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1 Executive Summary

Across most organizations, rapid data growth outpaces storage budgets. But adding Enterprise storage to fix this imbalance is a costly strategy while the alternative, tape, does not have the performance to meet application needs. With the introduction of Serial ATA (SATA) disk, a new type of storage solution is available that can fill the gap between Enterprise storage and archival tape.

With all these storage choices, the next question is “how and when do I take advantage of them?” Most organizations have data with different characteristics, requirements and importance to the organization. But in most cases, using a dedicated storage system for each type of data is expensive to acquire, manage and support. A tiered storage solution can support a variety of data types and requirements in the same solution. This innovative storage solution allows IT professionals to make their storage infrastructure more efficient matching data with the appropriate storage.

DataDirect Networks’ disk-based S2A9550 Tiered Storage Solution has been specifically designed to enable the creation of the world’s largest most scalable disk-based tiered storage solution allowing organizations to store, protect, access and manage a variety of different data types in a single, consolidated storage solution. The S2A9550 Tiered Storage Solution is up to 5 times more scaleable than other disk based storage systems. With multiple levels of redundancy, double parity protection, and Hardware RAID 6 functionality, the S2A Tiered Storage Solution delivers solutions that span all levels of price, performance, reliability and capacities.

The S2A9550 Tiered Storage Solution is a combination of DataDirect’s industry leading, 7th generation Silicon Storage Appliance (S2A) with Fibre Channel and SATA disk drives in the same storage system. The S2A9550 with its silicon enabled intelligence delivers continuous on-the-fly data protection with no loss in performance allowing organizations to implement a reliable enterprise-class tiered storage solution that can scale up to 560 TB nondisruptively.

As organizations consolidate greater portions of their data into large disk pools, additional levels of robustness and resiliency will be required. The S2A9550 Tiered Storage Solution’s groundbreaking ability to withstand multiple drive failures within and across individual parity groups maintains data availability, host performance and quality of service under the most severe failure modes.
S2A9550 Tiered Storage Solutions assist organizations in tiering and managing storage based on data and application requirements. The objective is to deliver Data Life Cycle Management (DLM) or Information Lifecycle Management (ILM) building blocks that lower storage cost by migrating data from primary to secondary storage based on factors such as age or criticality to the organization.

DataDirect S2A9550 Tiered Storage Solutions assist organizations in framing their technology and storage roadmaps. This alignment with DataDirect’s storage solutions allow for easy integration with best-in-class solutions and partners including cluster solutions, disk-to-disk backup, remote disaster recovery and long-term archival.

2 The Right Storage for the Right Job, Tiered Storage Model

The storage industry has used a pyramid or triangle for years to depict a hierarchy of storage products and solutions that span all levels of price, performance, and capacities. Broad ranges exist within all three parameters but, DataDirect Networks’ discussion will be focused on its Tiered Storage Model based on disk and tape based solutions (Figure 1).

The purpose of this tiered framework is to assist organizations in tiering and managing storage based on data and application requirements. The objective is to deliver DLM and ILM building blocks that lower storage cost by migrating data from primary to secondary storage based on factors such as age or criticality to the organization.

This model will also assist organizations in framing their technology and storage roadmaps. This alignment with DataDirect’s storage solutions allow for easy integration with best-in-class solutions and partners including cluster solutions, disk-to-disk backup, remote disaster recovery and long-term archival.

2.1 Enterprise Storage

Enterprise storage is used in Tier 1, online and primary storage solutions where access times are important and continuous disk operation is a must. Maximum disk reliability supports heavy, nearly continuous read/write activity for mission-critical or business vital applications.

Enterprise storage is based on high performance and high duty cycle Fibre Channel, SAS or SCSI disk (fastest rotational speeds — 10 or 15K RPM and 60% - 80% duty cycle — nearly continuous read/write activity). These drives are designed and best suited to applications that require constant,
instantaneous access to data, such as high performance simulation and analysis for intense supercomputer processing, online transactional processing, decision support, and enterprise messaging.

2.2 Archival Storage

At the other end of the spectrum is Archival storage such as tape or MAID (massive array of idle disks), which is used primarily for applications where infrequent serial access is required, such as long-term data storage.

2.3 Economy Storage

In between Enterprise and Archival storage is Economy storage based on Serial ATA (SATA) disk drives. Economy storage spans a range of applications, including online or active archival, reference data, backup and remote disaster recovery. Economy storage is for applications that require quicker access and higher throughput of data compared with long-term Archival storage, but do not require the continuous, instantaneous access provided by Enterprise storage.

