Fibre-channel:
The Ultimate Interface for Flash Storage

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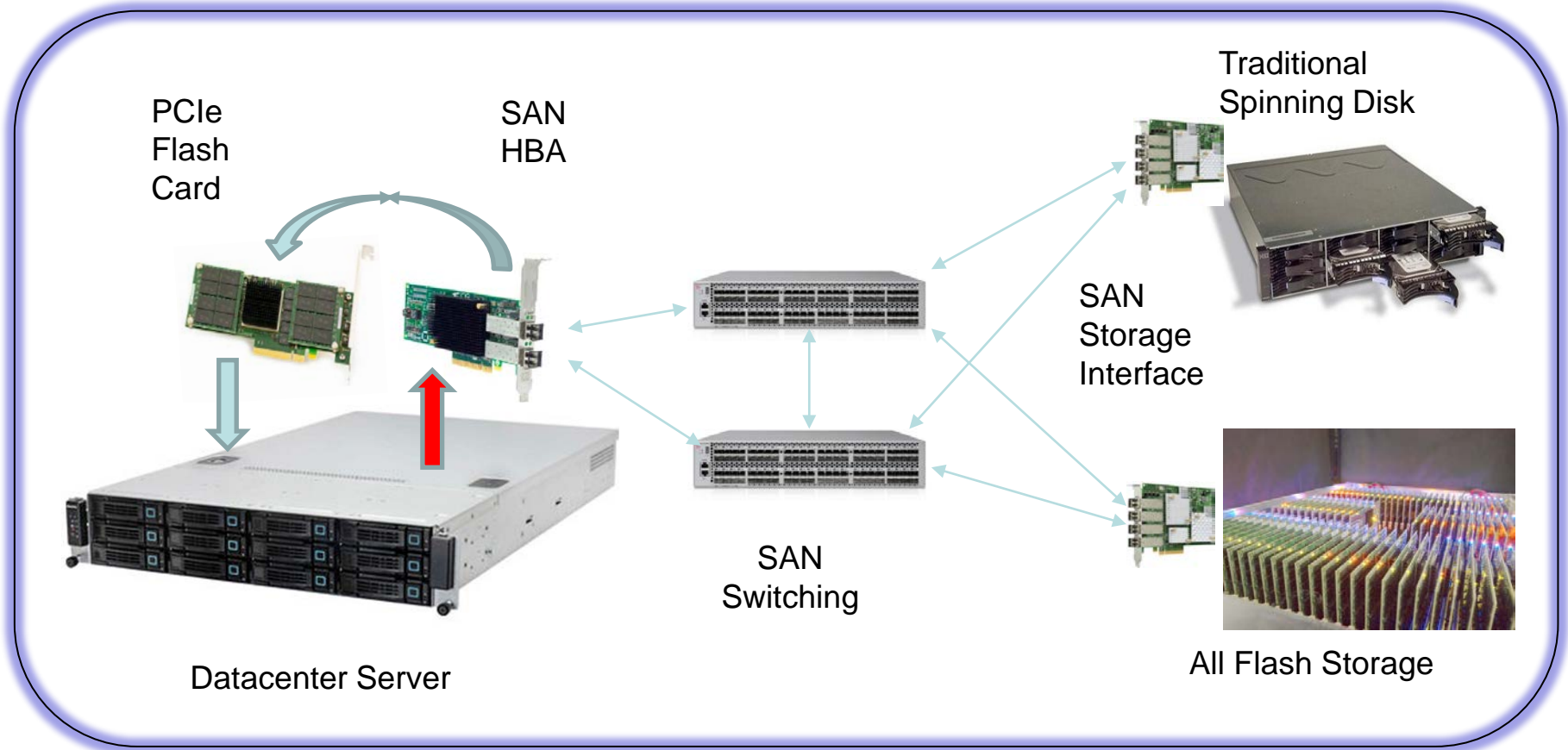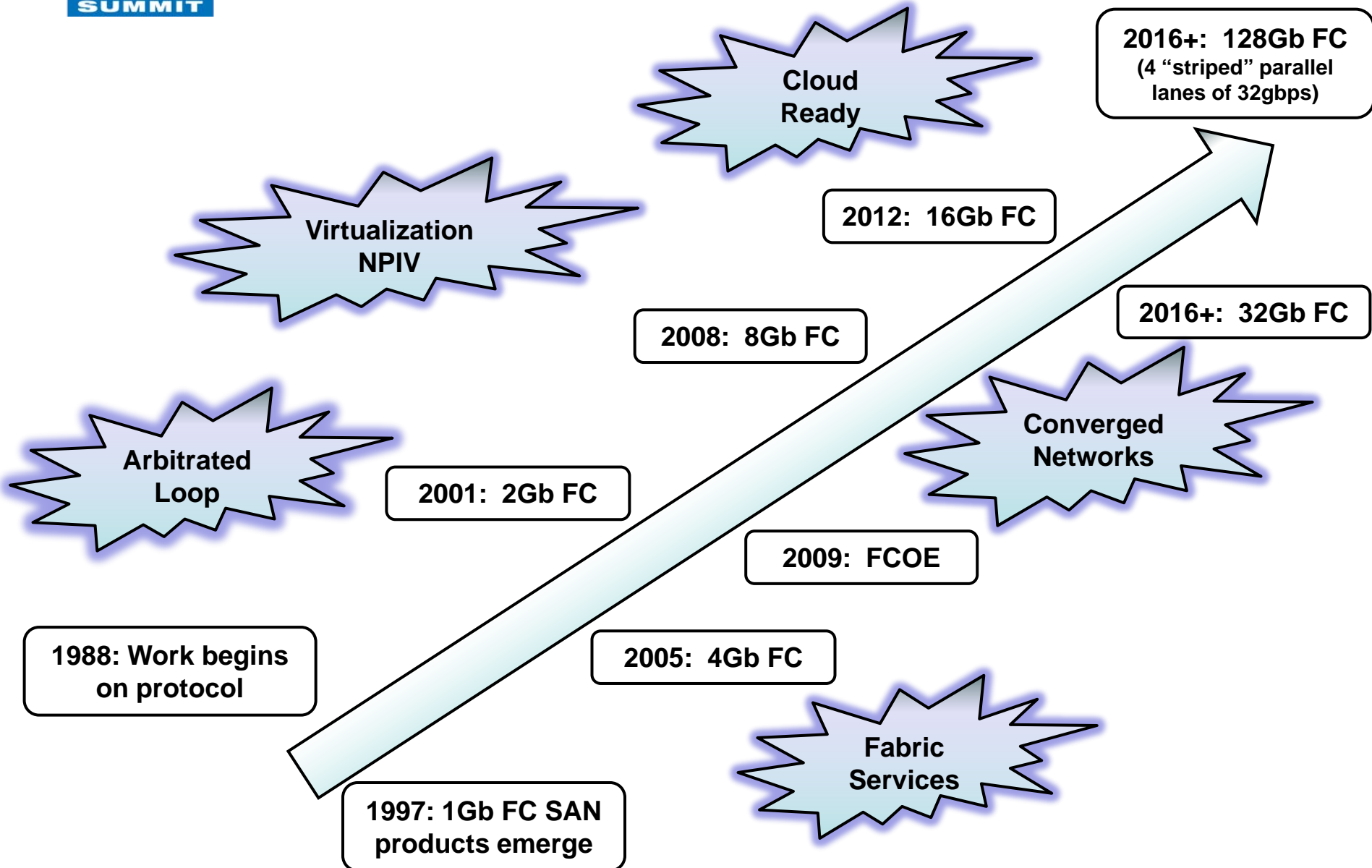Director, Technical Marketing
Emulex Corporation

