The SAN's Revolution Evolution

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What is a SAN?
Storage Area Network

- A SAN is a secondary network whose primary focus is off loading the traffic associated with data storage and movement from a primary network

The Movement Behind SAN's: Explosion of Data and Technology

- Data Growing 50-400% per year
- "Internet storage estimates say that capacity needs will double every three months"
  - Network World Fusion, March 15, 2000
- Overall forecasted installed storage capacity worldwide for 2003 is 300 times the capacity installed in 1993
  - IDC, Mass Storage News, March 2, 2000

The Movement Behind SAN's: Explosion of Data and Technology

- How handle the explosive growth in an easily managed, highly dynamic environment?

SAN's - Storage Area Networks

The Movement Behind SAN's: Explosion of Data and Tape Tech

- Move from Centralized to Distributed...and back
- Data storage and backup - backing up to tape has been done for years starting with reel to reel
  - DLT came along and helped revolutionize tape because of its speed, capacity and reliability
  - 4mm and 8mm were good, and now are overcoming quality and ruggedness issues

From Centralized to Distributed
The Evolution Begins

- Large data centers centralized administrative tasks including data storage and backups
  - Not much data moving at first over network
  - Backups not a big impact to the corporate enterprise since they are done locally
- Distributed computing becomes the rage
  - Reduced TCO (total cost of ownership)
  - Simpler (supposedly)
  - Lower loads on the over all network(s)
  - Administrative nightmare

From Centralized to Distributed
The Evolution Begins

- Data growth begins, the network impact grows
  - More data traversing the network
  - Link and node utilization's rise
  - Off-hours backups necessary
  - Must add additional storage, but how manage?
  - Distributed backups to isolated tape & libraries
  - Which systems should get backed up vs. do
- Data continues to grow, on a geometrical basis
  - Networks have a hard time keeping up

SAN's Emerge
Goal: Off-load increasing traffic

- Goal/purpose: a Storage Area Network (SAN) is a dedicated, storage-only secondary network that off-loads storage traffic from the primary or enterprise network
- Helps reduce the impact of data movement
- Remember, server backups are only 20% of the equation, the other 80% is the restore and how quickly you can do it
  - 10% and 90% ???

Review:

Let's review
networking capacities
and
backup media/hardware

or....

Where is the bottleneck?

Review:
Examine network speeds

In a perfect world...

- 10Base-T: **3.6GB/hr**
(=60MB/min=1MB/sec**)**
- 100Base-T: **36 GB/hour**
- 1000Base-T: **360 GB/hour** (Copper)
- FDDI: **36 GB/hour**
- ATM: **280 GB/hour**
- Fibre Channel: **360 GB/hour**

Review:
Examine network speeds

Let's be practical...

Ethernet - Divide by 2

Fibre - Think 90%

Review:
Hardware Specifications: 1/2”

3480	1.5 MB/sec	.2GB cap	5.4 GB/hour
comp*	3 MB/sec	.4GB	10.8 GB/hour
3490	3 MB/sec	.4GB cap	10.8 GB/hour
comp*	6 MB/sec	.8GB	21.6 GB/hour
3490E	3 MB/sec	.8GB cap	10.8 GB/hour
comp*	6 MB/sec	1.6GB	21.6 GB/hour
3590 Magstar	9 MB/sec	10GB cap	32.4 GB/hour
comp*	18 MB/sec	20GB	64.8 GB/hour

* based upon 2:1 compression

Review:
Hardware Specifications: 4mm

DDS2	336KB/sec	4GB cap	1.2 GB/hour
comp*	772KB/sec	8GB	2.4 GB/hour
DDS3	1.2MB/sec	12GB cap	4.32 GB/hour
comp*	2.4MB/sec	24GB	8.64 GB/hour
DDS4	3MB/sec	20GB cap	10.8 GB/hour
comp*	6MB/sec	40GB cap	21.6 GB/hour

