The ADIC Training Quick Reference Handout for Storage Area Networks, Fibre Channel, and SCSI Basics

For any questions or comments contact the training department at training@adic.com

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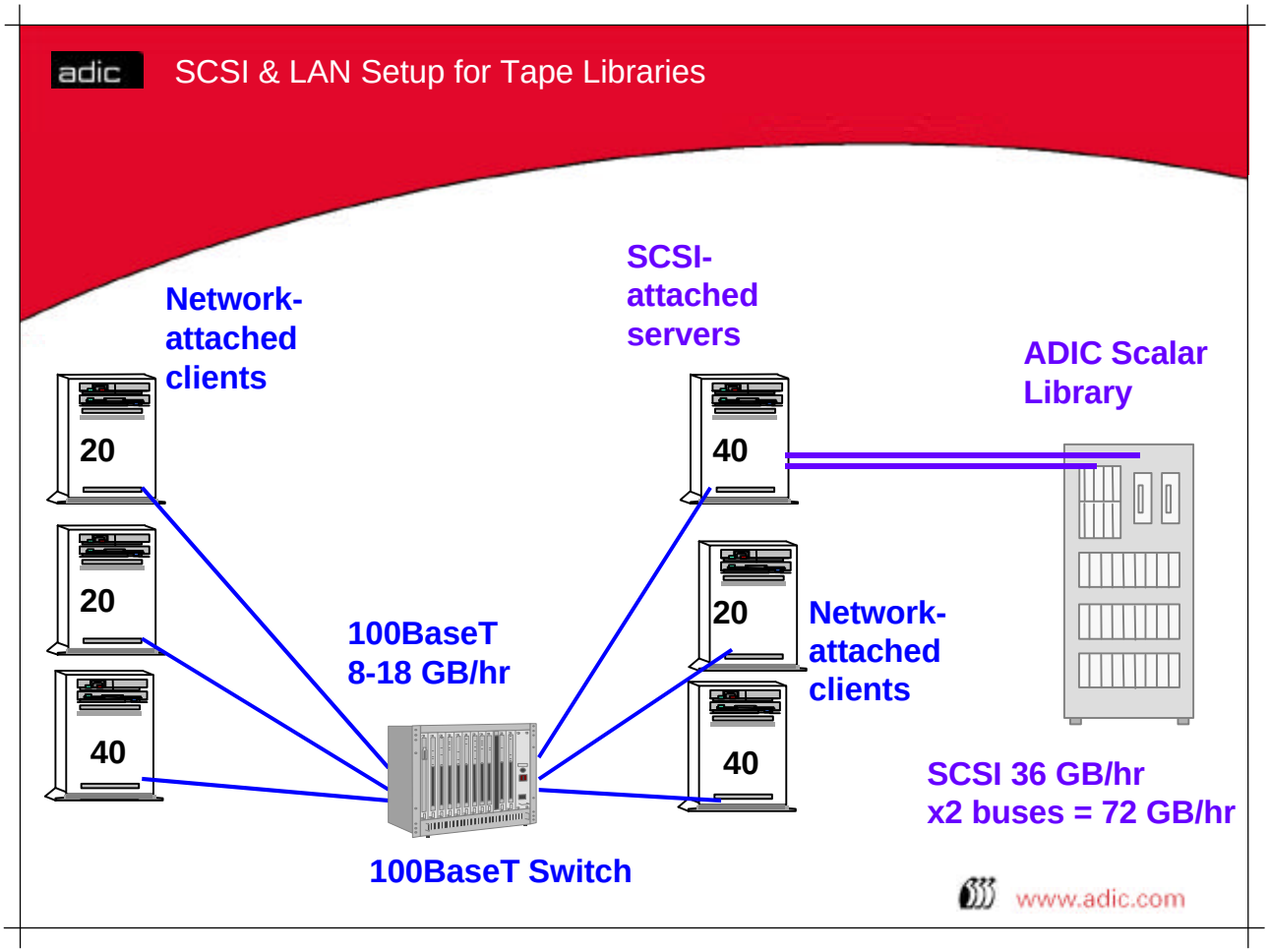
Purpose

The purpose of this document is to establish a basic and quick reference for all ADIC team members to have on the subjects of Storage Area Network, Fibre Channel, and SCSI concepts. This handout describes the basis concepts, configurations and troubleshooting of the solutions listed above. The first thing this handout addresses is the concept of a conventional scheme, describes a SAN scheme, then describes some basic SAN solutions using ADIC products, troubleshooting questions, SCSI information, and then has a few descriptions for Fibre channel terms. The recommended way to use this handout is to take the pages and review the entire layout then get into the specifics. Also, more in-depth information can be found on the World Wide Web.

