

FIBRE CHANNEL SOLUTIONS GUIDE

FIBRE CHANNEL: CONTINUOUS INNOVATION

Mike McNamara – NetApp, FCIA Marketing Committee Chair

Fibre Channel (FC) has been the major storage system interconnect since the mid 1990s and is the data center standard for storage area networks (SANs) and enterprise storage, with more than 80% market share today and projected through 2010, according to Gartner External Controller-Based Disk Storage WW 2006–2010, October 6, 2006. FC SANs offer a range of benefits such as improved backup and restore, enhanced business continuance, and simplified consolidation. This article addresses some of the common concerns about Fibre Channel and discusses some of the recent developments.

Fibre Channel is a mature interface, interoperability is well understood, and management is becoming more standardized. FC has been designed to scale from simple to the most complex topologies, and the FC Simple Configuration and Management (FC-SCM) initiative will help to streamline and cost-optimize system configurations and simplify installation and interoperability for smaller FC SANs.

For nearly a decade, FC has been the mainstay for companies looking to increase storage resiliency and bandwidth performance while maintaining backward compatibility. FC is evolving to continue to be the standard for storage networking, from enhancing server and storage infrastructure consolidation to delivering the highest levels of performance and data reliability.

ABOUT THE FCIA

THE FIBRE CHANNEL INDUSTRY ASSOCIATION (FCIA) IS A NON-PROFIT INTERNATIONAL ORGANIZATION WHOSE SOLE PURPOSE IS TO ACT AS THE INDEPENDENT TECHNOLOGY AND MARKETING VOICE OF THE FIBRE CHANNEL INDUSTRY.

WE ARE COMMITTED TO HELPING MEMBER ORGANIZATIONS PROMOTE AND POSITION FIBRE CHANNEL, AND TO PROVIDING A FOCAL POINT FOR FIBRE CHANNEL INFORMATION, STANDARDS ADVOCACY, AND EDUCATION.

TODAY, FIBRE CHANNEL TECHNOLOGY CONTINUES TO BE THE DATA CENTER STANDARD FOR STORAGE AREA NETWORKS AND ENTERPRISE STORAGE, WITH MORE THAN 80 PERCENT MARKET SHARE.

FCIA MEMBERS

THE FCIA CONSISTS OF OVER 80 COMPANIES GLOBALLY, ALL OF WHICH ARE LEADERS IN THE FIBRE CHANNEL INDUSTRY AND CONTINUE TO PROVIDE THOUGHT LEADERSHIP, EDUCATION AND GUIDANCE TO THE GROWING STORAGE NETWORKING MARKET. FCIA MEMBERS INCLUDE MANUFACTURERS, SYSTEM INTEGRATORS, DEVELOPERS, VENDORS, INDUSTRY PROFESSIONALS, AND END USERS.

IN ADDITION THE FCIA MEMBER INCLUDES 63 JAPAN-BASED COMPANIES THROUGH OUR AFFILIATE FCIA-JAPAN, AN ORGANIZATION OF JAPAN DATA STORAGE FORUM (JDSF).

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16GFC STANDARDS REACH FIRST MILESTONE

Scott Kipp – Brocade

The 16 Gigabit Fibre Channel (16GFC) standard passed its first major milestone when Fibre Channel Framing and Signaling 3 (FC-FS-3) went to letter ballot in the August 6th, 2009 T11 plenary meeting. FC-FS-3 defines various logical aspects of 16GFC including the 64b/66b coding and transmitter training. These two new features of 16GFC enable long links at low cost and define the fastest electrical lane speed for data communications. The T11 letter ballot signifies that the FC-FS-3 standard is technically complete and the standard should be finalized in early 2010.

The first key aspect of FC-FS-3 standard defines the super efficient 64b/66b coding that doubles the data rate of an 8GFC link to yield a throughput of 3200 Megabytes per second (MBps) – 1600 MBps in each direction. 64b/66b coding places 64 bits of data on the lane for every 66 bits that are transferred – making it 97% efficient. The 64b/66b coding is also used in 10GFC and 10 Gigabit Ethernet. 16GFC doubles the data rate of 8GFC but only increases the line rate by 65% to 14.025 Gbps – 40% faster than the electrical lanes of 40 and 100 Gigabit Ethernet that operate at 10.3125 Gbps/lane. When 8 electrical lanes of 16GFC are trunked to form one virtual lane like 100 Gigabit Ethernet, the resulting speed of the link is 128GFC – faster than 100GE or 12 lanes of Quad Data Rate InfiniBand.