* based upon 2:1 compression

Review:
Hardware Specifications: 8mm

8mm Mammoth	3MB/sec	20 GB	10.8 GB/hour
comp*	6MB/sec	40 GB	21.6 GB/hour
8mm Mammoth-2	12MB/sec	60 GB	43.2 GB/hour
comp**	30MB/sec	150 GB	108 GB/hour
8mm Mammoth-3	20MB/sec	120 GB	72 GB/hour
comp**	50MB/sec	300 GB	180 GB/hour

- due Q2 or Q3/2001

* based upon 2:1 compression

** based upon 2.5:1 compression

Review:
Hardware Specifications: 8mm

8mm AIT	3MB/sec	25 GB cap	10.8 GB/hour
comp*	6MB/sec	50 GB	21.6 GB/hour
8mm AIT-2	6MB/sec	50 GB cap	21.6 GB/hour
comp*	12MB/sec	100GB	43.2 GB/hour

* based upon 2:1 compression

Review:
Hardware Specifications: DLT

DLT 4000	1.5 MB/sec	20 GB cap	5.4 GB/hour
comp*	3.0 MB/sec	40 GB	10.8 GB/hour
DLT 7000	5 MB/sec	35 GB cap	18 GB/hour
comp*	10 MB/sec	70 GB	36 GB/hour
DLT 8000	6 MB/sec	40 GB cap	21.6 GB/hour
comp*	12 MB/sec	80 GB	43.2 GB/hour

* based upon 2:1 compression

Review:
Hardware Specifications: Latest

Ecrix (8mm)	3 MB/sec	33GB	10.8 GB/hour
comp*	6 MB/sec	66GB	21.6 GB/hour
9840 (STK)	20 MB/sec	20GB	72 GB/hour
comp***	80 MB/sec	80GB	288 GB/hour (7-to-1?)
SuperDLT	15 MB/sec	100-500GB	54 GB/hour
comp*	30 MB/sec	200GB-1TB	108 GB/hour
LTO (Ultrium)	15 MB/sec	100-500GB	54 GB/hour
comp*	30 MB/sec	200GB-1TB	108 GB/hour

* based upon 2:1 compression *** based upon 4:1 compression

First Stage in Evolution: Multi-Hosting

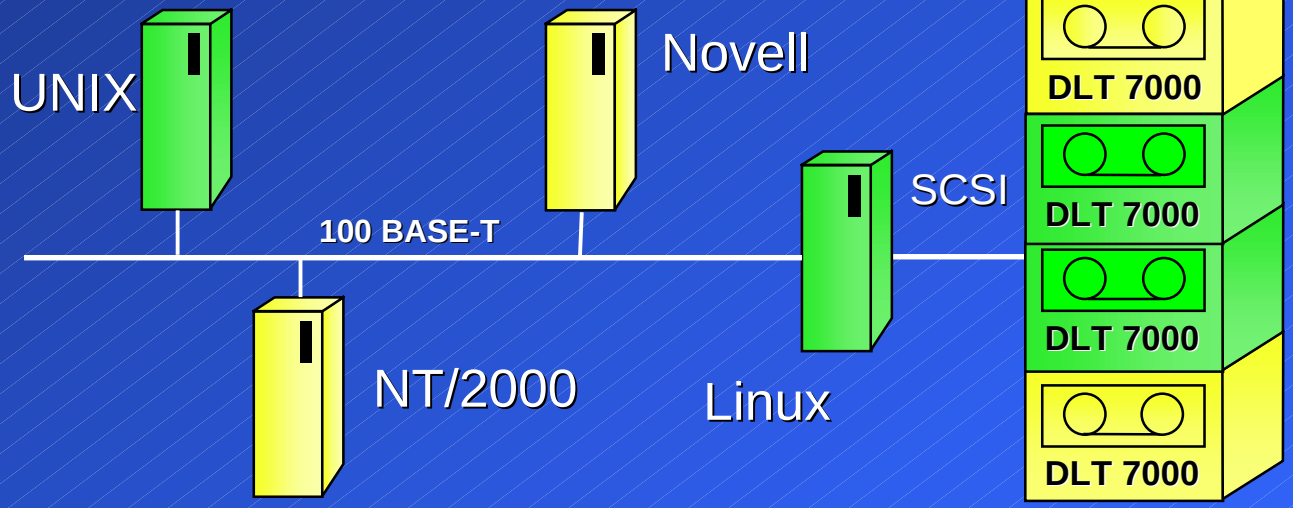
- Multi-hosting – direct SCSI connect server to tape library
  - Cheap – cost of SCSI cables
  - Fast – 40MB/sec –most tape drives can only write at 5MB/sec
  - Off-loads traffic and maximizes tape investment – speeds are fast enough to keep tape spinning all the time
  - Only downside – distance - 25 meter limit of SCSI

