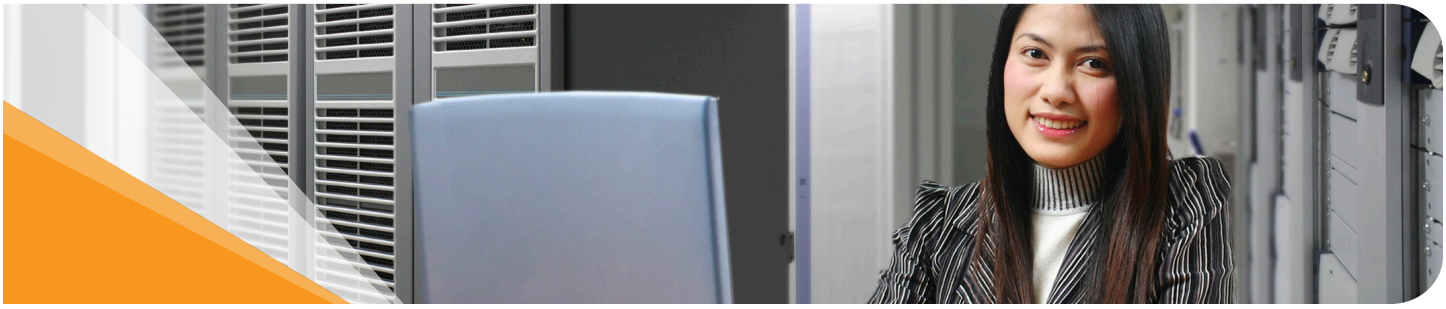
White Paper

Enhanced Backup Using StoreAge multiView™ and Asynchronous StoreAge multiMirror™

Integration with Enterprise Backup Applications for a Complete Data Protection Solution



Executive Summary

Data protection requirements have changed dramatically as corporations have become more dependent on IT applications to run their businesses. As the value of data has increased, and as organizations better understand the financial impact of system downtime, many IT departments are now requiring their data to have multiple layers of protection.

These multiple layers of data protection typically include:

- **Daily (single) backups to tape**
- **Intraday (multiple) backups to tape or disk**
- **Rapid data restore to previous points-in-time**
- **Data replication/mirroring to secondary sites for remote disaster recovery capabilities**

This white paper describes how the StoreAge multiView data snapshot and asynchronous StoreAge multiMirror data mirroring applications from LSI can be integrated with existing backup tools to provide superior data protection as required by today's enterprise environment.

Introduction

Over the years, several factors have been driving the evolution of backup tools and methods. Among these are:

- The exponential growth of data
- The extreme dependency of companies on their data
- The speed and cost of tape and disk devices
- Government regulations

In response, a variety of technologies have been developed to help meet IT data backup requirements – tape libraries that automate the backup process, SANs that provide a dedicated storage network where backup traffic is offloaded from the main corporate network and data snapshot technologies that minimize backup windows.

Time vs. Frequency

However, the core issue for many organizations is that the "amount of data" and the "dependency of companies on their data" have grown at unprecedented rates. While the growth in the amount of data suggests that more time is necessary to do backups, the increased dependency on the data requires more frequent backups. As we all know, time is the inverse of frequency. To accommodate the rapid growth of both variables simultaneously, the technology of backup speed must advance at a pace that is the product (multiplication) of each, yet this often becomes an exponential number.

New Approaches Are Needed

Unfortunately, advances in traditional tape technology have not resulted in sufficient speed enhancements to accommodate the growth of data or the protection frequency required. In addition, the cost of constructing an adequate tape backup infrastructure to meet growing needs can be prohibitively expensive. To fill this "data protection gap," alternative technologies are needed.

To illustrate the point, assume that an organization needs to backup an average of 1TB of data per hour. The equipment necessary to backup 1TB of data to tape each hour can cost hundreds of thousands of dollars, yet the cost of acquiring 1TB of disk has dropped to only a few thousand dollars.

This white paper proposes a solution to these problems via the use of LSI's StoreAge multiView™ (data snapshot) and asynchronous StoreAge multiMirror™ (incremental disk-to-disk replication) technologies.

While overnight tape backups will continue to be the preferred method for creating physical copies of data for offsite and archival purposes, new approaches are needed to meet the need for more frequent backups and reduced recovery times. This white paper proposes a solution to these problems via the use of LSI's StoreAge multiView (data snapshot) and asynchronous StoreAge multiMirror™ (incremental disk-to-disk replication) technologies, which add disk-to-disk data protection capabilities while enhancing disk-to-tape data protection, providing a cost-effective and flexible method for overcoming the data protection gap.

