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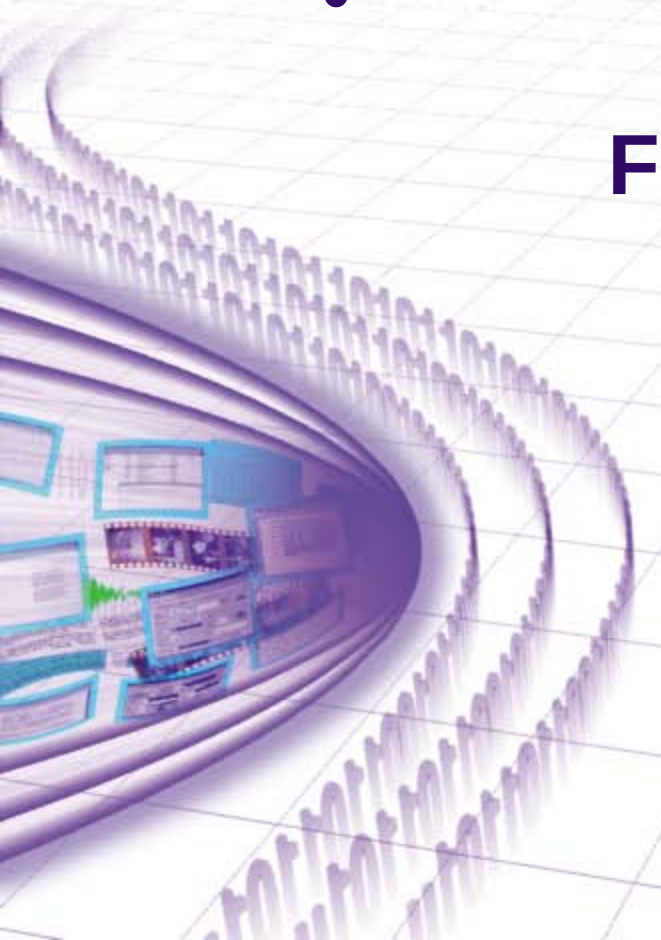

# Fibre Channel Update

**Greg McSorley, Amphenol**
**FCIA Secretary**

# *Agenda*

- Innovations
  - Tiered Storage
  - ILM
  - Speeds and Feeds
  - Green Storage
  - Initiatives
- Summary

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# Innovation

- **Designed from the beginning for high throughput mission-critical applications with minimal latencies, data integrity and guaranteed delivery**
- **Supports all storage connections from disk drives to datacenters to campuses to 100 km remote sites**
- ***The*** **trusted and deployed technology in Fortune 1000 for Mission Critical storage applications**
- **Innovating through initiatives like FC-SCM to bring enterprise-class capabilities to the SMB SAN market**
- **Thousands of proven reference designs**

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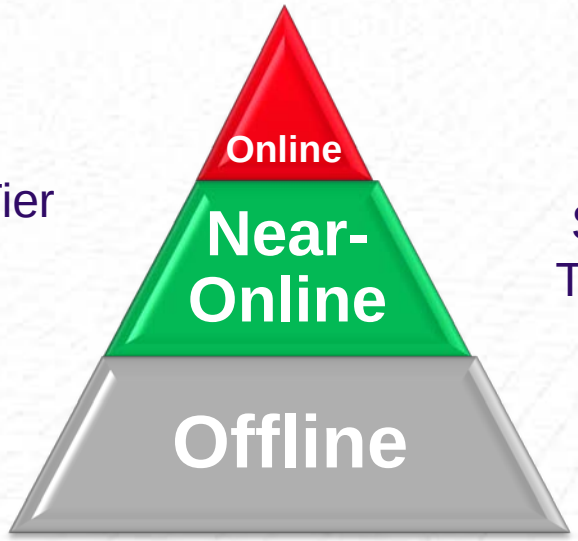
# Fibre Channel Powering Tiered Storage and ILM!

