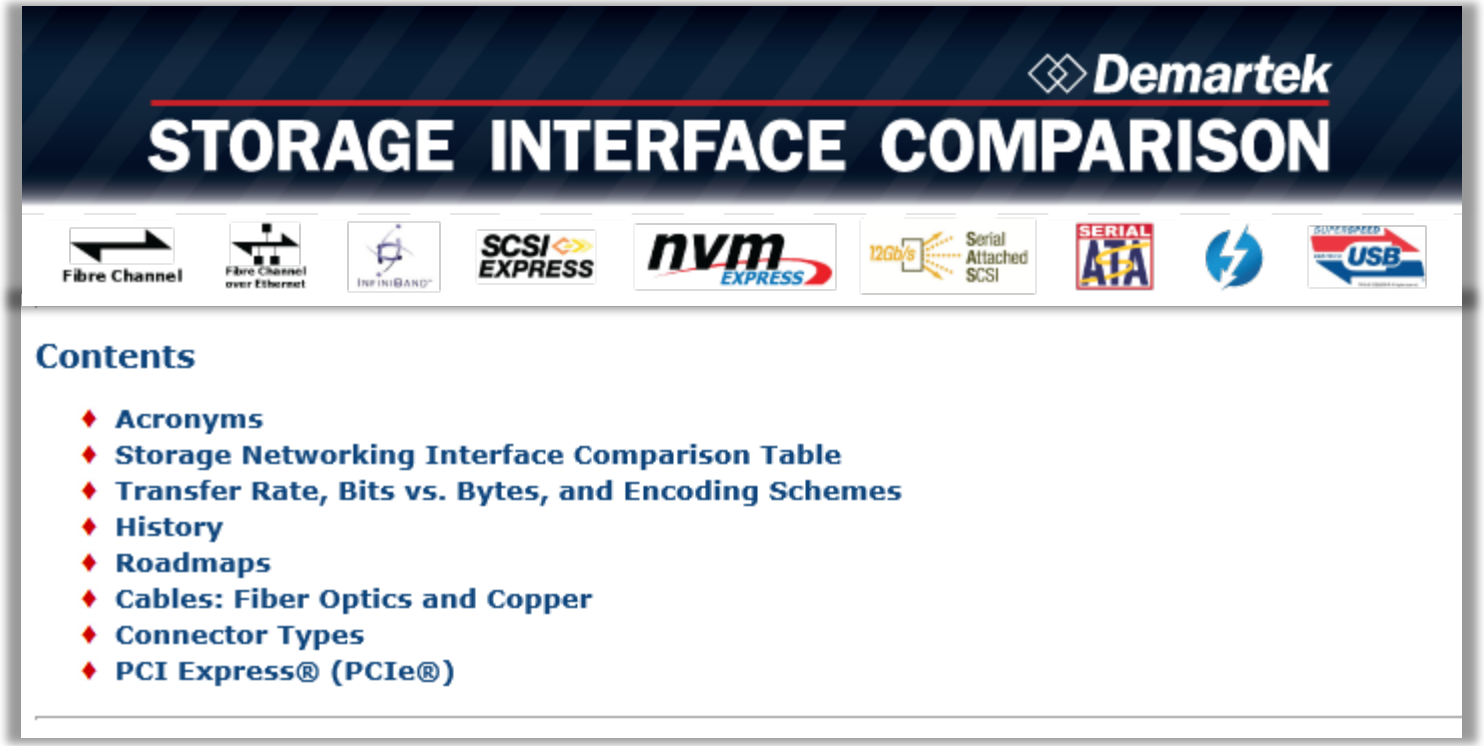
➢ Future Technology Outlook

- **As interface speeds increase, expect increased usage of fiber-optic cables and connectors for most interfaces**
  - At higher Gigabit speeds, passive copper cables and interconnects experience “amplitude loss” and become too “noisy” except for short distances (within a rack or to adjacent racks)
  - Expect to see “active copper” for some higher-speed connection types
    - **Active copper can go longer distances than passive copper**
    - **Active copper is thinner allows for better airflow than passive copper**
    - **Active copper uses more power than passive copper**

Demartek Free Resources

- Demartek comments on Flash Memory Summit 2014
  www.demartek.com/Demartek_Flash_Memory_Summit_2014_Commentary.html
- Demartek comments on IDF2014 & NVMe
  www.demartek.com/Demartek_Comments_IDF2014_and_NVMe_Thunderbolt_2_USB_3_1.html
- Demartek SSD Deployment Guide
  www.demartek.com/Demartek_SSD_Deployment_Guide.html
- Demartek Video Library - www.demartek.com/Demartek_Video_Library.html
- Demartek FC Zone – www.demartek.com/FC
- Demartek iSCSI Zone – www.demartek.com/iSCSI
- Demartek SSD Zone – www.demartek.com/SSD

Storage Interface Comparison



- Downloadable interactive PDF version now available
- Search engine: “storage interface comparison”
- www.demartek.com/Demartek_Interface_Comparison.html

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Dennis Martin, President
dennis@demartek.com
www.linkedin.com/in/dennismartin

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*also on the back of Dennis' business card

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