

Technology Paper

SAS and SATA: Multiple Benefits of Unified Storage

Introduction

Just as parallel lines never intersect, so too were the parallel storage interfaces of the last two decades destined to remain independent. When parallel SCSI and parallel ATA were conceived over 20 years ago, their roles in IT infrastructure were fundamentally distinct: servers needed the speed and reliability of SCSI storage, while economical ATA storage was adequate for desktop use. Given their disparate duties, compatibility between the two seemed unnecessary.

However, over time it became increasingly clear that server storage embraced a broad variety of data, some of which didn't necessitate the superior performance and dependability of SCSI storage (and the higher cost per GB that such storage entailed). Deploying a separate, redundant parallel ATA infrastructure for such data was an inefficient and unwieldy workaround.

Furthermore, the fundamental physical and electrical constraints of parallel storage buses had become increasingly problematic as faster throughput was sought, discouraging further development. By contrast, serial interfaces were growing by leaps and bounds thanks to recent breakthroughs in very large scale integration (VLSI) technology and high-speed serial transceivers. Simpler, faster and more robust, serial architecture was clearly the wave of the future.

Change for the Better

Thus when Serial ATA (SATA) arrived to supplant its parallel predecessor, the substantial gains it delivered in speed, scalability, data integrity and reliability were more than enough to ensure swift and enthusiastic adoption throughout the storage industry. Serial Attached SCSI (SAS) soon followed, and had it merely emulated SATA's transition from parallel to serial architecture, it would nevertheless have represented a significant advance in SCSI storage.

SAS and SATA: Multiple Benefits of Unified Storage



But the authors of the SAS standard wanted something better; they had no intention of repeating the interface isolationism that had hamstrung parallel storage flexibility. And so compatibility with SATA became a central component of the SAS feature suite. This unified interface approach produces remarkable storage synergies and efficiencies, enabling IT professionals to achieve both their performance and capacity objectives with a single SAS infrastructure.

Advantages of Unified Storage

The one-two punch of the SAS/SATA value proposition is simple: SAS hard drives deliver the speed, reliability and scalability demanded in high-availability enterprise environments, while high-capacity SATA drives are ideal for bulk storage applications, combining low cost per GB and greater reliability and scalability than their parallel ATA ancestors. Complementary by design, SAS boasts the best performance/dollar while SATA offers maximum capacity/dollar.

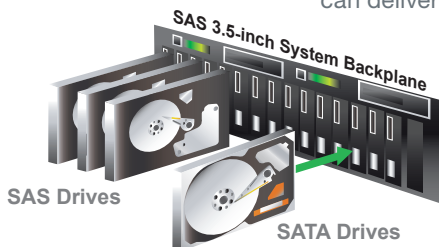
The advantages of SAS/SATA compatibility benefit every sector of the storage landscape, from burgeoning firms with modest needs (and budgets to match) to vast Fortune 100 enterprises with a complex mix of transactional and reference data storage requirements. Savvy system builders and integrators have been quick to recognize the unique blend of performance, capacity and flexibility advantages that a SAS infrastructure can deliver to their customers.

Advantage: Room to Grow

Smaller companies with limited resources can save money by deploying a SAS infrastructure (HBAs, backplanes, cabling, and so forth) that is initially populated with low-cost, high-capacity SATA drives. As business expands and greater capacity is needed, more SATA drives can easily be added. With far greater scalability than a SATA infrastructure, a SAS infrastructure can connect over 16,000 SAS and/or SATA drives in one domain, ensuring vastly more room to grow than even the beleaguered IT departments of today typically require.

A SAS infrastructure can easily support a multitude of SATA drives with a single SAS HBA port. As more SATA drives and SAS RAID backplanes are added to a storage enclosure, SAS expanders on those backplanes can be seamlessly cascaded together. Requiring only a minimal number of ports on the HBA, and with more ports available on the expanders, a SAS infrastructure becomes increasingly cost effective as the number of drives rises.

When these growing firms move further into online/transactional applications (entailing critical data with high availability to multiple, concurrent users), adding high-performance SAS drives is literally a snap, with zero modifications of the existing infrastructure required.