AGENDA

- Flash Compute Model
- The Fibre Channel Industry
- Roadmap
- Benefits of Fibre Channel
- Fibre Channel Benefits for PCIe Flash
- More performance for Flash Storage Arrays
- Summary

TODAYS FLASH I/O COMPUTE MODEL

PCIe
Flash
Card

SAN
HBA

Traditional
Spinning Disk

SAN
Storage
Interface

SAN
Switching

Datacenter Server

All Flash Storage

FIBRE CHANNEL: TIMELINE

Cloud Ready

2016+: 128Gb FC
(4 "striped" parallel lanes of 32gbps)

Virtualization NPIV

2012: 16Gb FC

2008: 8Gb FC

2016+: 32Gb FC

Arbitrated Loop

Converged Networks

2001: 2Gb FC

2009: FCOE

1988: Work begins on protocol

2005: 4Gb FC

Fabric Services

1997: 1Gb FC SAN products emerge
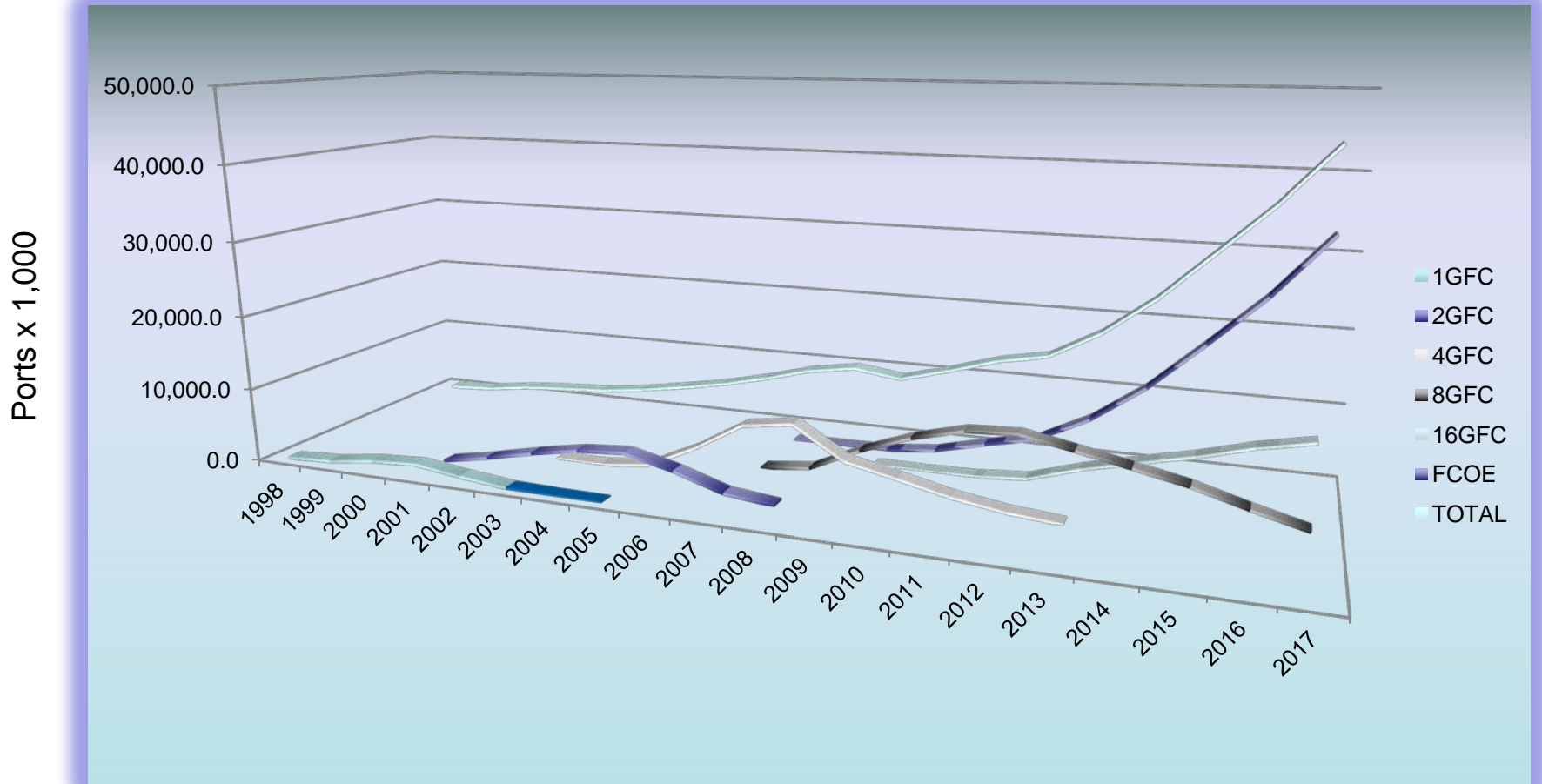
2012 – FIBRE CHANNEL MILESTONES!

