



# GST Research Report

## AIT Tape Technology

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InternalDR™ Family



EntryDR™ Family



SafeDR™ Family



GrowthDR™ Family



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### **Abstract**

*The preservation of critical data has become one of the most critical functions in any IT installation. The selection of the proper tape technology has a long-ranging effect on the overall effectiveness of backup and restore strategies, as well as the effectiveness of the disaster recovery function. Tape technologies have taken a giant leap forward in capacities, performance and reliability in the past decade. Use of the newer tape technologies can bring tremendous benefits. Advanced Intelligent Tape (AIT) is a tape technology that brings the latest tape developments to servers of all sizes. This report presents AIT and describes how GST provides the benefits of AIT through its own tape product line.*

*A dedicated manufacturer of tape storage solutions, GST, Inc. is providing this GST Research Report as part of its commitment to provide information leading to the better management of data and application protection within the IT industry.*



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# AIT Tape Technology

This GST Research Report summarizes Advanced Intelligent Tape (AIT) technology, and discusses how GST has leveraged the benefits of this newer tape technology to deliver needed solutions to the data storage community. High-capacity, high-performance and high-reliability tape technologies are a new development that is making the backup, restore and DR processes more effective. Such a development deserves attention, for the benefits can be quite significant.

What follows is a discussion of the value of AIT technology and how it has been used by GST in its own tape solution product line.

## General Information about AIT

### **1. What is the background of AIT tape technology?**

With the ever-increasing need for higher capacity, reliability, and performance, Sony recognized the importance of developing a format to meet these requirements rather than making compromises to achieve compatibility with older tape technologies. The requirement to have a format that was scalable into four new product generations was of paramount importance.

Sony developed Advanced Intelligent Tape (AIT) technology and it forms the basis of Sony's new 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. AIT allows for greater storage capacity in a smaller form factor, and 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.

Since its inception, AIT has been a tape technology leader, offering superior capacity, durability, reliability, and scalability for backup, restore, disaster recovery and archiving applications. Current versions of AIT technology are AIT-1, AIT-2 and AIT-3. Here is a quick summary of the capacity and save rates for the three AIT technologies:



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	AIT-1	AIT-2	AIT-3
Capacity			
Native	35 GB	50 GB	100 GB
Compressed (2.6:1)	91 GB	130 GB	260 GB
Sustained Transfer Rate - MB/s			
Native	4 MB/s	6 MB/s	12 MB/s
Compressed (2.6:1)	10 MB/s	16 MB/s	31 MB/s

### 2. Is there an AIT technology organization?

AIT technology benefits from the support and influence of many well-known solution suppliers in the data storage industry. These industry leaders form the infrastructure known as the AIT Forum ([www.aittape.com](http://www.aittape.com)), an industry consortium dedicated to advancing the art of data storage and protection through AIT. Some of the members of the AIT Forum include Compaq (now H-P), Overland Data, Qualstar, Seagate Technology, Veritas Software and Sony Electronics. Many other organizations, including GST, have joined since the founding of the AIT Forum in 1999. The three most critical aspects of AIT, all developed with the participation of AIT Forum members are the physical cartridge characteristics, the Advanced Metal Evaporated (AME) tape formulation, and the cartridge's built-in memory called Memory-In-Chip (MIC) to reduce search times.

### 3. Who uses AIT technology?

AIT has been adopted by tape hardware solution providers, system manufacturers, system integrators and storage solution providers. Sony's AIT tape drives have become a popular offering as a backup medium for NT and Unix platforms, and this fast access, high-density, tape recording technology is incorporated by manufacturers such as GST into their own tape solutions. Over 400,000 AIT drives have been shipped, sold and installed since the inception of AIT technology.

### 4. Where is AIT technology headed?

In early 2000, Sony and the AIT Forum outlined a migration path for AIT that looks out to its sixth generation version in 2008, which is expected to feature a native capacity of 800GB and a native data transfer rate of 96MBps (345GB/hour). AIT's extended roadmap shows a doubling of capacity and data transfer rates every 2 years. This is a testimony to the commitment of AIT Forum members, and to the dedication of Sony's AIT research and development team. The AIT roadmap is located on the AIT Forum site at: <http://www.aittape.com/roadmap.html>



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### **5. Is AIT an industry-standard tape format for data storage?**

Yes. AIT-1 format is a European Computer Manufacturers Association (ECMA) standard format (ECMA-246). Furthermore, ECMA has submitted ECMA-246 to the International Organization for Standardization (ISO) and ISO has registered the format as ISO/IEC DIS 15780.

