FIBRE CHANNEL SOLUTIONS GUIDE

STATE OF THE FIBRE CHANNEL INDUSTRY

Today's data explosion presents unprecedented challenges incorporating a wide range of application requirements such as database, transaction processing, data warehousing, imaging, integrated audio/video, real-time computing, and collaborative projects. For nearly a decade storage area networks (SANs) have become mainstays for companies looking to increase storage utilization and manageability while reducing costs. SANs represent a topology for connecting storage assets directly to the network and establishing a peer-to-peer server/storage implementation and solve multiple issues for enterprises with data centers to remote offices.

As the volume and criticality of data grow, companies need efficient, scalable solutions for making data available to servers, applications, and users across the enterprise. By providing a network of storage resources to servers, Fibre Channel SANs uncouple storage from individual platforms, allowing data transfer among all nodes on the storage network.

Fibre Channel is an ideal solution for IT professionals who need reliable, cost-effective information storage and delivery at fast speeds. With development starting in 1988 and ANSI standard approval in 1994, Fibre Channel is a mature, safe solution for 1Gb, 2Gb, 4Gb, 8Gb and 16Gb communications, providing an ideal solution for fast, reliable mission-critical information storage and retrieval for today's data centers.

GUIDE INCLUDES

- BENEFITS OF FIBRE CHANNEL SANS
- 8GB/S FIBRE CHANNEL
- FIBRE CHANNNEL OVER ETHERNET
- FIBRE CHANNEL ROADMAP
- ENERGY EFFCIENCY AND THE FIBRE CHANNEL INDUSTRY
- T11 STANDARDS UPDATE
- FIBRE CHANNEL MANAGEMENT
- THE PATH TO UNIFICATION
- SERVER VIRTUALIZATION

FCIA
FIBRE CHANNEL INDUSTRY ASSOCIATION

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 90 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.

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

www.fibrechannel.org

BENEFITS OF FIBRE CHANNEL SANs

For nearly a decade storage area networks (SANs) have become mainstays for companies looking to increase storage utilization and manageability while reducing costs. SANs represent a topology for connecting storage assets directly to the network and establishing a peer-to-peer server/storage implementation. SANs have historically been based on Fibre Channel, but also incorporate iSCSI as a method of serverstorage communication. SANs solve multiple issues for enterprises with data centers to remote offices.

FIBRE CHANNEL SANs have proven to:

- Accelerate backup and restore
- Improve business continuance
- Boost high availability
- Foster storage consolidation

ACCELERATE BACKUP AND RESTORE

As enterprise data becomes a much more valuable business asset, ensuring its stability and protection is more critical than ever. SANs can accelerate and simplify the data backup and restore process. SANs are ideal for backup-intensive environments, especially when there are clearly defined areas for isolating backup workloads. The switched 8Gb full duplex capabilities of Fibre Channel fabrics can significantly improve backup and restore performance. Moreover, Fibre Channel is designed to transport large blocks of data with great efficiency and reliability. Two popular SAN-based backup and restore approaches are typically referred to as the "LAN-free" and "server-free" backup and restore models.

IMPROVE BUSINESS CONTINUANCE

Because SANs can integrate multiple storage devices and applications, they provide many high-availability options for organizations that need to support a wide range of business continuance activities in a cost efficient manner. The distributed networked approach of SANs addresses the ability to recover data and quickly bring systems back online following a disaster. Without this level of protection even minutes of downtime can pose significant consequences to many types of organizations. To guard against downtime and to reduce business risk, a SAN solution would eliminate single points of failure, incorporate failover software, streamline data backup and recovery, and enable high-performance mirroring over great distances.

BOOST HIGH AVAILABILITY

With the increase in the volume and criticality of corporate data and the importance of industry regulations, companies demand the highest possible system availability. Some of the key availability benefits of SANs include built-in redundancy, dynamic failover protection, and automatic I/O rerouting capabilities. Flexible connectivity options enable the development of SANs that have no single points of failure. SANs provide hot-plugging capabilities that enable organizations to install, configure, and bring storage online without experiencing server downtime. SANs can also support high-availability operations by enhancing clustering implementations.

