Fibre Channel · Overview of the Technology

Early History and Fibre Channel Standards Development

In the early days, a single computer vendor provided a proprietary solution to a single buyer, the data processing manager. With the minicomputer, the process changed, and departments bought their own computing solution. The market transitioned to multiple solutions sold to multiple buyers, resulting in incompatible, proprietary data processing systems. Over time users realized they needed to combine all data processing into an integrated environment. This requirement opened the door for open standards-based solutions. Now, companies are connecting their mainframes with enterprise and department servers for distributed client/server architectures.

Distributed computing and parallel processing has resulted in a significant increase in process-to-process communications. At the same time, the data storage requirements have exploded. This new paradigm only works if data can be moved and shared quickly. The need for very high-bandwidth and extremely low-latency I/O is paramount. Fibre Channel is the solution that delivers.

After a lengthy review of existing equipment and standards, the Fibre Channel standards group realized that channels and networks should be able to share the same fiber. In this note, "fiber" is used as

a generic term which can indicate either an optical or a copper cable.

Fibre Channel is attractive because it offers a standards-based solution. With the emphasis on open systems, end-users are shying away from proprietary solutions and vertically integrated, single provider solutions. Today, they are integrating the best industry offers into integrated, seamless systems.

These new systems are being driven by the technology and marketing forces associated with client/server implementations. Fibre Channel is the only technology available with the reliability, responsiveness, scalability, high-throughput, and low-latency needed to meet the broad range of market and technology requirements.

IT systems frequently support two or more interfaces, and sharing a port and media makes sense. This reduces hardware costs and the size of the system, since fewer parts are needed. Fibre Channel is a family of ANSI standards. Taken as a whole, these standards provide a common, efficient transport system supporting multiple protocols or raw data using native Fibre Channel guaranteed delivery services. Profiles define interoperable standards for using Fibre Channel for different protocols or applications.

The requirements given the standards group were:

- Performance from 266 megabits/second to over four gigabits/second
- Support for distances up to 10 km
- Small connectors
- High-bandwidth utilization with distance insensitivity
- Greater connectivity than existing multidrop channels
- Broad availability (i.e., standard components)
- Support for multiple cost/performance levels, from small systems to supercomputers
- Ability to carry multiple existing interface command sets, including Internet Protocol (IP), SCSI, IPI, HIPPI-FP, and audio/video.

Fibre Channel contains network features that provide the required connectivity, distance, and protocol multiplexing. It also supports traditional channel features for simplicity, repeatable performance, and guaranteed delivery.

Fibre Channel architecture provides an active, intelligent interconnection among devices. All a Fibre Channel port has to do is to manage a simple point-to-point connection. The transmission is isolated from the control protocol, so point-to-point links, arbitrated loops, and switched topologies are used to meet the specific needs of an application.

The fibre channel fabric is self-managing. Nodes do not need station management, which greatly simplifies implementation.

Interoperability

The Fibre Channel Industry Association has two independent laboratories for Fibre Channel testing. The Interoperability Laboratory (IOL) at the University of New Hampshire develops test

suites for vendors to check compliance with the Fibre Channel standard. The Computational Science and Engineering Laboratory at the University of Minnesota is focused on functionality and extending the application of Fibre Channel.

Storage and Storage Devices and Systems

Fibre Channel is the next storage interface. Fibre Channel has been adopted by the major computer systems and storage manufacturers as the next technology for enterprise storage. It eliminates distance, bandwidth, scalability, and reliability issues of SCSI.

Fibre Channel is being provided as a standard disk interface. Industry leading RAID manufacturers are shipping Fibre Channel systems.

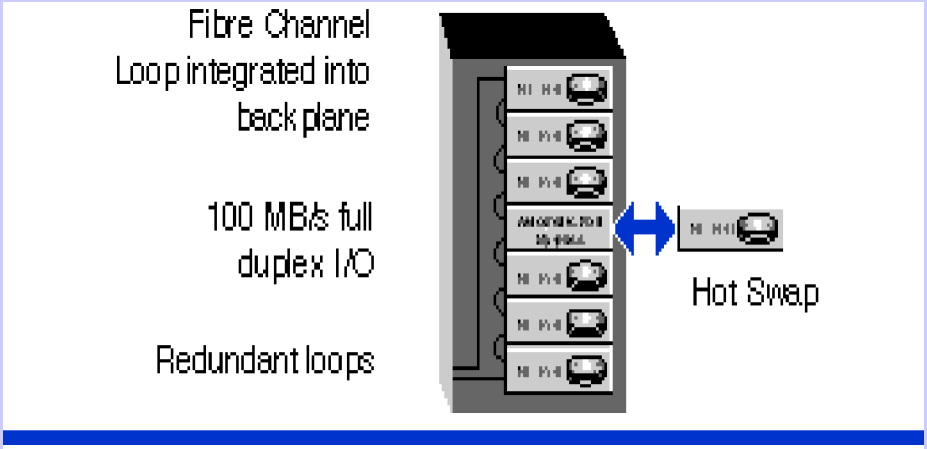

Figure 3.1 Fibre Channel disks define a new standard of performance

Storage Area Network

The network behind the servers linking one or more servers to one or more storage systems. Each storage system could be RAID, tape backup, tape library, CD-ROM library, or JBOD (Just a Bunch of Disks). Fibre Channel networks are robust and resilient with these features:

- Shared storage among systems
- Scalable network
- High performance
- Robust data integrity and reliability
- Fast data access and backup

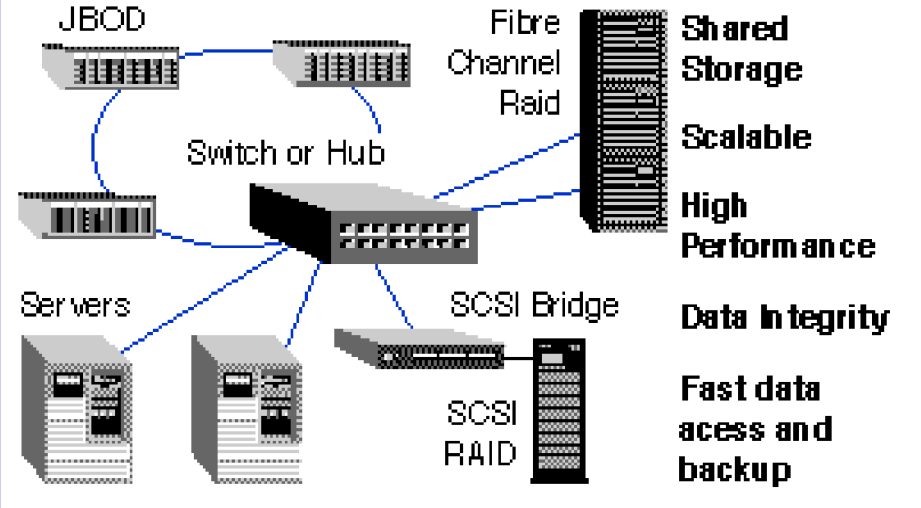

Figure 3.2 Networks behind the server deliver flexibility

In a Fibre Channel network, legacy storage systems can be interfaced using a Fibre Channel to SCSI bridge. IP is used for server to server and client/server communications.

Storage networks operate with both SCSI and IP networking protocols. Servers and workstations use the Fibre Channel network for shared access to the same storage device or system. Legacy SCSI systems are interfaced using a Fibre Channel to SCSI bridge.

Fibre Channel products have defined a new standard of performance, delivering a sustained bandwidth of over 97 MB/second for large file transfers and tens of thousands I/Os per second for business-critical database applications on a Gigabit link..

Networks

Fibre Channel networks provide enterprises new levels of performance and reliability. The many network applications for Fibre Channel include:

- Nonstop corporate backbone
- High-performance CAD/CAE network
- For movie animation and post-production projects to reduce the time to market.
- Quick-response network for imaging applications.

Fibre Channel development efforts focused on removing the performance barriers of legacy LANs. Features are:

- Confirmed delivery.
- Complete support for traditional network self discovery protocols, such as ARP and RARP.
- Supports circuits with dedicated bandwidth, point-to-point, or scalable bandwidth switched circuits.
- True connection service or fractional bandwidth, connection-oriented virtual circuits to guarantee quality of service for critical backups or other operations.
- The option of real circuits or virtual circuits.
- Instant microsecond circuit setup time using hardware enhanced Fibre Channel protocol.
- Extremely low-latency connection and connectionless service.
- Automatic self-discovery of Fibre Channel topology.
- Full support for time synchronous applications like video, using fractional bandwidth virtual circuits.
- High-bandwidth, low-latency transfers using (0-2KB) frames, which are effective for both small and large bulk frames.

Fiber Channel users enjoy these advantages:

- Scalable systems and more cost effective systems
- Straightforward migration to Fibre Channel
- Continued legacy support and upward migration

Fibre Channel's scalability provides a continued return on investment long into the future.

Technology Comparison

Fibre Channel is a product of the computer industry. Fibre Channel was specifically designed to remove the barriers of performance existing in legacy LANs and channels. In addition to providing scalable gigabit technology, the architects provided flow control, self-management, and ultra-reliability.

Gigabit Ethernet is designed to enable a common frame from the desktop to the backbone. Fibre Channel is designed to be a transport service independent of protocol and has the ability to use its single technology for storage, networks, audio/video, or to move raw data is superior to the common frame feature.