10 – 10 - 10

- 10 Million ports shipped [1]

- $10 Billion spent on FC technology [2]

- 10 Exabytes in FC storage shipped [3]

[1] Worldwide Storage Area Network Market – Fibre Channel Forecast, January 2012

[2] Worldwide External Enterprise Storage Systems Revenue by Topology, Installation, and Protocol 2006-2015 ($B), IDC, 2011
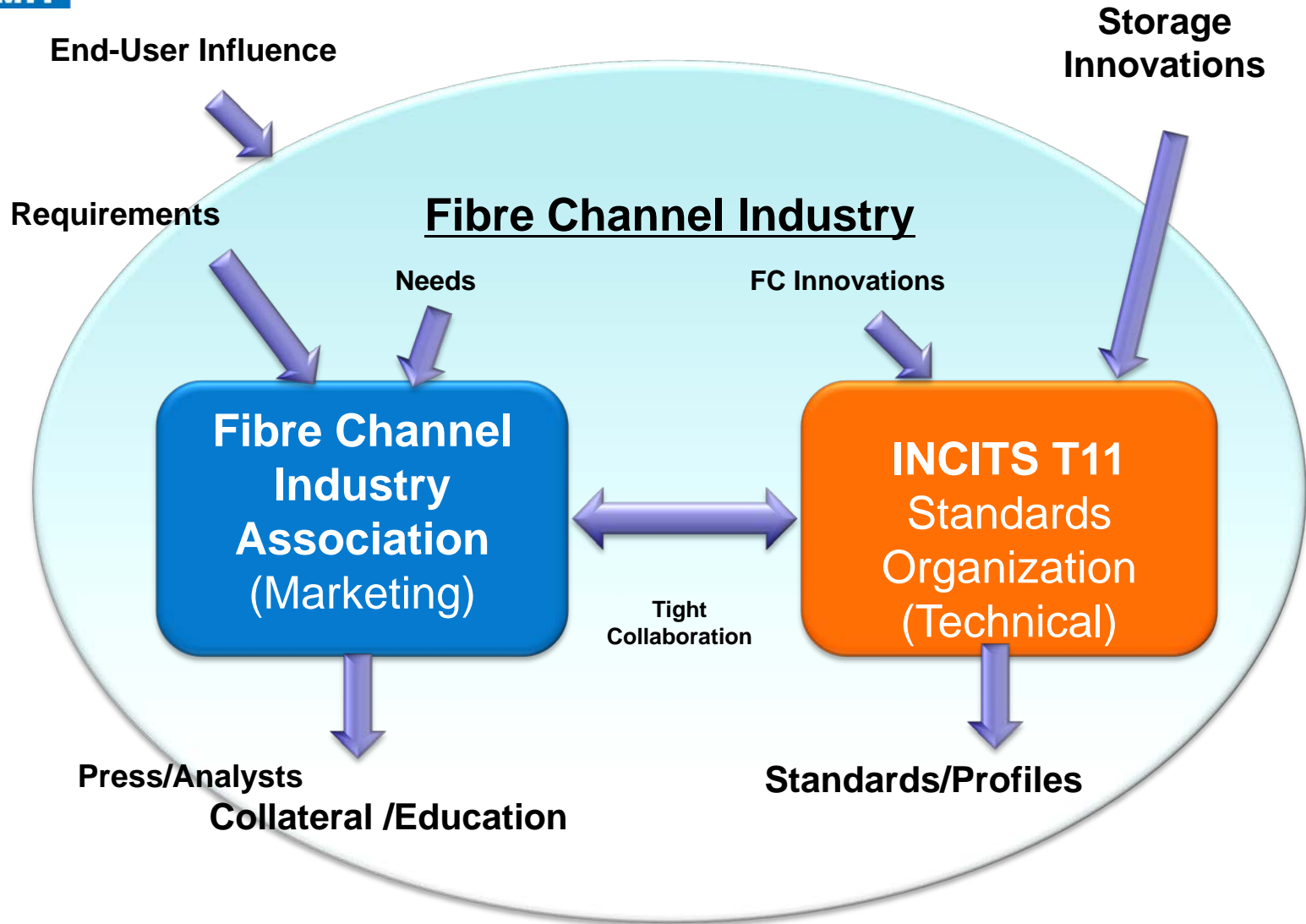
[3] Worldwide External Enterprise Storage Systems Capacity Shipped by Topology, Installation and Protocol 2006-2015 (PB), IDC, 2011

