Using Tape Drives & Libraries for Data Backup and Storage

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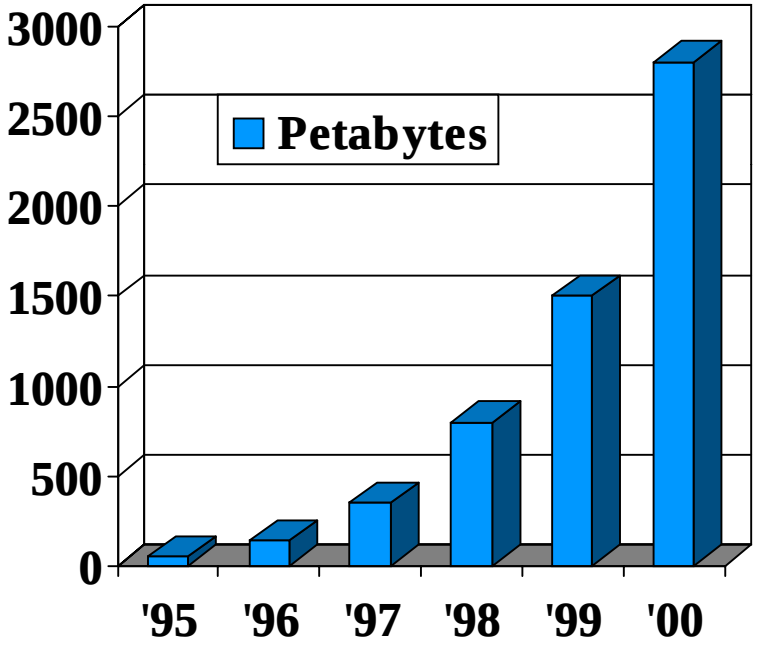
Why Backup?

- Explosion of mission critical data on PCs & servers
  - Data growing 60% to 100% per year
  - Disk capacity doubling every 18 months
  - Powerful database engines: Oracle, Informix, Sybase
  - Internet/Intranet
  - Trends toward 100% up-time
- Minimizes risk and cost of lost data
  - It costs $20k to $100k to recover just 20 MB of disk data

Disk Storage Shipped



Source: International Data Corp.

Backup Can Save Your Business

- 50% of companies suffering major data loss go out of business in 5 years or less
- Average hourly cost of system downtime:
  - Brokerage/Finance Operations = $6,450,000/hr
  - Credit Card Sales Authorization = $2,600,000/hr
  - Pay Per View Media = $150,000/hr
  - Home Shopping Retail = $113,000/hr
  - Catalog Retail Sales = $90,000/hr
  - Airline Reservation = $89,000/hr
  - Tele-Ticket Sales = $69,000/hr
  - Package/Shipping = $28,000/hr
  - ATM Fees = $14,500/hr

Source: Disaster Impact Research Report/Contingency Planning Research

Determine Your Site Requirements

- Local Backup
  - One desktop PC or workstation
- Network Backup
  - Several PCs connected to a backup server(s) and tape device(s)
- Archiving
  - Focus on long term storage and frequent retrieval
- HSM
  - Hierarchical Storage Management