![Figure 1: DataDirect Tiered Storage Model](image)

Economy storage is used in Tier 2, inline, nearline and secondary solutions enabling organizations to store data more economically than ever before. Utilizing less expensive SATA disks instead of high-performance SCSI, SAS or Fibre Channel disks, these solutions offer capacity at a lower price—roughly less than 1 cent per megabyte. SATA disks receive and send data faster than tape drives shortening access time and increase

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1 DataDirect Networks partners with tape vendors to provide this solution.
throughput rates over tape—a common problem that forces organizations to use more expensive high-performance drives.

These SATA disk-based solutions are not intended as a tape replacement but as an intermediate step to accommodate increasingly complex storage demands. In fact, since SATA-based storage solutions can support the most popular tape backup software, it acts as a repository of tape data for nearline recovery. Backing up to a SATA storage solution and then to tape enhances data protection management and improves primary storage and tape library performance. It's also faster and consumes less application-server CPU than direct backup to tape.

This Economy storage market is growing quickly with IT departments finding new uses for this low cost solution. Economy storage delivers the large capacities of tape with better performance. It also delivers disk based reliability, data protection and availability with greater scalability and volume-metric efficiencies (more storage in a smaller footprint).

These disk-based solutions can be used for production data that needs to be available in milliseconds or seconds but is infrequently accessed. Think of it as Infrequent Fast Read, Fast Write. For example, financial services where the ability to rapidly call up large amounts of simulation data for analysis can mean the difference between millions of dollars in lost new product fees or increased interest carry.

Economy storage is gaining popularity in a variety of applications including scientific research, simulation and modeling, bioinformatics, medical imaging, and oil and gas were large amounts of data need to be read or written quickly to support R&D efforts.

3  S2A9550 Tiered Storage Solution

DataDirect Networks’ disk-based S2A9550 Tiered Storage Solution has been specifically designed to enable the creation of the world’s largest most scalable disk-based tiered storage solution allowing organizations to store, protect, access and manage a variety of different data types in a single, consolidated storage solution.

The S2A9550 Tiered Storage Solution is up to 5 times more scaleable than other disk based storage systems. With multiple levels of redundancy, parity checking for all read I/Os, and Hardware RAID 6 functionality, the S2A Tiered Solution delivers solutions that span all levels of price, performance, reliability and capacities. All this storage is housed in the dense footprint delivering customers the best price per capacity storage solution.
The S2A9550 Tiered Storage Solution is a combination of DataDirect’s industry leading 7th generation Silicon Storage Appliance (S2A) with Fibre Channel and SATA disk drives in the same storage system. The S2A9550 with its silicon enabled intelligence delivers continuous on-the-fly data protection with no loss in performance allowing organizations to implement a reliable enterprise-class tiered storage solution that can scale up to 560 TB nondisruptively.

The S2A9550 with its built in intelligence delivers Hardware RAID 6 capability. The S2A9550 Tiered Storage Solution can overcome double disk failures in the same redundancy group without adversely affecting data availability or system bandwidth allowing “business-vital” and “business important” environments to implement a reliable enterprise-class tiered solution that can scale up to 560 TB nondisruptively (as 750 GB SATA drives become available late in 2006, the S2A9550 Tiered Storage Solution will scale to an amazing 840TB).
4 S2A Tiered Storage Benefit

The need for reliable tiered storage pools is demonstrated in Internet based photo galleries. Online photo galleries find that pictures take lots of storage and the need for storage outpaces their budgets.

Online customers expect it to be easy to store, view and share photos with friends and family. This service enables online photo companies to provide additional services like editing and creative tools. These are combined with specialty products such as photo books, calendars, cards, mugs, mouse pads, aprons, frames and more for additional revenue opportunities. A key success factor is to provide online users the freedom to view what they want, when they want leading them to take advantage of the other revenue producing services.

Internet based photos galleries find that there is a rapid fall-off in access of photos after even a few days, and virtually no access to photos more than a month old. However, with a “view what they want, when they want” business model, short access time and increased throughput rates are an important requirement — a common problem that forces photo galleries to use more expensive storage solutions.

In this example, the S2A9550 Tiered Storage Solution difference means the photo gallery can scale to 48 TB in a single rack using 300GB Fibre Channel disk drives for the data that is less than 30 days old, and scale to 80TB in the second rack using 500GB SATA disk drives for data that is more than 30 days old. All in a single solution. Further, the photo gallery can scale up this solution to 560TB mixing disk drive types.

