TECHNICAL BRIEF

Tape mirroring on the StorageNet 6000

Tape mirroring software feature on the StorageNet 6000 storage domain manager version 1.3

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TABLE OF CONTENTS

INTRODUCTION

StorageTek® Tape Mirroring software is a new product offering from StorageTek that has been implemented as an add-on software component for the StorageTek® StorageNet® 6000 storage domain manager (SN6000) system, which builds upon the backup consolidation features provided by the StorageTek® SN6000 Virtual Transport Manager (VTM) software package. Tape Mirroring software allows customers to efficiently create multiple copies of tape data and is particularly valuable as part of a disaster recovery solution.

This document discusses the features and benefits of Tape Mirroring software. Except for the brief section titled "Future Enhancements," this document describes features that are currently available.

INITIAL SUPPORTED CONFIGURATIONS

This section summarizes the basic configuration parameters of Tape Mirroring software and will describe the customer environments in which Tape Mirroring software provides value.

First, the basic requirements:

- VERITAS NetBackup application
- Legato NetWorker backup application
- StorageTek® T9840 and/or T9940 tape drives
- Tape libraries located in one or two data centers under control of one StorageTek® ACSLS® Manager server or one Library Station™.

CUSTOMER BENEFITS SUMMARY

Tape Mirroring software offers customers three major benefits:

- It simplifies and automates the tape replication process. Tape Mirroring software allows a customer to easily create a second copy of backup volumes for use (often offsite) as part of a disaster recovery plan.
- It supports a variety of local and remote configurations, combined with manual and online vaulting practices. Tape Mirroring software can be used in customer environments with libraries in either one or two locations, and procedures have been defined to support manual or online vaulting. **Future releases will increase the number and type of remote configurations that can be supported.**
- It improves backup/restore reliability. Traditional backup and restore operations occasionally fail due to drive or cartridge malfunctions. With Tape Mirroring software, a single failure can occur without impact on the backup/restore operation. The chances of two failures occurring during the same backup or restore are very slim.

OPERATIONAL ARCHITECTURES

Customers will get these Tape Mirroring software benefits, depending upon the specific operational architectures in which they choose to install the product:

- **Dual-site, remote vaulting.** During the backup operation, Tape Mirroring software writes one copy of the data to physical volumes in a local library and the other to physical volumes in a remote or offsite library. If a disaster disrupts local operations, the remote copy would be used to restore the data.
- **Single-site, manual vaulting.** Tape Mirroring software writes both copies of the data to physical volumes in local libraries during the backup operation. The customer then physically moves one of the copies to an offsite location. If a disaster disrupts local operations, the remote copy would be taken to a designated facility and used to restore the data.
- **Single-site, no vaulting.** All physical volumes and libraries are located in a single data center and the mirroring operation creates two copies, primarily in order to increase the probability of backup and restore operations completing successfully. Although not typically considered a disaster recovery architecture, this environment provides resiliency against certain local problems that would otherwise disrupt operations.

The following table presents the tradeoffs between these three architectures:

Architecture	Disaster Recovery support?	How is remote copy transported?	Improve backup/restore reliability and efficiency?	Which operations?
Dual site, remote vaulting	Yes	Electronic	Yes	Backup and restore
Single site, manual vaulting	Yes	Physical	Yes	Backup only
Single site, no vaulting	Limited	N/A	Yes	Backup and restore

VALUE PROPOSITION AND CUSTOMER BENEFITS

Tape Mirroring software extends the value of the SN6000/VTM solution by making it easier and more efficient to create multiple copies of tapes. Tape Mirroring software makes backup and restore more reliable and makes data safer and less expensive to protect by:

> Simplifying and automating the tape replication process, saving money and reducing staff resource requirements

> Creating two tape copies simultaneously, eliminating the time, complexity and risk of data loss from tape-to-tape copies

> Enabling restoration from either copy without server intervention

> Reducing the I/O load on backup servers by up to two-thirds (compared with alternative tape replication solutions).

The following table outlines the features, advantages, and benefits of Tape Mirroring:

Feature	Advantage	Benefit
Fully automatic, application-independent tape replication	• No operator intervention required • More reliable process • Available to any/all tape applications	• Data is safer • Frees admin staff for other tasks
Real-time, simultaneous tape copies	• Eliminates extra time needed to create second copy • Reduces I/O load on backup servers • Eliminates tape-to-tape copy operations • Eliminates data risks introduced by tape-to-tape copy operations	• Data is safer • Broader data protection (more data can be protected) • Reduced costs • Better server utilization
Centrally managed	• Can manage tape replication for multiple servers and applications • Reduces administration at each server	• Frees admin staff for other tasks • Reduced costs • DR process adapts to business to business changes • Common procedures for all applications
Transparent to servers (virtual tape volume management)	• Isolates tape replication activity from servers • Greatly simplifies tape replication process • Reduces risk of lost tapes	• Frees admin staff for other tasks • Data is safer • Reduced costs
Fault-tolerant backup and restore	• Improve success rate of restore operations • Restore from either tape • Fewer process restarts	• Data is safer • Lower operating costs

FUNCTIONAL DESCRIPTION

Tape Mirroring software is installed on SN6000 systems with the VTM software product.