The Conventional Configuration

In the conventional schemes, high performance data transfer is achieved by attaching a tape library directly to a single backup server, with data from other servers being brought over the network to the direct-attached server. For high volumes of data, this architecture clogs the network, degrading both backup and overall system performance.



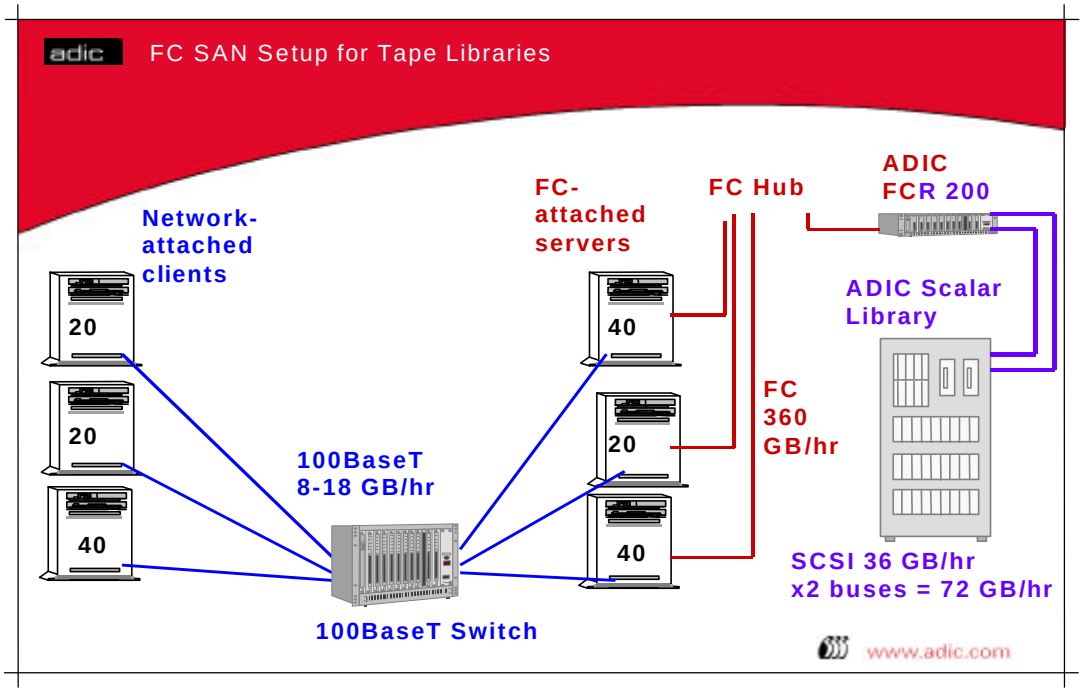
LAN-Free Backup, Shared Storage Resources, and Storage Area Networks

ADIC is a leader in the **Storage Area Network (SAN)** arena and here are some basic concepts. The SAN solution is primarily used from the tape library to more than one server.

Sharing backup resources with Fibre Channel SANs offers the advantages of**:**

- Increased performance, **Local Area Network (LAN)** -free backups
- Increased fault tolerance
- Consolidated storage management functions
- Easy performance and capacity scalability

Sharing backup resources means several things in a Fibre Channel SAN. Fundamentally, the architecture creates what is effectively a direct connection between each of the servers and the shared backup device. Inside the tape library, both media and drives can be shared in media and drive "pools," with any number of servers using them. The devices that make this sharing possible is Fibre Channel hubs and routers that allow SCSI signals to be carried over the SAN. Also critical to SAN operation is the management and arbitration, which is controlled by the backup software application.



Typical Problem Discovery

If software & hardware are both new and not installed yet:
Does software installation fail? Does software fail to find hardware or reports it's unsupported? Is the hardware installation configuration correct?