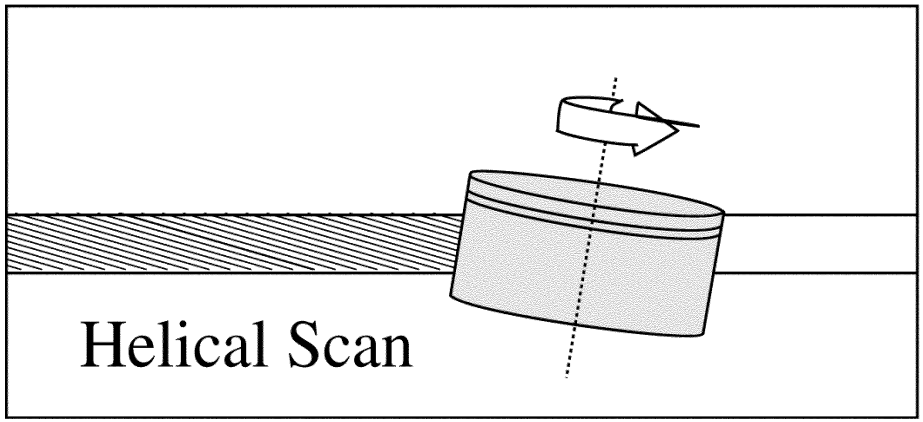
Determine Your Site Requirements

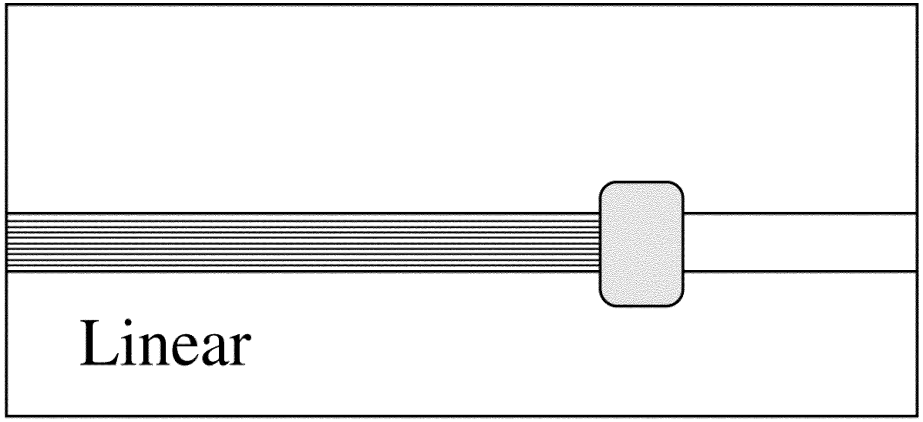
- **Full Backup** ➪ Back up all files on disk
  - Usually once a week
- **Incremental Backup** ➪ Back up only files changed since last backup
  - Usually each night
- **Backup/Restore Window** ➪ Amount of time available for backup or restore
- **Hot Backup** ➪ Performed while system or network is being used
  - Usually used in 7x24 environments

Which Drive Technology to Use?

- Helical Scan
  - » Exabyte 8mm, HP/Seagate/Sony 4mm DDS, Sony AIT, Ecrix VXA
- Linear
  - » Quantum DLT, QIC, Travan, IBM Magstar MP, DC6000, Tandberg MLR, IBM 3490/3590
- Exotic High-end
  - » STK Redwood, Ampex DST, Sony DTF

Fundamental Difference Between Helical Scan and Linear Recording





Pros:

Compact, lower cost, fast file access, broad range of capacity/transfer rate, high reliability in some (AIT), many 4mm manufacturers, libraries available,

Cons:

New formats with one manufacturer (AIT/Mammoth),

Pros:

Broad range of capacity/transfer rate, high reliability in some (DLT), many QIC/Travan manufacturers, many libraries available, some low cost (QIC/Travan)