FC-FS-3 also defines transmitter training that enables long backplane traces for modular switch and blade server products. Backplane traces connect ASICs within a product via printed circuit boards (PCB) traces that can exceed 16” and have multiple connectors. To overcome the challenge of driving high speed signals over these long distances, FC-FS-3 leveraged the transmitter training work developed for 10 Gigabit Ethernet known as 10GBase-KR. During initialization of a backplane link, the transmitter is trained or tuned to provide optimal signal quality for each 16GFC lane.

With FC-FS-3 entering letter ballot, the logical aspects of 16GFC have passed a major milestone. The physical aspects of 16GFC are being developed concurrently in the Fibre Channel - Physical Interfaces - 5 (FC-PI-5) standard. The FC-PI-5 standard is on track to be technically stable in late 2009 and released in mid-2010. With the completion of FC-FS-3 and FC-PI-5, the 16GFC standard shall be complete and the race to release 16GFC products enters a new stage.

What is FCoE anyway?

Skip Jones – QLogic, FCIA Chairman

Fibre Channel is the technology standard for datacenter SAN environments and Fibre Channel over Ethernet (FCoE) is a new extension of Fibre Channel storage protocol that uses Ethernet as its physical transmission technology, and is an example of the continued innovation that enhances investments in Fibre Channel-based architectures and business solutions.

FCoE combines Fibre Channel and Ethernet to provide end users with a “Converged” network option for storage SAN connectivity, client server messaging connectivity (often referred to as “LAN” traffic), and server-to-server messaging connectivity (sometimes referred to as server metadata or server sync heartbeat). Combined with enhancements to Ethernet, FCoE allows datacenters to consolidate their I/O and network infrastructures into a converged network for IT professionals looking to reduce capital expenses, power, heat, cabling and space.

Because FCoE looks like Fibre Channel to the rest of the system and OS upper layers, it transparently preserves existing Fibre Channel storage management and utility software. The future of FCoE promises to deliver leading performance without the latency and complexity issues of TCP, and since FCoE is fundamentally the combination of two vastly successful, tried and proven technologies, Ethernet and Fibre Channel, the user can expect swift and reliable deployment of FCoE.

For those organizations already relying on Fibre Channel in their datacenters, connecting servers with FCoE to either emerging FCoE native targets, Fibre Channel targets or directly to Fibre Channel networks is seamless – preserving your past, present, and future Fibre Channel investments in the datacenter.

FCoE and iSCSI—How They Compare and Where They Fit

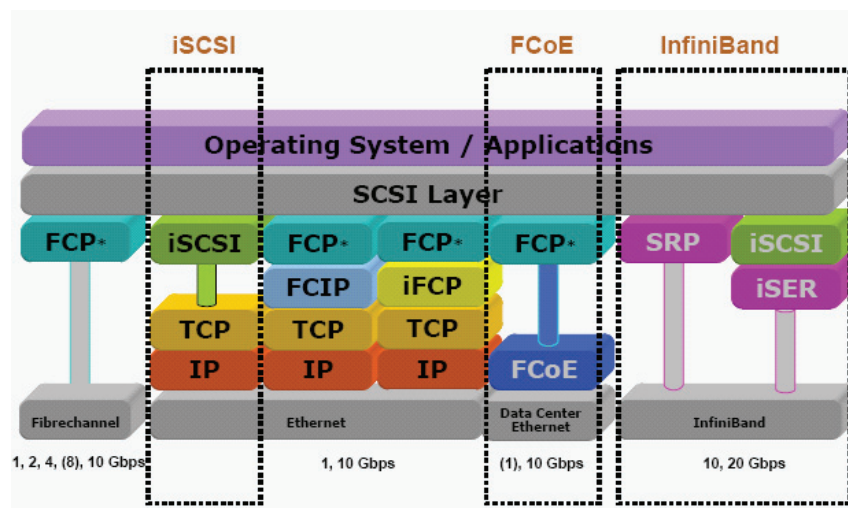
Mike McNamara – NetApp, FCIA Marketing Committee Chair

Fibre Channel over Ethernet (FCoE) is a new protocol that expands Fibre Channel into the Ethernet environment. FCoE combines two leading technologies: the Fibre Channel protocol, which is the predominant SAN technology; and Ethernet, which is supported in all servers and data centers to provide more options to end users for FC SAN connectivity and networking.