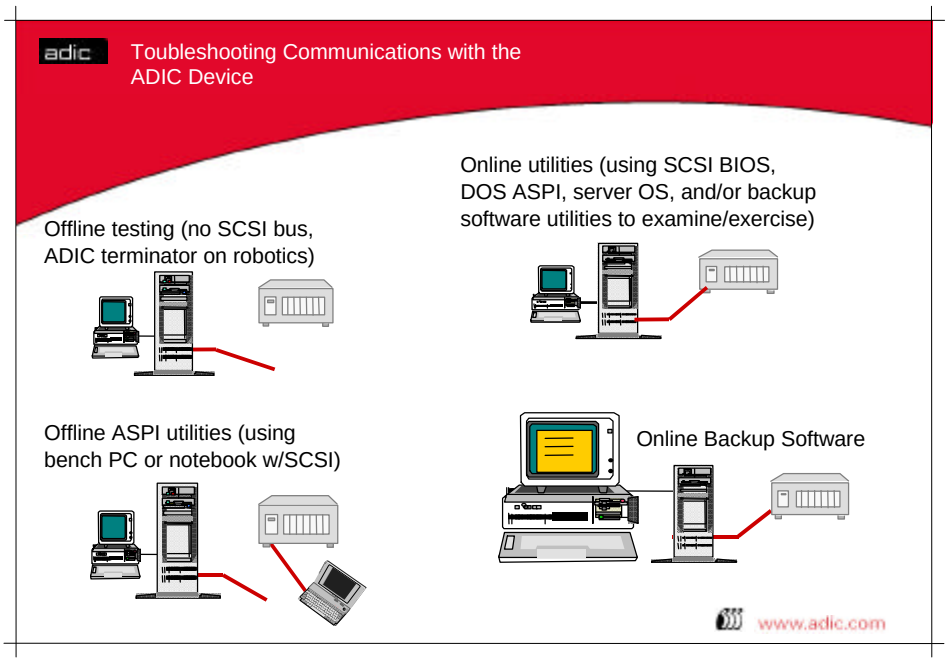
Software installed already, Hardware is new:
If Software can't see or configure new device; the device may be bad or improperly installed.

Software & hardware both installed already, was working ok:
Software error message pointing to hardware; the device may be bad

One or more drives failed in existing library:
Software operation fails; the software fails to mark hardware offline or device may be bad

One or more drives replaced in existing library:
Software can't see or configure new device; the software fails to mark hardware online

New drives / slots / FCR's added to existing library: Software loses drive associations to library; software identifies this as a new library & reports it can't find the old one



Check Customer's Isolation Steps: (Please give additional comments to these sections)

Were they up and running, or were several variables changed at once?

Can the problem be duplicated?

Does customer have ADIC and/or software company incident numbers/calls?

Isolate Problem to ADIC Unit:

Does swapping in a known good unit(s) remove the problem behavior?

Does swapping unit to a known good system continue problem behavior?

Is the software/robot/OS setup compatible?