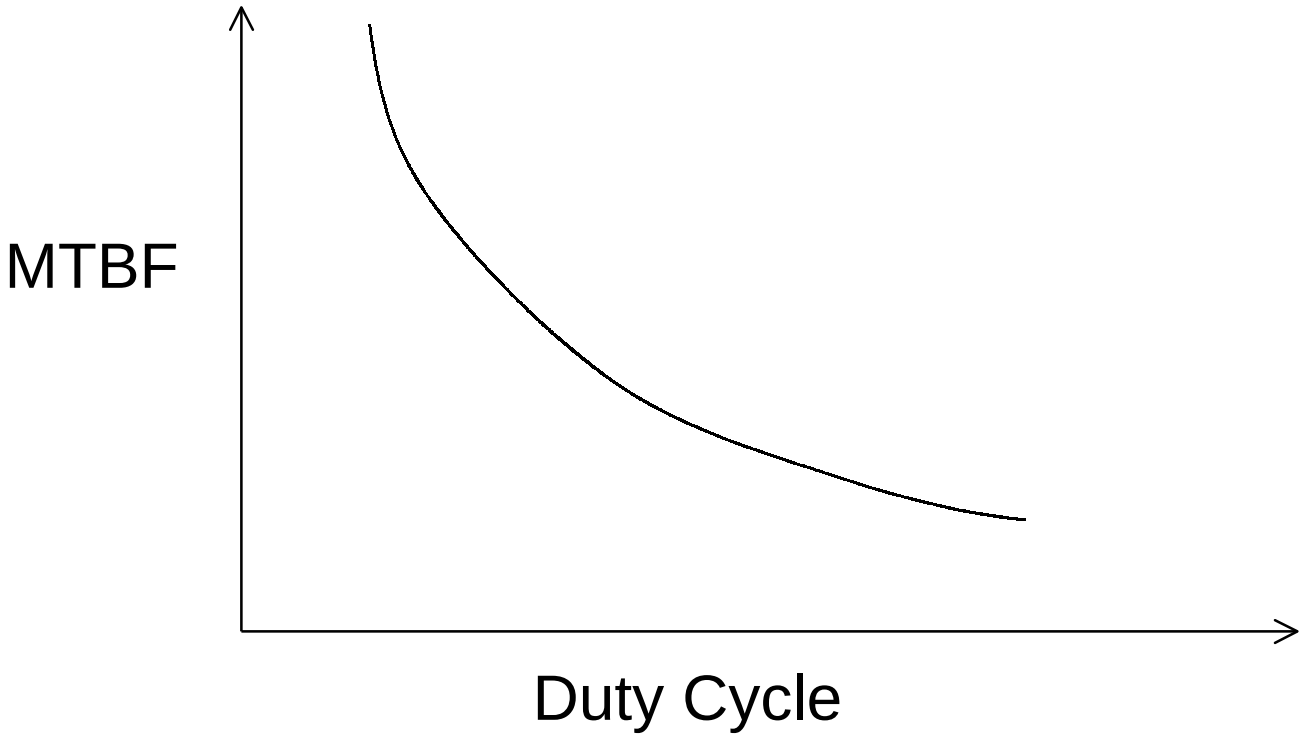
Cons:

Physically large (DLT), slow file access time, high cost (DLT), one manufacturer (DLT)

See *Tape Technology Comparison White Paper*

Estimating Reliability

- High Duty Cycle Application = Higher Failure Rate



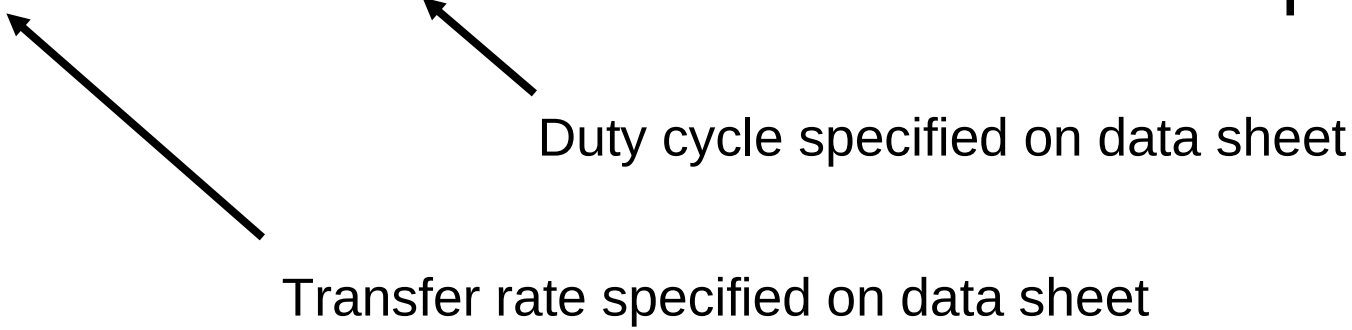
Maximizing Reliability

- Clean Your Tape Drive!
  - Debris/Dirt from air
  - Debris/Dirt from tape surface
  - MP tape worse than AME tape

Backup Ratings of Tape Drives

- Transfer Rate X Duty Cycle = Daily Backup Rating
  - White paper “Rating Tape Drive Technologies”
- Example DDS-3:

4.3GB/hr X 20% X 24hrs = 20.6 GB per day



Estimating Reliability

- Calculate Theoretical Annual Failure Rate from MTBF:

8,760 ÷ MTBF = Theo. Annual Failure Rate

(8,760 = # hours in 1 year)