FOSTER STORAGE CONSOLIDATION

There are many technical and business advantages to consolidating servers and storage with SANs. A SAN infrastructure enables any-to-any connectivity between heterogeneous server and storage systems. This allows much more efficient use of storage and server resources by consolidating widely distributed or underutilized resources into centrally managed environments and provides the following benefits:

- Increased storage utilization
- Decreased storage capital expenditures by enabling the purchase of storage on an "as-needed" basis
- Increased administrative staff productivity: manage more storage with fewer personnel
- Reduced application downtime and minimized business impact for storage upgrades
- Simplified storage management with centralized storage and server platforms

SUMMARY

As the volume and criticality of data grow, companies need efficient, scalable solutions for making data available to servers, applications, and users across the enterprise. By providing a network of storage resources to servers, FC SANs uncouple storage from individual platforms, allowing data transfer among all nodes on the storage network. SANs offer a range of benefits such as improved backup and restore, enhanced business continuance, and simplified consolidation that address the needs of today's data-intensive businesses.

FCIA MEMBERSHIP ROSTER

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FIBRE CHANNEL

THE DATACENTER STANDARD FOR STORAGE AREA NETWORKS AND ENTERPRISE STORAGE, WITH MORE THAN 80 PERCENT MARKET SHARE TODAY AND PROJECTED THROUGH 2010[1]. YET, WHILE MATURE AND STABLE, FIBRE CHANNLE HAS EVOLVED CONTINUOUSLY SINCE ITS RATIFICATION IN 1994, AND IS DRIVING NEW CAPABILITIES THAT SUPPORT IT AND BUSINESS OUTCOMES TODAY AND INTO THE FUTURE.

[1]Gartner External Controller-Based Disk Storage WW 2006-2010, October 6, 2006.

8Gb/s FIBRE CHANNEL

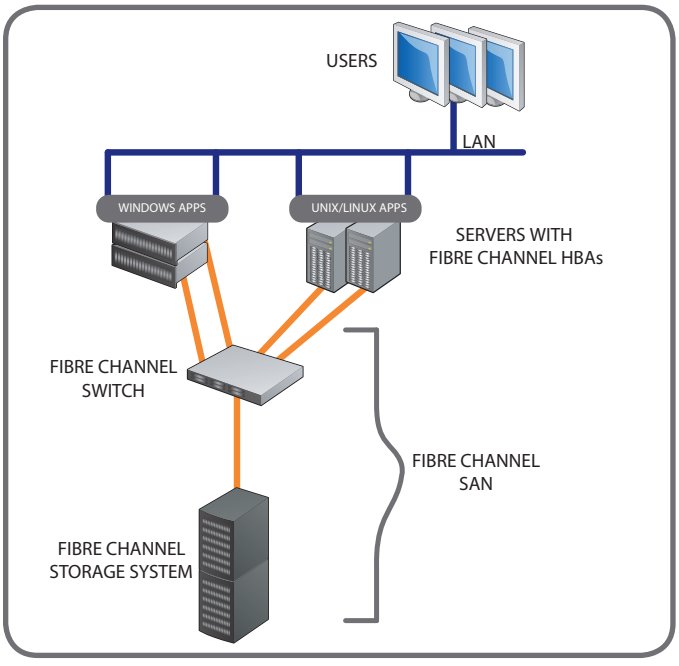
The decision to upgrade an existing 2GFC or 4GFC SAN (storage area network) infrastructure (Figure 1) involves a variety of factors, some related to business processes and others related to technology choices. Customers need to evaluate whether everything is working adequately and whether the SAN requires changes to any of its components, including servers, switches, storage systems, and applications.

If the SAN infrastructure is handling current workloads efficiently and is expected to adequately support anticipated growth, then an infrastructure upgrade is not needed in the near term. However, if business and data are growing at a rapid pace, or if network and application performance is becoming an issue, a change is probably warranted before performance degradation occurs.

Recent technology changes and improvements such as multicore processors, high-density servers, increased performance in server I/O, and server virtualization are driving the need for increased performance and bandwidth that can be satisfied by an upgrade to 8GFC. In particular, virtualization, which aggregates multiple applications and OS instances on a single physical server, with each application and OS instance generating significant I/O traffic, is putting a big demand on existing SAN infrastructures. The demand to support the higher I/O rates, greater capacity, and faster nondisruptive provisioning is very high, particularly on storage systems.