Matching Data To The Most Appropriate Storage Type Is The ILM Enabler




Storage Tier Type

- Enterprise-Class Disk Drives & SSD
  High Performance & Reliability
- Near-Online Optimized Hard Disks
  Near-Online & Temporary Retention
- Tape Backup
  Long-Term Storage

- ***The amount of information handled by each IT employee will explode over the next few years.***
- ***I don't want to pay a premium for rarely accessed data.***

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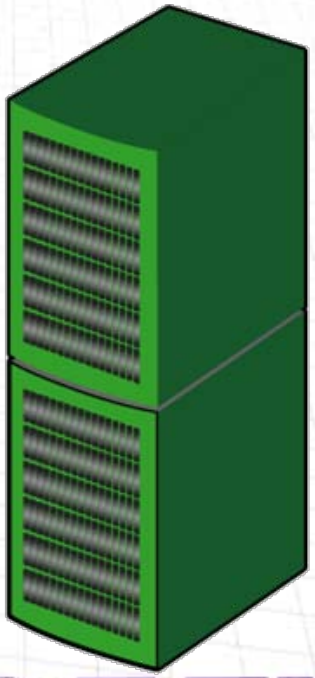
# Fibre Channel Powering Green Storage!

- Tiered storage introduces one aspect of Green Storage
- Fibre Channel offers the high performance Green Storage requires to obtain the best Efficiency/Watt ratings
- The FCIA has issued a Green Challenge to the T11



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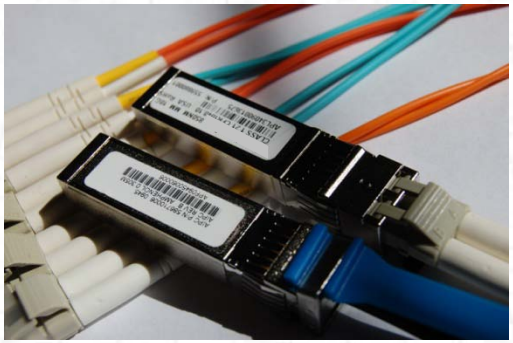
# Innovations – Compliments of Fibre Channel

- **The FCIA is helping to extend the FC protocol through close cooperation with the T11 Standards Organization through innovation in multiple areas:**
  - **8GFC**
  - **FCoE**
  - **16GFC+**
  - **Simplified Configuration**
  - **Security**
  - **Virtualization Technologies**



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# Innovations - 8GFC

- Multi-core CPUs Increase Demand for IOPS
- Virtual Machines are Dominant in FC SANs
- Slot Limited Servers Demand >IOPS/PCIe Slot
- High-end Features Appear 1st with Fibre Channel
  - Security
  - Data Integrity Initiatives
- Greater IOPS Efficiencies Lead to Better **Resource Efficiencies**

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# Innovations - Fibre Channel Over Ethernet

***Provides the extension of Fibre Channel SAN traffic over Ethernet networks, while retaining existing and new Fibre Channel storage management frameworks transparently***

- Seamless extension and protection of existing FC investments
- Network flexibility via one infrastructure for SAN, LAN, or BOTH!
- Lower operating costs via consolidated connectivity & management
- FCoE technically stable 1H 2009
  - Became technically stable February 2009
  - Ratified June 3, 2009
- OEM quals started 2H 2008, general product availability 2010
  - Numerous product announcements – full eco-system available
  - Customer pilots
- *2nd Generation FCoE products 2H 2009*
  - *Single chip CNA and Switch ASICS*

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# Innovations – FCoE

- **Data Center Bridging (DCB)**
  - Previously known as Data Center Ethernet (DCE), Converged Enhanced Ethernet (CEE)
  - Enables 10GbE I/O consolidation
  - Consists of Priority Flow Control, Congestion Notification, and Enhanced Transmission Selection at IEEE 802.1 levels
- **FC over Ethernet (FCoE)**
  - Ethernet encapsulates FC; another upper-layer protocol
  - Managed like FC at initiators, switches, storage systems
  - Same cabling (SFP+) for 8GFC and 10G FCoE