First Stage in Evolution:
Multi-Hosting

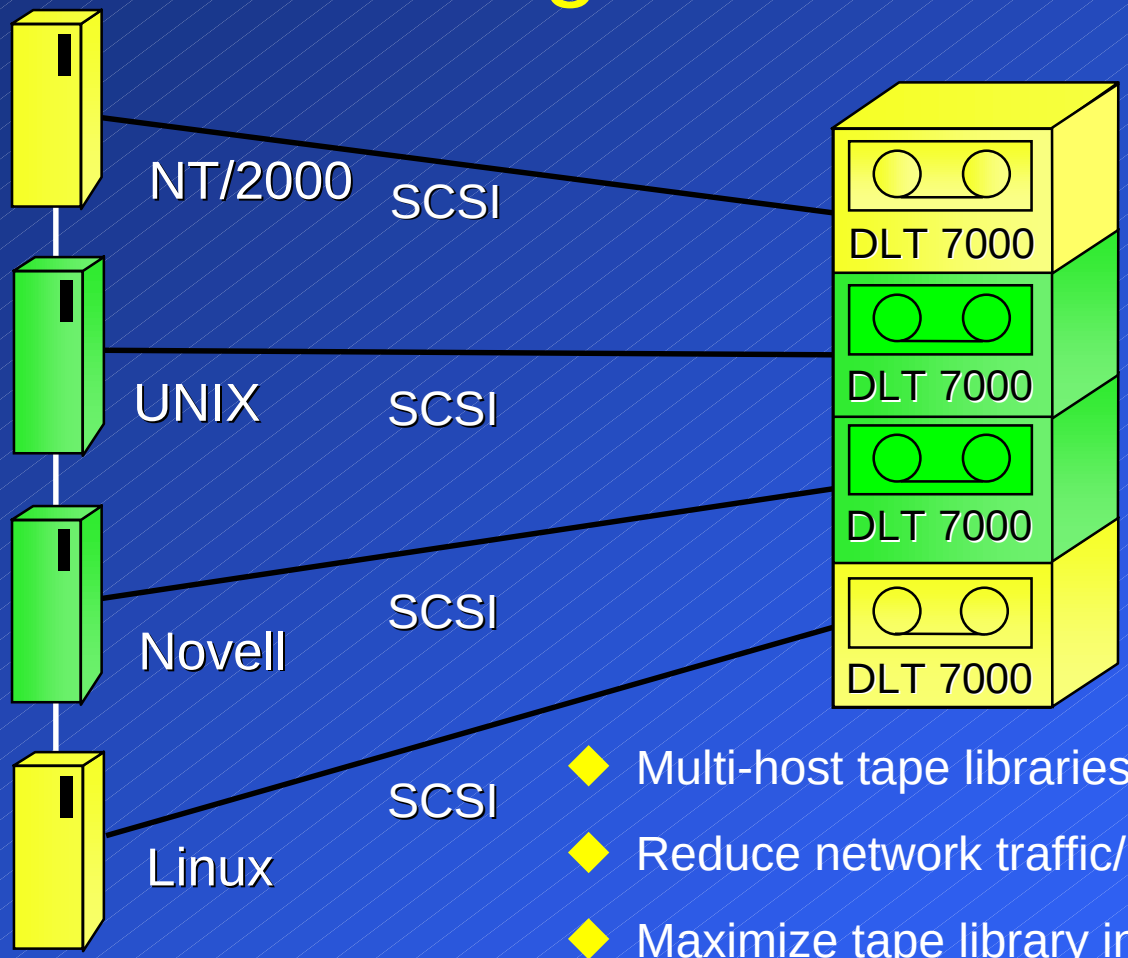
Network Speed = 10 MB/sec

Library Speed = 20 MB/sec

-10 MB/sec
Lost Throughput



First Stage in Evolution: Multi-Hosting