FC AND FCOE (ENABLED) PORTS

Source: Dell'Oro Group: SAN Forecast Report, January 2013

HOW THE FC INDUSTRY INNOVATES

End-User Influence

Storage Innovations

Requirements

Fibre Channel Industry

Needs

FC Innovations

Fibre Channel Industry Association (Marketing)

INCITS T11 Standards Organization (Technical)

Tight Collaboration

Press/Analysts
Collateral /Education

Standards/Profiles

FIBRE CHANNEL SPEEDMAP

V18

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	2013	2015
128GFCp	25600	4X28.05	2014	2015
64GFC	12800	TBD	2016	Market Demand
128GFC	25600	TBD	2019	Market Demand
256GFC	51200	TBD	2022	Market Demand
512GFC	102400	TBD	2025	Market Demand
1TFC	204800	TBD	2028	Market Demand

FC

- "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 "…GFC" speeds listed above are single-lane serial stream I/O's. All "…GFCp" speeds listed above are multi-lane I/Os
- ‡ Dates: Future dates estimated

FIBRE CHANNEL SPEEDMAP

V18
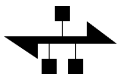
FCoE

Product Naming	Throughput (MBps)	Line Rate (GBAUD)	Spec Technically Completed (Year)	Market Availability (Year)
10GFCoE	2400	10.3125	2008	2009
40GFCoE	9600	4X10.3125	2010	2014
100GFCoE	24000	10X10.3125	2010	Market Demand
100GFCoE	24000	4X25.78125	2015	Market Demand
400GFCoE	96000	TBD	TBD	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.

ATTRIBUTES OF FIBRE CHANNEL

- Data Center Hardened over 15 Years
- On the cutting edge of Performance
  - Performance boost every 3-4 years
- Backwards compatibility
  - 2 generations back, allows for upgrade as you grow
- Proven high availability
  - Both OEM and OS high availability features
- Inherent Security
  - Separate network for storage is not easily hacked
- Lossless Network
  - Allows for high resource utilization while maintaining consistent performance

