

GST's Annual State of Tape Report



LTO



AIT



SAIT

Abstract

The importance of safeguarding enterprise records is now foremost in executives' minds. This has placed greater importance on the backup function as well as on how records are stored and the data on them protected from alteration. Central in most data protection strategies since the beginning of the first backup efforts has been magnetic tape technology. Tape will continue to play a key roll in data protection and disaster recovery for many years to come.

This paper presents GST's annual assessment of the tape market, other analyst assessments and summarizes what happened with tape in 2004 and where tape appears to be headed in 2005. The purpose is to provide planning information useful to IT managers planning to help determine how tape fits into their data protection strategy.

A dedicated manufacturer of tape storage solutions, GST, Inc. produced this GST Research Report as part of its commitment to provide information leading to the improved safeguarding of mission-critical applications and data within the IT industry.



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Executive Summary

GST constantly monitors developments in the tape backup and data protection markets. Our discussions are conducted with other tape storage manufacturers, our own distributors and ultimate buyers of data protection products. This provides us a unique view of the tape world today. IT managers don't pull any punches about what they are doing and what they want to do with the backup/recovery function in their organizations. They and their users are seeking a foolproof way to save their critical data frequently so it is safe from destruction and cannot be altered or accessed in an unauthorized manner.

Although the market for tape backup and protection products is not considered high-growth, it is steady and shows no sign of abating. An annual CAGR (combined annual growth rate) that hovers around three percent results in a constant \$3+ billion/year industry that continues to grow and evolve. This steady growth has fueled improvements in capacity, performance, reliability and features for tape products that have kept tape as the preferred backup resource.

The trend for consolidation in IT includes consolidating servers, disk storage and backups. Backup consolidation uses a tape library to backup a separate server for each drive in the library. This development is driving the need for greater capacity and performance in tape backup solutions.

Regarding compliance regulations, WORM (Write Once Read Many) is a technology that is available with some tape backup solutions. It complies with regulations mandating non-erasable and unalterable data storage media. This satisfies requirements codified by HIPPA covering medical records, the Sarbanes-Oxley Act covering corporate governance, and the SEC's Regulation 17a for the securities industry. AIT and SAIT tape technologies both offer WORM support today, and it has been announced for LTO third generation (LTO3) as well.

The major challenge to tape is use of Serial ATA (SATA) hard drives for the initial backup; its faster and much more costly. Backup data on disk is offloaded to a tape device for removal to offsite storage. This technology is called disk-to-disk-to-tape (D2D2T) and provides a means for executing fast backups that demand fewer processor resources. It offers the ability to retrieve data directly from the SATA secondary disk arrays at much faster speeds than tape offers.

Hardware improvements in 2004 were led by the release of newer generations of leading tape technologies. Improvements were delivered in 2004 for Advanced Intelligent Tape (AIT) from Sony, for Linear Tape Open (LTO) from the LTO Consortium but primarily IBM, HP and Certance, and from Super Digital Linear Tape (SDLT) from Quantum. The AIT3 and AIT4 formats, plus LTO3 and SDLT-1, are the leading formats to consider for high reliability, speed and capacity when planning for new tape backup solutions.

Other developments occurred in improved drive reliability, and in new autoloaders and tape libraries, all contributing to improvements in magnetic tape-based backup products in 2004.



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The material that follows provides additional detail on our assessment of the world of tape in 2004. It can be useful to organizations assessing the value of various tape technologies when planning backup infrastructure and acquiring new backup resources.

Background – Importance of Tape

Today, magnetic tape is a storage media used almost exclusively for backing up and archiving important data for protection and possible later use to restore servers or recall past data. It is no longer used much as a medium of data transfer between different platforms or installations as in the past. Magnetic tape media itself has grown in four ways: capacity, speed (performance), reliability and functionality. All of these have been critical growth factors for tape and have extended the useful life of this technology far beyond original predictions, to the point where tape technology continues to be the preferred backup and archiving strategy for the majority of IT organizations.

Recent Experiences

Experiences of US businesses show why the backup function continues to grow in importance. Here is a brief summary of some relevant experience for IT planners.

A survey of 222 IT managers made by one of GST's engineering partners reported the following results:

- Two thirds of managers said their backups take too long.
- Over half worry or know that their current backup schedule leaves data exposed to loss.
- 58 percent could tolerate no more than four hours of downtime.
- One third of managers experience significant revenue loss or other adverse conditions within an hour of application failure.
- Most felt the anticipation of recovery times was a constant worry.
- Growth of Enterprise Resource Planning (ERP) data was straining their backup windows.