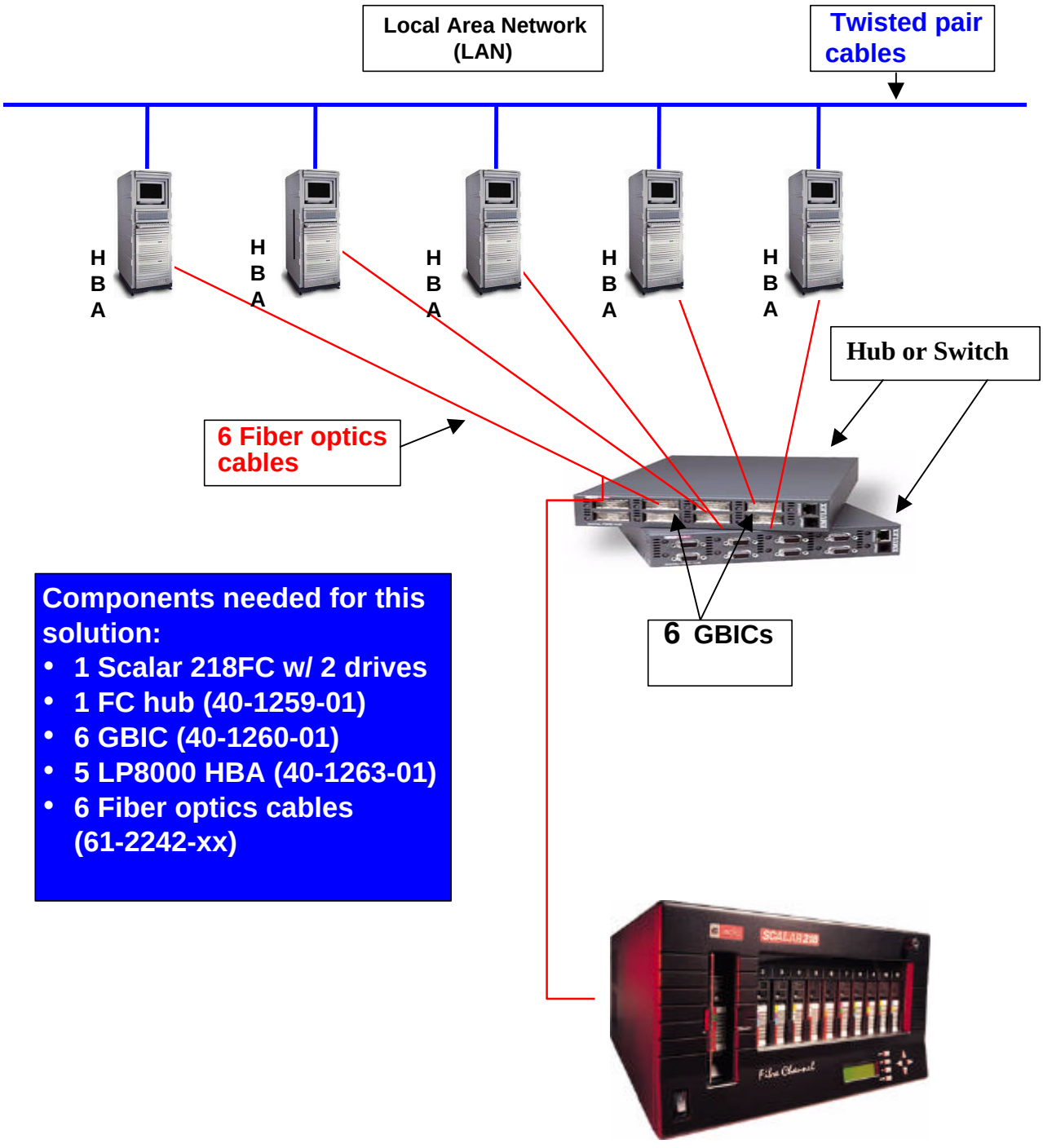
Are the robot, server, Operating System, and software setup right?

Any history on this setup, unit or customer?

Any glitches & gotcha's for this OS/software/hardware setup?

ANY OTHERS?

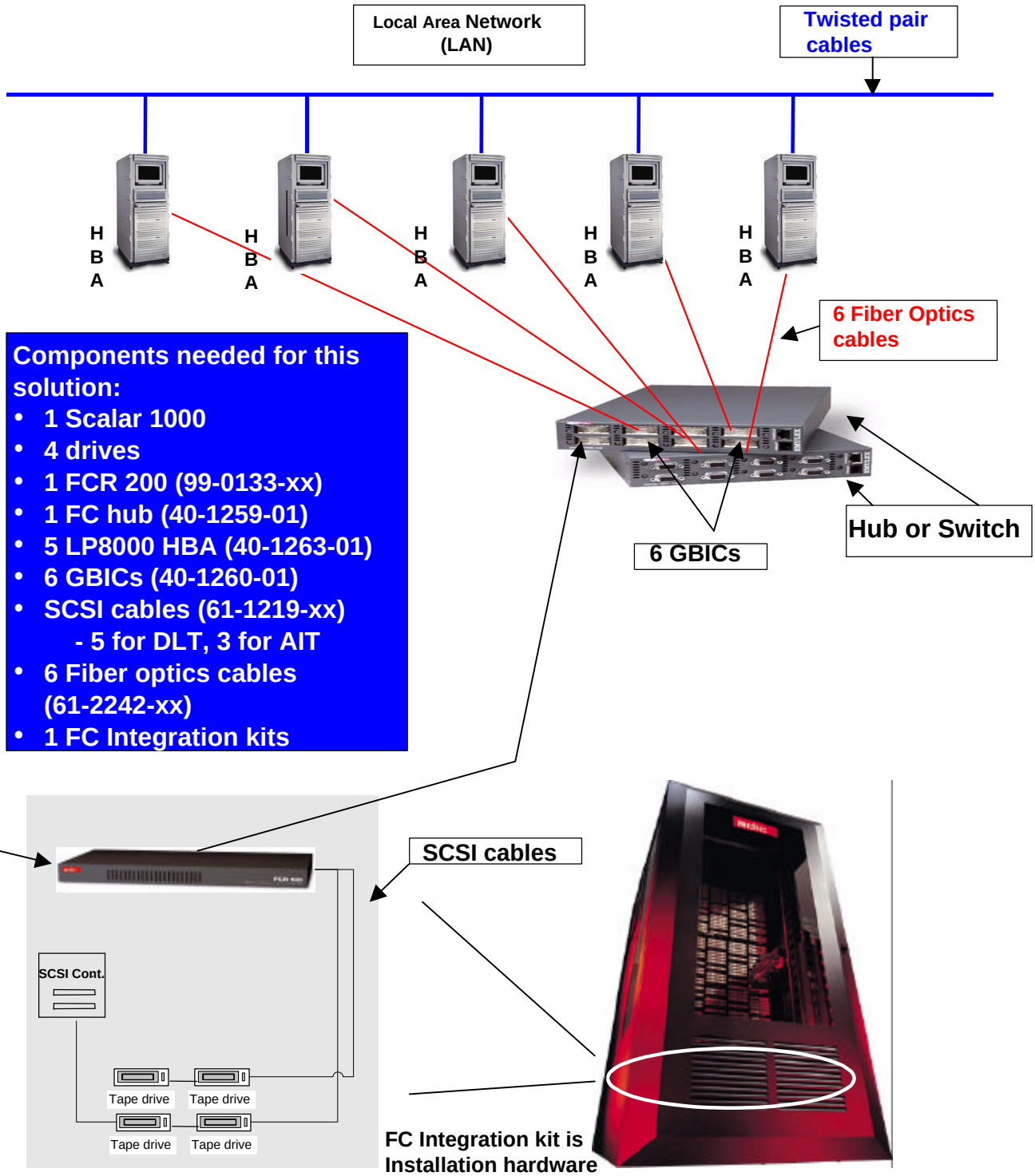
ADIC Open SAN Solution - Scalar 218FC with 2 drives