PERFORMANCE FOR FLASH STORAGE FABRIC INTERFACES
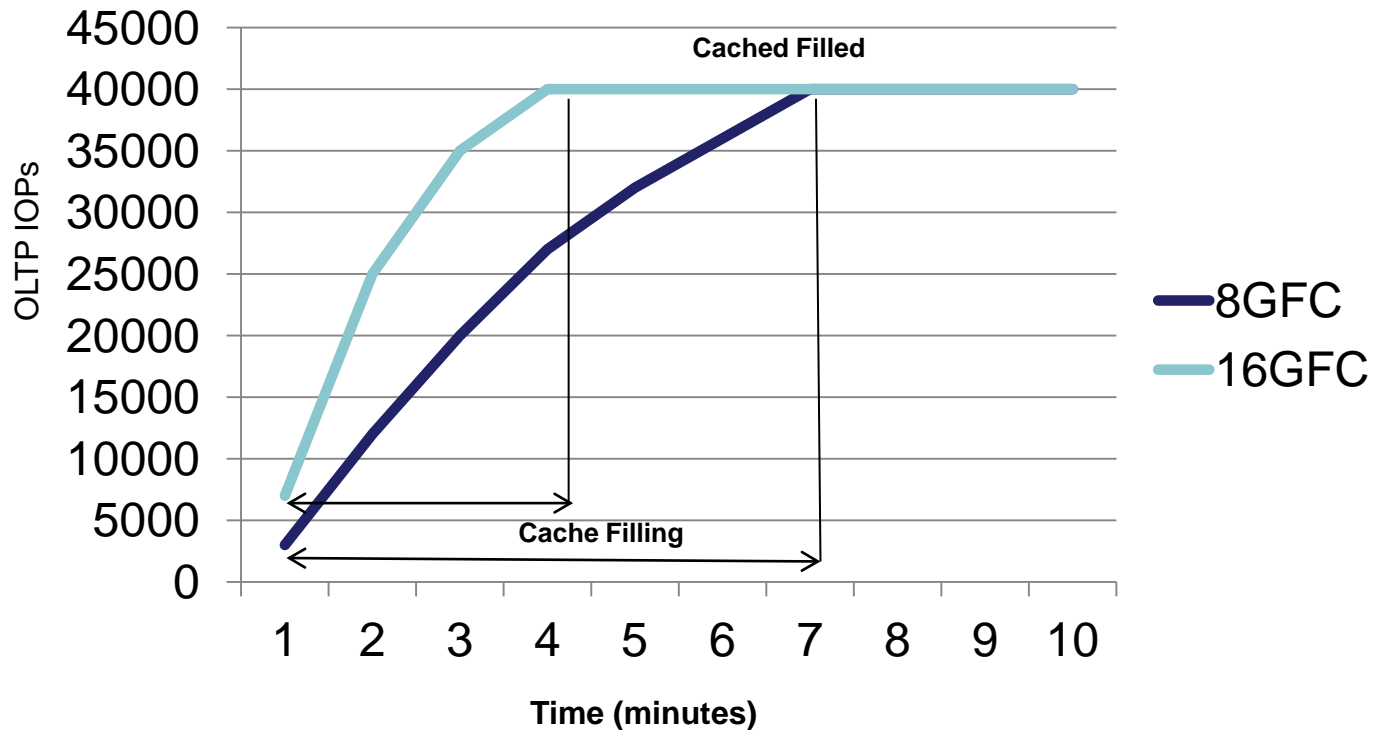
▪ 16GFC Delivers:

- Double the SAN throughput
- Double the IOPs
- Lower Latency
- Increased Power Efficiency

IOPs @ 4k

4GFC
8GFC
16GFC

MB/s @ 64k

4GFC
8GFC
16GFC
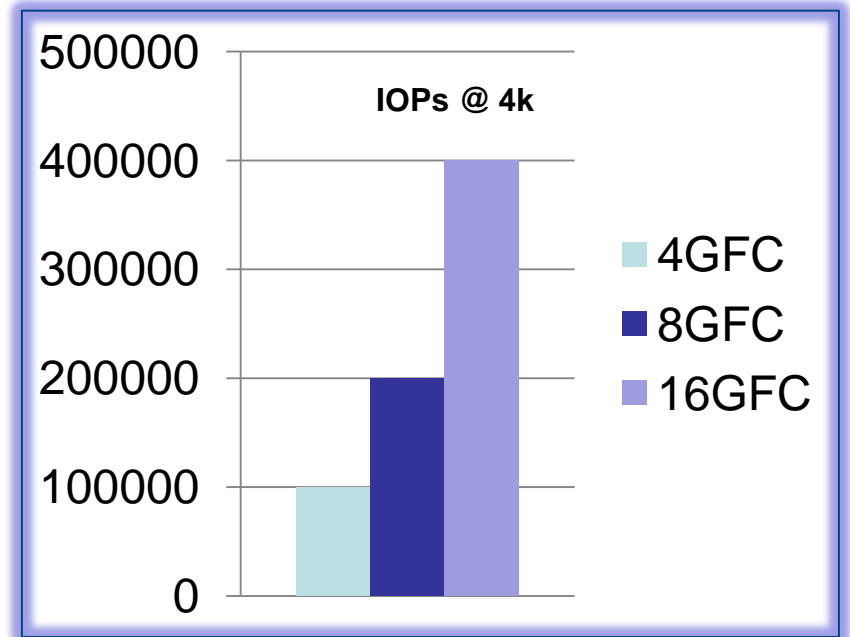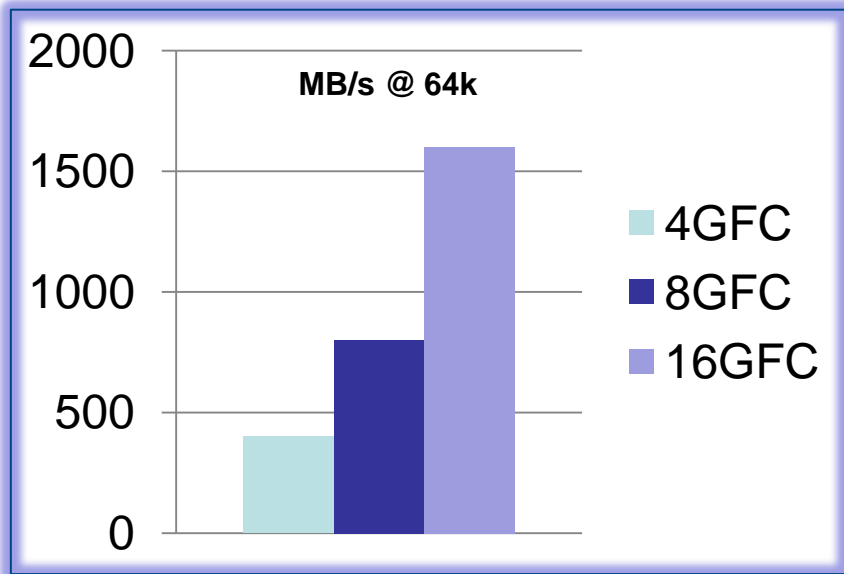
PERFORMANCE YOU NEED FOR HOST CACHING