Here are some other survey results to consider when preparing your data protection strategy:

1. **Organizations in the 1993 WTC terrorist bombing that were out of business within two years** – 60 percent (Canadian Insurance Company).
2. **U.S. firms that never reopened after a disaster** – 43 percent; 29 percent more closed their doors within three years of a disaster (U.S. National Fire Protection Agency).
3. **Small to medium-sized businesses that suffer a major disaster based on loss of business-critical data every five years** – 20 percent (Richmond House Group, a UK-based insurance provider for business).
4. **Result of 1992 flood in the midtown district of Chicago** – 230 buildings suffered a black-out of more than a week; some 10,000 businesses experienced losses collectively of more than \$1.5 billion (Disaster Recovery Journal, Spring 1998).



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The Gartner Group, a leading IT industry analyst organization, has listed the following findings in connection with disasters and loss of critical data and application software:

- Nearly 75 percent of all U.S. businesses have experienced an interruption.
- 20 percent of all small to medium businesses suffer a disaster every 5 years.
- 43 percent of all U.S. companies never re-open after an unexpected business interruption and 29 percent close within 3 years (same as U.S. National Fire Protection Agency results above).
- 93 per of companies with a significant data loss are out of business within 5 years.

Furthermore, a recent study by the Contingency Planning Group shows that the financial impact of one or more hours of downtime by a main server can be quite costly:

- Nearly half of all companies reported that each hour of downtime costs them at least \$50,000.
- One in four companies reported their cost of downtime ranges from \$250,000 to a \$1 million or more.

In summary, the major forces in the IT industry driving improvements in tape technology today are the following:

- **Capacity** – The volume of data stored on servers is exploding.
- **Speed** – Enterprise-level applications are expanding, making demands on production time, leaving less time to handle backups.
- **Technology** – Newer server technologies are delivering faster/better capabilities.
- **Reliability** – Intolerance to downtime caused by device failure is growing.
- **Compliance** – Need to meet requirement deadlines from regulatory agencies is looming.

Bottom line: failure of a backup operation can threaten the entire organization for days. Organizations that fail to have access to their critical computer files for periods of as short as a week can find themselves out of business within the next several years.

Implications: backup processes have become one of today's major lines of defense against catastrophic operational failure of the enterprise. The development of an effective data protection strategy is now a critical function of the IT organization.

The Economy

The current world economic climate in 2004 is anything but robust. The U.S. economy is a little stronger than the rest of the world, but IT spending has been tight for the past several years. Tight economic times call for more cost-effective IT solutions to meet the dual demands for restricted budgets and greater productivity in an effort to squeeze more workload out of the IT budget.



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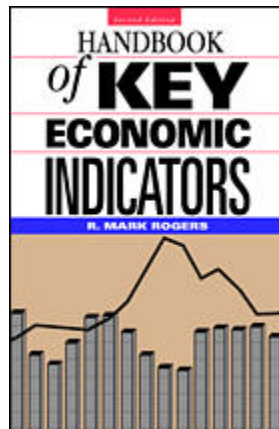
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Timothy Prickett Morgan, in the November 29, 2004 issue of [The Four Hundred](#) reports that industry analyst firm [Forrester Research](#) IT spending in 2005 will be up seven percent over current spending levels and will grow at this same rate through 2008. Prickett also notes that brokerage house Goldman Sachs surveyed 100 CIOs and learned they expect their 2005 spending levels to exceed 2004 levels by 2.5 percent. Goldman Sachs' own predictions are much more optimistic, set at a worldwide growth rate of 3 to 5 percent in 2005.

The December 6th issue of [The Four Hundred](#) reports, "Frank Gens, senior vice president of research at [IDC](#) expects worldwide IT spending to be up around 5 percent in 2004 (a lot still depends on the final few weeks of the year); 2005 spending should be up 6.1 percent, reaching above \$1 trillion and bringing about another \$60 billion or more into the IT economy."

Good news: Both the iSeries and its predecessor the AS/400 bring a highly stable and increasingly powerful computing platform to the commercial arena. Each succeeding model of this successful platform brings cheaper computing power, greater reliability and sophistication. From an economic viewpoint, the elegant design of the operating system enables installations to do without the overburden of communications, database and systems programmers that larger mainframe or UNIX installations must carry on their budgets. Even so, IBM midrange server users need to exercise economy in the formulation of their year 2005 data protection strategy.