The biggest challenge of I/O consolidation is to satisfy the requirements of different traffic classes with a single network without creating “traffic interference,” that is, without having one class of traffic starving another. For this reason, the IEEE 802 standard group created a working group named DCB (Data Center Bridging) to extend the Ethernet standards to satisfy these new data center requirements.

How FCoE Differs from iSCSI

The FCoE layer replaces the TCP/IP layer used in iSCSI (Figure 1) and relies on the DCB improvements in Ethernet.



Since FCoE was designed as a data center technology with no IP layer, it is not routable over IP. However, FCoE routing can be performed using already established protocols like FCIP. iSCSI can be implemented in lossy networks. FCoE requires a lossless network. The table below summarizes the differences.

FCoE and iSCSI Comparison

FEATURE	FCoE	iSCSI
Enables existing FC infrastructure to interface directly with an Ethernet network	•	
Leverages existing FC management construct over Ethernet	•	
Lossless Ethernet improves quality of service in network	•	•
Leverages pervasive Ethernet skill set	•	•
Supports 1GbE		•
Native IP routing		•

FCoE Deployment Scenarios

Mike McNamara – NetApp, FCIA Marketing Committee Chair

FCoE extends Fibre Channel into the Ethernet environment and is an evolutionary approach to I/O consolidation. The following five scenarios examine where FCoE is likely or not likely to be deployed.

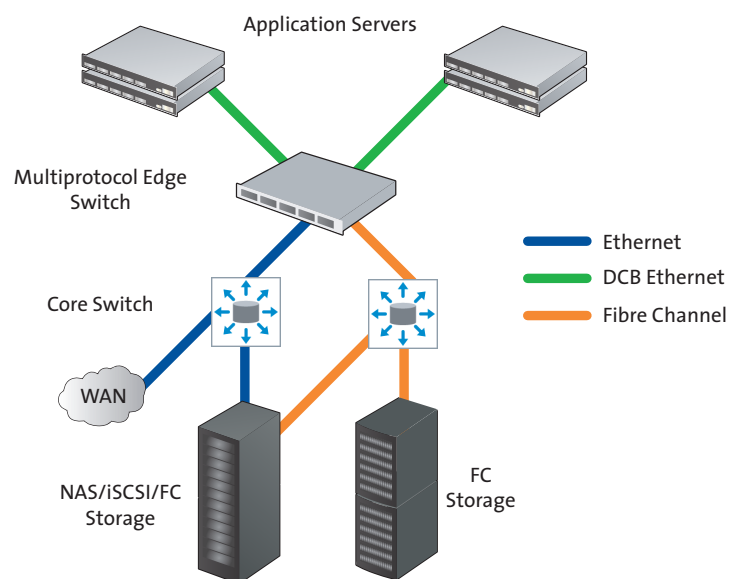
Scenario 1: Existing data centers with large investment in FC storage

Most large data centers have a separate dedicated storage network using Fibre Channel. Fibre Channel is the SAN fabric of choice for tier 1 data centers. Data centers with large Fibre Channel installations are likely to consider FCoE networks in order to leverage and extend investments in their FC SAN and management infrastructure. Transitions to FCoE will likely begin at the edge, where new servers and edge switches will be updated to support FCoE and DCB enhancements, providing access to existing data on FC storage.

Scenario 2: New data center installation

With a new data center, the choice is less clear, because FC, FCoE, or iSCSI may satisfy the required I/O load. Assuming the customer is planning an Ethernet infrastructure, then installation timing and existing IT personnel skill sets become the deciding factors. If the data center is coming on line now or in the near future, then iSCSI and FC are available choices. However, if the data center is planned to come online in six months or more, then FCoE is a very viable option.