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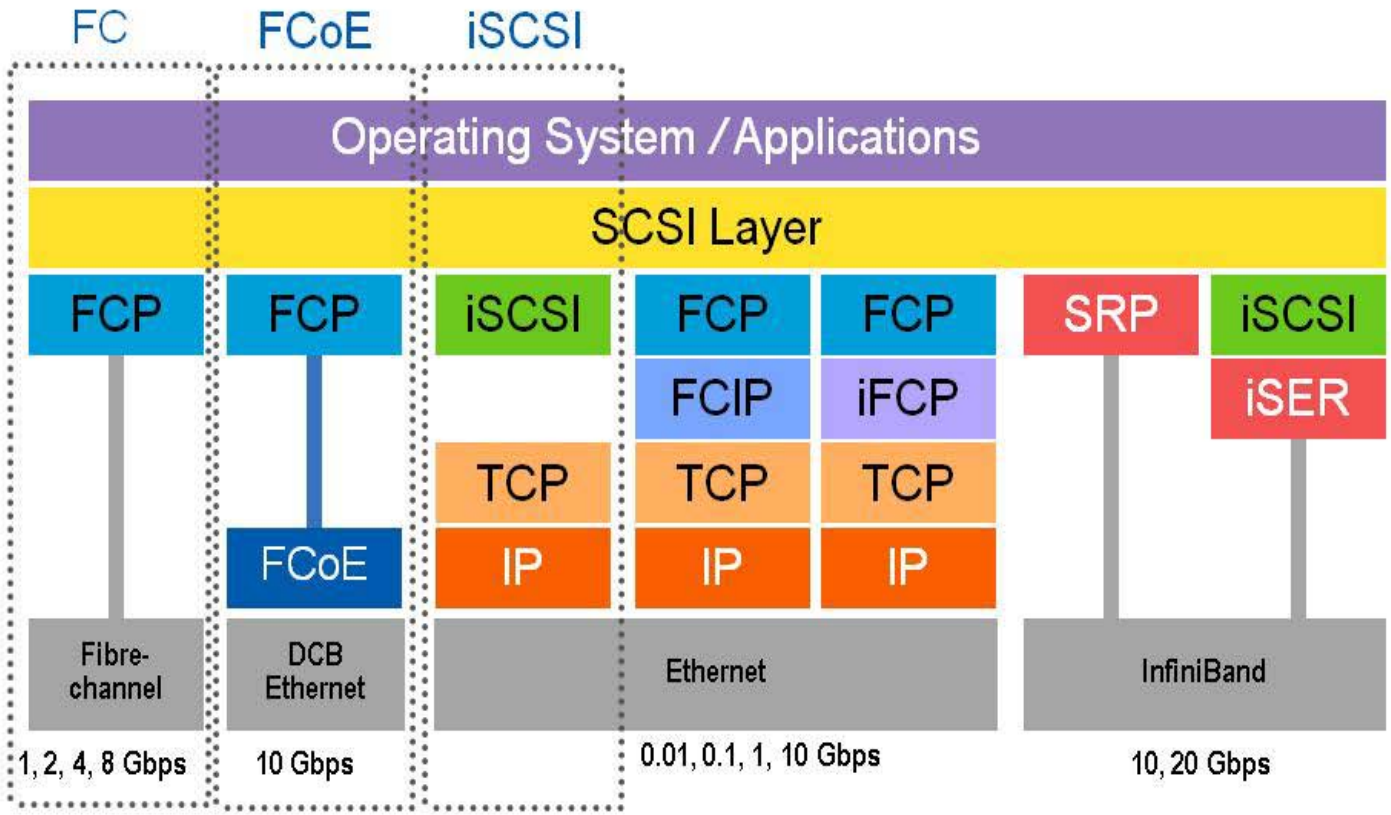
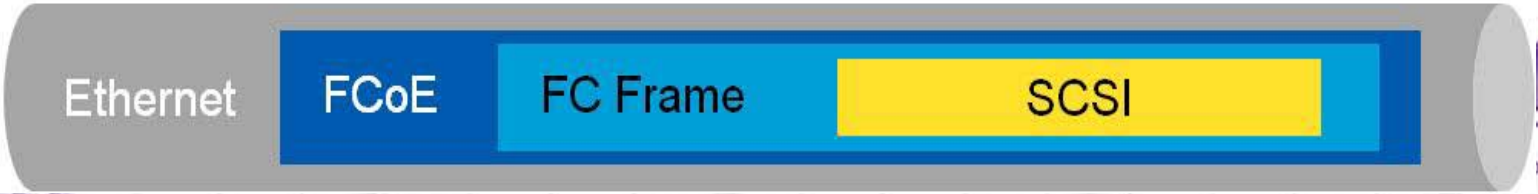
# Innovations – FCoE



# 4th FCoE Plugfest (Jun '10)

**Testing the interaction of FCoE end devices with DCBx switches. This will validate that FCoE devices operate properly with PFC (Pause) and other Ethernet traffic in a Data Center Ethernet environment**

**Using only the standard BB5 frame format and standardized that all devices will must FIP**

**Enhanced Transmission Selection is now in the test plan. Manages the bandwidth of the links**

**Evolution of a WINNING I/O Technology!**

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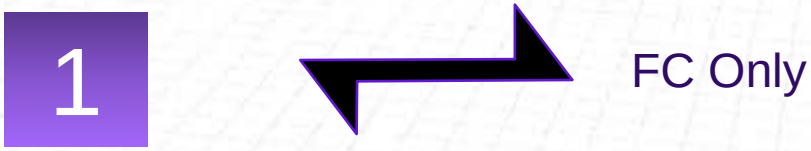
# FC and FCoE ICONs

