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FIBRE CHANNEL INDUSTRY ASSOCIATION

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# A brief history of Fibre ChannelInnovations

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- •Tiered Storage
- •ILM

Agenda

- •Speeds and Feeds
- •Green Storage
- Initiatives
- Virtualization
- •Summary



# In the Beginning...

Data storage was:

•Susceptible to natural disasters

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- •Limited in capacity
- •Unreliable
- •Difficult to replicate
- •Limited in longevity

The original datacenter storage repository of information resided with the priests and witch doctors





#### Technology Helped, but still...

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•Limited in capacity •Unreliable reproductions•Difficult to replicate

# Technology Continued to Advance

•Extensive scalability •High availability •True innovation •Responsive to customer needs, wants and desires •Virtualization trail-blazing United States of the state of the st



# Data Storage Needs Exploded and are Still Exploding

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Fibre Channel has been the Solution Fibre Channel Continues to Bring Solutions Fibre Channel Offers Continuous Innovation ...ensuring Future-Proofed Solutions ...leading the charge to Virtualized Storage



## **Storage Explosion!**

Whether through targeted
messaging or tormented screams
in IT rooms, businesses
everywhere are *waking up* to the
fact their data needs are *more than doubling* each year

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- They need Fibre Channel
- They need virtualization
- The need to manage, store, backup and retrieve data is pushing and will further push the limits of IT staffs
- Fibre Channel is meeting the challenge with simpler, scalable and manageable storage





# Fibre Channel Meets Customers Needs

Fibre Channel is not only proven; it has evolved and is evolving to fully and predictably meet business needs for businesses of all sizes

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*"Our customers and employees increasingly expect increased application performance."* 

#### AFFORD/ABLE RELI/ABILITY

"We require the same ultrareliable storage as a large enterprise, priced affordably."

#### SUPERIOR TOOLS

"We need superior storage management tools to boost our productivity."

#### SIMPLE AND SCALABLE

"Our data storage needs are expanding rapidly. We need a simple, scalable solution."







Percent of organizations planning to increase spending from previous year.





# **Fibre Channel Continuous 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
- <u>The</u> trusted and deployed technology in Fortune 500 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
   The Safest Storage Implementation



# Innovation

Fibre Channel Helped Blaze the Trail to

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Tiered StorageILM"Greening" of Storage





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#### Fibre Channel Powering Tiered Storage and ILM!

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



- 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.



# 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







# **Innovations** – Compliments of Fibre Channel

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- 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





# **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 1<sup>st</sup> 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

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- 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

## The only TRUE Unified IO



# Innovations – FCoE

- Data Center Bridging (DCB)
  - Previously known as Data Center Ethernet (DCE), Converged Enhanced Ethernet (CEE)
  - Enables 10GbE I/O consolidation

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- 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





# 4<sup>th</sup> 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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# Fibre Channel Bandwidth Roadmap





450

400

350

MFG Revenue (\$M)

10

50

0

0

# FCoE Adapters: 200% Growth Per Year

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#### FCoE Switching Also Expected to Boom!



# Source: Dell'Oro



# **Innovation - 16GFC**

- 16GFC Standard Finished
  - This June NCITS T11 FC-PI-5 forward to ANSI for publication

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- 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



# **Innovation - 32GFC**

#### • Highlights of FCIA 32GFC MRD for T11 standard

• Stay serial and single-lane; 28.05Gbaud (2x 16GFC)

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- 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</p>
- 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



# FC and FCoE ICONs

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• Indicates FC-ONLY capability



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• Indicates Enet and FCoE capability







#### Fibre Channel Speed Roadmap - v12 - 2/4

Base2*	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

See Page 3 for Base10, Page 4 for FCoE

\*Base2 used throughout all applications for Fibre Channel infrastructure and devices. Each speed maintains backward compatibility at least two previous generations (I.e., 8GFC backward compatible to 4GFC and 2GFC) +Line Rate: All Base2 speeds are single-lane serial stream ±Dates: Future dates estimated





#### Fibre Channel Speed Roadmap - v12 - 3/4

3ase10*	Product Naming	Throughput (MBps)	Equivalent Line Rate (GBaud)†	T11 Spec Technically Completed (Year)	Market Availability (Year)
	10GFC	2400	10.52	2003	2004
	20GFC	4800	21.04	TBD	2008‡
	40GFC	9600	TBD	TBD	Market Demand
	100GFC	24000	TBD	TBD	Market Demand

See Page 2 for Base2, Page 4 for FCoE

\*Base10 is for ISLs, core connections, and other high speed applications demanding maximum bandwidth. Except for 100GFC (which follow Ethernet standards and compatibility guidelines), each Base10 speed is expected to be compatible at least one previous generation. †Equivalent Line Rate: Base10 rates listed are equivalent data rates for serial stream methodologies. ‡ 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.



# Fibre Channel Speed Roadmap - v12 - 4/4

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*	Product Naming	Throughput (MBps)	Equivalent Line Rate (GBaud)†	T11 Spec Technically Completed (Year)‡	Market Availability (Year)‡
Ю О	10GFCoE	2400	10.3125	2008	2009
	40GFCoE	9600	41.225	TBD	Market Demand
	100GFCoE	24000	100.3125	TBD	Market Demand

#### See Page 2 for Base2, Page 3 for Base10

Fibre Channel over Ethernet tunnels FC through Ethernet. For compatibility all 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



#### Normalized Switch and HBA Port Count and Market

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# Innovations – FC-SCM

(Simplified Configuration and Management)

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- 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



#### Integration with Virtual Environments Drives IO Bandwidth amongst a bounty of other things!

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#### EVERYTHING indicates insatiable thirst for higher bandwidth





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# **Innovations - Virtualization**

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- Increasing power leads to underutilization which leads to virtualization to drive consolidation
- Types of Virtualization
  - N\_Port\_ID Virtualization (NPIV)
  - Inter-Fabric Routing (IFR)
  - Fabric-Based Virtualization (FAIS)
  - Virtual Channels (QoS)
  - Virtual Switches
- Virtualization increases control and improves manageability
- Virtualization increases the Resource Efficiencies
- All of these techniques are based on standards



# Orlando, Florida

# **Innovations - N\_PortID Virtualization**

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#### **NPIV** Powers the Emergence of Server Blades





# Innovations - N\_PortID Virtualization

NPIV Powers VPS Sites

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- Allows migration and management of tens of thousands of Virtual Private Servers
- Highly efficient and easy to use
- Another aspect of GREEN Storage









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Layer 2 – Switching FSPF = Fabric Shortest Path First ISL = Inter-Switch Link

#### **Fabrics and Inter-Fabrics**

Layer 3 – Routing

IFR = Inter-Fabric Router Simple Routing



Fibre Channel Link



## **CONVERGENCE** Innovations - Fabric Based Virtualization

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#### FC-Fabric Application Interface Specification (FAIS)





# Innovations - Virtual Channels (QoS)



# **Innovations - Virtual Switches**

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# **Backward and Forward Compatibility**

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- 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**



# Industry Cooperation and Coopetition

- Extensive vendor testing and qual cycles
- Plugfests since 1996
  - 1<sup>st</sup> FCoE plugfest September 2008

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- 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**



# Summary: Fibre Channel...

- Dominates the SAN market
- Well understood
- Easy to learn, use and implement
- Protects and future-proofs storage investments
- Future-proofs storage
- Provides comprehensive solutions
- Vision for extending into additional markets
- Continuous speed & Bandwidth/\$ improvements
- Listening to customer needs
- Aggressively pursuing Energy Efficiency

## Fibre Channel: Unchallenged in Storage









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