StoreAge multiView

StoreAge multiView works with all brands of SAN-attached storage arrays, allowing users to deploy one snapshot solution per SAN rather than multiple snapshot applications specific to each storage array.

StoreAge multiView is a vendor-neutral, network–based data snapshot application that creates instant, read/write, low-capacity, Point-in-Time (PiT) snapshots of any data on any storage device in a SAN. It works with all brands of SAN-attached storage arrays, allowing users to deploy one snapshot solution per SAN rather than multiple snapshot applications specific to each storage array.

PiTs can be used to make data available to any host on the SAN for any purpose, including zero-window backup, online restores, application testing and data warehouse updates, while production data remains online and fully available.

Space-Efficient Snapshots

Each StoreAge multiView PiT volume snapshot is a fraction of the original volume size, because it only keeps track of the changes that are made to a volume after the PiT is created. Disk space for PiTs does not need to be pre-allocated or reserved, and the PiT is expanded in small increments as new data is written to the volume. Multiple PiTs of each volume can be retained online, enabling frequent snapshots to be stored in a space-efficient manner.

Automatic Creation of PiT Snapshots

The low storage capacity of each PiT, combined with the ability to maintain large numbers of PiTs of each volume online, allows StoreAge multiView to be used for making quick and frequent disk-based "backups" throughout the day. In addition, a built-in scheduling capability allows each PiT to be automatically created at user-defined times. For example, a PiT could be automatically created at noon and 6:00 pm each day, minimizing the amount of data "at risk" between overnight tape backups.

Data Consistency

To ensure the data integrity of each PiT, consistency groups allow snapshots to be created of logical groupings of volumes, such as the data and log files in a database. In addition, application-aware data consistency capabilities allow applications such as databases to be quiesced prior to creating snapshots, ensuring the data integrity of each snapshot's contents.

No Data Movement

One of the key advantages of StoreAge multiView™ is its ability to create PiTs without physically duplicating data. By simply opening up a new volume that keeps track of any changes to data in the source volume, StoreAge multiView avoids the physical movement or copying of data, enabling each PiT to be created in seconds, regardless of the size of the source volume.

Rapid Restores In Minutes

As opposed to the lengthy process of restoring data from tape – which often takes many hours to complete – restoring data from a PiT typically takes just a few minutes. When a file, record or filesystem must be recovered, any PiT can be mounted to create an "instant View" of the data at a previous point in time, and the selected data is quickly restored. Again, the fact that there is no movement of data enables restoration of data in minutes rather than hours or even days.

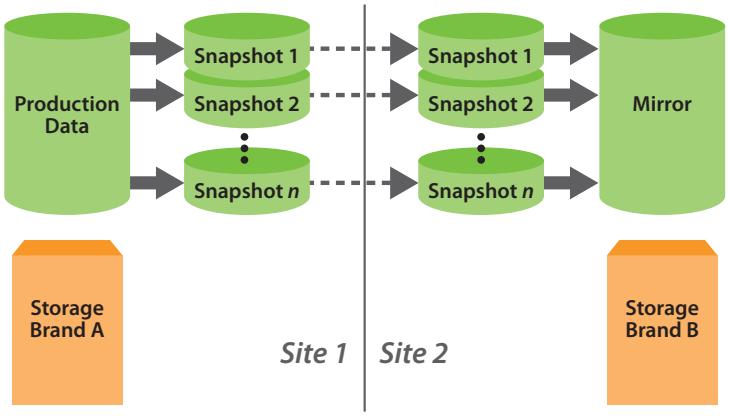
Asynchronous StoreAge multiMirror™

Asynchronous StoreAge multiMirror is a snapshot-enhanced Disaster Recovery solution that mirrors data from any storage device, to any device, at any location, either locally or remotely. Asynchronous StoreAge multiMirror technology combines platform-independent, any-to-any, asynchronous mirroring with instant, read/write low-capacity point-in-time (PiT) snapshots to ensure data integrity between sites while enabling rapid recovery after a disaster. It works with all brands of SAN-attached storage arrays, allowing users to deploy one mirroring solution per SAN rather than multiple mirroring applications specific to each storage array.

Asynchronous StoreAge multiMirror technology combines platform-independent, any-to-any, asynchronous mirroring with instant, read/write low-capacity point-in-time (PiT) snapshots to ensure data integrity between sites while enabling rapid recovery after a disaster.