Backup Ratings with Theoretical Annual Failure Rates

Product	Native Cartridge Capacity	Native Transfer Rate	Duty Cycle Spec.	Daily Backup Rate	MTBF Specification	Calculated Annual Failure Rate
DDS-3	12 GB	4.3 GB/hr	20%	21 GB/day	200,000 hrs	4.4 %
Exabyte Mammoth	20 GB	10.8 GB/hr	10%	26 GB/day	250,000 hrs	3.5 %
Quantum DLT-4000	20 GB	5.4 GB/hr	100%	130 GB/day	80,000 hrs	11.0 %
Sony AIT-1	35 GB	10.8 GB/hr	60%	155 GB/day	250,000 hrs	3.5 %
Sony AIT-2	50 GB	21.6 GB/hr	60%	311 GB/day	250,000 hrs	3.5 %
Quantum DLT-7000	35 GB	18 GB/hr	100%	432 GB/day	300,000 hrs	2.9 %

Real-World Backup Ratings and Annual Failure Rates

- Compare Reliability *specifications* (MTBF) to *actual* Field Reliability
- Assume 45% duty cycle

Product	Native Cartridge Capacity	Native Transfer Rate	Daily Backup Rating @ 45% Duty Cycle	Actual Annual Failure Rate
DDS-2	4 GB	.778 MB/s	30.2 GB/day	11.0%*
DDS-3	12 GB	1.2 MB/s	46.7 GB/day	N/A
Tandberg MLR-1	13 GB	1.5 MB/s	58.3 GB/day	1.5%***
DLT-4000	20 GB	1.5 MB/s	58.3 GB/day	4.5%****
IBM Magstar MP	5 GB	2.2 MB/s	85.5 GB/day	N/A
Exabyte Mammoth	20 GB	3.0 MB/s	116.6 GB/day	3.1%*****
Sony AIT-1	35 GB	3.0 MB/s	116.6 GB/day	2.2%**
DLT-7000	35 GB	5.0 MB/s	194.4 GB/day	4.5%****
Sony AIT-2	50 GB	6.0 MB/s	233.3 GB/day	N/A

About Data Compression

- Data Compression chip in the tape drive
- Actual compression rates vary:
  - Exabyte uses IDRC with 1.8:1 on average*
  - Quantum DLT uses DLZ with 1.8:1 on average*
  - Sony AIT uses ALDC with 2.6:1 on average*
- Base your requirements on un-compressed or *native* capacity & transfer rate

*Based on tests preformed by Spectra Logic Corp.

Choosing the Right Tape Drive

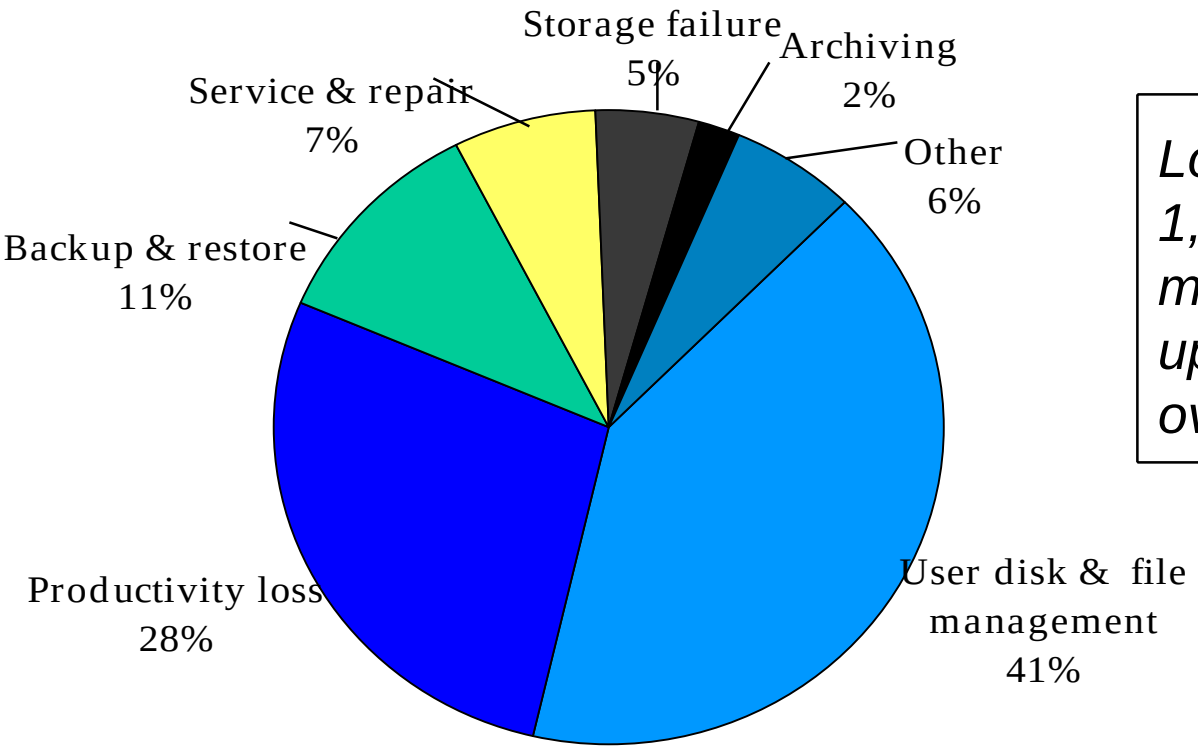
- Req'd Capacity = Full Backup x 3
  - More if data is uncompressible or growing fast
- Req'd Transfer Rate = Backup Window ÷ Full Backup x 3
  - Factor in network speed if not directly attached to backup server