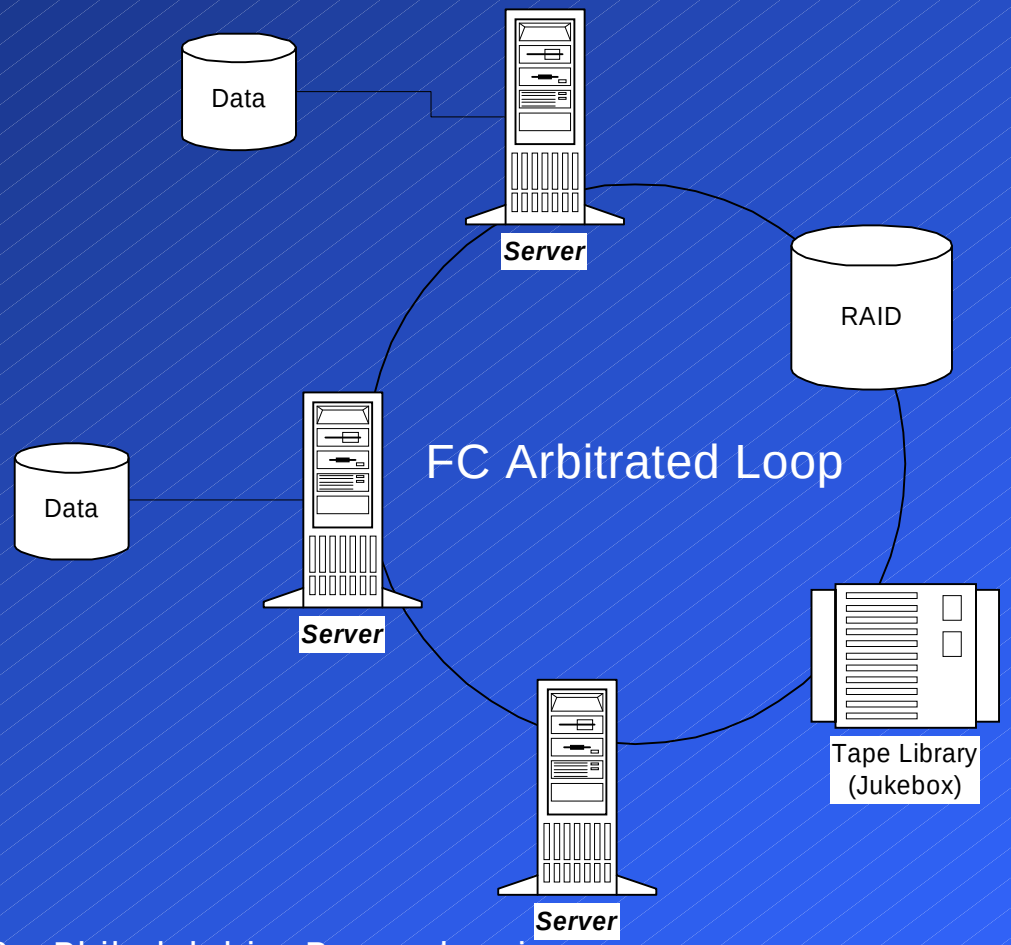


- Multi-host tape libraries with multiple servers
- Reduce network traffic/improve performance
- Maximize tape library investment