### **6. What is the tape media quality?**

All AIT tape drives (whether AIT-1, AIT-2 or AIT-3) used a specially-engineered media/tape called Advanced Metal Evaporated (AME) tape. The coating for this tape contains a high percent of magnetic cobalt which allows higher recording densities and reduces the number of passes of the tape accordingly. The lower number of passes to access data cuts down the wear and tear on the tape drive mechanism and read-write heads, as well as the build-up of tape coating debris from the heads. When the drive senses the need for cleaning, a built-in cleaning wheel is automatically activated.

In addition, a Diamond-Like Coating (DLC) on the surface of the tape reduces tape and head wear and results in a head life of 30,000 hours and 20,000 media uses. This is because the tape surface is protected by a smooth carbon coating that is nearly as hard as diamond and 20 times harder than metal oxides. The benefit is increased reliability and higher tape life. The lower wear statistics reduces the need for head cleaning as well as increasing the longevity of the drives to 50,000 hours with a rating of 300,000 hours Mean Time Before Failure (MTBF).

The AIT drive accepts only AME media and rejects all other 8mm cartridges that might fit into the drive.

### **7. What type of data recording methodology does AIT use?**

The Sony AIT drive uses the Helical Scan recording method. This method uses a spinning recording head that records on an angle (bias), allowing more data to be recorded in a fixed period of time than with linear recording drives. In addition to the rotating read and write recording drums, there is an additional servo head that records alignment data to permit precise alignment and avoid the "shoe shining" (repetitive back and forth movement) of linear recording drives.



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The benefit of Helical Scan drives is a significantly higher transfer rate than other data recording methods. This increases performance in terms of data transfer speeds and reduces wear on the drive heads and media because the tape does not have to be moved so fast to gain high speeds.

### 8. For what applications is AIT suited?

The primary use of AIT is high-quality backup and restore operations, as well as the production of tapes needed for disaster recovery. In addition to conventional unattended backup, AIT is also suited to a wide range of applications, such as image/multimedia storage and retrieval, real-time data acquisition, transportable storage, as well as data storage management applications utilizing the Memory-In-Cassette (MIC).

## GST's Utilization of AIT Technology

"AIT not only meets our stringent tape drive design requirements, it gives our subsystems and Midrange Library Family the scalability to larger capacities and speeds they need to handle the relentless growth and demanding disaster recovery response times demanded by most organizations today," reports David Breisacher, CEO and Chairman of GST. GST has leveraged the benefits of AIT in a variety of ways useful to IT installations.

### 9. What was GST looking for in tape technology for its tape product line?

Three design requirements drove the final decision for the high-performance drive GST wanted for their tape product line:

**Accommodate an LCD Module** – The drive and technology must support an intelligent LCD Module that provides the operator with key aspects of the backup/restore operation; must fit along with the tape drive within a standard 5.25 inch internal drive bay.

**Small-footprint Enclosures** – The drive must fill a small-footprint modular enclosure for individual drives or controllers. The modular enclosure for the drive had to be small enough to accommodate GST's LCD Module as well.



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**DDS and SLR Replacement** – Source a tape technology that has the form factor of DDS (4mm drive), the reliability and features of a high performance drive like LTO, and can replace or co-exist with IBM's SLR internal drive.

### 10. Why did GST select Sony's AIT tape technology for its tape product line?

The Sony AIT technology was selected by GST for four key reasons:

**AIT Drives were able to accommodate GST's LCD Module for operators** – AIT drives, with their 3.5-inch form factor, can be incorporated with GST's LCD Module into the 5.25-inch internal tape bay of the iSeries. GST's developers discovered a strong interest in a display that would provide operators critical backup status measures. GST's LCD Module displays: tape presence, readiness, when to clean, movement operations like read - write - load - unload - rewind - position, plus remaining unused media capacity.

**AIT Drives support GST's Design Objective for a Small-Footprint and Modular Enclosures** – GST's single and dual-drive tape subsystems utilize AIT-1, AIT-2 and AIT-3 tape drives for a variety of reasons, including their compact size and scalability. GST was able to design modular enclosures (3.5"h, 9.0"w, 11.25"d) for AIT drives resulting in small units that weigh 3 pounds and are only 3.5 inches tall -- a stack of six modular enclosures is less than two feet high. All this combines to save valuable datacenter space.