Another factor to consider is whether the host bus adapters (HBAs), servers, switches, and storage systems in the SAN will eventually be upgraded to 8GFC SAN technology. Although the components are backward compatible, and incremental upgrades are possible, for the SAN to meet its full potential and optimize performance the core infrastructure pieces should be based on 8GFC.

For many organizations, the wholesale conversion to 8GFC technology can be gradual. The transition to 8GFC is a natural progression, just like the transition from 1GFC to 2GFC and 2GFC to 4GFC, with no additional skills or training required.



8GFC BENEFTIS

Upgrading to an 8GFC SAN has the following benefits:

- Up to 2x faster communication between servers and storage, with little or no increase in price
- Increased throughput for consolidated servers, ensuring that the network does not become the bottleneck for virtual servers supporting multiple virtual machines
- State-of-the-art interconnection technology that reduces the need for additional switch and HBA ports
- The ability to handle large-block, sequential I/O applications such as modeling, streaming video, data analysis, and medical imaging
- High-bandwidth performance that shortens recovery time, improves data access, and increases productivity
- Investment protection with backward compatibility to 4GFC and 2GFC infrastructures

Today's organizations must weigh any decision to upgrade to an 8GFC SAN infrastructure against their current and future service requirements in terms of functionality, scalability, and strategic growth. If self-containment is important, and the SAN infrastructure is performing adequately, it is likely that no changes need to occur near term.

However, if the SAN is part of an IT infrastructure that is expected to keep pace with technology advancements and server virtualization, 8GFC SAN solutions should be an integral part of any strategic storage infrastructure plan. Increased throughput, investment protection with backward compatibility, and less SAN infrastructure (fewer ports) provide the benefits of increased SAN performance, reliability, and availability.

FIBRE CHANNEL OVER ETHERNET

OVERVIEW

Fibre Channel over Ethernet (FCoE) is the proposed industry standard being developed by an ecosystem of Fibre Channel and networking product vendors to drive network convergence in the enterprise data center. The technology will map native Fibre Channel traffic onto Ethernet frames, and be capable of benefiting from proposed enhancements to Ethernet. FCoE's Ethernet compatibility will leverage the ubiquity and economics of Ethernet networks while preserving the infrastructure, strengths, and tools of the existing Fibre Channel storage management framework.

EVOLUTIONARY PATH FOR NETWORK CONVERGENCE

Conventional data centers have maintained two sets of disparate networks, one for local area networking (LAN) based on Ethernet and the other for storage area networking (SAN) based on Fibre Channel. Converging the individual networks on to a common Ethernet infrastructure gives rise to new set of requirements that include creating lossless characteristics of Fibre Channel networks in Ethernet environments, maintaining a non-disruptive approach towards storage management processes. FCoE takes an evolutionary approach towards addressing these requirements.

A major drawback of today's Ethernet technology is that Ethernet frames are prone to be discarded under network congestion. The Ethernet 'pause' frame was designed for flow control but is rarely implemented today because it pauses the entire traffic on the link. Lossless Ethernet fabrics will be enabled by using IEEE 802.1Qbb Priority Flow Control (PFC), to pause traffic base on the priority levels. During periods of heavy congestion lower priority traffic can be paused, while allowing high priority and latency sensitive tasks such as data storage to continue.

Ethernet will be further enhanced by IEEE 802.1Qaz Enhanced Transmission Selection, which will enable isolation and prioritization between storage and other traffic types. This enhancement provides flexibility in assigning bandwidths based on the changing needs of SAN and LAN traffic loads.

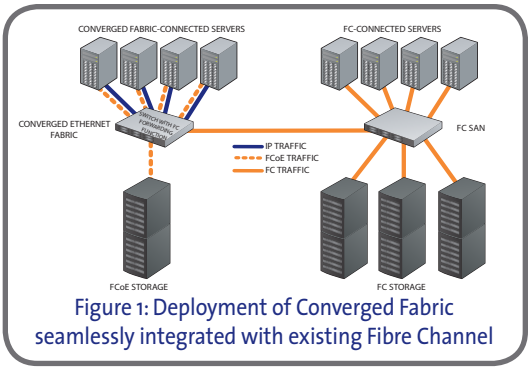


Figure 1: Deployment of Converged Fabric seamlessly integrated with existing Fibre Channel

FCoE will fully utilize these Ethernet enhancements to provide a transport service that mimics the low latency, lossless characteristics of Fibre Channel fabrics. This evolutionary approach also retains existing SAN management practices through the continued use of the Fibre Channel software stack in the servers.