As shown below, asynchronous StoreAge multiMirror uses the following procedures for mirroring data between sites:

- The initial PiT snapshot of production data is created (Snapshot 1).
- Snapshot 1 begins accumulating a copy of any production data that changes.
- On a user-defined schedule, Snapshot 1 is "frozen" and the next snapshot is automatically created (Snapshot 2).
- The contents of Snapshot 1 are mirrored from Site 1 to Site 2, and Snapshot 1 is then retained at both sites for a user-defined length of time.
- Each site is now assured of having an identical copy of data as of a specific point-in-time.
- The above process is repeated for each subsequent snapshot.



Snapshot-enhanced mirroring with asynchronous **StoreAge multiMirror** allows data to be mirrored between heterogeneous storage devices while providing exceptional levels of data integrity and bandwidth utilization.

Key Issues

There are three key issues addressed by asynchronous StoreAge multiMirror™ technology that are of critical importance in an effective Disaster Recovery implementation:

1. Data Integrity Issue #1

   In many mirroring products, data integrity is not assured, since all data – whether corrupt or not – is immediately replicated to the secondary storage device. In other words, a database or filesystem that is corrupted at one end will become corrupted at the other end as well. Recovering from this type of corruption typically takes hours or even days, and in some instances may be nearly impossible.

   Asynchronous StoreAge multiMirror avoids this problem by retaining PiT snapshots at each sites. If any type of data corruption should occur, the system administrators can "roll back" the mirrored systems at all sites to the last known good point-in-time in a matter of minutes. This snapshot-enhanced mirroring approach allows extremely rapid recovery from a potentially disastrous situation.

2. Data Integrity Issue #2

   When mirroring data over IP connections, IP does not guarantee in-order delivery of each I/O. If a Write I/O arrives out of sequence and the mirroring solution does not correct the order, the data at the target site is now "out of sync" with the data at the source site (i.e. the data has become corrupted).

   To ensure that I/O's are correctly applied to remote data sets, asynchronous StoreAge multiMirror incorporates an innovative "Last Block Changed" algorithm that examines the transactions within each snapshot prior to transmission. If the same block of data within a snapshot has changed multiple times, only the last known change for each block of data is transmitted. This ensures that both sites will have synchronized copies of data, even if the data arrives out of sequence.

3. Optimized Use of Low Bandwidth Connections

   One of the major costs of any mirroring solution is the ongoing monthly fee for maintaining a communication link between data centers. Generally speaking, the lower the bandwidth of a connection, the lower the monthly cost.

   Asynchronous StoreAge multiMirror's PiT and Last Block Changed technologies minimize data movement between sites, enabling enterprise-class mirroring to occur using lower bandwidth connections. A block of data could be modified hundreds of times between PiT snapshots, yet asynchronous StoreAge multiMirror would only need to apply the last change – eliminating the need to move all the preceding updates to that block. In addition, these techniques have other advantages:

   - Reduces the need for large buffers, or the possibility of having a buffer overflow disrupt the mirroring process.
   - Latencies resulting from long transmission distances do not affect data integrity.
   - During any transmission outages, snapshots continue to accumulate data changes until transmission links are restored, and then synchronize changes with the remote site(s).

Backing up to tape is often an inadequate solution for other critical business requirements, such as the need for frequent backups, quick restore capabilities and fast disaster recovery.

How StoreAge multiView™ and Asynchronous StoreAge multiMirror Complement Backup-to-Tape

Backing up to tape will continue to be used to meet a variety of data protection requirements, including archiving, offsite vaulting and regulations concerning data retention periods. However, backing up to tape is often an inadequate solution for other critical business requirements, such as the need for frequent backups, quick restore capabilities and fast disaster recovery.

While the traditional overnight backup to tape will continue to occur in most organizations, customers can improve their data protection and disaster recovery capabilities by using StoreAge multiView

and asynchronous StoreAge multiMirror™ to create snapshots of production data during the day. Also, they can alleviate the performance bottlenecks during backups by offloading data movement tasks from production servers to dedicated backup server(s). This allows backups to occur without disrupting application availability or response times.

Key Benefits

In a combined tape–StoreAge multiView™–asynchronous StoreAge multiMirror environment, daily tape backup sets are still used for archiving and offsite storage purposes. However, the levels of business continuity, data protection and restore capabilities are all greatly enhanced:

- Disk-based PiT snapshots may be automatically created several times per day at each location, minimizing the amount of data "at risk" since the last tape backup.
- Rapid recovery of data from disk can occur within minutes, minimizing the downtime experienced by users and eliminating the lengthy process of restoring data from tape.
- Copies of production data at any site can be created and moved from disk to tape without impacting production application service levels.
- Data can be mirrored from any device, to any device, at any location, allowing one solution to be used across all servers and storage devices in a SAN.