Recommendation: review ways to cut costs for backup hardware, media and remote storage of backup media.





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Key Areas for Tape

1. Key Markets Stats

As noted in the Background section above, the data protection function has taken on extreme importance in almost every organization and is seen as essential to the enterprise's survival. This is due to four factors in our opinion:

- **Global Terrorism** – This is a real and ongoing threat to people and organizations today and has spurred new levels of protection within the enterprise.
- **Mission Critical Applications** – These apps are those critical to the functioning of the enterprise that can no longer be performed manually. They are often highly complex, generate increased transaction volumes and balloon the size of storage files.
- **Customer Attitudes** – Customers today demand service now. If one company is not online and available, they simply switch to another vendor/supplier. Once switched, these customers rarely switch back if the new experience has been satisfactory.
- **Compliance** – The need to meet the mandates from government and industry regulatory boards for data protection practices to ensure integrity and privacy of stored information has significant implications on the broader data protection function.

These factors and others have combined to make data protection a multi-billion dollar market around the world. The market for tape devices and media for backup and archiving has been steady over the past several years and shows no sign of abating. Today it is a \$3+ billion/year industry that is growing at a steady 3 percent a year. New backup products contribute to a replacement activity that has brought improvements in capacity, performance, reliability and new features that have kept tape as the preferred backup resource.

The drive for consolidation in IT (see section on consolidation below) is driving the use of tape libraries which drives the need for greater capacity and higher performance to handle backups for multiple servers.

The tape market has seen growth in all four areas of tape backup:

- **Individual drives** – internal and external (stand alone)
- **Autoloaders** – single drive with multi-cartridge magazine
- **Libraries** – multiple drives and large numbers of cartridges
- **Media** – specific to each tape technology
- **Software** – the packages used to automate backup procedures



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Growth in all these areas has been steady, but autoloaders received the most attention in 2004 due to outstanding improvements in their capacity, performance and reliability.

Studies done by industry experts show the tape industry grew from around \$3.2 billion in 2003 to an expected \$3.5 billion in 2006. About 250,000 drives are installed annually.

The market saw tape being replaced by *virtual tape* in the mainframe world where data is spun to secondary disk and then later to tape. This Disk-to-Disk-to-Tape (D2D2T) development is beginning to move into the midrange and smaller server markets and will become a more significant option in 2005 (see Section on D2D2T below).

2. Challenges faced by tape

Backup media are generally compared using the following criteria:

- Capacity (using GB native or compressed)
- Performance (using MB/s or GB/hr)
- Cost (often using cost/GB)
- Reliability (using MTBF and MTTR among many measures)

Magnetic tape storage is always one of several alternatives among backup strategies. Others include optical disk media, magnetic disk-based backup (often referred to as virtual tape) and mirroring to another processor in a safe location. So far, the backup alternative with the greatest portability and cost effectiveness continues to be tape. In a study by Quantum Corporation of the costs of competing forms of backup, all tape technologies studied (AIT-3, DLT, SDLT, LTO) cost less per gigabyte than alternative disk-based storage technologies. The one exception was DVD-RW which can only hold 4.7GB making it impractical for backup in most installations. The average tape drive in their study holds approximately 70GB.

As time progresses, tape will continue to progress on all the key criteria cited above. So will optical disk, DVD and virtual tape. This report will continue to monitor these changes annually.

3. Drive and media developments

Basic tape drive technology is usually discussed first in terms of a particular tape technology used in the design of the tape drive and the tape media associated with it. We have organized this section to cover the most common tape technologies in use for backup today:

- AIT – Advanced Intelligent Tape by Sony Electronics
- LTO – Linear Tape Open produced by the LTO Consortium that includes Certance, Hewlett Packard and IBM Corporation
- SDLT – Super DLTape by Quantum Corporation

Significant improvements occurred with each of these tape technologies in 2004, both in the drive itself and in the media cartridges used with the drive.

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Sony Electronics developed Advanced Intelligent Tape (AIT) technology. AIT forms the basis of Sony's SDX series of tape drives and media. SDX is Sony's series name for the media and hardware associated with the AIT format incorporated in a 3.5-inch form factor unit. AIT was engineered to provide greater storage capacity in a smaller form factor; it is scheduled to double in capacity and performance every two years. The technology debuted in 1996 and has been steadily improving in capacity, performance and reliability since then.

The [AIT Forum](#) is an industry consortium devoted to the further development of AIT solutions. The [AIT Roadmap](#) is shown on the AIT Forum.