By encapsulating complete Fibre Channel frames (including checksum, framing bits) directly within the Ethernet payload, FCoE avoids the overhead of any intermediate protocol conversions. This light-weight encapsulation approach also ensures that Fibre Channel forwarders are less compute intensive, enable seamless integration, and thus ensuring high levels of end-to-end performance.

BENEFITS OF FIBRE CHANNEL OVER ETHERNET

FCoE enables more efficient use of network resources through consolidation and will provide the following benefits:

- Increased SAN Adoption in the Data Center

FCoE will expand the opportunity for servers to use networked storage cost effectively. FCoE enables this by using fewer adapters and fewer cables than conventional dual network topology. With initial network convergence driven by FCoE, mid-tier and front-end servers will be able to take advantage of external storage and migrate from a direct attached storage (DAS) model to a SAN infrastructure.

- Fibre Channel Investment Protection

Enterprises have made significant investments in Fibre Channel SANs. FCoE will enable a seamless extension and protection of existing Fibre Channel investments by enabling servers connected to a converged network to be forward compatible and tap into these resources (see Figure 1) using high performance Fibre Channel forwarders.

- Unified Management Framework

FCoE seamlessly extends the Fibre Channel storage management framework into the converged network. Since the servers on the converged network will continue to use the Fibre Channel software stack, the existing storage resource management (SRM) software, personnel, storage management policies and processes are easily extended across the entire data center which in turn lowers the operating cost of managing the data center.

- FCoE continues to support data center green initiatives

By avoiding the need for multiple network infrastructures, FCoE enables network consolidation that will potentially reduce the overall power consumption required for data center connectivity.

- VLANs for FCoE

IEEE 802.1Q (Virtual LAN) can be use to partition the physical Ethernet fabric to create high levels of security by isolating traffic types and to enhance Quality of Service by configuring guaranteed bandwidth and latencies per VLAN. Using VLANs and 802.1Qbb Priority Flow Control, several lanes of high performance lossless FCoE can be established on a single 10 Gigabit Ethernet fabric.

STANDARDIZATION AND PRODUCT AVAILABILITY

On February 12, 2008 the INCITS Fibre Channel (T11) Technical Committee adopted a common addressing structure for the Fibre Channel over Ethernet (FCoE) standard. This common addressing structure will allow products to be built by the industry to a single standard. This new feature is supported by the following Fibre Channel Industry Association (FCIA) members: Amphenol Corporation, Broadcom, Brocade, Cisco Systems, Corning Cable Systems, EMC, Emulex Corporation, Finisar Corporation, Hitachi Data Systems, Hewlett Packard, IBM, Intel Corporation, LSI Corporation, Mellanox Technologies, NetApp, Nuova Systems, PMC-Sierra, QLogic Corporation and TrueFocus, Inc.

FIBRE CHANNEL OVER ETHERNET (FCoE) UPDATE

The Fibre Channel portion of FCoE is completing development in T11 as part of the Fibre Channel Back-Bone 5 (FC-BB-5) project. By the October T11 meeting, the FC-BB-5 specification should be very stable and ready to enter letter ballot. The FC-BB-5 specification is well on its way to be approved by mid 2009.

FIBRE CHANNEL ROADMAP

Although Fibre Channel s a mature technology, it is by no means a dead-end technology. It has a vibrant evolution and growth track in the following areas: performance, security, distance, lower costs, EMI management and disk and tape devices. It is designed to allow incremental growth so that both the costs and the risks can be absorbed gradually, without exposing the user's business to excessive risk, and it does not need to employ radical new technologies to move with the demands of new applications and solutions.

While most back-end fibre channel is based on arbitrated loop, the loop implementation is generally implemented as a switched loop architecture. This has the benefit of not requiring fabric services, while offering the benefits of a switched topology. This architecture takes advantage of high-performance disk drives while providing the performance of a switched architecture.

