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Protecting Your World of Data

Overview of SE Training

➜Fibre Channel	Tue	1 - 5
➜SAN Solutions	Wed	8 - 12
➜SCSI & Fault Isolation	Wed	1 - 5
➜Application Training	Thu	8 - 5
➜Apps; ADIC products; Open discussion; Wrap	Fri	8 - 12

Overview of SE Training: Fibre Channel

- Networking & Fibre Channel Basics
- Fibre Channel Routers - FCR Training
- FCR & Scalar 218FC Configuration
- FC Configuration:
  - Operating Systems
  - Host Bus Adapter drivers & parameters

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Networking & Fibre Channel Basics

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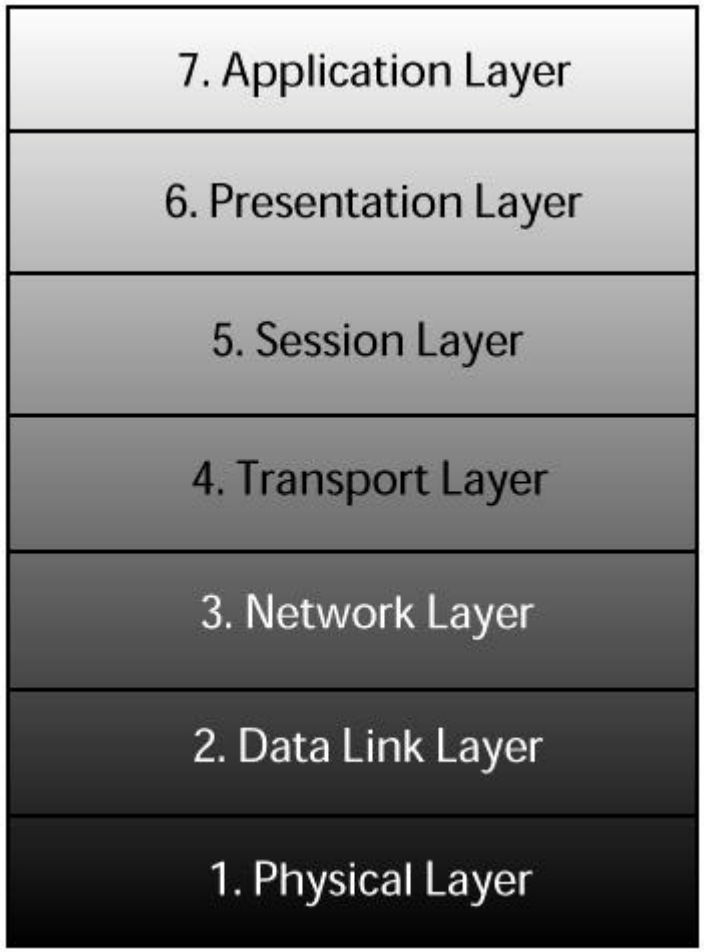
Transport Layers in the OSI Model



- Network/Transport Layer: TCP/IP
- Data Link (Logical Link Control) Layer: Ethernet, Token Ring, ATM, ESCON, Gigabit Ethernet
- Data Link (Media Access Control) Layer: FDDI, Fibre Channel, 10BaseT, 100BaseT
- Physical Layer: Copper Cable, Fiber Optic Cable

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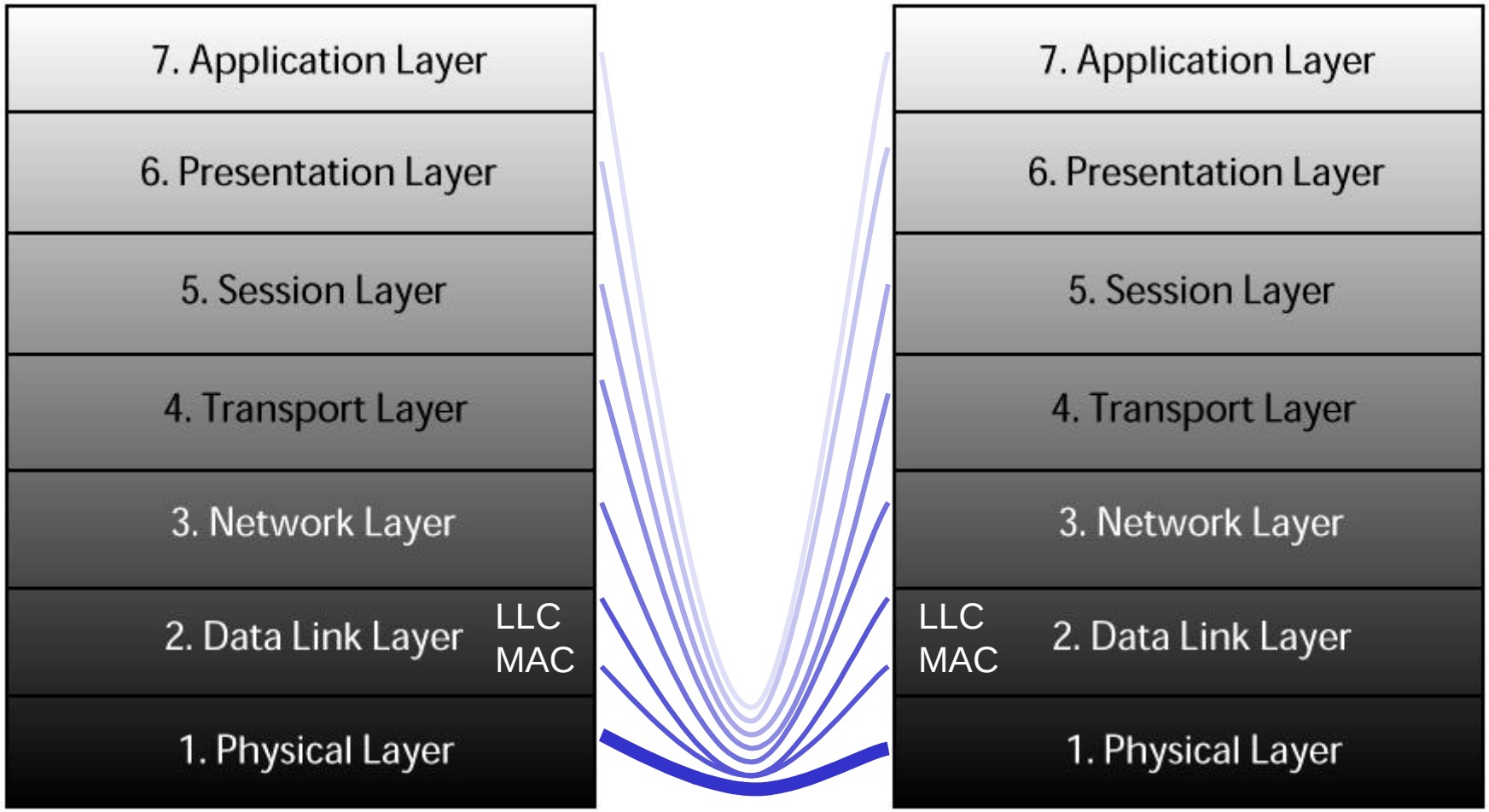
The OSI Model



Sender at each layer communicates with receiver's same layer
Physical is the only layer with an actual connection

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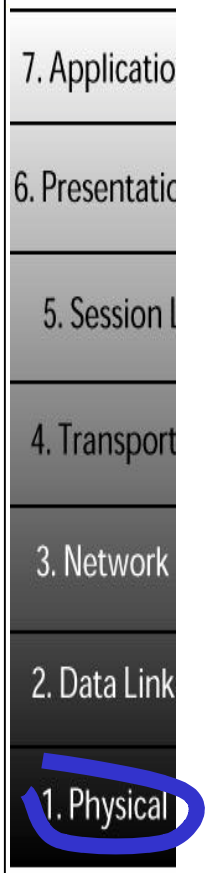
Physical Layer: Copper Cables



➡Unshielded Twisted Pair:
10BaseT, 100BaseT, Gigabit Ethernet over Copper;
T1, T3, POTS, ISDN, ADSL, Frame Relay

➡Shielded Twisted Pair:
Token Ring, FC over Copper = 25 meters max

➡"Thinnet" (RG58): 10Base2 (10Mbps)

➡Parallel Cabling:
SCSI, IDE, Parallel (printer) ports on PC Systems

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Physical Layer: Fiber Optic Cables

- 2 Glass Fibers, each in its own casing

- Multimode: signals refract off multiple paths as they travel; 62.5 micron = 500 meters max
  Single mode: signal runs down a single path as it travels; 7 microns wide = 10 km max

- Supports FDDI, FC, Gigabit Ethernet, etc.