**AIT Technology provides an excellent SLR and DDS replacement** – Like DDS, the form factor of AIT is 3.5 inches. Yet AIT performance is more like a high performance drive such as LTO. The compactness, capacity, speed and reliability of AIT technology enables GST's Internal AIT Tape Subsystem to replace or augment IBM's SLR internal drive that comes standard on the iSeries platform. Thus, AIT technology enables GST to replace or augment installed DDS drives (formerly 4mm DAT) on a variety of platforms, as well as SLR (formerly QIC) drives on the iSeries.

### 11. How is scalability handled with AIT?

GST offers AIT tape technologies in its External AIT Tape Subsystem and its Dual AIT Tape Subsystem. All of GST's AIT drives are housed in upgradeable modular enclosures that are stackable. AIT has evolved through three generations (AIT-1,



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AIT-2, AIT-3) and provides a wide range of capacities and speeds (see #1 above) to accommodate expansion of native cartridge capacities of 35, 50 and 100GB and expansion of native performance from 14, 22 and 43 GB/hour.

GST also uses AIT-3 technology in its Midrange AIT Library. This library holds up to four magazines, each with five AIT cartridges plus two fixed slots for a total of 22 AIT-3 cartridges. Capacity ranges up to 2.2TB native (5.7TB compressed). One-drive models of the library can be upgraded to two-drives models, doubling the 43GB/hour transfer rate to 86GB/hour (224GB/hour compressed). The two-drive libraries can be configured with Mirrored Backup or for Virtual Library Partitioning (see below for explanations of each).

### **12. How is investment protection provided with AIT?**

All GST modular drives are field-upgradeable by GST's own technical support organization or by customers themselves. Single AIT modular drives can be upgraded to dual-drive systems and fully incorporate the original drive, adding to investment protection.

All of the Midrange AIT Library upgrades described in #11 above take advantage of the equipment already installed, thus protecting that investment as well.

AIT-3 and AIT-2 are backward read-compatible with earlier generations of AIT cartridges, and forward read –compatible with future generations to protect investment in AIT media.

### **13. How does GST handle the repair of a unit?**

GST uses the concept of Field-Replaceable Unit (FRU) design in developing its tape products. If a modular tape unit needs to be examined or repaired, the entire unit is treated as a FRU and trans-shipped to the customer so the customer has a fully-working unit to rely on while the suspect unit is being shipped to a service location.

Furthermore, many GST library components are packaged in easily-installed FRUs requiring no wiring. Quick-Swap drives, power supplies, controllers and robotics are easily removed/installed simplifying field servicing.



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### 14. What is the function of the LCD Panel?

The multi-functioned LCD Display Panel is mounted alongside the AIT drive in the Single and Dual AIT Subsystems. The LCD Panel continuously displays key drive functions and status of the backup operation. The following key operational status indicators are displayed:

**Presence:** tells whether a tape cartridge is present or absent in the tape drive. This fact is not always visible by simply viewing the drive.

**Ready:** whether the tape drive is ready for operation or not.

**Clean Me:** the need for cleaning functions to be performed on the drive.

**Read:** this status is displayed when a read operation is taking place in the drive.

**Write:** this status is displayed when a write operation is taking place.

**Load:** this status is displayed when a tape cartridge is being loaded into the drive.

**Unload:** this status is displayed when a tape cartridge is being unloaded from the drive.

**Rewind:** this status is displayed when the tape cartridge is being rewound.

**Position:** this status is displayed when the tape cartridge is being positioned prior to reading.

**Remaining MB:** the remaining megabytes of unused capacity on the tape, updated as data is written to the tape. This is displayed in uncompressed bytes. It can be used to determine when the capacity of the tape is close to being used up.

Continuous display of these ten critical operational factors ensures the operator of the storage device has awareness of all key performance and operational measures for the AIT tape unit. This additional information can eliminate errors made by operators based on incomplete information.



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### 15. What is Mirrored Backup?

GST's Dual AIT Tape Subsystem generates identical sets of backup cartridges with no performance penalty on the server, i.e., it takes no additional time to produce the second set of cartridges. One set can be safeguarded remotely for rapid access in the event that a disaster recovery procedure needs to be initiated, thus ensuring the rapid deployment of DR activities. The second identical set of backup cartridges can be retained at the server site to be immediately available for expediting the restore process.