SAS for Performance, SATA for Capacity			
Device	Application	Work Environment	Seek Time (typical)
SAS (15K RPM, 10K RPM)	Performance-intensive, high availability, random reads	24 hrs/day 7 days/week	3.5 ms (15K RPM); 3.9 ms (10K RPM)
SATA (7200 RPM)	Capacity-intensive, low availability, sequential reads	8 hrs/day 5 days/week	9.5 ms

Figure 1. Combining SATA with SAS in a unified storage system ensures ultimate application support.

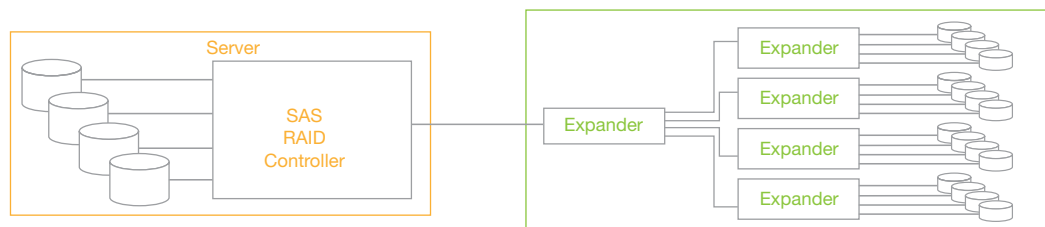


Figure 2. SAS infrastructure delivers exceptional expandability and flexibility by enabling direct cascading of multiple expanders.

SAS and SATA: Multiple Benefits of Unified Storage



Advantage: Dynamic by Design

Typically, more established enterprises already have extensive transactional (online) storage application needs, which they've historically addressed with parallel SCSI hard drives. SAS wisely leverages the proven strengths of its parallel predecessor (rock-solid reliability, mature SCSI command set) while offering dramatic improvements in speed, scalability and compatibility.

Not surprisingly, storage managers welcomed the many benefits of SAS drives over legacy parallel SCSI drives, and are transitioning to SAS drives for online applications. As an added benefit, SAS enables these companies to eliminate their existing SATA infrastructures (used for bulk storage) and standardize on SAS infrastructure for both SAS and SATA drives.

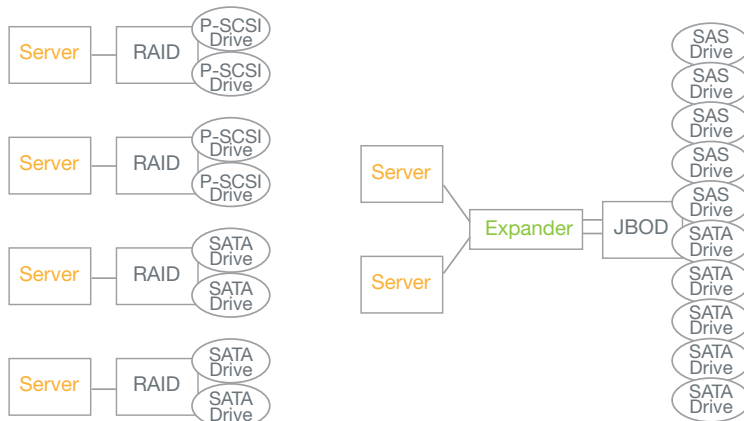


Figure 3. SAS drives can be deployed for performance-intensive applications in place of parallel SCSI, while being housed in a common cabinet with SATA drives used for capacity-intensive duties.

For many firms, the optimal blend of performance-optimized storage and capacity-optimized storage is not fixed but dynamic, changing as business needs continually evolve. SAS is particularly appropriate for such environments, entailing only a simple plug/unplug process to seamlessly fine-tune the mix of SAS and SATA drives as application needs dictate.

Beyond the obvious efficiency of specifying the optimal hard drive for a given application, standardizing on the SAS platform significantly reduces the cost and complexity of the storage infrastructure by minimizing the number of

individual components that must be qualified, purchased, inventoried and maintained. Such component rationalization also results in a smaller storage footprint and places fewer demands on support resources and staff.