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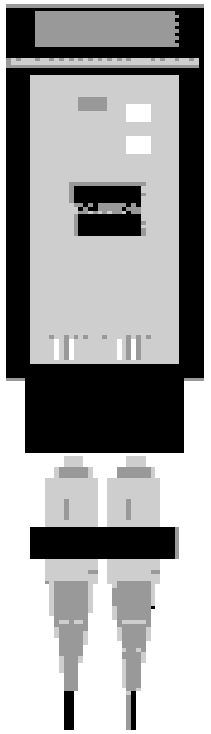
5. Session L
4. Transport
3. Network
2. Data Link
1. Physical

Physical Layer: Fiber Optic Modules

- GLM: Gigabit Link Module
- Mounted onto HBA or Motherboard
  Difficult to replace or upgrade
- GBIC: Gigabit Interface Converter
- Plugs into Socket on HBA, Motherboard, Hub, Switch, etc.
  Easy to replace or upgrade

Gigabit Link Module



Gigabit Interface Converter

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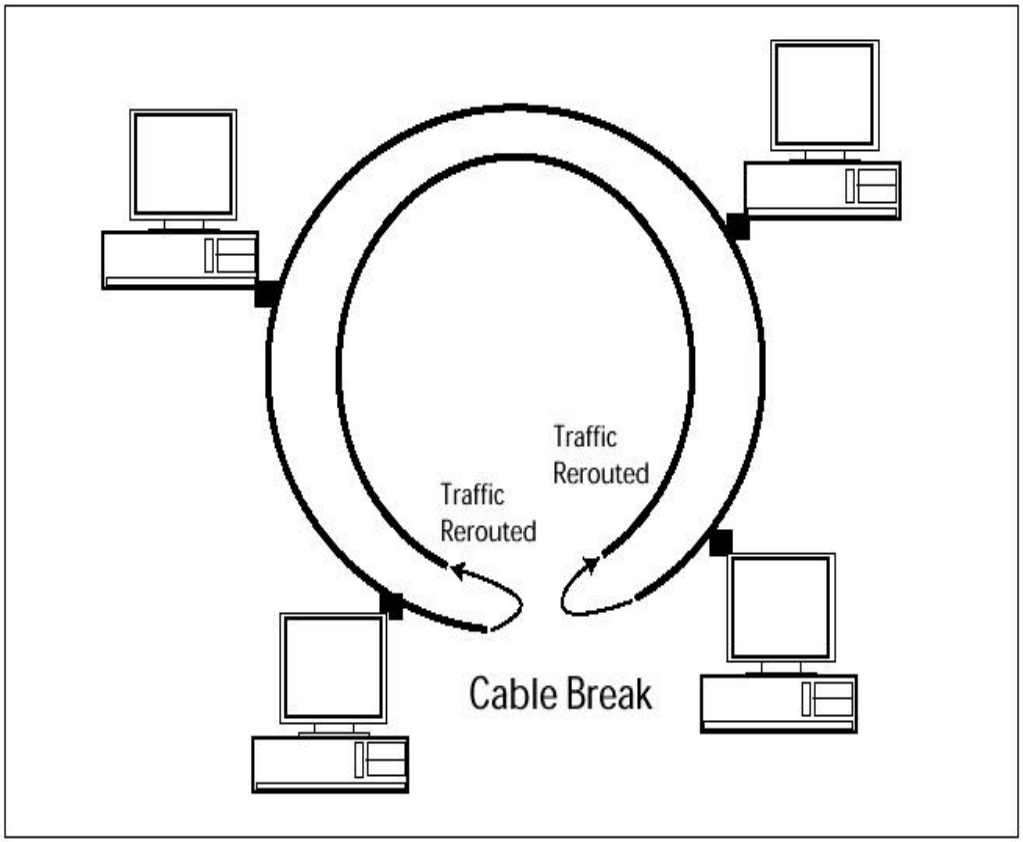
Data Link Media Access Control: FDDI (Fiber Distributed Data Interface)

- 100 Mbps
- Up to 500 nodes over 100KM
- Token-Passing
- Ring Topology
- Rings are Redundant



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3. Network
2. Data Link
MAC
1. Physical

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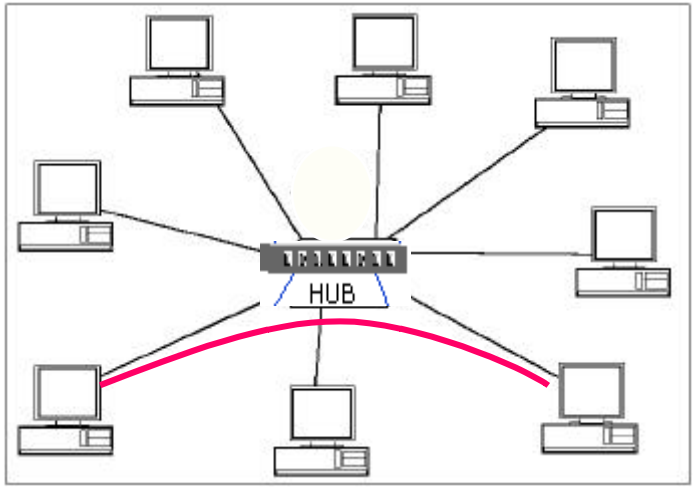
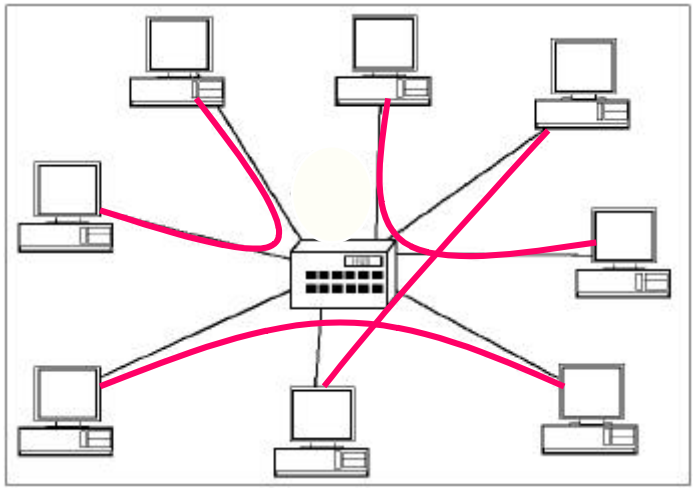
Data Link Media Access Control: 10/100

- Shared: Hub allows only 1 pair of systems at a time to connect
- Switched: Switch allows several point to point data paths at a time
- 10BaseT, 100BaseT, Gigabit Ethernet can all use twisted-pair





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Data Link Media Access Control: Fibre Channel