This added feature supports the automatic replication of tape volumes.

The following description focuses on product-level functionality associated with Tape Mirroring software. In order to use Tape Mirroring software as part of a backup/disaster recovery DR environment, customers will need to change procedures or develop additional procedures to carry out functions such as manual vaulting. StorageTek has developed best practices information and sample scripts that can be made available to customers. These will be shared with customers as part of the StorageTek Professional Services implementation offerings associated with Tape Mirroring software. StorageTek employees can also download the Operational Best Practices document; this is available through the Sales Community website.

With Tape Mirroring software, we introduce a new concept to the SN6000, **Virtual Volumes**.

Note The term "Virtual Volume" refers specifically to virtual tape volumes and should not be confused with virtual disk volumes.

A Virtual Volume is a volume serial number that is associated with multiple physical volumes. A Virtual Volume is limited to the size of a physical cartridge; applications that span cartridges will use multiple Virtual Volumes. An administrator creates Virtual Volumes using the SN6000 GUI. These Virtual Volumes are used by backup applications when a mirrored tape is required. The Tape Mirroring software on the SN6000 uses an internal database to keep track of the mapping of virtual to physical volumes.

Note that backup and other tape applications cannot tell the difference between a Virtual Volume created on and presented by the SN6000 and a physical volume that they normally use.

After installation on an SN6000 system, Tape Mirroring software is set up in the following manner:

- Using the SN6000 GUI, the administrator creates a Virtual Volume pool, using a range of volume serial numbers that is unique within the complex.
- The administrator then identifies a range of physical volume serial numbers that will be dedicated for use with Virtual Volumes. The administrator must ensure that no backup or other applications will be asking to mount these physical volumes.
- These physical volumes may optionally be assigned to different volume groups within the SN6000. This can be done for any number of administrative purposes, such as to easily manage a dual-site, remote vaulting operation.
- The administrator then uses the SN6000 GUI to associate Virtual Volumes with two physical volumes. The administrator either control the selection or can allow the SN6000 software to automatically select the two physical volumes to create the Virtual Volume. Controlled selection is useful when the administrator needs to ensure that the two physical volumes are located in separate libraries.
- The administrator identifies these Virtual Volumes to backup applications, just as is done today with physical volumes. Often things will be set up so the backup application can choose from (at least) two pools based on the desired class of service—mirrored or nonmirrored.

At this point, the user can create mirrored tapes. This is done automatically and transparently to the backup application. The application simply calls for a mount of a Virtual Volume.

When a backup operation begins and a Virtual Volume has been selected, the following steps are carried out:

> The backup application requests ACSLS to mount the Virtual Volume. The SN6000 ACSLS proxy intercepts this request. The SN6000 will look up the Virtual Volume in its database to identify which physical volumes are to be mounted and will request ACSLS to mount these physical volumes.

> The backup application starts writing to the Virtual Volume. These write operations go through the SN6000, which then initiates writes to both physical volumes at the same time.

> If the backup operation completes successfully, the backup application will issue a dismount request for the Virtual Volume, which the SN6000 will translate into a dismount of both physical volumes. The Virtual Volume will have an "OK" status.

> If an error occurs during a write operation to one of the physical volumes, the SN6000 will stop writing to that volume. Subsequent write operations will continue to the remaining physical volume, and no error will be reported to the backup application. (An error will be reported and logged on the SN6000.) The Virtual Volume will have a "degraded" status within the SN6000, with the "bad" physical volume flagged as defective.

> If an error then occurs during a write operation to the other physical volume in a degraded Virtual Volume, the backup application will be notified that an error occurred on the Virtual Volume. This permits the backup application to re-queue the job and request a different Virtual Volume.

When a restore operation begins with a Virtual Volume, the following steps are carried out:

> The backup application requests ACSLS to mount the Virtual Volume. The SN6000 ACSLS proxy intercepts this request. The SN6000 will look up the Virtual Volume in its database to identify the status of the Virtual Volume and its physical volumes.

> If the Virtual Volume is in "OK" status, Tape Mirroring software will ask ACSLS to mount both physical volumes. If one of the physical volumes can't be mounted (as would be the case if it had been removed from the library and taken offsite), then the other physical volume will be mounted; the status of the Virtual Volume will be changed to "degraded."

> If the Virtual Volume is in "degraded" status, Tape Mirroring software will ask ACSLS to mount the good physical volume.

> The backup application starts reading from the Virtual Volume. These read operations go to the SN6000, which will then initiate a read from one or both of the physical volumes. If both volumes were mounted, data will be read from one volume while the second volume will be forward-spaced for use in the event there is a read error on the first volume.

> If the restore operation completes successfully, the application will request a dismount of the Virtual Volume. The SN6000 will then translate this request into commands to dismount the physical volumes.

> If an error occurs to the physical volume during a read operation, the results depend on the number of physical volumes that were mounted. If only one was mounted, the read operation is a failure and an error is reported to the backup application. If both were mounted, the SN6000 will repeat the failing read operation using the other physical volume, and will continue to use that physical volume for subsequent read operations. The first physical volume (the one with the error) will be flagged as defective and will no longer be used, and the status of the Virtual Volume will be changed to "degraded".