This current year (2004) saw AIT tape move from AIT generation 3 (AIT-3) to the next generation (AIT-4) doubling both capacity and speed to a native cartridge capacity of 200GB (520GB compressed using AIT's 2.6:1 compression ratio). AIT-4 speed doubled to 86GB/hour (223.6GB/hour with compression).

Sony appears to be on track to announce and release AIT-5 late in 2005.

In early 2000, Sony and AIT Forum members outlined a migration path for AIT that looks out to AIT-6 in 2010, which targets a native capacity of 800GB, a native data transfer rate of 96MBps (345GB/hour) and a reliability rating of 400,000 MTBF (Mean Time Between Failures).

AIT cartridges incorporate a chip with Sony's Remote-sensing Memory-in-Cassette (R-MIC) media interface system. AIT-4 media with R-MIC enables the drive to access key parameters rapidly, improving media management and enabling WORM technology. All AIT-2, AIT-3 and AIT-4 drives are enabled to support both standard and WORM data cartridges. WORM was first available on tape with AIT technology and Sony continues to lead other tape technologies providers in introducing WORM implementations. WORM tape cartridges provide superior protection for files that cannot legally be erased or altered. For example, the Securities and Exchange Commission requires securities brokers to retain records in an unalterable state for six years. Similar restrictions apply to public documents, other regulated industries and to electronic patient records.

LTO Developments

In 2004, Linear Tape-Open Ultrium (LTO) tape drives moved forward on their technology roadmaps. The year started with all three LTO drive makers (Certance, HP, IBM) producing LTO generation 2 (LTO2) tape drives and LTO2 media, as well as the earlier LTO1 technology. In 4Q 2004, Certance announced their LTO3 drives and media (full height external and half-height internal drives) and LTO3 media. All of this became available before year-end except the WORM LTO3 media that will be available in 1Q 2005. This constitutes the first WORM media available to LTO users.

Certance's LTO3 drive doubled its capacity over LTO2 drives, to 400GB (800GB using compression) per cartridge. With a dual-drive tape backup system, this placed the upper limit for unattended backups at 1.6TB (dual drives with compression). Transfer rates for the Certance LTO3 doubled to 252GB/hour (504GB/hour with compression) ...that's moving half a Gigabyte an hour during backups.

Another interesting development for LTO also came from Certance. They introduced their Advanced Tracking as part of their Smart Verify feature that performs 100 percent data checking after a write. The



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Advanced Tracking capability significantly increases the ability to read and write data under heavy vibration conditions, which hardens the backup gear against hostile environments such as areas where earthquakes are prevalent or near a foundry or other source of intermittent vibration.

LTO-3 drives can write in LTO-2 formatted media and can read data written on LTO-1 and LTO-2 media. LTO Ultrium 3 media including the WORM version is manufactured by TDK, Maxell and Fuji. TDK entered the LTO media market in 2004 and provides Barcode labels at no cost for use in autoloaders and tape libraries.

SDLT Developments

In 2004, Certance, the former Seagate Technology unit, and Quantum Corp. announced plans for the friendly acquisition of Certance by Quantum. Certance is one of three companies with a license to manufacture and sell LTO drives. Quantum is the developer and manufacturer of the venerable DLT tape technology and the newer SuperDLT (SDLT) tape technology. The new larger company will produce DLT, SDLT and LTO tape technologies.

In 2004, SDLT320 users saw the arrival of the SDLT600. Native capacity went from 160GB to 300GB (600GB with compression). Performance jumped from 58GB/hour to 130GB/hour (259GB/hour with compression). This level of improvement definitely put SDLT600 tape technology in the super drive category with AIT3 and LTO-4.

SDLT is based on the DLTtape platform, a popular tape format for many years with PC users. SDLT is specifically designed for the high duty-cycle requirements of high activity and automated environments. SDLT drives are rated at 250,000 hour MTBF (Mean Time Between Failures) at a 100% tape motion, i.e., running constantly. Reliability is enhanced with SDLT because of low-tension tape design, a simple tape path and use of linear serpentine recording tape path.

DLTSage is a feature Quantum builds into their SDLT drives that some tape manufacturers (including GST) use. It offers predictive and preventative maintenance built into the drive/media combination. The DLTSage toolset permits monitoring drive and media statistics to manage tape storage environments, predict future events and prevent problems before they have they can occur.

DLTIce functionality in SDLT 600 tape drives and media provides the use of standard Super DLTtape II media cartridges with SDLT 600 tape drives. Separate WORM media is not needed to achieve WORM data storage on tape where data cannot be overwritten or reformatted, but can be appended.