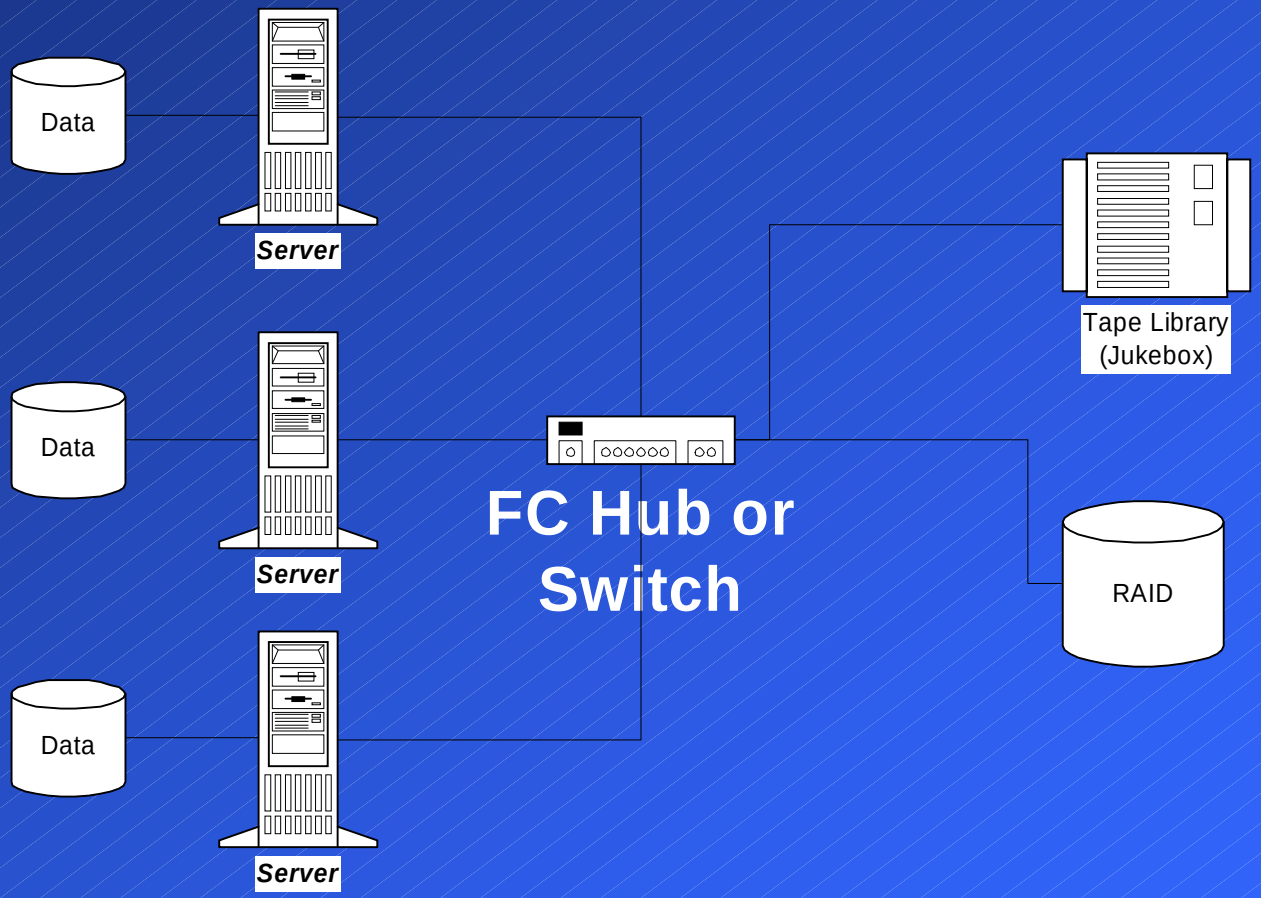
Second Stage in Evolution: Fibre Channel - Arbitrated Loop

- 100 MB/sec speed
- Arbitrated - circuit based - only one conversation at a time without redundant loops, hubs or using a switch
- Not a bandwidth consideration, but latency of arbitrating connections
- 126 devices on one loop vs. 16 for SCSI
  - Current suggested/recommended is 3-6 servers
  - Must bring down entire loop to add or remove a device without node-bypass circuitry or switch