- **Indicates FC-ONLY capability**




- **Indicates Enet *and* FCoE capability**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# Fibre Channel Bandwidth Roadmap

**FCoE**

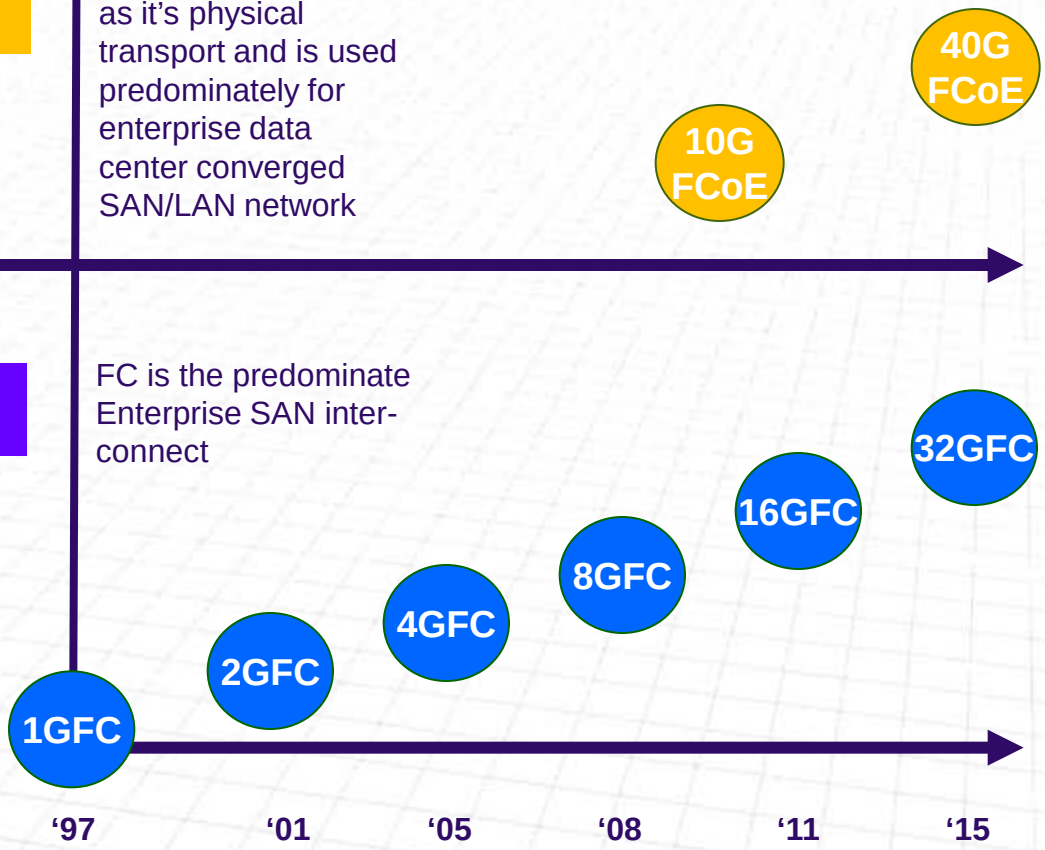
*Roadmap to 100GFCoE*

FCoE uses Ethernet as it's physical transport and is used predominately for enterprise data center converged SAN/LAN network

**FC**

*Roadmap to 128GFCoE*

FC is the predominate Enterprise SAN inter-connect




2GFC, 4GFC, 8GFC, 16G FC ***and*** 10G Ethernet/ FCoE, use same typical data center optical and copper assemblies (i.e., OM2, OM3, OM4, twin Ax) with same SFP+ module connection

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# Fibre Channel Speed Roadmap – v13

FC

| Product Naming | Throughput (MBps) | Line Rate (GBaud) | T11 Spec Technically Completed (Year)‡ | Market Availability (Year)‡ |
|---|---|---|---|---|
| 1GFC | 200 | 1.0625 | 1996 | 1997 |
| 2GFC | 400 | 2.125 | 2000 | 2001 |
| 4GFC | 800 | 4.25 | 2003 | 2005 |
| 8GFC | 1600 | 8.5 | 2006 | 2008 |
| 16GFC | 3200 | 14.025 | 2009 | 2011 |
| 32GFC | 6400 | 28.05 | 2012 | 2014 |
| 64GFC | 12800 | TBD | 2015 | Market Demand |
| 128GFC | 25600 | TBD | 2018 | Market Demand |
| 256GFC | 12800 | TBD | 2021 | Market Demand |
| 512GFC | 25600 | TBD | 2024 | Market Demand |