The S2A9550 Tiered Storage block level virtualization functionality makes the migration and management of this data very easy to perform. The S2A9550 has the ability to virtualize storage through LUN aliasing, WWN masking/filtering and port zoning allowing for very easy deployment and ongoing system management of very large storage pools. Additionally, a large variety of statistical data is available and clearly presented to enable easy tuning, optimization, and network troubleshooting. The S2A9550 offers a rich set of management tools that make it is easy to install, scale and manage a tiered storage solution.

Further, the high performance, continuous on-the-fly data protection architecture of the S2A9550 allows photo customers to reliably access their photos in milliseconds to seconds regardless of storage tier.
5  S2A Tiered Storage Difference

Organization requirements mandate that a block-level storage device be capable of quickly accessing Logical Unit (LUN) storage targets from very large pools of storage. The S2A9550 Tiered Storage Solution embodies this with a broad, parallel backend via its twenty fully redundant Fibre Channel loops controlled by multi-processing multi-ported block-level storage controllers. This truly parallel access from very large and deep storage pools driven at wire speeds allows for quick, reliable access of data.

With large pools of business vital or business important data, reliability becomes a critical consideration. The S2A9550 supports a fully redundant host and disk side parallel architecture with on-the-fly parity checking of all read I/Os. This architectural parallelism enables mass scalability with robust data reliability.

Reliability and availability does not stop there. The S2A’s Hardware RAID 6 capability overcomes double disk failures in the same redundancy group without adversely affecting data availability or system bandwidth. This function provides data access protection even in the case of multiple simultaneous disk failures in individual parity groups, especially important with very large tiered disk pools and particularly with modern ultra-capacity drives that can take time to rebuild.

Architectural parallelism extends through the entire system allowing drive configurations that supporting up to 1,120 disk drives. Built into this parallelism are advanced data protection features enabled by RAID protected cache and disks. This parallel, fully redundant, dual pathing front and back end delivers true mission critical data integrity and with no loss in performance.

What’s in it for your organization? You can scale as large as you need using less expensive storage. Provide the highest levels of Quality of Service for consistent, predictable data delivery. Reduce storage operating costs. Deploy, support and manage simply and easily reducing management costs. All this with enterprise-wide reliability ensuring high data availability and uptime even while servicing full host loads.

6  Benefits Summary

DataDirect Networks’ S2A9550 Tiered Storage Solution allows organizations to build cost-effective highly scalable tiered storage infrastructures. This massively scalable storage solution lowers storage purchase costs as well as storage operating expenses. Create worry-free disk-based solutions for online data, online and nearline archive, fixed
content and large file storage, backup and recovery systems, storage consolidation and ILM storage with the industry’s best price per capacity storage solution.

7 Optimize Storage Capacity

With a new storage tool, the next question is “how do I take advantage of it?” The following methodology helps an IT department rationalize its storage to its data delivering on the cost savings of tiered storage.

IT organizations can optimize storage tiers by a two step process.

1. List all your storage and its data.
2. Align data performance requirements with storage tiers

Step One: List All Your Storage and Its Data

Reviewing the storage environment has the focus of determining what data the organization has, its location, characteristics and importance to the organization.

This review takes place in a two parts, first, identifying the data to be stored, and its importance to the organization. This starts by segmenting data into three, four or five discrete tiers (Figure 2). For example, 10 percent of an organization's data might be deemed *mission critical* and needs it to be accessible in milliseconds; 20 percent is *business vital* but could be accessed from milliseconds to seconds; 20 percent is *business important* and could be accessed in minutes to hours but not exceeding eight; and the remainder *not important to business operations* but necessary to keep for regulatory or archival purposes, or else may be *important for productivity* but could wait three days to recover it from tape.
The second part is to map data to storage, like in Figure 3. Each dot represents a collection of data related to a specific application. These groups of data are mapped to their respective storage tiers. Note, however, these data groups may not be aligned with the performance and availability offered within the storage tier.

For example, disk mirrors, shown in Figure 3 as two data points connected by dotted line, is often stored on the same storage tier. Yet the protection copy — the lower data point — may have lower performance requirements.

Age can also be a key factor affecting data needs. For example, Internet based photo galleries find there is a rapid fall-off in access of photos after a few days, and virtually no access to photos more than a month old. If an organization stores all photos on Enterprise storage, an opportunity exists to move the older photos to less expensive Economy storage.