Second Stage in Evolution:
Fibre Channel - Arbitrated Loop



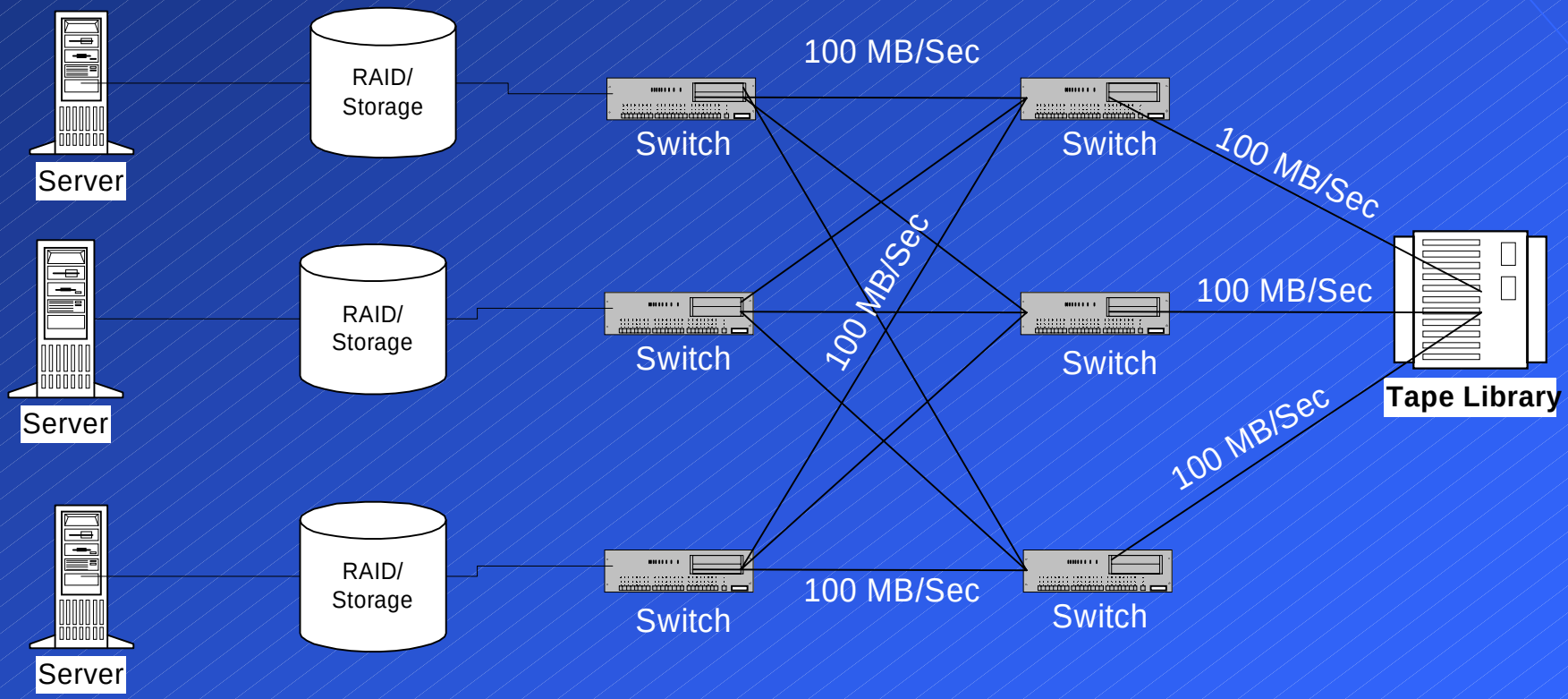
Second Stage in Evolution:
Fibre Channel - Arbitrated Loop



Third Stage in Evolution: Fibre Channel - Switched Fabric

- More expensive
  - Multiple switches, hubs and routers
  - Can help some with SCSI to FC converters at the end points, but the fabric in the middle is where the costs climb quickly
- Fast speeds
  - Multiple paths allow multiple channels of gigabit speed in system
    - 8 simultaneous 100MB/sec pipes through a 16 port switch
- Redundancy/failover
- Zoning