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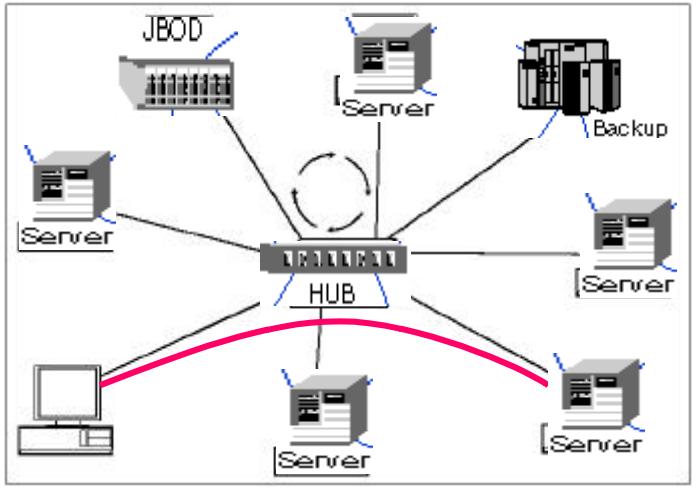
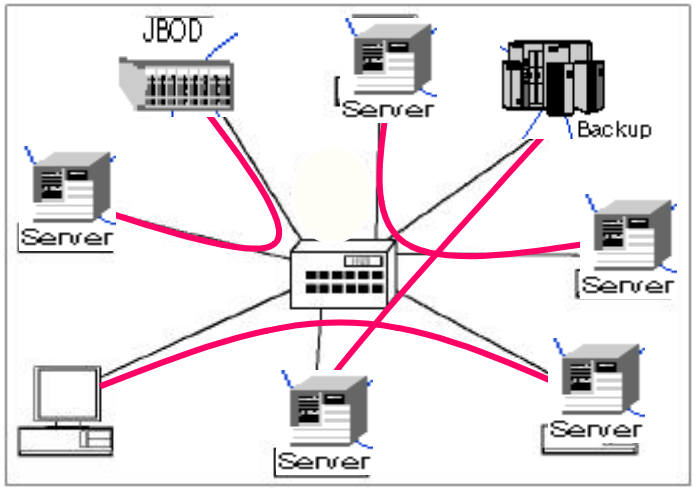
5. Session L
4. Transport
3. Network
2. Data Link
MAC
1. Physical

➡FC-AL = Arbitrated Loop: Hub used to centralize connections, but “loop” allows only 1 data path at a time

➡FC-Switched: Switch allows several point to point data paths at a time





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Data Link Logical Link Control: Network Protocols

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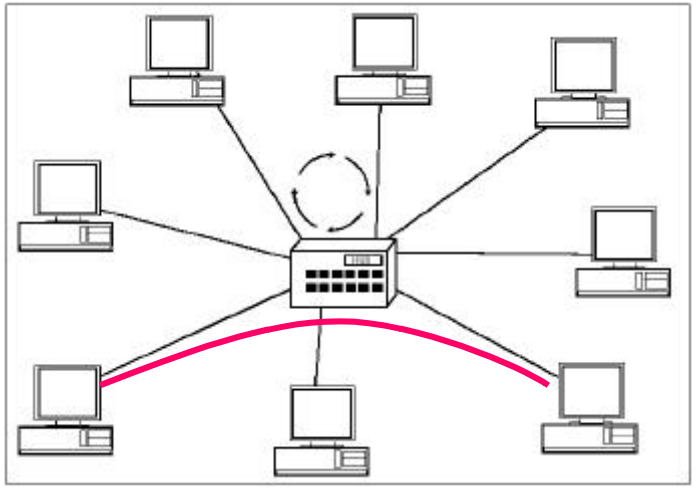
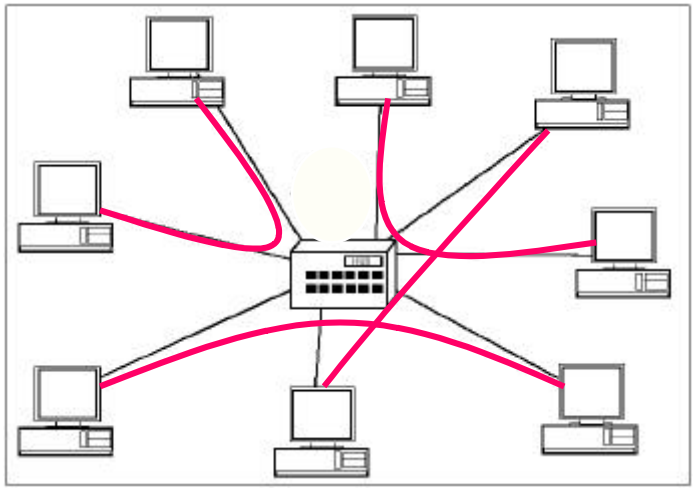
2. Data Link
1. Physical

- Token Ring: uses larger data packets; 4-16 Mbps
- Ethernet: Shared or Switched; 10, 100, 600 Mbps
- ATM: Switched; large packets; 155 Mbps
- ESCON: Enterprise System Connect (IBM)





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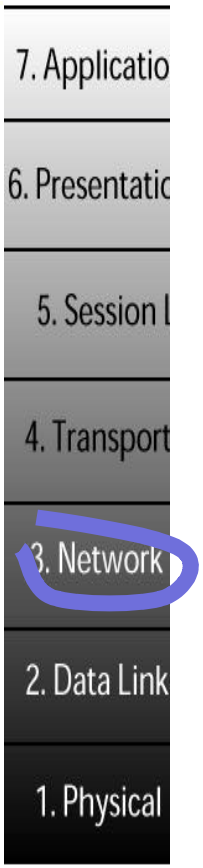
Network Layer: IP



- Internet Protocol
- Sends data from IP address to IP address
- IP Addresses are Logical: 1 adapter can have multiple IP addresses
- IP Attaches to Data Link Layer (Ethernet, Token Ring, FC, etc) to gain transport to other IP addresses

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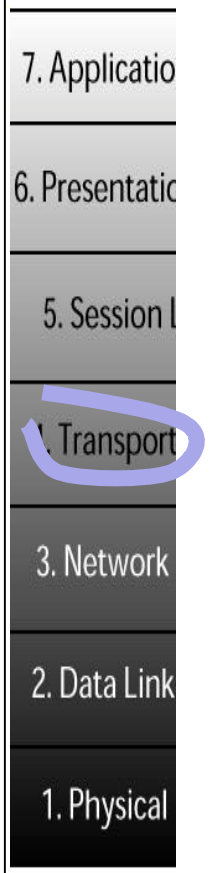
Transport Layer: TCP



- Transmission Control Protocol
- Establishes TCP “session” from TCP port to TCP port
- Sends data from application “socket” to application “socket” in software; each socket gets its own TCP port
- If TCP session is between TCP ports at different IP Addresses, IP is used to transport data

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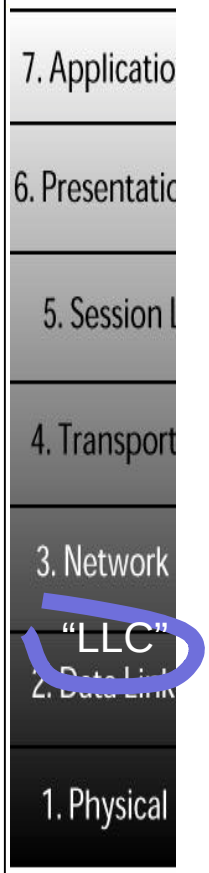
Non-OSI, “Logical Link”: SCSI



- Parallel Data Transmission
- Designed for Very Large Packets & High I/O
- SCSI over Copper (50-pin, 68-pin, etc) most common
- SCSI over FC is newer, faster, runs farther