"FC" used throughout all applications for Fibre Channel infrastructure and devices, including edge and ISL interconnects. Each speed maintains backward compatibility at least two previous generations (I.e., 8GFC backward compatible to 4GFC and 2GFC)
†Line Rate: All "FC" speeds are single-lane serial stream
‡Dates: Future dates estimated

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# Fibre Channel Speed Roadmap - v13

**ISL**
(Inter-Switch Link)

| Product Naming | Throughput (MBps) | Equivalent Line Rate (GBaud)† | Spec Technically Completed (Year) ‡ | Market Availability (Year) |
|---|---|---|---|---|
| 10GFC | 2400 | 10.52 | 2003 | 2004 |
| 20GFC | 4800 | 21.04 | TBD | 2008‡ |
| 40GFC/FCoE | 9600 | 41.225 | 2010 | Market Demand‡ |
| 100GFC/FCoE | 24000 | 103.125 | 2010 | Market Demand |
| 400GFC/FCoE | 96000 | TBD | TBD | Market Demand |
| 1TFC/FCoE | 240000 | TBD | TBD | Market Demand |

ISLs are used for non-edge, core connections, and other high speed applications demanding maximum bandwidth. Except for 100GFC (which follow Ethernet),
†Equivalent Line Rate: Rates listed are equivalent data rates for serial stream methodologies.
‡ Some solutions are Pre-Standard Solutions: There are several methods used in the industry to aggregate and/or “trunk” 2 or more ports and/or data stream lines to achieve the core bandwidth necessary for the application. Some solutions follow Ethernet standards and compatibility guidelines. Refer to the FCoE page 4 for 40GFCoE and 100GFC0E.

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# Fibre Channel Speed Roadmap - v13

## FCoE

| Product Naming | Throughput (MBps) | Equivalent Line Rate (GBaud)† | Spec Technically Completed (Year)‡ | Market Availability (Year)‡ |
|---|---|---|---|---|
| 10GFCoE | 2400 | 10.3125 | 2008 | 2009 |
| 40GFCoE | 9600 | 41.225 | 2010* | Market Demand |
| 100GFCoE | 24000 | 103.125 | 2010* | Market Demand |

Fibre Channel over Ethernet tunnels FC through Ethernet. For compatibility all 10GFCoE FCFs and CNAs are expected to use SFP+ devices, allowing the use of all standard and non standard optical technologies and additionally allowing the use of direct connect cables using the SFP+ electrical interface. FCoE ports otherwise follow Ethernet standards and compatibility guidelines.

‡Dates: Future dates estimated

* It is expected that 40GFCoE and 100GFCoE based on 2010 standards will be used exclusively for Inter-Switch Link cores, thereby maintaining 10GFCoE as the predominant FCoE edge connection

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# Innovation - 16GFC

- 16GFC Standard Finished
  - This June NCITS T11 FC-PI-5 forward to ANSI for publication
  - October 2009 PI-5 was “technically stable” standard
    - Also finished joint T11.2/T11.3 work for auto-negotiation 8b/10b to 64b/66b
  - FCIA Issued Press Release October 19, 2009
    ***“ANSI INCITS T11.2 Committee Completes Technical Work on 16GFC”***
- Industry Roll-out
  - Potential SNW Fall 2010 Demos
  - Potential Q4 Plugfests this year
  - Potential 2010/11 OEM Quals, 2011/12 Fortune 1000 End User Adoption

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# Innovation - 32GFC

- **Highlights of FCIA 32GFC MRD for T11 standard**
  - Stay serial and single-lane; 28.05Gbaud (2x 16GFC)
  - T11.2 starts work on FC-PI-6 June ‘10, stable by August ‘11, release Feb ‘12
  - 70 to 100 meters on OM3 optics, 7 meters on copper
  - <=50% Watts/Port of 40GE and <=50% $/port of 40GE
  - T11.2 FC-PI-6 (and potential T11.3) to include FC-EE (Energy Efficient)
- **2014 products**
  - **Leverage work from multitude of technologies**
    - “Perfect Storm” flocking towards 25Gbaud range
    - Expect feasibility for FC core markets around 2014-2015
      - *Ethernet 100G mandates a 25G/lane technology 2015*
      - *IB will have 25G per lane option in 2014/2015*