Choosing the Right Tape Drive

- Capacity per Tape
  - Should be at least 3 times your typical backup
- Data Transfer Rate
  - Must fit your backup window (nightly, weekends)
- Reliability & Duty Cycle
  - White paper “Tape Drive Comparisons”
- Ask User References Similar to Your Application

The High Cost of Manual Data Storage

$80,000 per 10GB per year



Lost productivity of 1,000 users manually managing and backing up their own files costs over $1,000,000 per year

Source: Strategic Research Corp.

Why Backing Up With Automated Tape Libraries Makes Sense

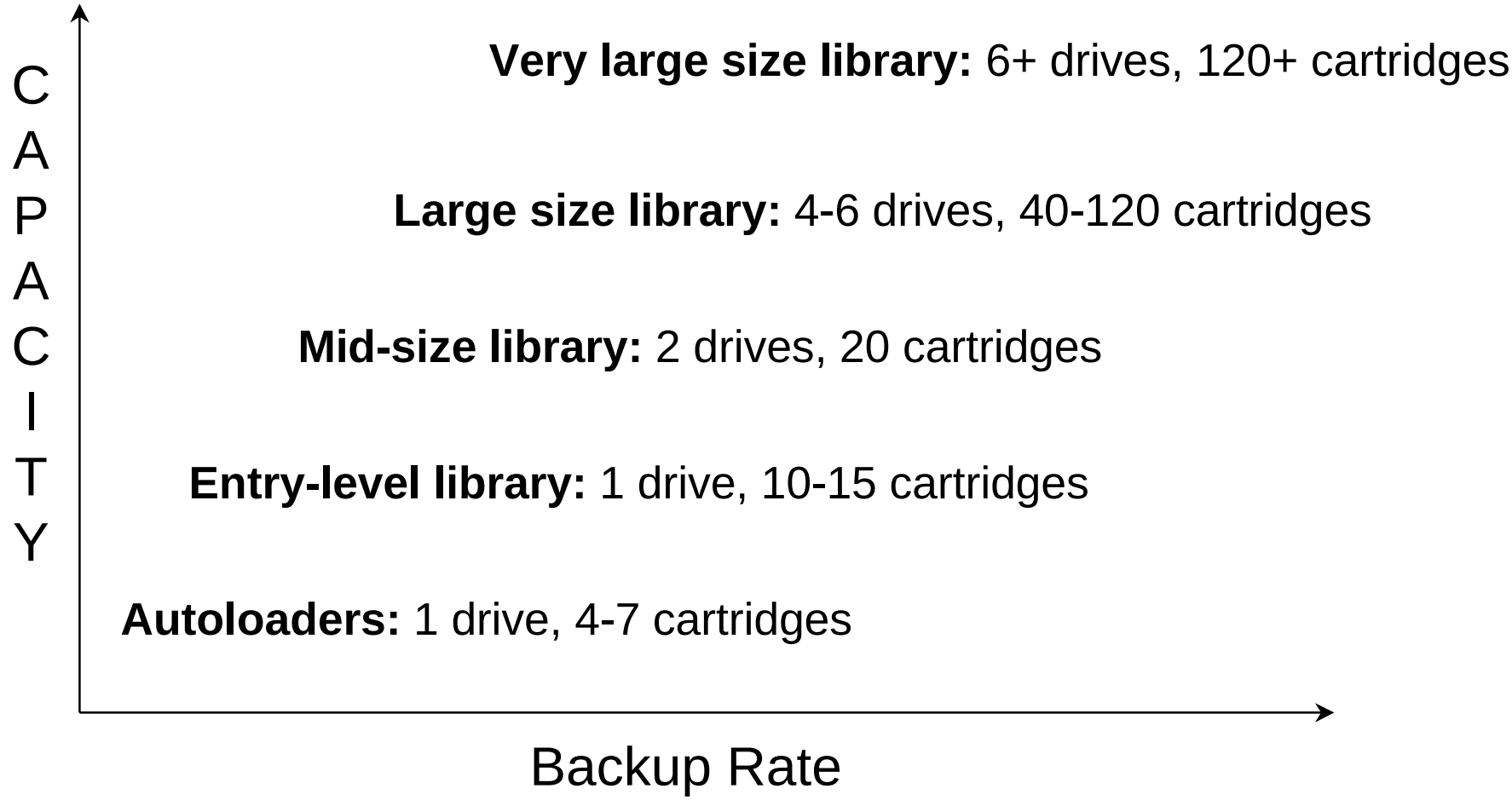
- Reduces disk and file management costs by 50%
  - Storage management of only 10GB costs $80,000 per year
- Minimizes human errors in complex network environments
  - Human error causes 32% of all data loss
- Automates daily and weekly backups
  - Typical network storage requirements are growing at over 60% per year