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SAN Solutions

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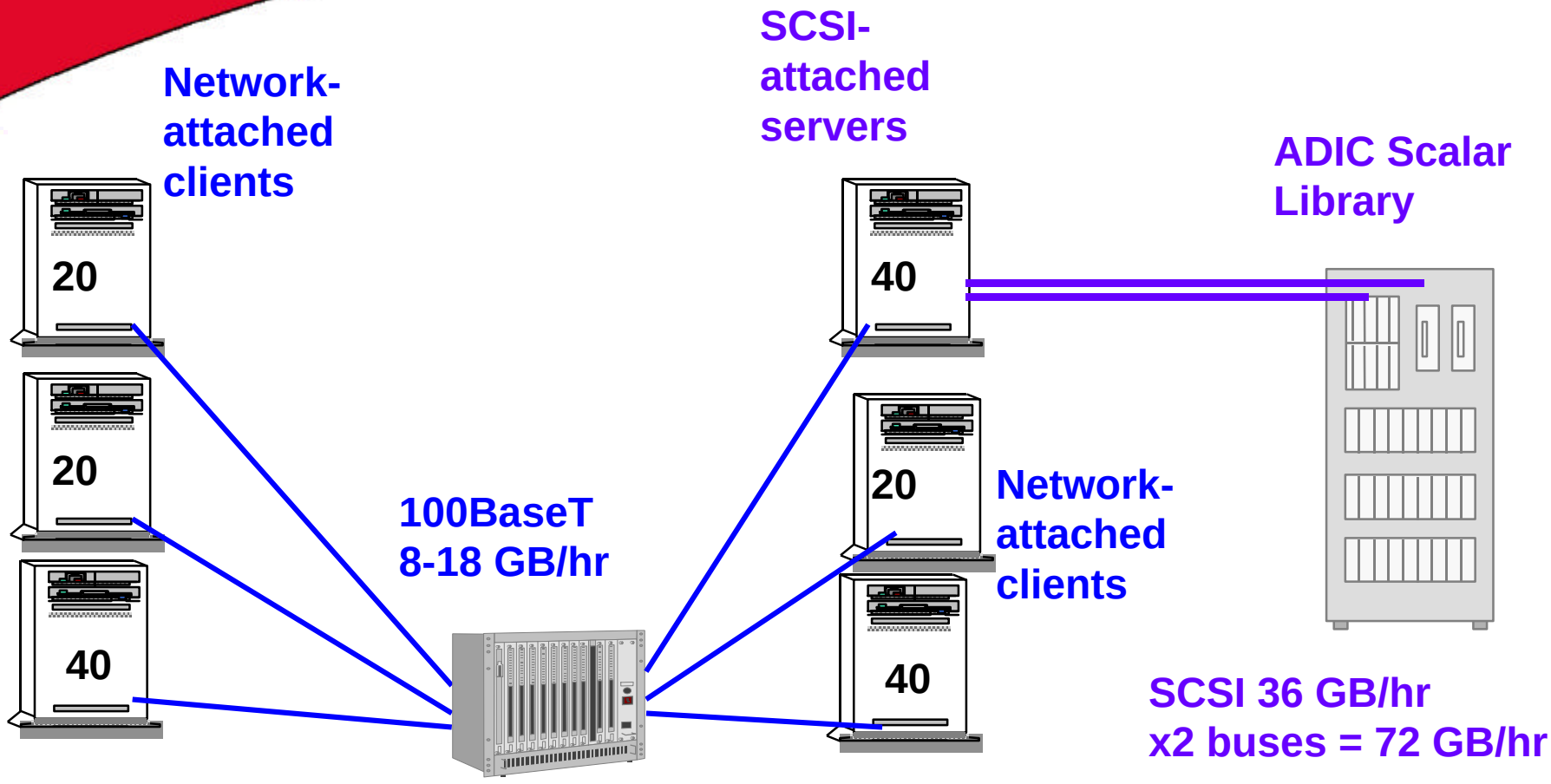
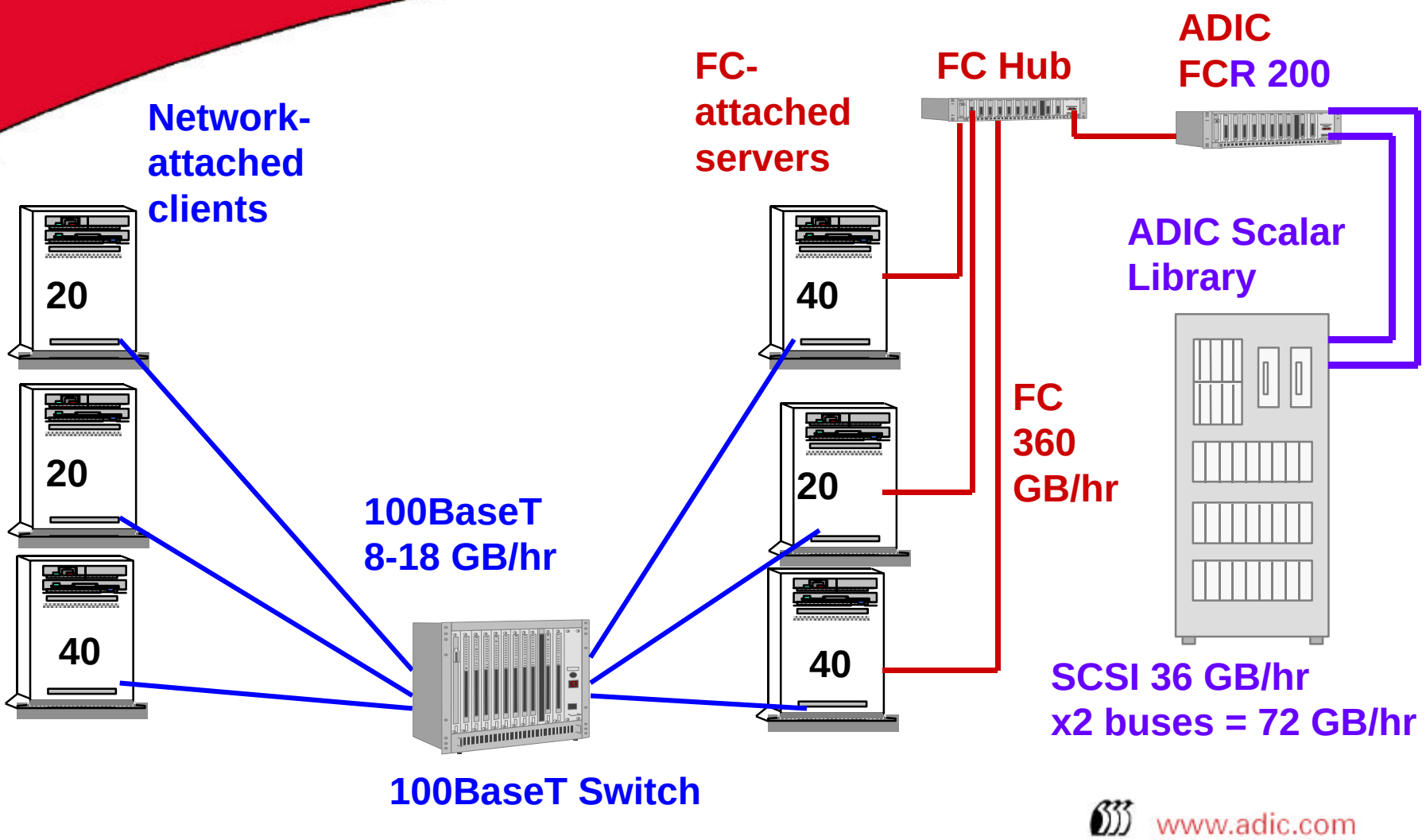
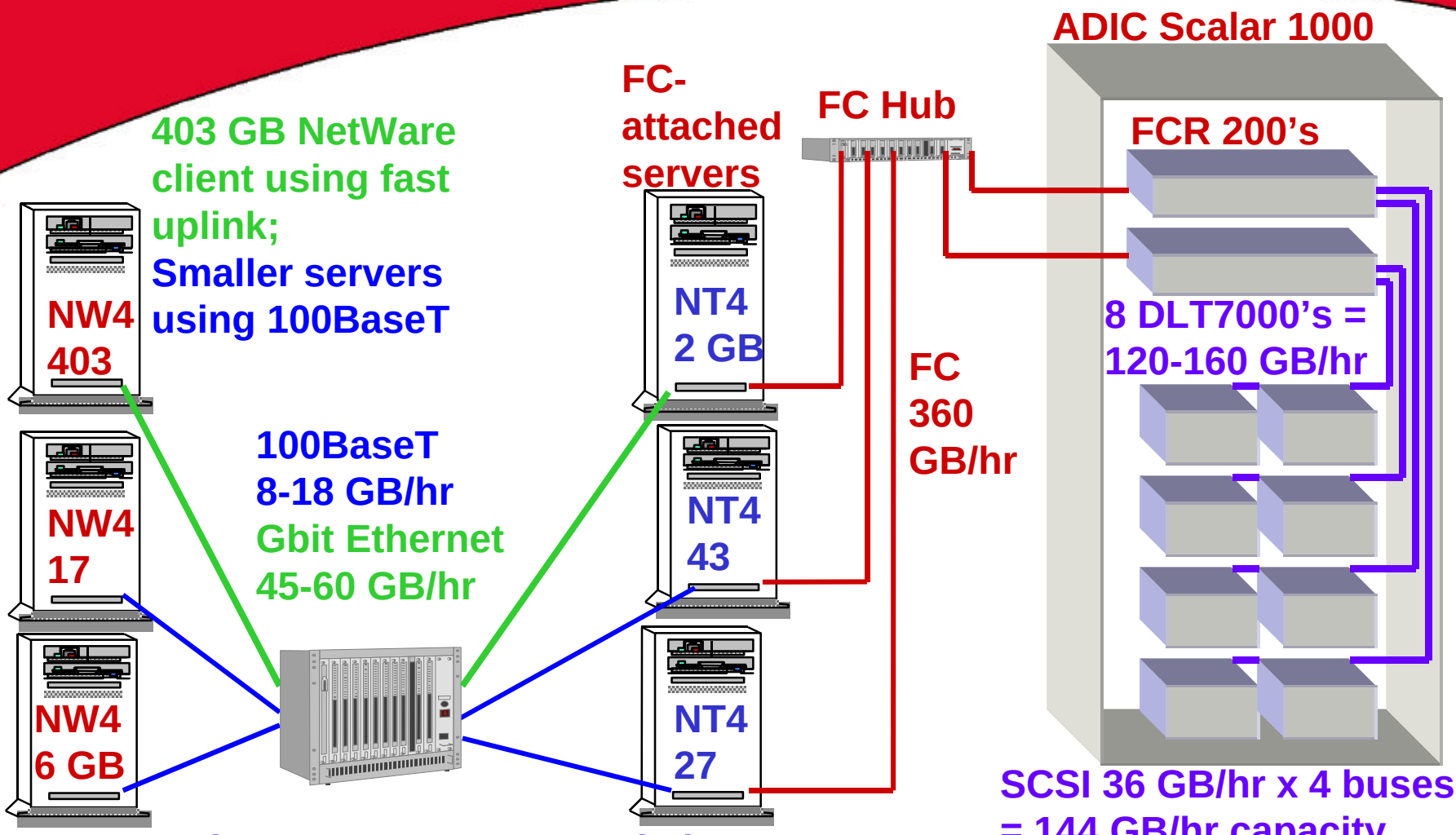
SCSI & LAN Setup for Tape Libraries