Components needed for this solution:

- 1 Scalar 218FC w/ 2 drives
- 1 FC hub (40-1259-01)
- 6 GBIC (40-1260-01)
- 5 LP8000 HBA (40-1263-01)
- 6 Fiber optics cables (61-2242-xx)

ADIC Open SAN Solution - Scalar 1000 with 4 drives



Some General Fibre Channel and Storage Area Network information:

SCSI Bridge
Fibre Channel provides the ability to link existing SCSI based storage and peripherals using a SCSI bridge. SCSI-based peripherals appear to the server or workstation as if they were connected directly on Fibre Channel. The ADIC FCR 100/200/400 is considered a SCSI Bridge device.

Hubs
Fibre Channel hubs are used to connect nodes in a loop. Logically, the hub is similar to a Token Ring hub with "ring in" and "ring out." Each port on a hub contains a port bypass circuit (PBC) to automatically open and close the loop. Hubs support hot insertion and removal from the loop. If an attached node is not operational, a hub will detect this and bypass the node. Typically, a hub has seven to ten ports and can be stacked to the maximum loop size of 127 ports. The hubs allow everyone on the network see everyone else

Switches
Fibre Channel switches are among the highest performing switches available for high-bandwidth and low-latency communications. The secret is in the Fibre Channel protocol, designed specifically by the computer industry to remove the barriers of performance with legacy channels and networks. Today, a Fibre Channel switch provides connection and connectionless service (Classes 1, 2, and 3) or only connectionless service (Class 2 and 3). Typical connection set up or frame switching time is less than 1microsecond.Switches are stackable to meet the most demanding application. The number of addresses available is 224 or over 16 million. Switch options provide high-availability features.

Host Bus Adapters (HBAs)
Host Bus Adapters are similar to SCSI host bus adapters and Network Interface Cards (NIBs). FC HBAs are available for copper and optical media. A typical FC PCI HBA, is half-length, and utilizes a highly integrated Fibre Channel ASIC for processing the Fibre Channel protocol and managing the I/O with the host. Adapters are also available for SBus, PCI, MCA, EISA, GIO, HIO, PMC, and Compact PCI.

Gigabit Interface Converters (GBIC)
Distances in a data center are supported with twin-ax copper circuits and, therefore, hubs, disks, and many host bus adapters come standard with a copper interface. Gigabit Interface Converters and media interface converters plug into the copper interface and convert it to an optical interface. GBICs use an HSSD connector for the copper interface and media interface converters use the DB-9

copper interface. The benefit is a low cost copper link and optics for longer distance when required.

