

# Choosing the Right Tape Technology

By James Nall

**Tape backup technology is critical to today's dynamic businesses. This article identifies current tape and automation technologies, analyzes their strengths and weaknesses, and describes how they fit into a backup and restore storage solution that meets key business requirements.<sup>1</sup>**

**T**ape technologies, the basis for all automated tape autoloader and library solutions, include two main groups: helical scan technology and linear technology. These two technologies differ primarily in the mechanical relationship between the tape media being written to and the tape head that does the writing.

Figure 1 shows the physical positioning of tape media to the tape head.

## Helical Scan Technology

Helical scan tapes are digital analog tape (DAT) and can be either 4mm or 8mm wide. In physical appearance, helical scan drives are similar to a standard VCR. The tape is wrapped around the head, and the head is inclined or slanted slightly from the vertical (see Figure 2).

Many UNIX users favor helical scan technology, which has several advantages over linear technology:

- It achieves full capacity after only one "pass" from the start of the tape to the end. This is significant because the number of passes can vary up to more than 200.

- It allows the tape media to move much more slowly across the tape head than linear technology, thereby causing less wear on the surface of the tape head.
- It lends itself to multiposition loading, which permits faster retrieval of individual datasets, for example, in a video-on-demand application.

Vendors of 8mm helical scan tape drives include AIT, ECRIX, Mammoth, STK Redwood, and others. Seagate, Hewlett-Packard® (HP®), and SONY® produce the standard 4mm DDS3 and DDS4 DAT tape drives based on helical scan technology.

## Linear Technology

Linear technology has a physical form similar to that of a cassette player with only one reel, as shown in Figure 3. The tape is loaded at the beginning of the tape cassette and passed in a linear fashion across the surface of the tape head without being wrapped around the head. The tape passes multiple times in both directions at a relatively high speed.

The surface of the tape to which data is written never contacts the tape head. As a

---

*Helical scan tapes*

*are digital*

*analog tape (DAT)*

*and can be either*

*4mm or 8mm wide.*

---

<sup>1</sup>See "Choosing the Right Tape Backup Architecture" by Eric Eldridge in *Power Solutions*, Issue 2, 1999.

result, many believe that linear technology produces less wear and tear on the tape heads and tape media than helical scan technology.

Three types of linear tape products include: digital linear tape (DLT), linear tape-open (LTO) technology, and single (channel) linear recording (SLR). Their main difference is the format for writing data to tape: Each is different and none are compatible with each other.

A majority of Windows NT customers use the DLT technology currently available only from Quantum, Benchmark, and Tandberg®. During the year 2000, HP, IBM, Seagate, and Fujitsu® will challenge Quantum with their LTO standard technology. Benchmark, which offers DLT1 technology based on Quantum DLT technology, is expected to further extend the DLT technology family into the value-priced market. Tandberg produces DLT drives identical to those produced by Quantum, as well as drives that use its own SLR linear technology.

STK offers linear technology with its 9840 tape drive, and IBM with its Magstar™ tape drive. These products have limited applicability to customers who want both high capacity and high performance.

### Criteria for Choosing Tape Backup

The major criteria listed in the sidebar govern tape backup technology choices. Determining which criterion is most important to a business often dictates the choice of technology, and sometimes the vendor.

#### Speed

Because speed costs money, speed and price often vary inversely. Prices for tape drives can range from \$300 to

---

*Three types of linear tape products include digital linear tape (DLT), linear tape-open (LTO) technology, and single (channel) linear recording (SLR).*

---

more than \$100,000 per drive, partially depending on speed. The amount of data for backup and the amount of time available for backups determine the required level of performance.

A DDS3 drive can back up 18 GB in five hours. To back up the same amount of data in one hour, a faster drive, such as the DLT7000, is necessary. If an organization uses “hot” database backup, mirroring, or replication, and never takes the data off-line, the backup window can be essentially infinite, and a less expensive drive may be appropriate.

#### Capacity

Capacity, which is a measure of the maximum amount of data that can be written to a single tape data cartridge, also tends to vary inversely with price. Capacity affects not only the price of the drive, but also the cost of the tape cartridge.