FC SAN Setup for Tape Libraries



FC SAN Setup using High Speed Network Uplinks



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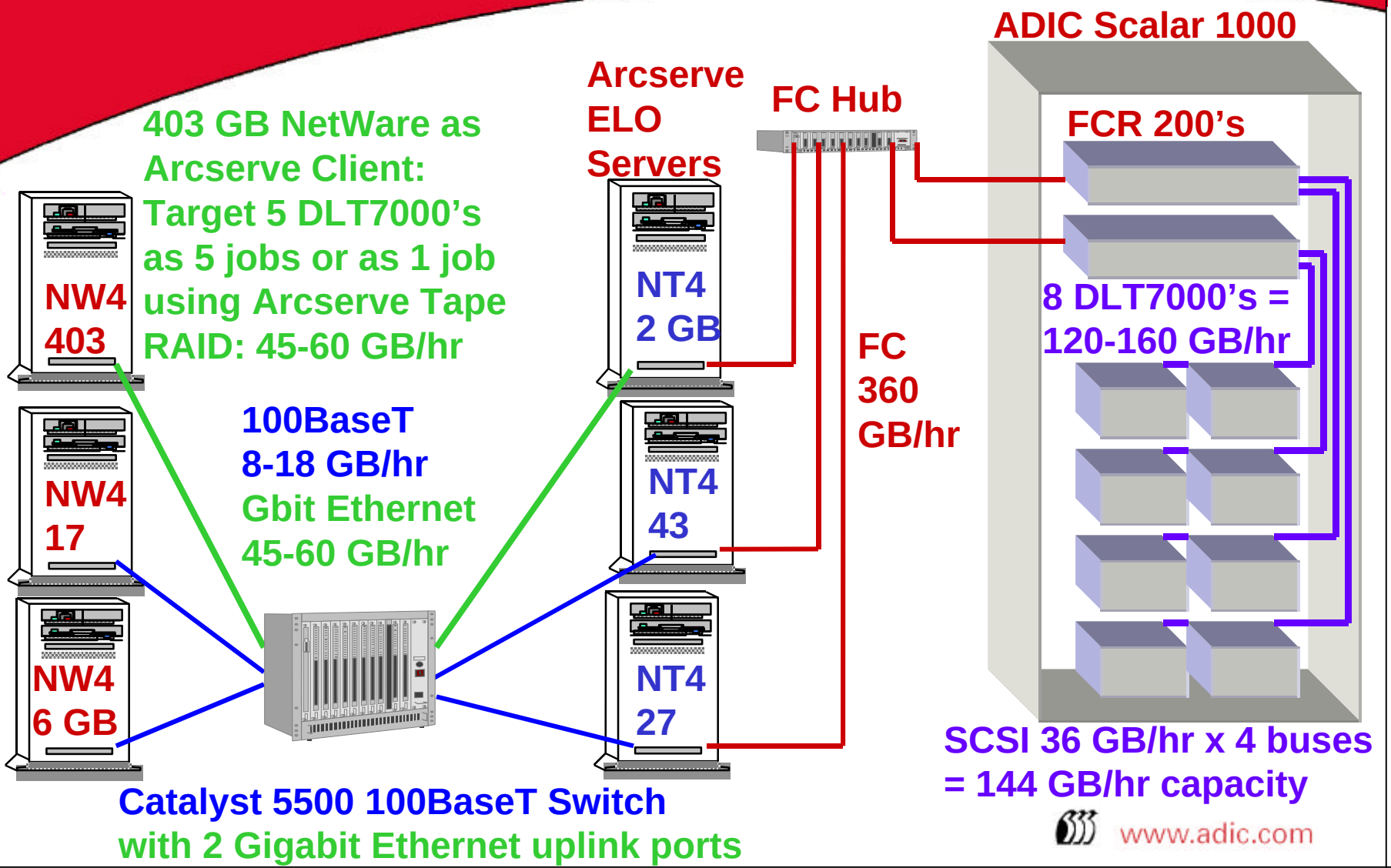
Backing up 403 GB NetWare 4 Server using Arcserve/NT ELO: TCP/IP over Gigabit Ethernet