Age may drive the usage frequency of some data but not for all data. There are some variables that can influence data performance requirements. The assessment process provides a reality check for the organization’s operations. Objective measures such as age of data and how often data is accessed are easy to list. These must be combined with a more subjective weighting of the data’s value. Some data may be old and rarely accessed, such as a call centers customer list from last Christmas. Nevertheless, storing that data on Economy storage may be justified when the same customer calls next Christmas to make a purchase.
Profiling data by its access, throughput and availability characteristics will reveal sub-optimal uses of capacity and opportunities to more efficiently apply the right storage to the right data, moving less critical data to less expensive disk and reallocating unused capacity.

**Step Two: Align Data Performance Requirements With Storage Tiers**

Step Two aligns data performance requirements with storage tiers, like in Figure 4. Each dot should yield a clear view of the requirements of different data types and how well these requirements are met in the current environment. IT can now plan and move data where appropriate to lower performance and lower cost storage while still delivering adequate performance for the critical applications.
Figure 4. Migrating Data to Align Performance Requirements with Storage.

This alignment will identify and target appropriate storage solutions optimizing existing storage resources and reducing storage costs by delaying or eliminating the need for new enterprise disk.
8 Storage Comparison

DataDirect Networks’ disk-based S2A9550 Tiered Storage Solution has been specifically designed as the world’s most scalable tiered disk-based solution housed in the industry’s smallest footprint. The S2A9550 Tiered Storage Solution delivers the industry’s best price per capacity storage solution.

<table>
<thead>
<tr>
<th>Primary Use</th>
<th>Online Enterprise Disk-based</th>
<th>Nearline SATA Disk-based</th>
<th>Archive, MAID</th>
<th>Archive Tape Library</th>
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<tr>
<td>Data Accessibility</td>
<td>% Media Spinning</td>
<td>60%-80%</td>
<td>15%-30%</td>
<td>&lt;15%</td>
</tr>
<tr>
<td></td>
<td>Data Accessibility</td>
<td>Milliseconds</td>
<td>Milliseconds to seconds</td>
<td>Seconds</td>
</tr>
<tr>
<td></td>
<td>Cost</td>
<td>High</td>
<td>Medium - Low</td>
<td>Medium</td>
</tr>
<tr>
<td></td>
<td>Performance</td>
<td>High</td>
<td>High - Medium</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>Data Protection</td>
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<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Reliability</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Scalability</td>
<td>Low</td>
<td>High</td>
<td>High</td>
</tr>
</tbody>
</table>

**Data Accessibility** — How quickly can you get your work done? Disk drives access data in milliseconds to seconds, even when in power saving mode. Tape takes minutes to hours or days depending if it is on site or not. If data accessibility is a key requirement, the S2A9550 Tiered Storage Solution is the industry leader for cost effective accessibility.

**Cost** — the S2A9550 controller and its tiered drive package delivers a blended disk based solution that approaches the price of SATA storage. With Sleep mode and other power saving features, the S2A9550 Tiered Storage Solution saves on power and cooling for the best price per capacity disk solution in the market.

**Performance** — How much data do you need to move and how much time do you have to move it? With a parallel architecture and broad back end, the S2A9550 Tiered Storage Solution delivers up to 3 GBytes/s, or 10.8 TB per hour bandwidth. There is nothing in the tiered storage market that even comes close.

**Data Protection** — The S2A with its continuous on-the-fly dual parity protection allows the S2A Tiered Storage Solution to continually monitor...
media reliability responding with corrective measures to avoid data loss. The S2A9550 also monitors drive health and responds with preventative measures to maintain data availability.

**Reliability** — With the Hardware RAID 6 feature, the S2A Tiered Storage Solution delivers enterprise-class reliability even with SATA drives. This innovative feature protects against a dual drive failure even in the same redundancy group without adversely affecting data availability. No tiered storage solution has this level of reliability.

**Scalability** — S2A9550 Tiered Storage Solution is up to 5 times more scaleable than other disk based storage systems packing up to 80 TB in each cabinet and up to 560TB in a fully configured solution. This extremely scalable solution reduces the need for multiple system easing management headaches and costs.
Mr. Woolery is responsible for identifying, defining and executing DataDirect’s product and business development plans. Mr. Woolery brings years of proven success in marketing, business development and executive management successfully positioning companies for growth with customer-centric products and services. Mr. Woolery’s prior experiences include Executive Vice President at Valuation Software, Vice President, Product Marketing at Xiotech Corporation and Vice President, Sales and Marketing at Balance Marketing, Inc. Mr. Woolery holds a BSIE from California State University at San Luis Obispo and an MBA from UCLA.