Tape costs vary from \$20 per 12 GB DAT cartridge (\$1.67 per GB) to an anticipated \$100 or more per 100 GB SDLT cartridge (\$1.00 per GB). Industry analysts say that some purchasers annually spend 10 times the purchase price of the drive for data cartridges. Thus, the cost of the cartridge may determine the choice of tape drive technology.

#### Price

Price, speed, and capacity are not always tightly correlated. Redwood drives are fast, at 20 Mbps, and expensive, but their capacity—at 50 GB—is equal to that of much more modestly priced drives. The 9840, at 14 Mbps and 20 GB, is fast but medium sized and moderately priced. SDLT and LTO promise to deliver 10 Mbps to 15 Mbps and 100 GB for a

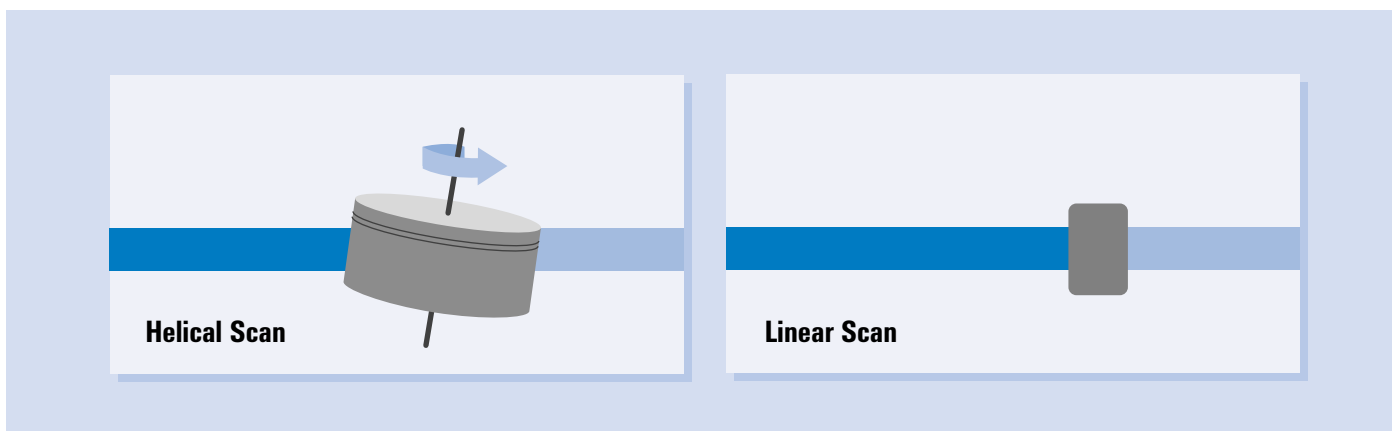


Figure 1. Helical Scan vs. Linear Technology

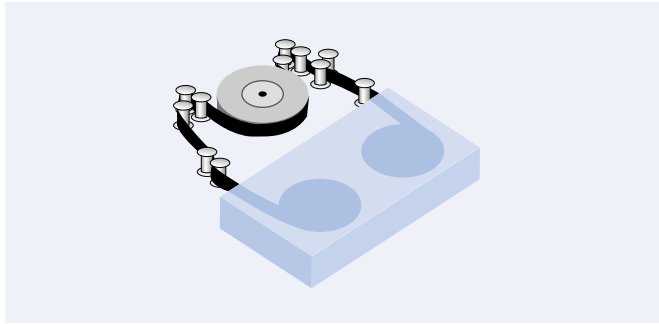


Figure 2. Physical Setup for a Helical Scan Drive

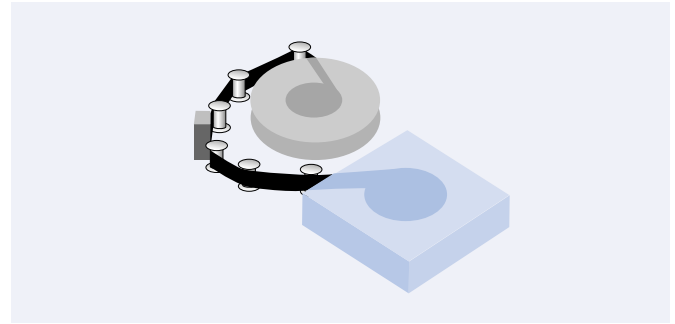


Figure 3. Physical Setup for a Linear Drive

medium price. Benchmark, at 3 Mbps and 40 GB, delivers high capacity and respectable speed at a very low price.