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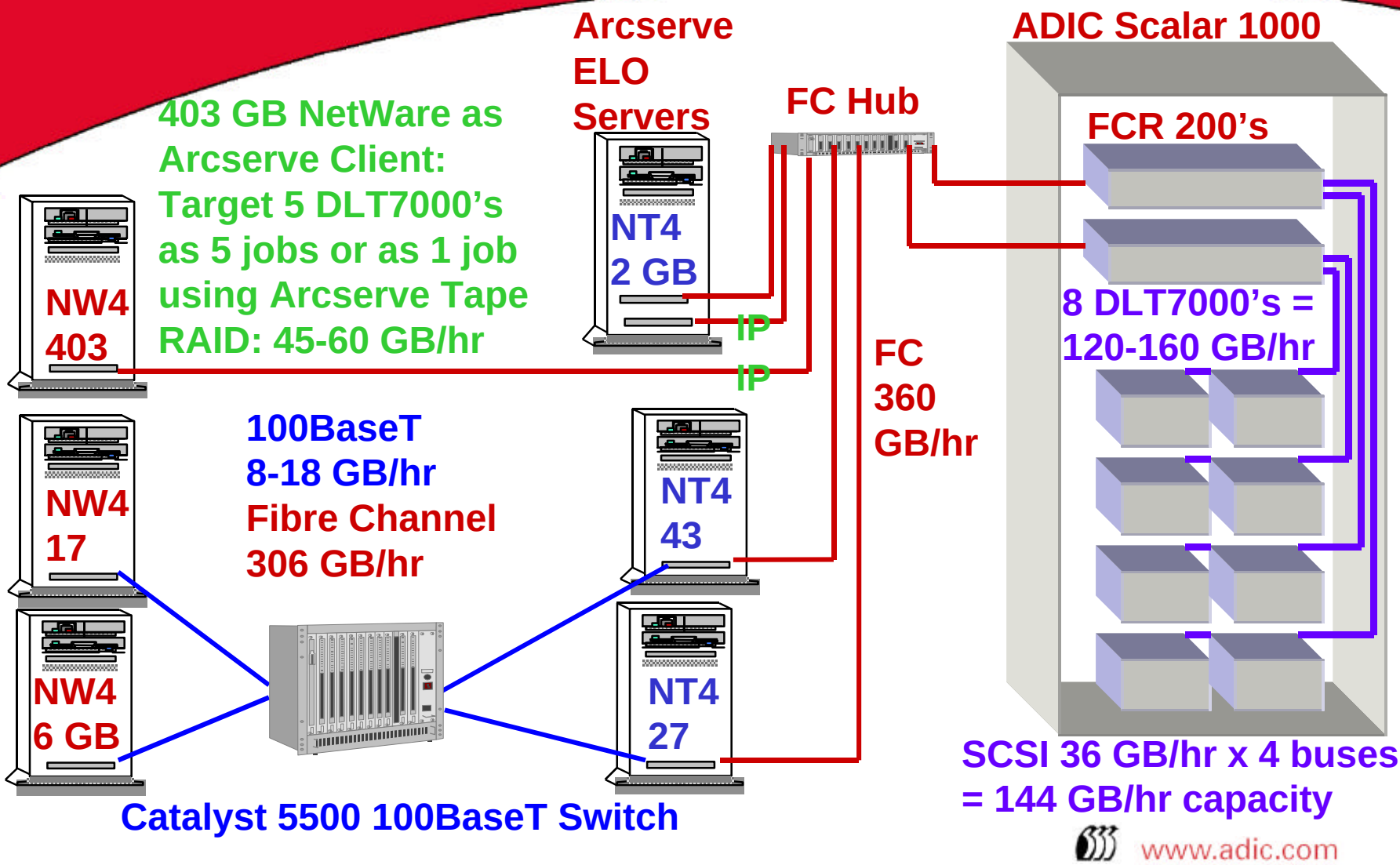
Backing up NetWare Server via Arcserve/NT ELO: TCP/IP over FC



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SCSI Concepts & Basics

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SCSI Connectivity Overview

- **SCSI 1 – Original SCSI Specification, Loosely Defined**
- **SCSI 2 – Standard SCSI, Clean up of SCSI 1 and addition of advanced features (ADIC Devices)**
- **SCSI3 – Still not formally defined, double speed of SCSI 2**

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SCSI Standards

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

ADIC Product Cable Lengths

Product	Internal Cable	Maximum External Cable Length*	
		SE	DE
Scalar 224,234,448,458	3’ + drives	6’	72’
Scalar 218	1’ + drives	8’	74’
Scalar 1000	0’ + drives	n/a	75’
Scalar AIT 480	6’	n/a	69’
Scalar AIT 220	3’	n/a	72’
FastStor	1’	8’	74’
VLS 4mm, SDX, DLT	2’	7’	73’
Standalone Drives	1’	8’	74’

* Assuming Fast Wide (20 MB/sec) devices on HD68 cables; if attaching Ultra Wide (40 MB/sec) devices, max. SE cable length drops from 9’ to 4.5’

Single Ended vs. Differential SCSI

- **Single Ended**
  - All signals referenced to common ground
  - Active termination required (Use only ADIC-Supplied)
  - Good for short cable length environments
  - More sensitive to noise/signal integrity
- **Differential Ended**
  - Signal levels obtained from difference of 2 separate signals
  - Active termination not available
  - Good for longer cable length environments

- **No Support Distinction**
  - Apps and Operating Systems that support SE support DE
- **SE and DE Devices can not be mixed on the same bus**

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SCSI Termination & Cable Quality

- **Termination**
  - **Each end of the SCSI bus must be terminated**
  - **Active Terminators required (ADIC Supplies Only)**
  - **Specific Differential Terminator required**
  - **All ADIC devices supply Term Power to the SCSI bus as default**

- **Cable Quality**
  - **Many manufacturers of cable with different quality/electrical characteristics**
  - **Poor quality cables directly impact signal integrity**
  - **ADIC cables are certified internally – strongly recommended**
  - **DE vs. SE**

LVD SCSI

- **LVD (Low Voltage Differential)**
  Double speeds of Ultra Wide SCSI

  Long transmission lengths

  Can not mix regular 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 Cabling Problems

Cable Length over spec

Cable Quality under spec

Connector Confusion

Termination not installed or low quality

Connector Coming Loose

Bent Connector Pin

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Troubleshooting & Fault Isolation

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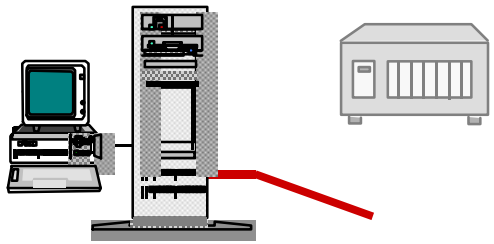
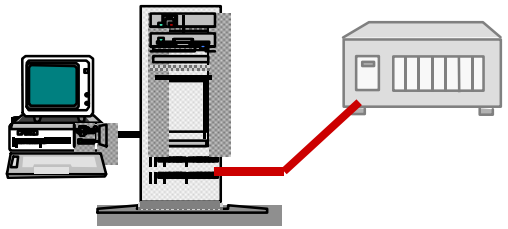
Communicating with the ADIC Device

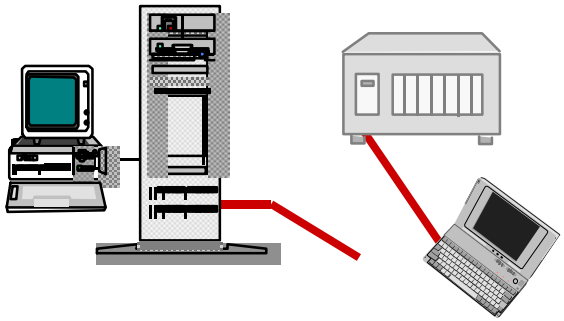
Offline testing (no SCSI bus, ADIC terminator on robotics)



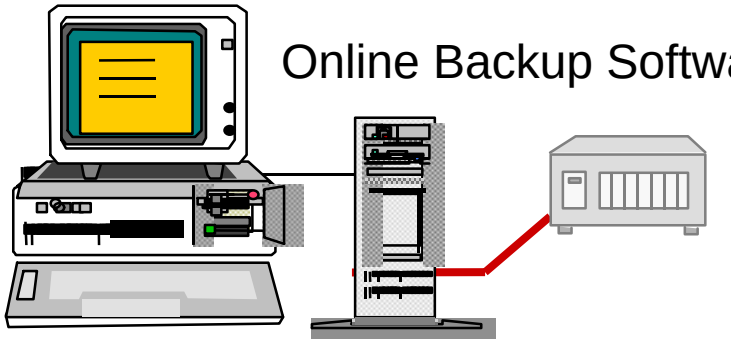
Online utilities (using SCSI BIOS, DOS ASPI, server OS, and/or backup software utilities to examine/exercise)



Offline ASPI utilities (using bench PC or notebook w/SCSI)



Online Backup Software



Problem Isolation

➜What stage of Setup?