Source: Strategic Research Corp.

Which Library to Use?

- Tape Libraries
  - Exabyte, ADIC, Breece Hill, ATL, Overland Data, Spectra Logic, Hewlett Packard, IBM, StorageTek, Hitachi, Sony, Digital, Qualstar, LMS

Basic Tape Library Sizes



Choosing The Right Size Library

- Size of full backup = A
- 3 x A = minimum capacity of library
  - More for uncompressible data or rapid data growth
- Capacity divided by GB per cartridge = # cartridges required

Determining # of Tape Drives Needed

- 3 x Size of full backup = A (in Gigabyte)
- Backup window = B (in hours)
- A/B = minimum GB per hour required
- (A/B)/(tape drive transfer rate in GB/hr) = minimum # drives required

Barcode Reader … Yes or No

- Faster library cartridge inventory during power-up or after cartridge removal
- Facilitates off-line media/cartridge management
- Requires barcode labels on each cartridge
- Adds to cost of library ... but worth it

Specify The Type of SCSI Connection

- SCSI-1 = 5 MB/sec
- Fast SCSI = 10 MB/sec
- Fast/Wide SCSI= 20 MB/sec
- Ultra SCSI Wide = 40 MB/sec
- Fibre Channel = 100 MB/sec

Which Software Package to Use?

- Backup Software
  - **More Features/Higher cost** ➪IBM ADSM, Sterling Alexandria, Legato Networker, Veritas BackupExec, Computer Associates ARCserve, HP OmniBack
  - **Fewer Features/Lower Cost** ➪Novastor, Stac, Smarch, Ultraback, Novanet

Choosing The Right Software

- Compatibility with host system, backup software, tape drive *and* tape library
  - Never trust vendor's claim "it will work"
- Multiple device support?
  - Parallel backup of multiple clients or servers
  - Multiple libraries
- Scheduling flexibility per your needs
  - Calendar based very desirable
- Media management capability
  - Barcode handling, off-site archival, disaster recovery

Choosing The Right Software

- Hot backups?
  - CPU overhead use during hot backup
- Optimized for your database application
  - Oracle, Sybase, Informix, SAP
- Archive or HSM options
- Restore speed
- Fail-over capability
  - Run backup or restore by backup server or from client
- Customer support
- Ease of use/installation

Reference *Windows NT Backup* by Jody Leber, Oreilly Press

Summary

- Quantify your needs for size & speed with an eye on the future
- Choose your tape drive technology wisely
- Ditto for backup software

Reap the rewards of automated backup!