SOLUTION BRIEF
TAPE VERSUS DISK
FOR DATA STORAGE

Some IT organizations continue to use tape for data storage because of its perceived low cost-per-byte. Yet, when real-world reliability, performance, management and expense are factored, disk storage emerges as the hands-down winner.
THE EVOLUTION OF STORAGE

The oldest known form of data storage dates back to 1725 when Basile Bouchon used a perforated paper loop to store patterns for machines that weaved cloth. In September of 1884, Herman Hollerith filed a patent for the Hollerith card, which was widely used in the 19th century to control textile looms and in the late 19th and early 20th century to operate fairground organs. These cards were ultimately used until the mid 1970s for input, processing and storing data (25 bits per inch). Subsequent data storage technologies included Selectron tubes, magnetic drums and floppy disks. Today, storage devices commonly store 100 billion bits of data per square inch and emerging devices will hold 1 trillion bits of data per square inch.

New technologies will continue to come out as storage demands outgrow the capabilities of aging media to store, rapidly access and adequately protect data. Transition to new technologies may lag until retention periods for valuable data on legacy media expire, but eventually the old gives way to new.

And so it is with magnetic tape.

With multiple billions of dollars in revenues, tape was once the standard backup media. The advent of automated libraries and compression provided additional savings of as much as 2 to 1. But tape has seen a steady decline in recent years in the face of new, more capable technologies.

Many factors have driven the move away from tape. Chief among these is the advent of inexpensive SATA disks, which have seen continual improvements in reliability, capacity and energy conservation. Backing up to disk becomes far more cost effective when augmented with block-level deduplication, which reduced the amount of required storage by 20 to 1. While some tape proponents hold to the belief that the price-per-bit-stored favors tape, a close look at real-world organizations using tape reveals that disk storage delivers the greater advantage in total cost of ownership, the performance of disk over tape notwithstanding.
SOLUTION BRIEF

TAPE VERSUS DISK ARCHITECTURE

When comparing tape to disk backup, IT organizations that continue to use tape typically do so because they perceive tape to cost less. Indeed, tape is slightly cheaper on a narrowly-considered cost-per-byte basis. While tape proponents acknowledge that disk offers better performance, they rationalize their choice of tape with arguments like, “tape is still fast enough to meet their window,” or, “their organization can handle extended periods of downtime while waiting on a restore.”

Yet, when one considers the way organizations actually use tape—with typical requirements for constant media upgrades, new transports, complex management, remastering and replication of copies—the total cost of ownership for tape becomes considerably higher than for disk. And the risk to business is even higher.

Some IT professionals implement tiered solutions that use both tape and disk, known as Disk-to-Disk-to-Tape (D2D2T). Using this approach, IT professionals write directly to a disk array to backup data for 90 days and then pass the data to tape for last ditch recovery and off-site portability. Organizations using this approach leverage the many benefits of online disk storage while maintaining the portability and long-term retention characteristics of tape. Even so, managed archive disk products have major advantages over tape for long-term retention of active data, leaving the only real advantage for tape being portability.

FAIR ANALYSIS - TAPE VS. DISK

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<th>ITEM</th>
<th>DISK</th>
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<td>Compression 2:1 (typically less)</td>
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<tr>
<td>Deduplication</td>
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<td>5 Year Replacement</td>
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<td>Removable and Portable</td>
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<td>Performance Advantage</td>
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<td>Cost Advantage</td>
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<td>Management Complexity Advantage</td>
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<td>Encryption</td>
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<td>WORM (Write Once Read Multiple)</td>
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KEY CONSIDERATIONS
Advantages of disk over tape include greater reliability, better performance and simpler management—all of which contribute to a far lower total cost of ownership. While tape continues to offer better power efficiency (because tapes used for archiving require no power), new disk technologies dramatically reduce power consumption.

Tape vs. Disk - Reliability
Firms that continue to use tape put their operations at considerable risk because tape is highly unreliable.

Considering the high rate of failure, even the most reliable tape represents a significant operational risk for a data center. Organizations must make multiple copies of every tape backup to increase the reliability of their protection architecture. So, while the media may be cheaper for tape than disk in a one-for-one comparison, when calculating the number of copies necessary for tape to achieve acceptable levels of reliability, the overall cost far exceeds that of disk. And the costs of managing tape backups are far greater than disk as well.

Managing tape usually involves a tape rotation scheme called Grandfather, Father, Son (GFS). The number of tape sets used is based on the number of workdays that add data. In a GFS process, Son Backups are done daily. If the backup cycle is based on a five-day workweek, four daily tape sets are needed. On the fifth day, data centers use a weekly tape set. Three weekly tape sets will be needed. In the fourth week, a monthly tape set is used. Since there are 13 four-week cycles in a year, data centers need 13 “monthly” tape sets. Since the daily tapes are used more frequently than the weekly and monthly tapes, they will need to be replaced more often. About 20 copies of the data are made, plus one or more copies of the 20 copies, leaving as many as 60 copies in total to achieve reasonable reliability.

Tape does not incorporate an architecture or system of built-in redundancy. If one tape out of a backup job group fails, the integrity of the entire restore collapses.

In contrast, disk has numerous built-in reliability and protection capabilities, including RAID, which protects data against drive failures. As an example, Nexsan offers RAID capabilities in its enterprise-class storage solution for backup. Additionally, backup software includes features such as direct disk support, and deduplication, which make backup-to-disk the logical choice for simple and flexible backup and recovery.
Enterprise applications like VMware, Exchange and SharePoint demand protection, recoverability and performance. While many organizations continue to use tape for these applications, they rarely use it exclusively because of the inherent risks of tape. Most backups are written to disk first, and more often, disk is used exclusively in these applications.