By supplementing traditional backup methods with StoreAge multiView and asynchronous StoreAge multiMirror, IT organizations can enjoy a full suite of data protection tools.

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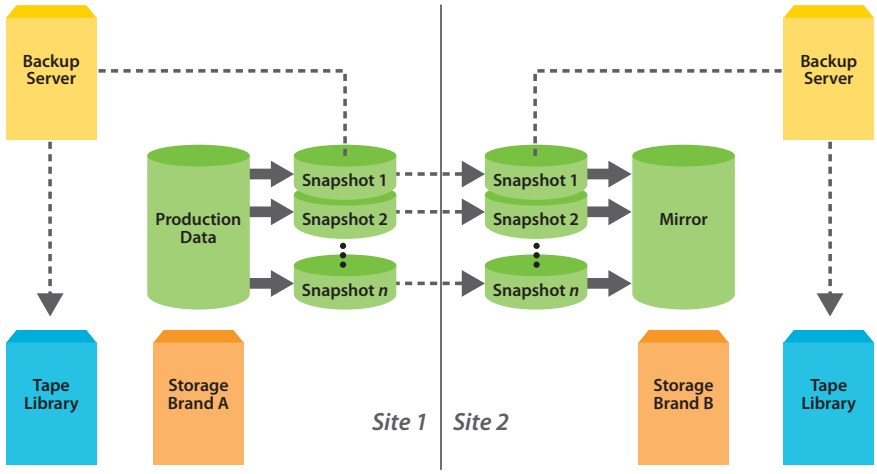

A combined tape–**StoreAge multiView**–asynchronous **StoreAge multiMirror** environment delivers higher levels of data protection, faster and less disruptive backups to tape and rapid recovery of data at any location.

By supplementing traditional backup methods with StoreAge multiView and asynchronous StoreAge multiMirror, IT organizations can enjoy a full suite of data protection tools.

Integration with Enterprise Backup Software Packages

StoreAge multiView and asynchronous StoreAge multiMirror incorporate API and CLI capabilities that allow them to be tightly integrated with existing enterprise backup software packages, enabling new levels of data protection to be realized.

Enterprise backup software packages have different modules to accomplish different tasks. For example, a job scheduler is used to schedule the various backup jobs of all the machines under its control; a catalog database is used to track the location of the different data sets available for restore; and a backup engine actually moves data from disk to tape (or disk to disk).

Using the LSI API and CLI capabilities, StoreAge multiView and asynchronous StoreAge multiMirror may be added as new backup engines to existing backup packages. This integrates the PiT snapshot

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capability of StoreAge multiView™ and asynchronous StoreAge multiMirror™ with the scheduler, policies, GUI and scripts existing within the enterprise backup software. As a result, a PiT can be initiated and used as part of the normal backup routine, and the snapshot copies will appear in the general catalog of data sets, allowing a quick restore to be done from the standard backup console. Once the backup jobs are programmed, the user can choose which type of backup to implement: 1) backup to tape, 2) snapshot copy, or 3) incremental disk-to-disk replication. The programmed backup job will activate the appropriate backup engine.

This integration results in a substantial enhancement of the current backup packages. The product combination also gives users a full range of data protection capabilities, all managed through the same central management console.

Conclusion

Immense data growth and increased data availability requirements have been driving most of the recent advances in the backup technology. However, in order to continue to meet the needs of IT organizations of all sizes, the next step in this evolution requires tools that can backup any amount of data very quickly.

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The StoreAge multiView data snapshot and asynchronous StoreAge multiMirror data mirroring applications from LSI are unique technologies that seamlessly integrate with existing backup infrastructures, and deliver the following benefits:

- More frequent "intraday" snapshots that minimize the amount of data at risk between tape backups
- Rapid restore of data from disk rather than tape
- Mirroring of data between heterogeneous storage devices at any location, with higher levels of data integrity and optimized bandwidth utilization
- Eliminates backup bottlenecks by offloading data movement from production servers to dedicated backup servers
- Integrates snapshot technology with backup software packages to enable non-disruptive backup of production data
- Allows backups to be started anytime, and finish anytime, without impacting normal operations or applications

StoreAge multiMirror and StoreAge multiView are key products in the comprehensive StoreAge™ product suite, a unique set of SAN storage management and data protection solutions.

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