IT sites using SDLT 320 media will find the newer SDLT 600 technology is backward-read/write compatible with 320 media, as well as forward-read compatible with future SDLT generations. Owners of SDLT 320 units can read and write SDLT 220 media; SDLT 320 is also backward-read compatible with DLT 8000, DLT 7000, DLT 4000 and DLT 1 media.



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4. Multi-Level Backup Strategies (D2D, D2D2T)

Direct backup to tape is being replaced in larger installations with what's being called *virtual tape*, where high-performance racks of Serial-ATA (SATA) disks look like tape to the server. A Disk-to-Disk (D2D) unit writes backup data directly to disk. When the disk appliance also include a unit to offload the data to tape cartridges, it is called a Disk-to-Disk-to-Tape (D2D2T) appliance. The result is backups performed at disk speeds rather than tape speeds. This permits servers to be backed up at server rates with backup data going directly to disk for online storage and access later. With a D2D2T appliance, backup data is then offloaded to tape for safe removal to a remote location. SATA hard drives are not removable and therefore offer no disaster recovery protection without the tape backup combination.

A typical 6- or 10-cartridge magazine generally holds high performance cartridges that hold many TB of backup data on WORM or traditional tape media. The nearline disk capacity is in the terabyte range.

High performance backups and restores are accomplished using Serial-ATA disks that handle data at rates of half a TB an hour or more. Transfer of backup from Serial ATA disks to physical tape media is scheduled at times selected to avoid impacting application performance, making tape speed less important.

Hierarchical Storage Management (HSM) capability is provided using the Serial-ATA disk drives (virtual tape) that that provide multiple Terabytes of nearline storage for frequently-accessed files. Instead of locating the data on backup tapes that have most likely left the premises, data can be retrieved from the target disk array for immediate use. D2D2T brings together the best features of tape automation and disk in a single, easy-to-use, highly functional appliance.

D2D2T appliances made significant progress in 2004. Companies like SpectraLogic and BreeceHill in the hardware arena and FalconStor in the backup software arena established themselves as significant producers of the basic technology that GST and other storage manufacturers leverage in their D2D2T offerings.

In a survey of IT managers taken by the Enterprise Storage Group:

- 58% had already implemented some form of D2D backup.
- 25% planned to purchase D2D backup solutions within the next 24 months.

Clearly, organizations are looking for ways to eliminate the drag on server resources by the backup/restore process; and D2D initially gained a magic bullet aura as a cure-all for the problem of ever-shrinking windows of time for performing backups. However, the popularity of D2D as a backup solution does not eliminate the need for a removable backup media like tape so that backup data can be easily and economically moved to a safe remote location.

Only when D2D is combined with removable tape backup, does it become a comprehensive strategy for protecting against the loss of the enterprise's data under all circumstances, since the backup data that was moved to disk must be move onto removable media for quick removal and remote storage



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D2D2T has two separate parts:

- **D2D** – Backing up data from a server's source disk to the target disk array.
- **D2T** – Backing up the target disk array to a tape device.

This requires two separate software resources:

- **D2D** – The existing backup software can be used with few if any changes.
- **D2T** – D2D2T software offloads data from the target disk array to the tape backup device.

Configuration requirements are quite simple. The target disk array must be in a separate LPAR (logical partition) from the server's source disk being backed up. As an alternative, the target disk array can be in a separate server.

Four unique benefits are inherent in D2D2T technology:

- **Reliability** – While tape continues to make strides in improving its reliability, disk is inherently more reliable, both in the device itself and in the media. Disk drives have a Mean Time Before Failure (MTBF) rating of 600,000 to 1,000,000 hours, while the latest advances in tape are in the 400,000 to 500,000 hour range.
- **Speed** – D2D speeds are far closer to the speed of the server than D2T speeds, resulting in a backup operation from disk-to-disk that takes much less time and can be accommodated in a much smaller backup window.
- **Fast Access** – The backup data on the target disk array is much faster to access than data backed up onto tape.
- **Security** – Data that was initially backed up to the target disk array is migrated using a product like GST's LPAReplication™ to move it to tape on a separate LPAR or server. This D2T work is performed in the background of the server being backed up.

5. Consolidation Trends

The last several years have seen a great amount consolidation in the computer storage marketplace. We have also seen many customers adopting the new LPAR technology. These two factors have contributed to changes in the backup and recovery world, leading many to rethink their backup strategies.