Fibre Channel distances have not been getting shorter as the speed increases. Fibre Channle is designed to offer the distances needed for fibre channel applications without increasing the complexity and cost of the interconnect as the speed grows. Fibre Channel has offered distances much longer than needed for SAN applications for several generations, without increasing complexity, power use, or costs and while allowing reuse of the same cable plant in many cases.

In our data-intensive world, faster is better: 8GFC in the fabric provides support for more servers with fewer connections for less expensive fabrics. The larger connection through the SAN enables bandwidth-intensive transfers to happen faster. Applications such as modeling, video, data analysis, and medical imaging require more speed to support data-intensive streaming applications, as do tapes for backup and archiving, where sustained streaming is vital.

Fibre Channel speeds have rececently doubled to 8GFC and is available in the market today, and is backward compatible to 4GFC and 2GFC. The backward compatibility of 8GFC is important because it assures users that their 2GFC and 4GFC investments will be protected and preserved going forward. 10GFC is deployed today for inter-switch links (ISL) providing 2.5x – 3x ISL core bandwidth for 4GFC edge links, and 16GFC is on the horizon.

Fibre Channel guarantees at least two generations of forward and backward compatibility, future-proofing storage and providing the best backward and forward compatibility of any data transport. In addition, Fibre Channel is also very secure, has fewer entry points compared to other protocols and the FC-SP protocol (authentication with DH-CHAP encryption) has recently been released.

Innovations such as SATA Tunneling Over FC (FC-SATA), Inter-Fabric Routing (IFR), N-Port ID Virtualization (NPIV) and Fabric Application Interface Specification (FAIS) will improve interoperability and reduce costs. All will support product within 12 months.

SATA Tunneling Over FC provides native connectivity of low cost Serial ATA (SATA) disk drives into existing enterprise storage systems that use FC embedded infrastructures, eliminating the layer of costly protocol bridging or discrete components used today to connect SATA disk drives into FC infrastructures. Inter-Fabric Routing is for heterogeneous fabric routing and improves scalability and interoperability. N-Port ID Virtualization makes the port ID autonomous from the server improving the sharing of HBAs, and the Fabric Application Interface Specification will speed up the deployment of storage applications in the fabric.

Summary

For nearly a decade, Fibre Channel has been the mainstay for companies looking to increase storage resiliency and bandwidth performance while maintaining backward compatibility. FC has a huge installed base, a dominate presence in the data center and a strong roadmap. FC will continue to be a leading storage interface for many years to come.

FCIA FIBRE CHANNEL SPEED ROADMAP - BASE2*

Product Naming	Throughput (MBps)	Line Rate (GBaud)♦	T11 Spec Technically Completed (Year)♦♦	Market Avaiability (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	TBD	2009	2011
32GFC	6400	TBD	2012	MARKET DEMAND
64GFC	12800	TBD	2016	MARKET DEMAND
128GFC	25600	TBD	2020	MARKET DEMAND

* Base2 used throughout all applications for Fibre Channel infrastructure and devices. Each speed maintains backward compatibility at least two previous generations

♦ All Base2 speeds are single-lane serial stream

♦♦ Future dates estimates

Soucre: FCIA

Energy Efficiency and the Fibre Channel Industry

The world today is quite concerned over energy usage - and for good reason. Whereas some businesses have co-located next to hydroelectric power plants just to ensure essentially unlimited power availability, the vast majority of businesses have some limitation on the amount of power they can access. Some businesses are actually running out of the amount of power they can take off of the grid due to numerous reasons: Legal restraints, physical access and physical space among just a few of those reasons. This means there are times a business location can no longer grow and new sites must be found – a potentially very expensive solution. Ways of helping to mitigate these problems are needed and the Fibre Channel Industry Association (FCIA) is helping through challenging the industry to be more energy efficient.

The need to save power and be more energy efficient is especially true of businesses that save and access information in the form of data storage. Enterprises, datacenters and even small data intensive businesses find the need to cool, power and keep exponentially growing amounts of information a daunting task. With the writing on the wall, businesses everywhere are starting to look for ways to save power and still allow growth, and this is just as true for the Fibre Channel industry.