### Durability

Drive durability, in terms of expected *tape motion hours*, is the fourth factor. DAT drives typically offer about one half as many tape motion hours as the more expensive DLT drives. To measure durability, divide price by the product of tape motion hours times speed in gigabytes per hour to find the cost per gigabyte.

Figure 4 provides sample calculations for two drive types. Although the DDS3 drive may initially seem to be the better bargain because of its substantially lower price, the DLT7000 is only one-third as expensive on a cost-per-gigabyte basis.

---

*The amount of data and the amount of time available for backups determine the required level of performance.*

---

### Topology or Connectivity

The connection between the tape drive and the data source should also be considered. Just as all components of a stereo should ideally have a power output that can drive the speakers, the performance of a tape drive should match the data throughput rate for the LAN or SAN.

The typical maximum backup performance of a 100Tx Ethernet LAN is about 20 GB per hour. That rate closely

matches the performance of a single DLT7000 drive. Using an LTO or SDLT drive with a performance of about 36 GB to 54 GB per hour on that LAN limits the drive performance to the maximum for the LAN. The typical maximum backup performance of a SAN (FC1) has been measured at up to 400 GB per hour. Therefore, a SAN can comfortably handle up to 16 DLT7000 backup drives.

### Automation

Automation can also affect the choice of drive technology. Two types of automated backup devices exist: an autoloader and a library. Both the autoloader and the library have a robotic device that can exchange full cartridges for empty ones automatically. Both also have storage slots for cartridges. The autoloader has a single tape drive, but a library can have four to 20 drives.

The choice of tape technology affects the performance and capacity of automated backup devices. For example, an autoloader with one DLT4000 tape drive and seven slots is limited to 4.3 GB per hour and 140 GB of storage. An autoloader of equivalent physical size used with a Mammoth-2 tape drive could hold 10 cartridges, because the Mammoth-2 data cartridge is about two-thirds as large as the DLT Type IV

SAMPLE DRIVE DURABILITY CALCULATIONS		
Drive Type	Price (dollars)	Cost per Hour (dollars per gigabyte)
DDS3	599	0.023 [\$599 / (6,000 tape motion hours × 4.3 GB/hour)]
DLT7000	4,500	0.008 [\$4,500 / (30,000 tape motion hours × 18 GB/hour)]

Figure 4. Sample Drive Durability Calculations

### CRITERIA FOR TAPE BACKUP CHOICES

- Speed\* in backup and restore
- Capacity\*
  - “native” and “compressed”
- Price
- Durability
- Topology or connectivity
  - SCSI/direct attach
  - local area network (LAN)
  - storage area network (SAN)
- Automation
  - Availability of autoloaders or libraries

\*All performance and capacity estimates in this article are “native” rather than “compressed.”