Third Stage in Evolution:
Fibre Channel - Switched Fabric



Comparison: SCSI vs. Fibre Channel

- SCSI
  - Risk is low
    - Time tested
    - Widely installed
    - Simple to use
    - Inexpensive - mostly just cost of cables
- Limited to maximum distance of 25 meters from server
- Most versions of SCSI slower than FC
  - UltraSCSI III - 160 MB/sec vs. FC - 100MB/sec
  - FC - 200MB/sec, non-aggregated standard

Comparison: SCSI vs. Fibre Channel

- Fibre Channel - Risk is higher, but is dropping
  - No standard…yet: FibreAlliance & SNIA
- Greater distance – up to 10km on a single run
- Heterogeneous systems are still 1-2 years away
- Cost is higher, but dropping
  - Managed hub - $500-700/port, Switches - $625/port
  - Fully redundant switches (failover) - $4,000/port
- Zoning -
  - Security
  - Fail-over capabilities
  - Management / Load balancing

What is the best for you? Determine your need

- First question - how important is availability
  - - i.e. how much is it worth?
- ERP systems with verbose, highly redundant subsystems
  - worth it
    - Easy to justify
    - Link aggregation can help scale up as needs grows
    - Helps handle data transfer bursts (i.e. mirroring/backups)
- Sales Force Data - lead tracking, etc.
  - May only need simple backup depending on data
  - High volume, try multi-hosting
  - Has the largest backup window

What is the best for you?
Server Farms

- Greatest advantage is distance, or lack there of
  - SCSI
    - Distance isn't a problem
    - Simple – SCSI is an accepted standard
    - Inexpensive – just the cost of cables
    - Multiple servers can be connected to one tape library
    - Configure a server with more than one SCSI adapter
    - Multi-hosting - Multiple channels from one source
  - Fibre Channel
    - More expensive, but could be first step to implementing a SAN
    - Faster speeds - not that important if use multiple SCSI connects

What is the best for you?
Campus or MAN

- FC or SCSI
  - Distance is solved with FC connects or SCSI routers
    - Simplifies management
- Arbitrated Loop (AL)
  - May work if only have a few servers - dedicated loops
- Switched Fabric (SF)
  - If you have great value to the data on a 24/7 basis
  - Expensive, but reliable, flexible and dependable

What is the best for you? Enterprise

- Combination based on distance and needed availability
- Can look to multiple “sites” within the organization
  - One main location, but each building it’s own SAN with aggregated links to main data center
  - Will have to use the same vendor for everything to ensure interoperability … for now
- Depending on amount of data to move, a combination of SCSI, FC-AL and FC-Switched may be the best
  - Beware the upgrade path

What is the best for you?
3rd Party Copy

- Designed to provide low server utilization for backups
- How does it work?
  - Need equipment that supports 3rd Party Copy
  - Build block list
  - Transfer info
  - Who controls?
  - Problem with Database backups

What is the best for you?
Network Attached Storage

- NAS devices - how do they work
- What is NDMP
  - Network Data Management Protocol
- Can they work in a SAN?
  - How?

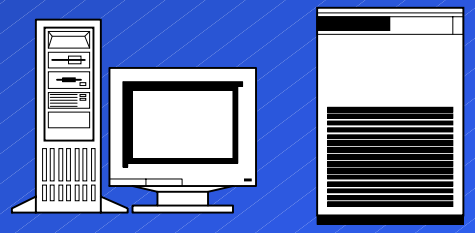
What to do?
How Do I Start?