The FCIA and the Storage Networking Industry Association (SNIA) formed an alliance in 2006 called the FC-AWG, or Fibre Channel Alliance Working Group. The FC-AWG has recently been working as a conduit between the Green Storage Initiative (GSI) of the SNIA and the FCIA. The GSI is tasked with developing metrics through which storage systems can be measured, and developing a taxonomy that makes sense for the multitude of markets for which the storage industry offers solutions. This taxonomy slices and dices the markets up into categories and capabilities that allow storage solutions to be evaluated for their energy efficiency in a reasonable fashion.

The FC-AWG investigated how the FCIA might be able to help in efforts towards a more energy efficient Fibre Channel world and came up with the FCIA Green Challenge. The FCIA Green Challenge arises from the symbiotic relationship between the FCIA and the T11 standards organization. Essentially, the FCIA is the marketing arm of the industry and the T11 is the technical arm of the Fibre Channel industry, with both groups meeting in face-to-face meetings every other month. At the February, 2008, FCIA/T11 meeting in Austin, TX, the FC-AWG issued the following challenge to the T11:

1. Identify existing aspects of the FC protocol that offer greater (or equal) efficiency compared with other protocols
2. Identify aspects of current standards efforts that increase efficiency
3. Evaluate applicability of efforts in other protocols to FC
4. Consider efficiency factors in all current and future standards efforts
5. Inform the FCIA of all the above efforts with the FC protocol

T11 STANDARDS UPDATE

- Fibre Channel Set for New Markets
  The Simplified Configuration Management (FC-SCM) project is defining a profile oriented towards Fibre Channel configurations requiring simple installation, management, and operation. SCM devices will target the Small and Medium Business market. The FC-SCM specification is nearing letter ballot and will be completed within the next few months.

- Operational Flexibility
  Due to its large install base, Fibre Channel has the benefit of developing standards that address real customer requirements. For example, Inter-Fabric Routing (FC-IFR) provides a way for devices on disparate Fabrics to communicate without the Fabrics merging into one. This simplifies management and alleviates traffic storms associated with large Fabrics.

- Virtualization
  Fibre Channel and virtualization environments go hand in hand. On the server side, recent developments in the N_Port_ID Virturalization architecture may be used to facilitate the hypervisor environments associated with larger servers. On the Fabric side, the Fabric Application API (FAIS) enables Fabric based storage applications. Both of these functions have been standardized in T11.

- Higher Speeds
  Work is currently underway in T11 to double 8GFC FIbre Channel to 16GFC. This work (FC-PI-5) follows the FCIA roadmap for higher speeds and most probably will be completed within two years. T11 is investigating different encoding schemes and technologies that will ensure backward compatibility with existing Fibre Channel SANs and provide 16GFC at the proper price point.

Engery Efficiency and the Fibre Channel Industry - continued

Since issuance, the T11 has enthusiastically accepted the challenge and is now actively seeking ways to influence the efficiency of the Fibre Channel protocol straight from the standards process. This approach has even been met with the appreciation and understanding of the Environmental Protection Agency, who consider the FCIA innovative in this approach. From powering down unused ports, to auto-negotiating speeds based on throughput, to adjusting output power based on the reception of received signals, the T11 is now on constant vigilance. These efforts simply complement the natural efficiency Fibre Channel already has, such as:

- Doubling the speed every 24 to 48 months with no accompanying doubling of the power
- Inducing the most efficient overhead of any protocol by being designed from the beginning for the transport of storage
- Ensuring multiple means of connecting devices at varying distances to ensure the best matching of power requirements

At each FCIA/T11 meeting the FCIA Green Challenge is now reviewed. As the unique energy efficiency benefits of the Fibre Channel protocol are identified, the FCIA will promote and present this information to the green community. So don't be surprised when you hear of advances from the Fibre Channel industry with energy efficiency, but do be surprised if they manage to specify a perpetual motion machine. Zero-point-energy hasn't quite been mastered yet.