### 16. What other functions are available with GST's Dual AIT Tape Subsystem?

GST's Commander™ Tape Controller enables GST's Dual AIT Tape Subsystem to support Mirrored Backup as described in #15 above. Additional tape functions are also enabled via the GST Commander™ Tape Controller:

**Off-Line Copy:** Permits copying one set of AIT cartridges to another set, producing duplicate sets. No server cycles are used.

**Off-Line Verify:** Same as Off-Line Copy, except the data on the cartridge in one drive is compared and verified to be identical to the data on the cartridge in the second drive.

**Cascade:** Permits switching control from one drive to another drive, once the first drive is full during a backup operation. This doubles the unattended backup capacity.

### 17. What are Virtual Library Partitioning and Backup Consolidation?

With the GST Midrange AIT Library, these two concepts go hand-in-hand. Virtual Library Partitioning is implemented with the two-drive model of the Midrange AIT Library. With the VLP feature, cartridge slots can be assigned to a particular drive so the library is divided into two partitions. Each partition can be assigned to a host server or Logical Partition (LPAR). This achieves Backup Consolidation, where two different hosts or LPARs can be backed up within a single tape library.



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### **18. What are Simplified Weekly Backups?**

Within GST's Midrange AIT Library, a rotating carousel holds four magazines each with up to five AIT-3 cartridges in a magazine. This provides unattended backup of up to 2.2TB native (5.7TB compressed). Such a large unattended backup capacity with up to 22 AIT-3 cartridges, permits fully automating weekly backups for a 7-day or 10-day rotation procedure. This allows a full week or more for unattended backup, for remote server locations where an operator is not available on a daily basis.

### **19. The effect of high-capacity cartridges on backups.**

The high increases in capacity per cartridge to the hundreds of Gigabytes of data per cartridge are quite a contrast to older cartridge capacities of 5 or 10 Gigabytes. These higher cartridges capacities result in backup operations that store the entire backup on one or two cartridges. This can cause some exposure in the restore process since the failure of one cartridge now takes out a much greater portion of the backup data than before. In the past, if one cartridge of a ten cartridge backup set was bad, there was a good chance of restoring the other nine cartridges. If a higher-capacity cartridge fails, much more of the backup data is lost. This has underscored the need for redundancy of backup sets. A second backup set generated with Mirrored Backup ensures that if one tape is bad during the restore or a DR operation, a second set is readily available and delays can be avoided. GST's Dual AIT Drives provide the Mirrored Backup function to ensure that there are always two sets of backup tapes.

### **20. What kind of connectivity exists with GST's AIT products?**

All GST AIT tape solutions can backup a wide variety of servers. They connect natively with LVD (low voltage differential) and HVD (high voltage differential) SCSI connections. For the Fibre Channel (FC) connection, the single and dual drive models connect through our BridgeLink™ family of bridges and SanMatrix™ family of routers. GST's Midrange AIT Library connects directly to FC via a variety of Fibre adapters.



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### Conclusion

AIT technology can be a key weapon in the organization's arsenal to fight off the expanding backup windows that eat into production time, and increase the reliability that is mandatory with larger backup and restore workloads.

Increasing demands for high capacity, faster and more reliable backup strategies are driving IT shops to seek better technologies to fulfill their backup, restore and disaster recovery functions. The combination of AIT tape technology and GST's patented backup solutions like Mirrored Backup, Backup Consolidation, Cascading backups and simplified weekly backups with high-performance tape subsystems and libraries presents a highly attractive way to protect what is fast becoming the organization's most prized asset: its data.

# # #

### About the author

This GST Research Report was prepared 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 server 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.

### Feedback

We value your feedback on this GST Research Report. Please send your comments, suggestions and questions to: [research@gstinc.com](mailto:research@gstinc.com).



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### **About GST, Inc.**

GST Inc. engineers, manufactures, markets and sells a full line of innovative storage backup and restore products to meet today's need for high-performance, fail-safe reliability and cost-effective data storage for a wide variety of servers. GST's advanced tape 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 the latest engineering technology in product design. Complete information about the company, its products and support can be found at: [www.gstinc.com](http://www.gstinc.com).

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