- 16GFC has higher throughput and IOPs
- Host cache fills at a faster rate due to faster read rate
- Optimum OLTP performance achieved / stabilized sooner

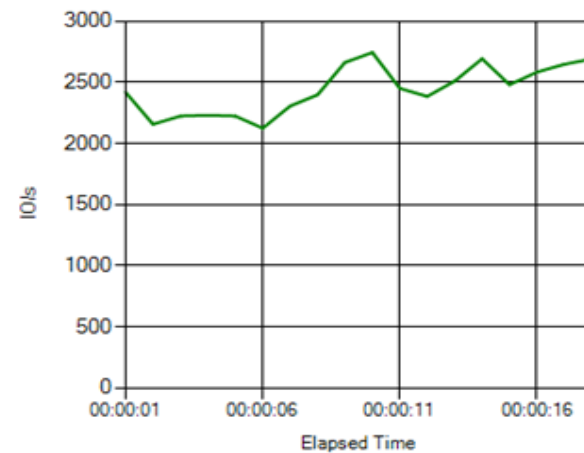- Of Course un-cached write I/O has direct benefits of 16GFC performance

LOSSLESS NETWORK

▪Fibre Channel is inherently lossless

– No dropped frames

– No performance degradation due to re-transmissions

– Higher effective link utilization and efficiency

– Consistent performance due to low jitter

▣ **Jitter of loss-full Protocol**
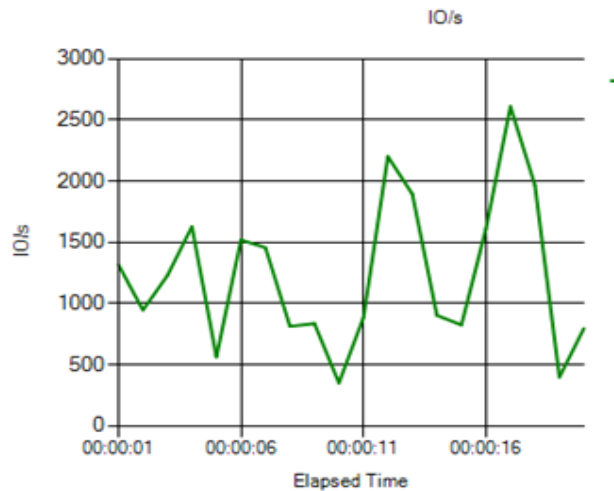
▣ **Reduced Jitter with Fibre Channel**

Summary: Fibre Channel…

- Flash I/O in the datacenter requires high performance networks that FC delivers
- Legacy and Roadmap continues to lead the industry
- 16GFC helps performance of host side caching
- All Flash Arrays can benefit from the latest FC advances

Thank You

www.Fibrechannel.org
www.T11.org

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