ATM was designed at a wide area network with the ability to provide quality of service for fractional bandwidth service. The feature of fractional bandwidth with assured Quality of Service is attractive for some applications.

Class 4 Fibre Channel provides guaranteed delivery and gigabit bandwidth as well as fractional bandwidth quality of service. Users can expect their most cost-effective, highest-performance solutions to be built using Fibre Channel.

As shown in Table 3.1 below, Fibre Channel is an excellent technology for applications that require high-bandwidth, reliable solutions that scale from small to very large.

	Fibre Channel	Ethernet	ATM
Technology application	Storage, network, video clusters	Network only	Network, video
Topologies	point-to-point loop hub, switched	Point-to-point hub, switched	Switched
Baud rate	1.06 Gbps	1.25 Gbps	622 Mbps
Scalability to higher data rates	2.12 Gbps, 4.24 Gbps	10 Gbps (2003)	1.24 Gbps
Guaranteed delivery	Yes	No	No
Congestion data loss	None	Yes/NO	Yes
Frame size	Variable, 0-2KB	Variable, 0-1.5KB	Fixed, 53B
Flow control	Credit Based	Rate Based	Rate Based
Physical media	Copper and Fiber	Copper and Fiber	Copper and Fiber
Protocols supported	Network, SCSI, Video	Network	Network, video

Table 3.1 Technology comparison

Why Fibre Channel?

Fibre Channel development started in 1988 and ANSI standard approval in 1994, Fibre Channel is the mature, safe solution for gigabit communications. Today's data explosion presents unprecedented challenges incorporating data warehousing, imaging, integrated audio/video, networked storage, real-time computing, collaborative projects and CAD/CAE. Fibre Channel is a mature and most reliable solution for information storage and retrieval.

Fibre Channel provides these advantages:

- Price Performance Leadership - Fibre Channel delivers cost-effective solutions for storage and networks.
- Solutions Leadership - Fibre Channel provides versatile connectivity with scalable performance.
- Reliable - Fibre Channel, a most reliable form of communications, sustains an enterprise with assured information delivery.
- Gigabit Bandwidth Now - Gigabit solutions are in place today! On the horizon is two gigabit-per-second data delivery.
- Multiple Topologies - Dedicated point-to-point, shared loops, and scaled switched topologies meet application requirements.
- Multiple Protocols - Fibre Channel delivers data. SCSI, TCP/IP, video, or raw data can all take advantage of high-performance, reliable Fibre Channel technology.
- Scalable - From single point-to-point gigabit links to integrated enterprises with hundreds of servers, Fibre Channel delivers unmatched performance.
- Congestion Free - Fibre Channel's credit-based flow control delivers data as fast as the destination buffer is able to receive it.

- High Efficiency - Real price performance is directly correlated to the efficiency of the technology. Fibre Channel has very little transmission overhead. Most important, the Fibre Channel protocol, is specifically designed for highly efficient operation using hardware.

Multiple terabytes of Fibre Channel interfaced storage are installed every day! Fibre Channel works equally well for storage, networks, video, data acquisition, and many other applications. Fibre Channel is ideal for reliable, high-speed transport of digital audio/video. Aerospace developers are using Fibre Channel for ultra-reliable, real-time networking.

Fibre Channel is a fast, reliable data transport system that scales to meet the requirements of any enterprise. Today, installations range from small post-production systems on Fibre Channel loop to very large CAD systems linking thousands of users into a switched, Fibre Channel networks.