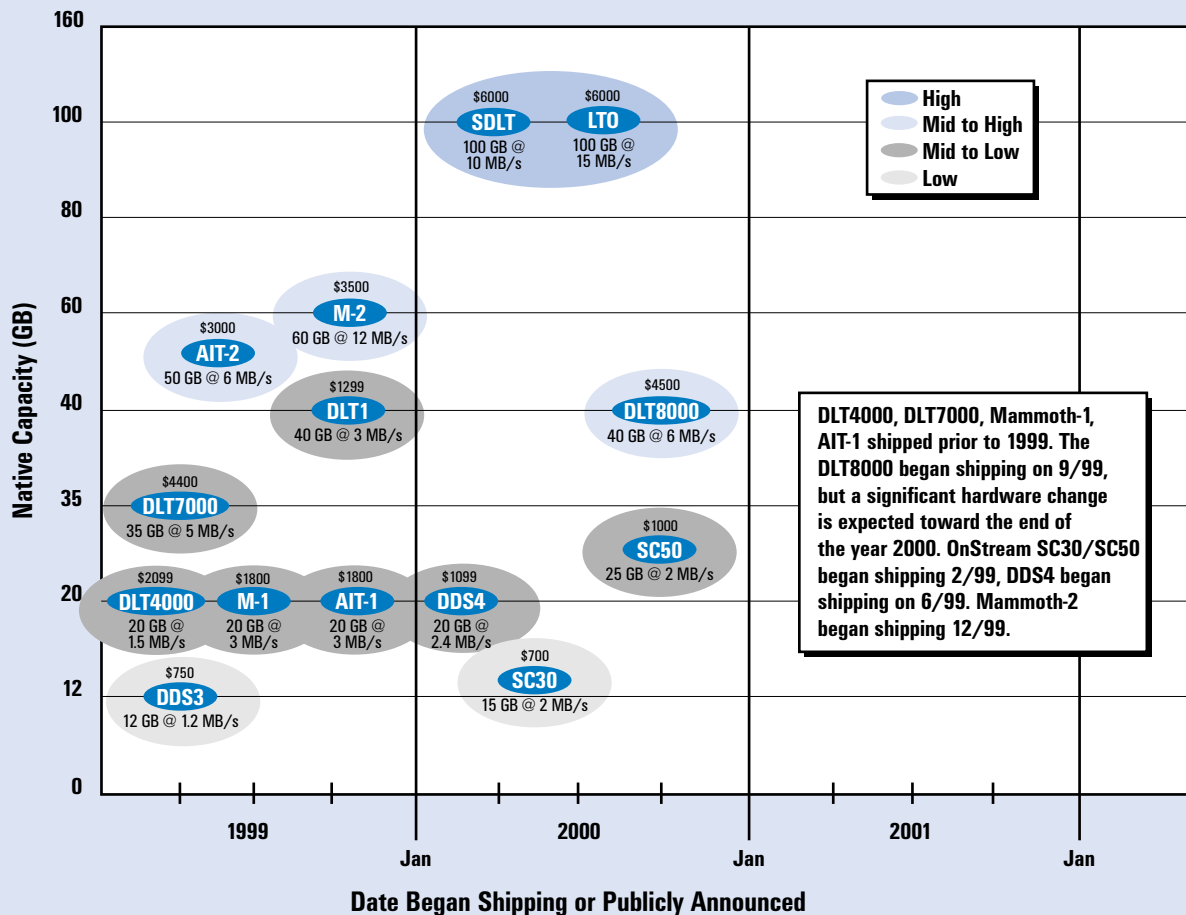


Figure 5. Commercially Available Tape Backup Drives: Performance and Capacity

cartridge. In this configuration, the autoloader could back up data at 43.2 GB per hour with a capacity of 600 GB. The same autoloader used with the SDLT tape drive might perform at up to 54 GB per hour with a capacity of 700 GB.

A library, which can hold multiple drives, can provide much higher performance and capacity than an autoloader. The choice of tape technology, therefore, has an even greater effect on library performance. One 16-drive library or four 4-drive libraries offer an excellent match to a SAN in performance and capacity.

Major vendors of libraries and autoloaders include ADIC™, ATL, Breece Hill, HP, IBM, ODI, Spectra Logic™, StorageTek®, and others. The choice of vendors depends on the ability of its autoloader or library to provide the desired tape technology at the required size and performance levels.

*The performance of a tape drive should match the data throughput rate for the LAN or SAN.*

### Comparison of Today's Tape Technologies

Figure 5 shows all commercially available or announced tape drives with the price, capacity, and performance of each drive. The chart shows approximate prices for drives not available today. To determine the cost of each drive in dollars per gigabyte per hour, multiply the performance estimates in megabits per second shown in the chart by 3.6 to determine gigabytes per hour. ♦

*James Nall (james\_nall@dell.com) is the product marketing manager for tape storage hardware at Dell Computer Corporation. He has worked in the computer storage industry for over 30 years in roles ranging from systems engineer to salesman to product manager. For the past five years Jim has focused on SCSI, LAN, and SAN tape storage solutions for Windows NT and NetWare.*