Static Switches
Static switches, also called Link Switches, provide point-to-point connections and are externally controlled. They offer a low-cost option for applications not requiring the fast, dynamic switching capability inherent in the Fibre Channel protocol.

Storage
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 **Small Computer System Interface (SCSI)**.

Storage Devices and Systems
Fibre Channel is being provided as a standard disk interface. Industries leading **Redundant Array of Independent Drives (RAID)**, “Originally Redundant Array of Inexpensive Drives”, manufacturers are shipping Fibre Channel systems. Soon, RAID providers will not be regarded as viable vendors unless they offer Fibre Channel.
Information Technology (IT) managers, system integrators, and **Premium Value Added Resellers (PVARs)** quickly discover that Fibre Channel is built upon the concepts and protocols they know well. Fibre Channel delivers the same type of functions, only faster, easier, more scalable, and much more reliable than SCSI and legacy networks.
Fibre Channel systems expand the flexibility of IT organizations with their inherent ability to run SCSI and **Internet Protocol (IP)** protocols on the same network. These networks bring new levels of capability and performance. Take a look at what goes into a network. You will find it quite familiar and interesting. Fibre Channel systems are built without restrictions. Virtually any topology that an IT organization requires is possible. The basic building blocks are point-to-point dedicated bandwidth, loop-shared bandwidth, and switched-scaled bandwidth. Switches and hubs are stackable. Fibre Channel networks and storage are built from products that are very familiar to IT professionals. These products and a short description are listed below in alphabetical order.

Copper Cables
Four kinds of copper cable are defined in the Fibre Channel standard. The most popular implementations are twin-ax using DB-9 or HSSD connectors.

Fibre Optic Cable Connector
The SC connector is the standard connector for Fibre Channel fiber optic cables. It is a push-pull connector and is favored over the ST connector. If the cable is

pulled, the tip of the cable in the connector does not move out, resulting in loss of signal quality.

Disk Enclosures
Fibre Channel disk(s) enclosures utilize a back plane with a built-in Fibre Channel loop(s). At each disk location in the back plane loop is a port bypass circuit which permits hot swapping of disks. If a disk is not present, the circuit automatically closes the loop. When a disk is inserted, the loop is opened to accommodate the disk.

Drivers
If software drivers for the host bus adapter vendor are not resident in your server or workstation, they are installed into the operating system using standard procedures for the OS. Fibre Channel drivers support multiple protocols, typically SCSI and IP. Most popular operating systems are supported including Windows NT, AIX, Solaris, IRIX, and HPUX.

Extenders
Extenders are used to provide longer cable distances. Most optical interfaces are multimode cable. Extenders convert the multimode interface to single mode and boost the power on the laser. Typically, an extender will provide a single mode cable distance of 30 Km or 18 miles.

Fibre Channel Disk Array
Fibre Channel disk arrays has the highest capacity and transfer capability available. Typically, these disks have a capacity of 9 GB and support redundant Fibre Channel loop interfaces. The new Centra Vision software uses these.

Multimode Cable
Multimode cable is dominant for short distances of 2 Km or less. Multimode has an inner diameter of 62.5 or 50 microns, allowing light to enter the cable in multiple modes, including straight and at different angles. The many light beams tend to lose shape as they move down the cable. This loss of shape is called dispersion and limits the distance for multimode cable. Cable quality is measured by the product of bandwidth and distance. Existing 62.5 micron **Fiber Distributed Data Interface (FDDI)** cable is usually rated at 100 or 200 MHz /Km, providing gigabit communications up to 100 or 200 meters.

Single Mode Cable
Single mode cable is used for long distance cable runs. Its distance is limited by the power of the laser at the transmitter and by the sensitivity of the receiver. Single mode cable has an inner diameter of 7 or 9 microns and only allows a single ray of light to enter the cable. Therefore, with single mode cables there is no dispersion.

Galaxy Connector
Fibre Channel has recently adopted a new connector called the Galaxy. It reduces the size of the connector by 50%, doubling the connector density for hubs and switches.

Gigabit Link Modules (GLMs)
Gigabit Link Modules are pluggable modules providing either a copper or fiber optic interface. GLMs include the serializer/deserializer (SERDES) and have a media independent parallel interface to the host bus adapter. Users can easily change the media interface from copper to fiber optics.