➜Software & hardware both new, not installed yet

➜Software installed already, Hardware is new

➜Software & hardware both installed already, was working ok

➜Typical Problem Discovery:

➜Software install fails; software fails to find hardware or reports it's unsupported

➜Software can't see or configure new device; software's tech support says device may be bad

➜Software error message pointing to hardware; software's tech support says device may be bad

Problem Isolation

➜What stage of Setup?

➜One or more drives failed in existing library

➜One or more drives replaced in existing library

➜New drives / slots / FCR's added to existing library

➜Typical Problem Discovery:

➜Software operation fails; software fails to to mark hardware offline

➜Software can't see or configure new device; software fails to mark hardware online

➜Software loses drive associations to library; software identifies this as a new library & reports it can't find the old one

Problem Isolation

➜Check Customer's Isolation Steps:

➜Were they clean, 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 remove problem behavior?

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

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Problem Isolation

➜Typical Isolation Items:

➜Server hardware (SCSI cards, RAM, CPUs, or the entire server)

➜ADIC Robotic Unit

➜Tapes

➜SCSI Cables: Make/model, length, routing

➜SCSI Terminators

➜Physical location

➜Power source

➜Server down/restart

➜Server power cycle

➜Software unload/reload

➜Software threads killed/restarted

➜Server I/O load high/low

➜LAN activity high/low

➜OS/Software Drivers

➜SCSI Card Drivers

➜OS Patches

➜Data volume or capacity increase

➜Other software processes added to server

Help Desk Tools

➜Is the software/robot/OS setup compatible?

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

➜Marketing Compatibility Guide:

At www.adic.com

➜Tech Compatibility Guide: call ADIC sales or Tech Support at 800-336-1233

➜Hardware manuals

➜Software manuals

➜NT device files

➜NetWare startup NCF's

➜UNIX conf/def/dev files

➜Software configuration & startup files

Help Desk Tools

➜Any history on this setup, unit or customer?

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

➜Your contact or incident database information

➜ADIC Tech Support incident history information

➜Software Release Notes

➜Software WWW bulletins

➜ADIC WWW bulletins

➜ADIC Tech Lab Reviews

➜Software Tech Support

➜ADIC Tech Support

ADIC Contact Information

- Advanced Digital Information Corporation
  11431 Willows Road NE, PO Box 97057
  Redmond, WA 98073-9757

- Main Switchboard: 425.881.8004 or 1.800.336.1233
- Technical Support: 425.883.4357 or 1.888.809.3052

- Fax: 425.881.2296
- E-mail support: support@adic.com
- Web page: http://www.adic.com

ADIC Contact Information

Redmond-based SE Contacts:

Jim Hibbard	**425-895-4246**	**Systems Engineering Manager**
Bob Davis	**425-895-3437**	**Applications Engineer**
Gordon Goins	**425-881-8004 x3498**	**Systems Engineer**
Muhammad Ali	**425-881-8004 x4485**	**Systems Engineer**

Field-based SE Contacts:

Mike Till		**Application Engineer (Calif/SW)**
	650-222-2388 cellular	
Bob Allen		**Application Engineer (Southeast)**

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System Performance & Throughput

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Factors Affecting Throughput

- Type of Data
- Location of Data
- I/O Path to Data
- Host Processor
- Backup Software
- I/O Path to Tape
- Tape Media/Drive

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Type of Data

- Type of Data: Large files back up faster than small files

- Flat files vs. Database files: Database agents may be more or less efficient than the operating system

- Compressibility: Tape drives' throughput and capacities are rated at 2:1 compression; LAN data may compress at 1.5:1 or less

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Location of Data & I/O Path to Data

- Disks: Hardware RAID faster than OS (software) RAID
- RAID card RAM: Adding RAM beyond card's midrange may have diminishing returns
- Network Speed: 100BaseT popular, but real speeds limited
- Network Switches: increase multi-server network capacity
- Faster Network Technologies: Enterprise switches can grow as new LAN and/or SAN uplink ports reach the market

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Host Processor

➡CPU Speed: Faster is Better; retired PC servers will yield retired-PC throughput speeds

➡CPU Design: Pentium Pro designed for higher I/O, Pentium II designed for more computation

➡# of CPUs: Many backup packages can use 1 or more CPU per data stream

➡OS CPU Support: OS Versions that support multiple CPUs provide a speed advantage

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Backup Software, I/O Path to Tape, & Tape Media/Drive

➡Backup Software: File System Backup Slower than Image Backup

➡Backup Agents: LAN-bound data streams can double in speed with use of agents to “package” data stream

➡# of SCSI cards to Tape Drives: Trade-off between SCSI bus capacities and PCI and/or EISA bus Bridging Issues

➡Drives & Media: Must have throughput capacity high enough for backup system

Isolating Throughput Issues

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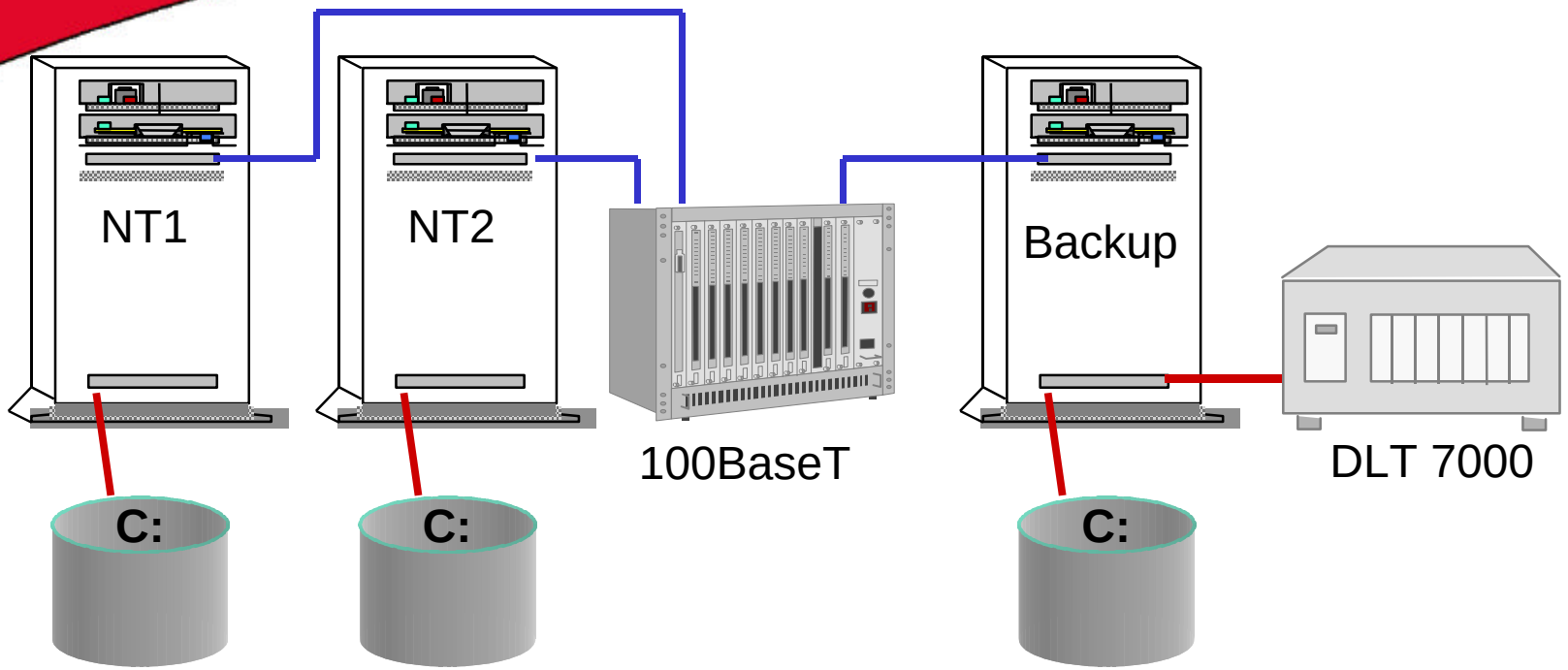
Isolating Throughput Issues