The fact that Tape Mirroring software is built on top of VTM is an important one—all the benefits of VTM continue to apply, whether or not a particular operation is using Virtual Volumes. The drives that are used for Tape Mirroring software can be selected from the same pools that are used for nonmirrored operations. Servers and backup applications using SN6000/VTM solutions today will continue to use the same set of logical drives. Tape Mirroring software simply extends the value of the SN6000 and Virtual Transport Manager for the customer.

SUPPORTED CONFIGURATIONS—DETAILS

The current release of Tape Mirroring software works with a variety of configurations. As additional testing is performed, more configurations will be supported. Many components make up these configurations. The following table summarizes the current combinations; more information (and information on additional components supported or under test) is available through the Sales Community website.

Remember that an SN6000 Tape Mirroring software solution also includes VTM, which supports tape drive sharing and pooling. For VTM operations, configurations may include other applications or physical drives that are not included in the table below.

Component	Options
Server-based applications	• Veritas NetBackup 3.4 and greater, combined with SSO. • Legato Networker 6.1 and greater, combined with AlphaStor. These applications can be running on any of a variety of servers, including Sun Solaris, Windows NT and Windows 2000, HP HP/UX, and IBM AIX servers.
Logical tape drives (presented by SN6000)	Any logical tape drive supported by VTM (T9840, 9490, and DLT7000)
Physical tape drives and media	Any model of T9840 and T9940 drives supported by VTM.
ACSLS servers	Configurations are limited to a single ACSLS server (ACSLS or LibStation). The SN6000 will serve as an ACSLS proxy. Configurations that cluster two ACSLS servers together for high availability are also supported.
Libraries	One or more libraries controlled by the ACSLS server. One or more of these libraries may be in a "remote" location connected to the SN6000. We will be testing with several different long distance connection technologies prior to FRS.

COMPETITION

Tape Mirroring software competition comes from two main sources: backup applications and hardware tape mirroring appliances described below.

BACKUP APPLICATIONS

Customers can use features of backup applications to create copies of the backup volume after the fact (manual replication) or during the backup operation (inline duplication):

> Most backup applications offer support for manual replication. The main drawback of manual replication is that it is a manual step performed after the backup has been performed. This adds extra time and operations before the second copy is available and also increases the wear and tear on drives and cartridges.

> Creating the two copies requires a total of three drives—one to create the backup and two for use during the replication operation.

> Inline duplication is becoming more common with backup applications. The backup application lets the customer create multiple copies as part of the backup operation.

> Manual replication and inline duplication have common drawbacks:

- These solutions address the creation of multiple copies during backup. But these applications all have the concept of a primary copy, and if there's an error on that copy during a restore operation, manual intervention is required to select and define a new primary copy. Tape Mirroring software helps with both backup and restore.
- Both approaches are server-based and require extra server and bandwidth resources. Tape Mirroring software runs on the SN6000 in the network, reducing the load on the server.
- These approaches work with a single backup application, and no two applications work the same. Tape Mirroring software provides a single interface that works across different applications.

HARDWARE TAPE MIRRORING SOFTWARE APPLIANCES

Hardware tape mirroring appliances are smaller devices that essentially split one data stream from the server into multiple streams being written to separate tapes. These products are usually from smaller companies such as Ultera, and most of the appliances are targeted at lower-performance drive types. (For example, none of these devices support StorageTek® T9840 and T9940 tape drive series.) These solutions don't offer any management of the multiple physical volumes, leaving this up to the customer.

PRICING MODEL

Tape Mirroring software is priced as a software enhancement for the SN6000 and VTM. Two components must be ordered:

> Tape Mirroring software—provides Tape Mirroring software functionality. Like VTM, one copy of Tape Mirroring software must be ordered for each interface board on the SN6000.
> Tape Volume Administration software—includes database software used to manage Virtual Volumes. One copy must be ordered for each SN6000 using Tape Mirroring software. These licenses allow customers unlimited use of mirroring within each SN6000 system.

FUTURE ENHANCEMENTS

The capabilities and configurations supported by Tape Mirroring software will be enhanced over time. There will be incremental improvements in the operational and management functionality of the product and in the applications, servers and physical devices that are supported. Also, we will be able to support additional and increasingly complex customer configurations, ultimately supporting dual-site configurations with full cross-connectivity, multiple ACSLS servers and redundancy.

ABOUT STORAGETEK®

Storage Technology Corporation (NYSE: STK), a $2 billion worldwide company with headquarters in Louisville, CO, has been delivering a broad range of storage management solutions designed for IT professionals for over 30 years. StorageTek offers solutions that are easy to manage, integrate well with existing infrastructures and allow universal access to data across servers, media types and storage networks. StorageTek's practical and safe storage solutions for tape automation, disk storage systems and storage integration, coupled with a global services network, provide IT professionals with confidence and know-how to manage their entire storage management ecosystem today and in the future.

StorageTek products are available through a worldwide network. For more information, visit www.storagetek.com, or call 1.800.275.4785 or 01.303.673.2800.

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