FIBRE CHANNEL MANAGEMENT

Fibre Channel SANs offer a single point of managment for the FC network enabling more storage to be managed with fewer personnel. Each device within the SAN has a name and address that are used for management. In large FC SANs, zones may be created using those names or addresses to restrict access between particular servers and devices for improved security. Fibre Channel over Ethernet (FCoE) continues to use the same names and addresses to ensure full compatibility and seamless integration of existing FC management methods and processes. Fibre Chanel SANs can also be monitored from a single point. Tools enable the SAN administrator to detect failures, track performance, and determine when changes occur in the SAN.

THE PATH TO UNIFICATION

I/O CONSOLIDATION AND UNIFICATION

Many IT organizations operate multiple networks to connect to servers (for example, one for IP networking, one for storage, and one for Inter-Process Communication [IPC] for high-performance computing environments). IT organization incur cost in numerous ways due to these overlapping networks such as: additional capital equipment, added cost and complexity of cabling and airflow, administrative costs, and the additional power and cooling imposed by multiple components.

The vision of I/O consolidation and unification is the ability of an adapter, switch, and/or storage system to use the same Ethernet physical infrastructure to carry different types of traffic with very different characteristics and handling requirements. For the IT network manager this equates to installing and operating a single network instead of three, but still having the ability to differentiate between traffic types. The data center manager can purchase fewer host bus and server adapters, cables, switches and storage systems reducing power, equipment, and administrative costs. Fibre Channel over Etherent allows an evolutionary approach to I/O consolidation by preserving all Fibre Channel constructs, maintaining the latency, security, and traffic management attributes of FC while preserving investments in tools, training, and SANs.

10 GIGABIT ETHERNET

I/O consolidation and unification promises to support both storage and network traffic on a single network (figure 1). One of the primary enablers for consolidation is 10 Gigabit Ethernet, a technology with the bandwidth and latency characteristics sufficient to support multiple traffic flows on the same link. The following factors are driving adoption and the eventual ubiquity of 10GbE:

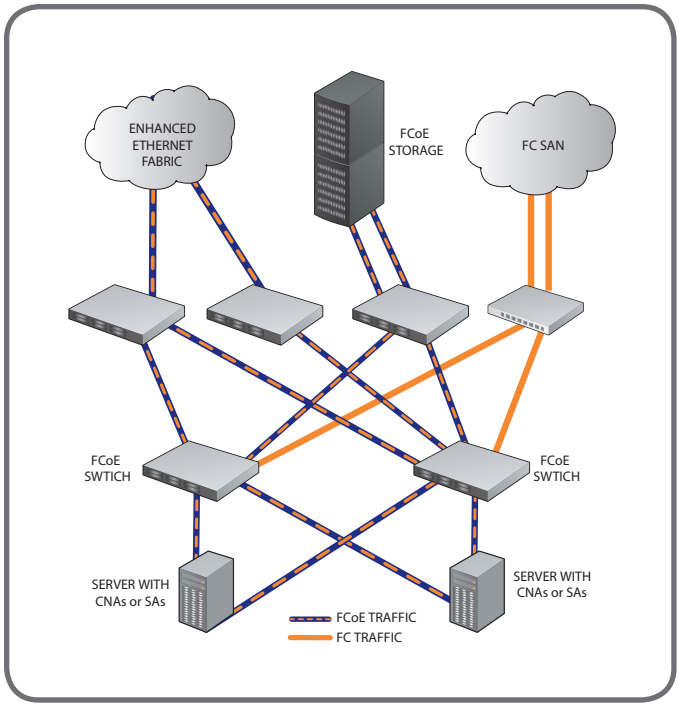
- Server virtualization enables workload consolidation, which contributes to network throughput demands. Virtualization, which aggregates multiple applications and OS instances on a single physical server with each application and OS instance generating significant I/O traffic, is putting a big demand on existing multiport 1GbE infrastructures. The demand is particularly high on 1GbE storage systems to support the higher I/O rates, greater capacity, and faster nondisruptive provisioning.
- Multisocket, multicore server technology supports higher workload levels, which demand greater network throughput.
- Increasing use of network storage requires higher bandwidth between servers and storage.

ETHERNET ENHANCEMENTS AND DATA CENTER BRIDGING

For 10GbE to be an even stronger option for server I/O consolidation and storage networking, enhancements need to be made to Ethernet to support the unification of multiple fabrics onto a single Ethernet network. Extensions to classical Ethernet in the IEEE, called Data Center Bridging (DCB), give 10GbE the performance to support transmission mechanisms beyond Internet Protocol, including Fibre Channel over Ethernet.