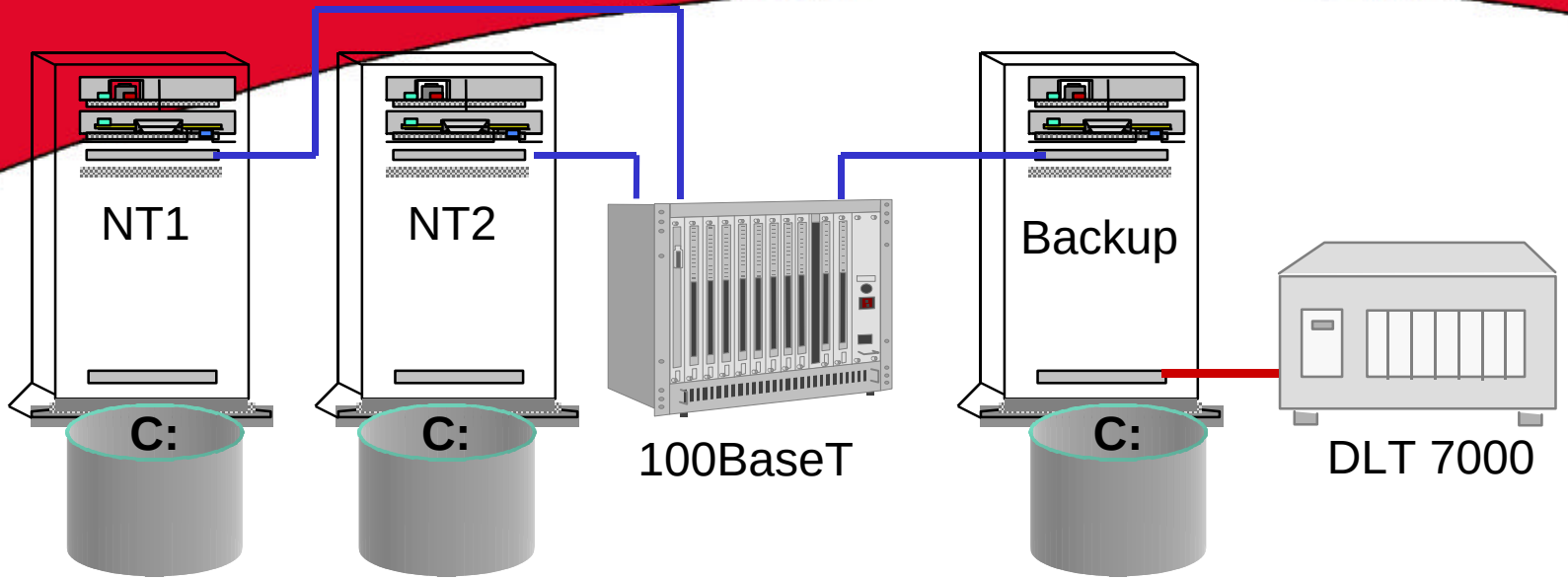
- Establish a Baseline Directory of test data
- Start Small: Use a 10MB Test before sending 1GB
- Use Real Data typical for your network: if your backups tend to compress at 1.4:1, use data that compresses at about the same rate
- Use the same data set every time
- Save the test data set for future tests and problem isolation sessions

Step 1: Map Your Network



- Servers (minimum of 3)
- Servers' Disks
- Network Switch
- Tape Device

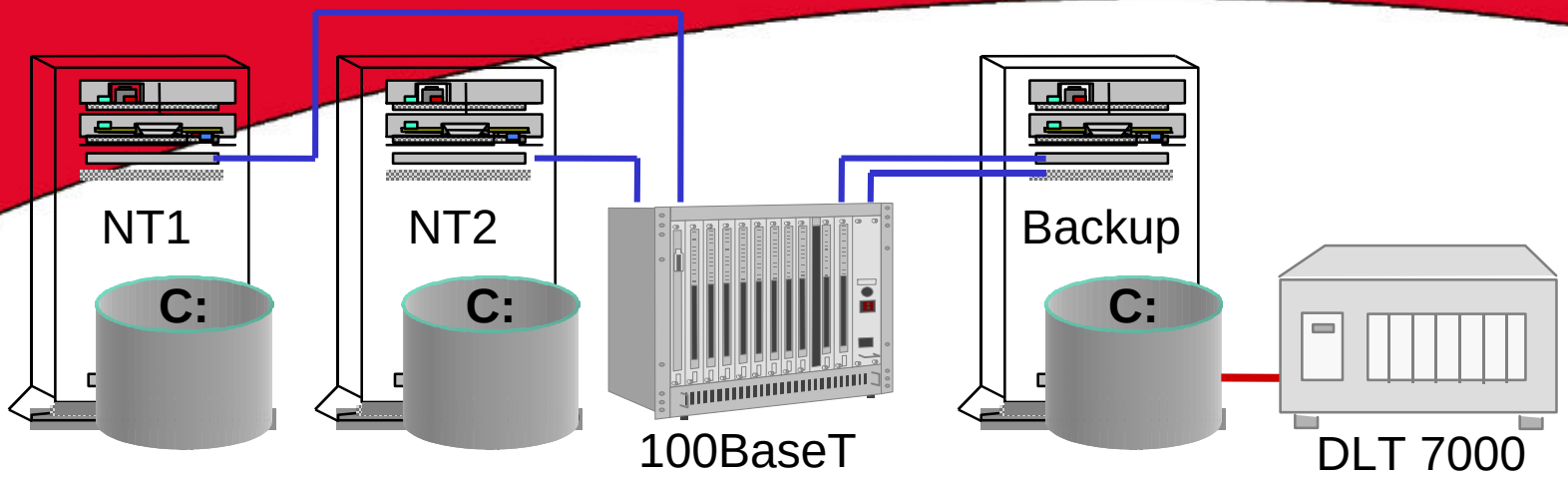
Step 2: Plan Your Tests



Test	Source	Target	Measures	Throughput (MB/Minute)	Notes
1	Backup C:	Tape	Local speed to tape		Should match point on Price/Performance Curve
2	Backup C:	Backup C:	Local speed to disk		If much different than (1), check SCSI or tape issues
3	NT1 C:	NT1 C:	NT1's disk speed		Should be similar to (2) if servers are similar
4	NT1 C:	NT2 C:	NT1's LAN disk speed		If much less than disk, check LAN issues
			NT1's speed to Backup		Should be similar to (4) if netcards are similar
6	NT1 C:	Backup Tape	NT1's speed to tape		If much less than (5), examine SCSI and tape issues

Throughput numbers shown for illustration only. Only you can determine your system performance!

Step 3: Run Tests & Record Results



Test	Source	Target	Measures	Throughput (MB/Minute)	Notes
1	Backup C:	Tape	Local speed to tape	***400***	Should match point on Price/Performance Curve
2	Backup C:	Backup C:	Local speed to disk	***350***	If much different than (1), check SCSI or tape issues
3	NT1 C:	NT1 C:	NT1's disk speed	***340***	Should be similar to (2) if servers are similar
4	NT1 C:	NT2 C:	NT1's LAN disk speed	***80***	If much less than disk, check LAN issues
			NT1's speed to Backup		Should be similar to (4) if netcards are similar
6	NT1 C:	Backup Tape	NT1's speed to tape	***40***	If much less than (5), examine SCSI and tape issues
			Duplexing mismatch		***Switchport didn't match netcard***
8	***NT1 C:***	***Backup C:***	***1/2-duplex***	***120***	***1/2-duplex faster than full for 1-way I/O***
9	***NT1 C:***	***Backup Tape***	***Backup Agent***	***240***	***Installed agent on NT1***
10	***NT1+NT2 C:***	***Backup Tape***	***Dual Stream Backup***	***240***	***Netcard on Backup Server Bottleneck?***
11	***NT1+NT2 C:***	***Backup Tape***	***Fast Uplink***	***400***	***Installed faster uplink on Backup server***

Throughput numbers shown for illustration only. Only you can determine your system performance!