Companies with lots of Fibre Channel SAN expertise will most likely consider FCoE, since it leverages existing staff and comfort levels. However, companies with limited or no Fibre Channel experience are likely to leverage their Ethernet and TCP/IP expertise and opt for iSCSI or FCoE.



Transition from FC to FCoE will begin at the edge

Scenario 3: Existing data centers with a mix of storage (DAS, FC, NAS) requiring near-term data center consolidation

Data centers today may be looking for consolidation solutions for any of the following reasons:

- Reduce cost through server virtualization
- Reduce environmental costs (power and cooling)
- Improve manageability (reduced labor expenses)
- Improve service levels for customers (data accessibility, test/dev)
- Data center space constraints

The decision criteria usually revolve around existing storage provisioning and data management practices. In existing NAS-dominated networks, IT is likely to recommend iSCSI for accessing block data over the network. In environments dominated by Fibre Channel storage networks, FCoE is likely to be deployed, since it leverages existing SAN management and infrastructure equipment, tools, and skills. Organizations with a mixture of network storage protocols will likely maintain that environment as value is placed on application optimization and performance over management simplicity.

Scenario 4: Small to medium data centers

For small to medium businesses, the choice between FCoE and iSCSI largely depends on budget, IT personnel skill set, and application requirements. iSCSI storage networks will continue to be successful and satisfy the performance requirements for the majority of business applications in this segment while also providing good value. Where high-availability or performance-oriented databases are the requirement, FCoE and iSCSI both offer solutions.

Scenario 5: Remote office installations

Given that remote offices are dispersed, iSCSI offers the benefits of native IP routing to address longer distances than FCoE, which requires some form of Ethernet bridging. Remote offices will likely remain mostly iSCSI based.

FCoE Plugfest

Leading Fibre Channel Vendors Participate in Second FCIA- Sponsored FCoE Plugfest at UNH-IOL

Sponsored by the FCIA, leading Fibre Channel vendors worked together to ensure interoperability for the stable FCoE standard. This year's Plugfest provided a forum for testing the interaction of FCoE end devices with data center bridge exchange (DCBx) switches. Participating companies in the Plugfest included Amphenol, Brocade, Cisco Systems, Finisar, Hewlett-Packard, Intel, IXIA, Mellanox, Microsoft, NetApp, QLogic, Tyco Electronics and UNH-IOL.

INCITS and T11 Standards Update

Steve Wilson – Brocade, FCIA Board Member

InterNational Committee for Information Technology Standards (INCITS) is the primary U.S. focus of standardization in the field of Information and Communications Technologies (ICT), encompassing storage, processing, transfer, display, management, organization, and retrieval of information. As such, INCITS also serves as ANSI's Technical Advisory Group for ISO/IEC Joint Technical Committee 1. JTC 1 is responsible for International standardization in the field of Information Technology. The Technical Committee T11 is the committee within INCITS responsible for Fibre Channel Interfaces. T11 has been producing interface standards for high-performance and mass storage applications since the 1970s.

- Approximately 17 standards are currently in process at ISO
- FC-SW-5 public review ended in August 2009. Currently awaiting ANSI Editor queries.
- FC-GS-6 is currently in public review until October 19, 2009. Management Review will be reviewed next.
- T11.2 – Physical Variants task group is currently working on FC-MSQS and FC-PI-5.
- T11.3, Interconnection Schemes task group is working on RDMA, FC-Warp RDMA proposal in addition to FC-DA-2, FC-IFR, FC-SB-4, FC-SCM and FC-SP-2.
- FC-GS-6 has been forwarded to INCITS for further processing
- FC-BB-6 for T11.3 which is the FCoE enhancements

For more information about INCITS and the T11 Technical committee - [click here or visit](#)

www.t11.org

FCoE Standard Ratification

Mike McNamara – NetApp, FCIA Marketing Committee Chair

On June 3rd 2009, the FC-BB-5 working group of the T11 Technical Committee completed its work and unanimously approved a final standard for FCoE. As a result, the T11 Technical Committee plenary session approved forwarding the FC-BB-5 standard to INCITS for further processing as an ANSI standard. This is a major milestone in the final ratification of FCoE.

For more details - [click here or visit](#)

<http://www.t11.org/ftp/t11/pub/fc/bb-5/09-056v5.pdf>

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