SUMMARY

Fibre Channel over Ethernet extends, rather than replaces Fibre Channel, allowing organizations to seamlessly integrate their Ethernet and Fibre Channel networks at the pace and path that works best. FCoE combined with enhancements to Ethernet will allow datacenters the ability to consolidate their I/O and network infrastructure saving both capital and operational expenses and increasing flexibility and control.



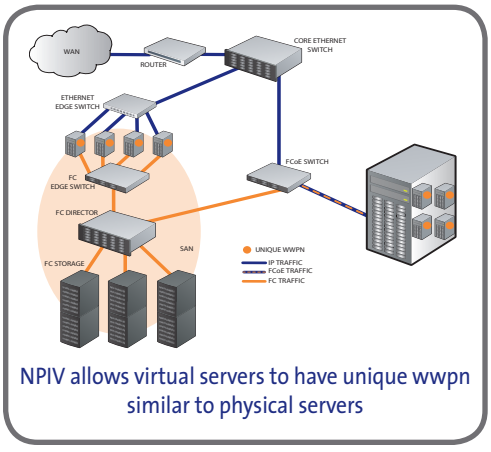
Fibre Channel Innovation for Server Virtualization

Fibre Channel has steadily evolved for more than a decade to meet the application requirements of enterprise data centers. A key innovation that fully complements the server virtualization deployments and makes them scalable is the emergence of N-Port ID Virtualization (NPIV) technology.

Fibre Channel provides isolation and protection of storage devices by using zoning and LUN masking techniques and the address (World Wide Port Name) of the Fibre Channel port. In a server virtualization environment, multiple virtual machines sharing a single Fibre Channel port are indistinguishable to the SAN fabric. This lack of visibility at a virtual machine level creates challenges implementing the same SAN security and monitor performance at the logical machine level that were deployed at the physical machine level in a non-virtualized environment. NPIV is an innovation in Fibre Channel that enables a single Fibre Channel port to take up multiple addresses (also referred to as multiple virtual ports) when registering with the SAN fabric. This capability provides virtual machines with their own dedicated virtual ports and thus limits storage access to only the required resources. Further, the ability to "tear down" a virtual port and reinitiate it on a different server greatly enhances virtual machine portability for load balancing and disaster recovery.

By embracing N_Port ID Virtualization, the leading adapter, switch, storage and server virtualization vendors have been working together to provide virtualization solutions that improves the flexibility and security of virtual server deployments. As enterprises transition to virtualized data centers they should also schedule their transition to NPIV enabled Fibre Channel infrastructure to improve the scalability and security of their virtualized resources.

The emerging Fibre Channel over Ethernet (FCoE) technology retains standard Fibre Channel functionality, including the NPIV innovations for supporting virtualized environments. This will enable data centers to retain SAN best practices and also seamlessly leverage popular storage management applications for implementing zoning and storage masking. With Fibre Channel and FCoE expected to be operating in parallel for a long time to come, NPIV is a key enabler for scalable server virtualization deployments.



NPIV allows virtual servers to have unique wwpn similar to physical servers

ROLE OF FIBRE CHANNEL IN SERVER VIRTUALIZATION

Server virtualization technology provides the ability to create one or more virtual machines that emulate a physical server. This enables multiple operating systems and multiple applications to be run on the same host server. Enterprises are deploying server virtualization to consolidate server infrastructure, reduce total costs, improve business agility and enhance disaster recovery capabilities. One of the key advantages of server virtualization is the ability to migrate the virtual machine from one physical server to another to meet the demands of server load distribution or for disaster recovery purposes. This virtual server migration capability requires the use of external shared storage and is most effective when combined with high performance Fibre Channel SAN connectivity.

Fibre Channel provides optimized solutions to meet the performance, reliability and capacity requirements of multiple virtual machines running business critical applications on a single physical server. In parallel, Fibre Channel also provides investment protection by enabling backward compatibility with existing Fibre Channel infrastructure. Today's 8GFC products are compatible with earlier generations of Fibre Channel, while offering roadmap for 16GFC products in the future.

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