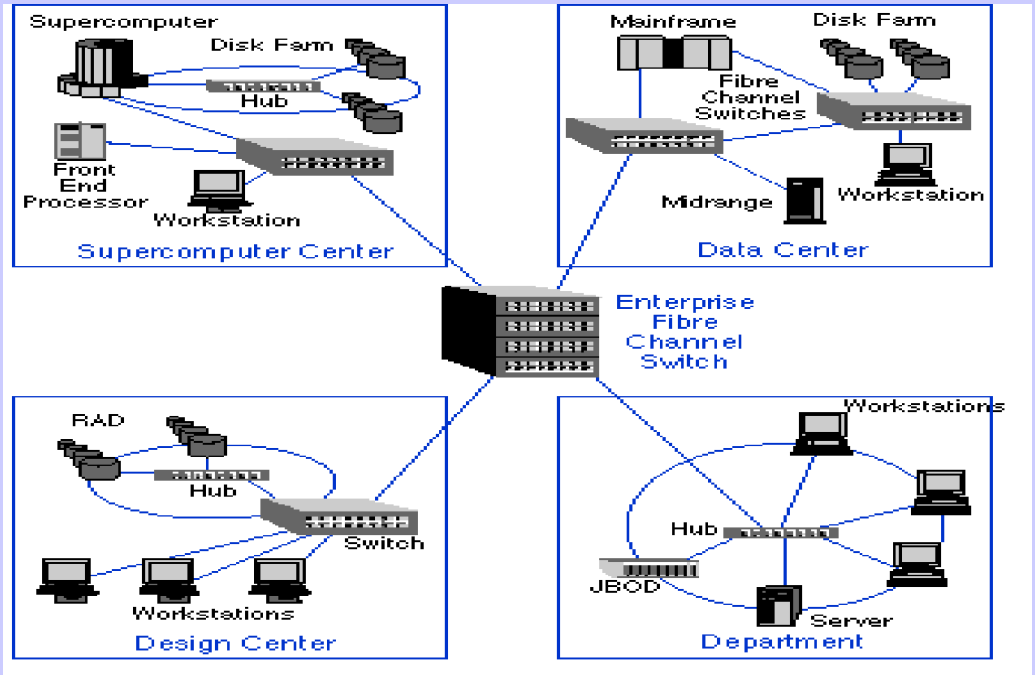

Figure 1.1 Fibre Channel meets the demands of IT systems

Fibre Channel Systems

Fibre Channel systems are assembled from adapters, hubs, storage, and switches. Host bus adapters are installed into hosts like any other SCSI host bus adapter. Hubs link individual elements together to form a shared bandwidth loop. Disk systems integrate a loop into the backplane. A port bypass circuit provides the ability to hot swap Fibre Channel disks and Fibre Channel links to a hub. Fibre Channel switches provide scalable systems of almost any size.

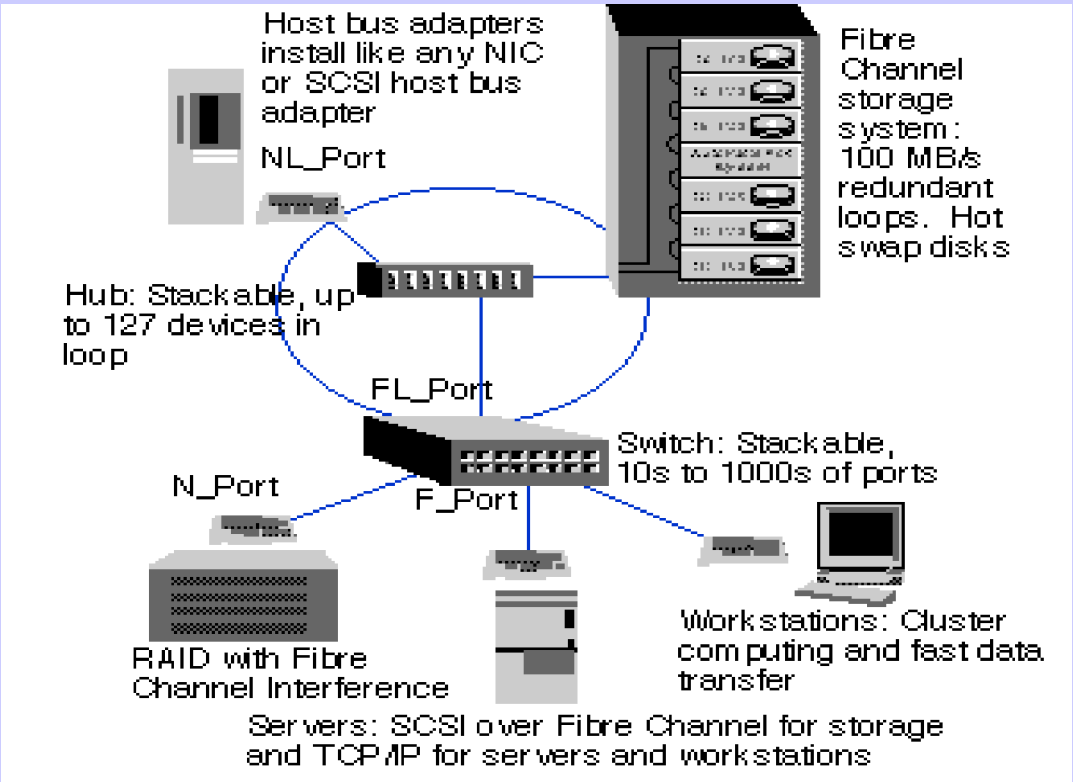

Figure 1.2 Fibre Channel systems are built from familiar elements

IT systems today require an order of magnitude improvement in performance. High-performance, gigabit Fibre Channel meets this requirement. Fibre Channel is the most reliable, scalable, gigabit communications technology today. It was designed by the computer industry for high-performance communications, and no other technology matches its total system solution.