Link Analyzer
Fibre Channel Link Analyzers capture cause and effect of data errors. Specific frame headers can be monitored and captured for analysis.

Routers / LAN Switch
Routers / LAN switches interface Fibre Channel with legacy LANs. These are layer 2 and /or 3 devices that use Fibre Channel for a reliable, gigabit backbone.

SNA Gateway
SNA gateways interface Fibre Channel to SNA. Fibre Channel host bus adapters are integrated into standard products like the Novell SAA and Microsoft SNA gateways.

Switch WAN Extender
Fibre Channel switches can be connected over wide area networks using an Interworking Unit (IWU). Expansion ports on switches are linked using either ATM or STM services. Since Fibre Channel may be faster than a single ATM or STM interface, multiple WAN channels can be used for full Fibre Channel bandwidth.

Interoperability

The Fibre Channel 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.

SCSI BASICS

LVD (Low Voltage Differential)

Double speeds of Ultra Wide SCSI

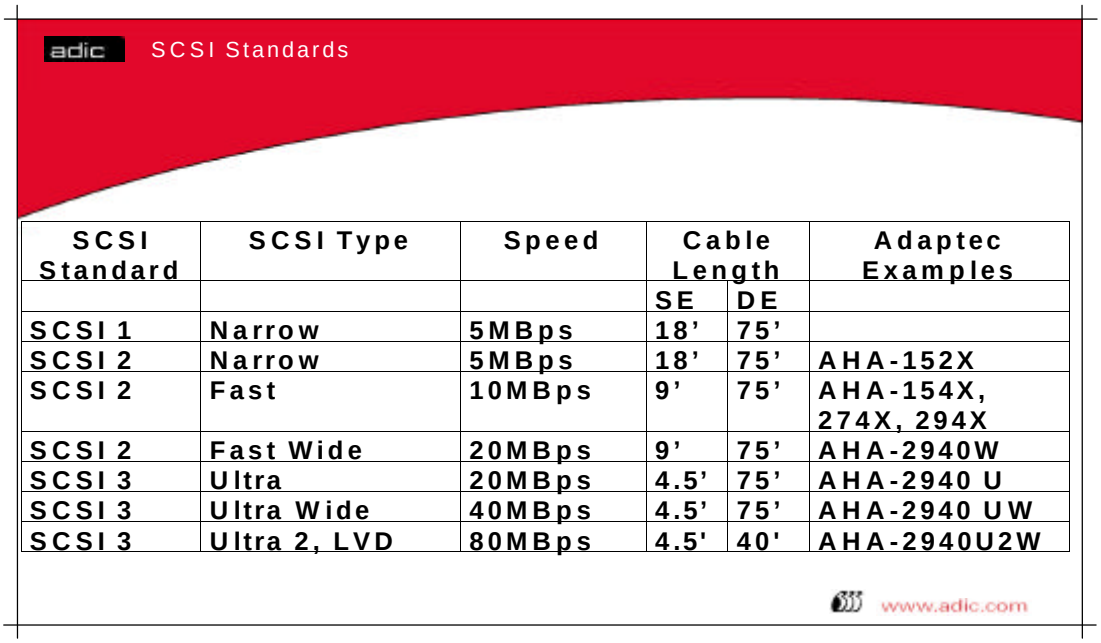
Long transmission lengths

Can not mix regular differential, referred to as high voltage differential (HVD), and low voltage differential devices on an LVD bus

Can convert bus to Single Ended: attaching a single-ended device converts bus to single-ended transmission

Common SCSI Problems
Is the Cable Length over spec?

Is the Cable Quality under spec?



SCSI Standard	SCSI Type	Speed	Cable Length		Adaptec Examples
			SE	DE	
SCSI 1	Narrow	5MBps	18'	75'	
SCSI 2	Narrow	5MBps	18'	75'	AHA-152X
SCSI 2	Fast	10MBps	9'	75'	AHA-154X, 274X, 294X
SCSI 2	Fast Wide	20MBps	9'	75'	AHA-2940W
SCSI 3	Ultra	20MBps	4.5'	75'	AHA-2940 U
SCSI 3	Ultra Wide	40MBps	4.5'	75'	AHA-2940 UW
SCSI 3	Ultra 2, LVD	80MBps	4.5'	40'	AHA-2940U2W

Any Connector Confusion or cross talk?

Was Termination not installed or low quality?

Any Connectors not plugged in or coming Loose?

Bent Connector Pin?