Consolidation of many servers onto one or a few has created a mainframe-like environment where taking down the server(s) for backups is no longer an option. As a result, your mission critical application just became even more mission critical, because you have the entire user community dependent on one or a few servers to deliver all their computer needs. You can address this greater exposure with high availability software and hardware, but that can be expensive and takes a huge time commitment that many are not prepared to undertake.

Use of dual-drive tape backup systems and of tape libraries with at least two drives can be helpful, since the onsite and offsite backup sets are made simultaneously. This permits very rapid removal of the backup set for safekeeping.

Another form of consolidation is Backup Consolidation. This is where a tape backup configuration of two or more drives are used to backup two or more servers simultaneously and in the same procedure. The result is faster overall backups with fewer hardware resources needed.

Server consolidation, disk consolidation and Backup Consolidation are all here to stay. With modern tape management software and faster and more reliable backup hardware, you can continue to run your backups in a totally lights-out environment. Many IT shops are using concurrent saves, save-while-active and have full automation of restricted-state saves every night. The automation of the backup process becomes a necessity when you are planning to consolidate servers and disk storage.

6. Compliance Developments

Most US corporations must show compliance with the Sarbanes-Oxley Act by year-end 2004. The balance of public companies must demonstrate compliance in 2005 by their fiscal year-ends. Companies needing to comply by December 2004 have to have their management testing completed and auditors will be scrambling to complete the testing and certification of their clients in early 2005.

This means that the big hammer that SOX delivers will start to fall in 2005. Companies that have not begun to make preparations for the implementation of SOX regulations concerning the inviolability of critical data, will find themselves in 2005 rushing to find and implement ways to ensure that all data files, including backup data, are secure from unauthorized access and cannot be erased or altered in any way. The main way that un-alterability and non-erasure is implemented with tape media is with Write Once Read Many (WORM) tape technology that prevents any data on the tape from being altered in any way.

Prediction: GST expects to see the adoption rate for WORM tape drives rise significantly in 2005.





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7. Tape Predictions

David Breisacher, Chairman and CEO at GST, Inc., offers the following predictions for the tape market in 2005.

Tape technologies expected to gain market share in 2005:

- AIT
- LTO
- SAIT

Tape technologies that are expected to lose market share in 2005:

- SLR
- VXA
- Magstar 3592

Tape technologies that are expected to exit market in 2005:

- Mammoth
- Magstar 3590

New technologies expected to be implemented with tape backup in 2005 will include the following:

- D2D backup – better and cheaper disk-to-disk backup units.
- D2D2T backup – many improvements in the relatively new disk-to-disk-to-tape appliances.
- Mirrored backups – more ways to backup multiple servers from central backup units.
- WORM technology – implemented on all remaining viable tape technologies.
- Fibre connectivity – coming for all high-performance tape solutions; tie to a SAN.

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About the authors

This GST Research Report was prepared by GST's Research & Engineering Group under the leadership of David Breisacher, CEO/Chairman at GST. David is the founder of several successful companies, including GST and BCC Technologies, a manufacturer of eServer disk, tape and memory storage devices. A visionary for the storage industry since the early 90's, David lends his market insight and predictions for the IBM midrange storage marketplace to the research conducted at GST. His experience in sensing shifts in technology and industry directions has made it possible for him to organize and structure successful companies to rapidly meet the evolving needs of storage users.

About GST, Inc.

GST Inc. engineers, manufactures, markets and sells a full line of innovative storage solutions including tape, disk and memory products. GST's storage products meet today's need for high-performance, fail-safe reliability and cost-effective data storage protection solutions for the IBM eServer family. This family includes i5/iSeries, p5/pSeries and xSeries servers. GST's advanced tape backup solutions focus on improved backup/restore processes and enhanced disaster recovery. Products range from single and dual tape subsystems and autoloaders to midrange tape libraries and modular enterprise-wide libraries. Unique modular design enables field upgrades, scalability, investment protection and lower life-cycle costs. Development is guided by expert advisory boards that closely track market needs and ensure use of latest engineering technology in product design. Complete information about the company, its products and support can be found at: <http://www.gstinc.com>. GST's eCommerce site with server offerings is located at: <http://www.gstinc.com/store/index.aspx?SID=1&>.

GST maintains corporate offices in the Spectrum Centre Business Park, one of Southern California's premier business centers with excellent access to the Santa Ana (I-5) and San Diego (I-405) freeways, Amtrak and John Wayne Airport. Lake Forest is in the heart of Orange County, California, a major high-tech development region in the United States.

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