- Check with vendors and who they have certified with
- If need be, visit their lab and see a demonstration of their system
- References – who's using what, where and how
- Know what your requirements are now AND in the future
  - Evolve your SAN as your enterprise does
- Test in your environment - one piece/segment at a time
- Feedback is the key
  - What do you learn, what's working or not
  - Roll back into the system and continue to fine tune

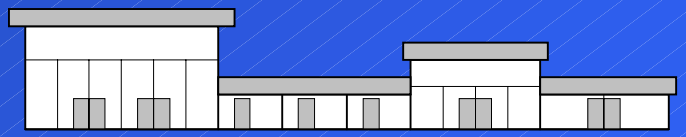
Step 1a:
Document Backup Requirements

Think Enterprise-wide

- Total data by machine
- Total data by location



18GB 100GB



500 GB

10GB

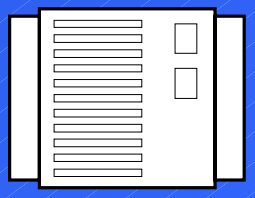
Create a spreadsheet!

Node	Partition	Tape#	base on	When	total data	Best case time	day of week	time	how long?
A	**C,D,E**	**1**	Saturday	3AM	Base 75Gig	13 hours	*Differential*	8PM	1 hour
A	**G,H,I**	**2**	Saturday	3:15AM	Base 75Gig	13 hours	*M - TH*	8:15	
A	**J**	**1**	Friday	7PM	Base 50 Gig	10 hours		8PM	
A	**K**	**2**	Friday	7:15PM	Base 50 Gig	10 hours		8:15	
B	**D,E,F**	**3**	Saturday	4AM	Base 75Gig	13 hours	*Differential*	8PM	1 hour
B	**G,H,I**	**4**	Sarurday	4:15AM	Base 75Gig	13 hours	*M-TH*	8:15	
B	**J**	**3**	Friday	8PM	Base 50 Gig	10 hours		8PM	
B	**K**	**4**	Friday	8:15PM	Base 50 Gig	10 hours		8:15	
C		**1,2,3,4**	Base on	7PM	***BASE 200Gig***	14 hours	*Differential*	8PM	1 hour
ATL 4/52			Friday				*M-TH*		
D			Base on	7PM	BASE 100 Gig	4 hours	Differential	8PM	1 hour
ATL 4/52			Saturday				M-F		
E			Base on	2AM	BASE 100 Gig	4 hours	Differential	8PM	1 hour
ATL 4/52			Sunday				M-F		
F			Base on	8AM	BASE 25 Gig	4 hours	Differential	8PM	1 hour
G			Sunday		BASE 75 Gig		M-F		
ATL 4/52									
H			Base on	2PM	BASE 85Gig	5 hours	Differential	8PM	1 hour
I			Sunday		BASE 25 Gig		M-F		
J					BASE 10 Gig				
ATL 4/52									
K			Base on	8PM	BASE 25 Gig	1 Hour	Catalog Backup		
			Sunday				Every Day		

Sample spreadsheet

Step 1b:
Document Backup Requirements

- What are your database requirements?
  - Backup window (if any)?
  - If you are 24/7
    - API's - Hot Backups
    - Mirroring
- How much data changes daily? By percentage of the machine?
- Data retention requirements? Any legal issues?



Step 2:
Identify Priorities

- Use all the information you have gathered
- Specify minimum requirements/ features - (a la zero base budgeting)
- Do you need a SAN? What type?
  - Multi-hosting
  - Arbitrated Loop
  - Switched Fabric

Step 3:
Choose Backup Software

- Evaluate (features)
- Test
- Implement

Step 4a: Implement hardware/software

- Identify Equipment/Needs
  - Main server (catalog)
    - Location
    - CPU, Memory, hard disk
    - Other applications to run on server?
  - Device servers
  - Client nodes

Step 4b: Implement software/hardware

- Implement strategy within backup window
- Local Backups are fastest
- Determine and test schedules
- Minimize network traffic

Step 5:
Implement Backup strategy

- Work with System Administrator to determine authorizations
- Define appropriate retention schemes. Double check.
- Refine backup schedules.

Step 6:
Put it into Production

- Monitor effectiveness of the Backups
- Survey users regarding restores
- Monitor growth - compare with predictions

Summary:

- Evaluate your environment
  - Use a spreadsheet
- Determine needs
  - Will a SAN help? Which type(s)?
  - Now AND/OR in future?
- Implement/Evaluate in your enterprise
- Review and Refine

Questions?