Tape vs. Disk - Performance

The only cost that really matters to most organizations is the cost of downtime to the business. The fundamental question to ask when comparing tape to disk is; “Does the media I use meet my recovery objectives?” Protection requirements are measured in terms of Recovery Point Objectives (the amount of data at risk) and Recovery Time Objectives (the amount of downtime a business can tolerate). In other words, the restore has to work and it has to work on time. RPO and RTO are both of considerable concern with tape.

Tape is notorious for its slow restore performance. Recovering an individual file, directory, user or application requires a recovery system to read all blocks across all tape cartridges used for the backup. Yet, most of this data is thrown away as unnecessary blocks. This dramatically slows performance. The so-called “backup window” to complete the necessary backup operations is typically overnight for incremental and over a weekend for full backups. As an example, when using an LTO-5 tape drive, it can easily take 7 hours or more to recover 10TB compared to 2.5 hours for a high performance Nexsan disk array. This assumes performance at 80% of a tape’s rated speed—even though 90% of users only experience 50% of rated speed. This window is no longer acceptable for most organizations.

Disk offers several advantages over tape that improve performance of the restore process. Disk always delivers full speed. Using disk for a protection library or backup target, users can share resources among multiple servers, simultaneously, whether on a SAN or through the network by way of iSCSI, without monitoring, switching or other hassles. Backup jobs run simultaneously, avoiding the need to wait to start a backup job until the previous one is complete, and resources are switched. Multiple streams can run at the same time with a disk array. Users can also easily collect or move data offsite on a WAN to geographically protect data. The random access nature of disk means data blocks for a recovery are read directly, dramatically improving recovery performance.

77% organizations who tested their tape backup and found failures.
Tape vs. Disk – Management and Expense

Backup to tape has always been an administrative challenge due to the amount of manual intervention needed to perform backups. A restore of a single user or application can easily require loading and reading 10 to 30 cartridges. Finding the right cartridges and having each one work reliably is a major concern. Additionally, equipment needs to be regularly maintained. Heads must be cleaned. Tapes must be loaded, replaced, labeled and transported.

The expense to implement, maintain and manage this level of protection with tape can be overwhelming, as well as cost and time prohibitive. As an example, an organization backing up 42TB of primary disk would need 420 LTO-4 tapes over the course of a year, assuming 80% usage efficiency for each cartridge. At $30 per cartridge, the cost is $25,612, including five transports to ensure an 8-hour backup window. A tape library would cost much more. Double that price if you want two copies. This assumes 2:1 compression, which most users have not achieved.

In contrast, backup to disk is a completely automated procedure – “just set and forget.” If an organization uses deduplication, it will need 3.12TB as a backup target, to store the same amount of data as the tape stored in the previous example. The cost is roughly $3,121; a savings of $22,491.

Tape vs. Disk - Power Efficiency

Tape has long been considered the most power-efficient media, since a cartridge can be stored without power. However, disk has made huge advances in power efficiency. Spin-down technology like Nexsan AutoMAID® enables highly cost efficient long-term data retention by progressively putting idle disks into deeper sleep modes while offering near instant response. This advanced power-saving technology enables Nexsan disk arrays to provide the performance and management simplicity of disk backup, while reducing power consumption by as much as 85% over other disks.

An easy-to-use power configuration manager enables policies for desired power savings to be set after user-defined periods of idle time. AutoMAID progressively reduces disk drive power consumption according to the idle thresholds.
ASSUREON ARCHIVE STORAGE SYSTEM
A self-managed archive provides ultimate protection and guarantees conformance to regulatory objectives for privacy, record integrity, and data longevity. Reduce complexity, infrastructure and cost to manage with the most efficient and secure disk archive available. Assureon completely eliminates the need to backup the data it protects.

CONCLUSIONS
From the early 1950s until the late 1990s, tape technology was a sensible backup choice, given the amounts of data in use. But the explosion of the digital universe has left tape unable to keep up with demand. Most organizations are no longer able to back up all their data within tape’s backup windows, let alone restore data fast enough to meet business requirements.

Today, a few holdouts continue to use tape because of its seemingly lower cost. However, while the cost-per-byte stored on a single tape cartridge may be less than disk, this figure hardly describes the full cost of back up to tape. Grandfather-Father-Son backup schemes increase copies by 20 to 1. In contrast, deduplication reduces disk requirements by 20 to 1. That alone makes the expense of tape greater than the expensive of disk. The choice becomes even more clear when adding the cost of labor to manage tape, the risk of data loss and downtime, performance limitations and the inconvenience of offline data. Protection, performance, reliability, management and cost all favor disk storage. In addition, AutoMAID power intelligence mean Nexsan disk systems offer considerable energy efficiency.

As the pioneer of disk-to-disk backup, Nexsan was the first to understand and deliver the benefit of low-cost disk for the backup environment. Nexsan has been delivering unparalleled value and leadership to enterprises of every size for over ten years. Whether your organization’s storage requirements are small or large, Nexsan has the disk library for your backup and archive needs.

ABOUT IMATION
Imation is a global data storage and information security company. Imation’s Nexsan portfolio features solid-state optimized unified hybrid storage systems, secure automated archive solutions and high-density enterprise storage arrays. Nexsan solutions deliver high performance for mission-critical IT applications such as virtualization, cloud, databases, and collaboration; and energy efficient, high-density storage for backup and archiving. Additional information about Imation is available at www.imation.com/nexsan.