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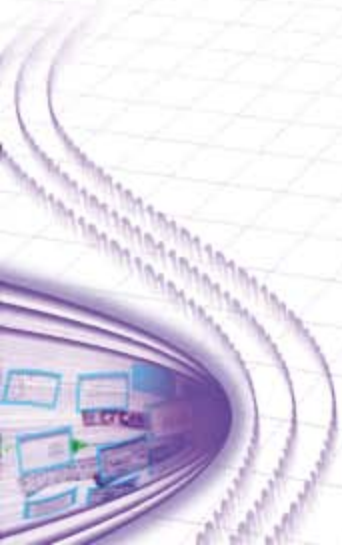
# Innovations – FC-SCM (Simplified Configuration and Management)

- **Qualification**
  - Testing and qualification of basic operation
  - Qualifying interoperable configurations
- **Reduce qualification to a limited set of standard features**
- **Maintain High Availability**
- **Bring Enterprise Capabilities to Smaller Organizations**



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# Backward and Forward Compatibility

- **Automatically enables intermixing 32GFC, 16GFC, 8GFC, 4GFC & 2GFC technologies without slowdown at any point in the system**
- **Unparalleled ability to seamlessly scale**
  - Capacity
  - Performance
  - Reliability, Availability and Serviceability (RAS)

***True Investment Protection***

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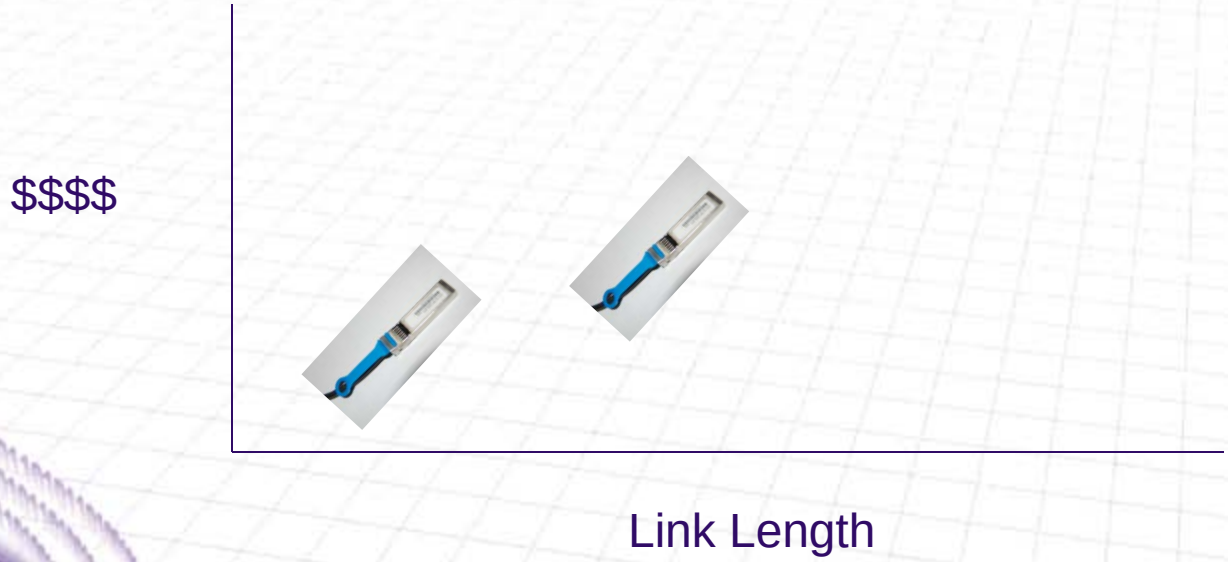
# SFP+ Interconnect

- **Back ward and forward compatibility**
  - SFP+ used for 2, 4, 8, 16, 32 GFC and 10GbE
- **Passive copper, Active copper and Optical transceivers enable interconnects from .5 meters, passive copper to 300 meters on OM3 and ?? kilometers on SM fiber.**
-

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# Industry Cooperation and Coopetition

- **Extensive vendor testing and qual cycles**
- **Plugfests since 1996**
  - 1st FCoE plugfest September 2008
  - Next FCoE plugfest June, 2010 at UNH
- **Active T11 interoperability profiles**
- **Multiple active interoperability test facilities**
  - UNH
  - SNIA Tech Center
  - Independent Test  Labs
  - Others

***Guaranteed Standards-Compliant Implementations***

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