SAS Compatibility Feature	Benefits
SAS backplanes, HBAs and expanders compatible with SATA	Connectivity for multiple device types lowers TCO, gives flexibility to specify best drive for intended use: SAS for transactional/online performance and reliability, SATA for bulk storage and backup/restore duties
SAS can connect over 16,000 SAS and/or SATA devices in a single domain	Delivers vastly greater scalability than parallel SCSI; also enables far greater scalability than SATA infrastructure
SAS platform can accommodate both SAS and SATA devices	Standardization on one platform reduces number of components to qualify and inventory

Going Green With SAS (Part 1)

But the advantages of SAS storage don't end there. As noted above, an effective storage infrastructure must be able to dynamically adapt as needs change. It's no secret that the enterprise is increasingly concerned with cutting space and power use in its data centers. For many forward-thinking enterprises, the answer can be found in the latest generation of space- and energy-efficient enterprise hard drives: small form factor (SFF) 2.5-inch 15K-RPM drives.

SFF drives are leading the green revolution towards high-I/O-density storage solutions that facilitate rapid and cost-effective data center rationalization. SFF 2.5-inch 15K-RPM drives are 70 percent smaller than conventional 3.5-inch 15K-RPM drives, enabling them to use 30 percent less power and run cooler, all while delivering 10 percent faster performance.

SAS is an ideal complement to SFF 2.5-inch 15K-RPM drives, with its enormous scalability easily accommodating the greater drive counts found in high-density storage solutions. Furthermore, SAS helps maximize IOPS/U (input output per second/unit), a metric that factors in both a storage device's performance and its space requirements. SAS combines superior throughput with compact cabling

SAS and SATA: Multiple Benefits of Unified Storage



and connectors that consume less enclosure space, enhancing airflow/cooling in high-density computing solutions such as 1U servers.

Going Green With SAS (Part 2)

Recently joining the green revolution is an innovative family of 3.5-inch 10K-RPM enterprise drives, specifically designed for enormous capacity and greater energy efficiency. Leveraged from the same platform as 3.5-inch 15K-RPM SAS drives, these new 10K-RPM SAS drives deliver best-in-class capacity, energy savings and performance compared to conventional 3.5-inch 10K-RPM enterprise drives.

Perpendicular recording technology enables these high-efficiency hard drives to provide 33 percent more capacity per drive (up to 400 GB), the highest drive capacity available for mission-critical network storage environments. Coupled with a best-in-class 34 percent reduction of power at idle (power consumption is rated as low as eight watts) and a 33 percent cut in operating power compared to standard 10K-RPM drives, these hard drives help energy-constrained data centers maximize efficiency.

What's more, these new high-efficiency enterprise SAS drives deliver higher IOPS performance than conventional 3.5-inch 10K-RPM SAS drives. Boasting a seek time of only 3.9 ms, random performance is increased by 10 percent while sequential performance is improved by as much as 23 percent.

Speed, Capacity or Efficiency: Pick Three

Speed

The real-world advantages of SFF SAS/SATA storage solutions are compelling: A 1U server using six 2.5-inch 15K-RPM SAS drives delivers full RAID 5 functionality in one-half the space required by a 2U server equipped with six 3.5-inch 15K-RPM drives—and the SFF-equipped 1U server boasts faster performance.

Capacity

SAS/SATA compatibility enables a SAS server to periodically migrate data off its SFF 15K-RPM SAS drives onto high-capacity 3.5-inch SATA

drives, freeing up more capacity for online/transactional applications. For example, servers and storage subsystems of varying sizes (1U, 2U, 4U, and so forth) stacked on top of one another in a single cabinet can transfer data interchangeably between SAS and SATA drives.

When extraordinary SATA capacity is required, a 1U server's external SAS port can always be connected to a RAID- or JBOD-configured enclosure carrying a multitude of 3.5-inch SATA drives that can store many terabytes of data.

Efficiency

The new breed of high-efficiency 3.5-inch 10K-RPM SAS drives delivers up to 33 percent more capacity at 400 gigabytes coupled with a 33 percent reduction in power and cooling requirements. In the data center, this greater capacity and reduced cooling profile translates into the lowest total cost of ownership (TCO) for a wide range of mission-critical enterprise network storage applications.

Conclusion

Greater storage efficiency continues to be an urgent priority for companies of every size, and SAS is uniquely positioned to facilitate this key goal. SAS was proactively engineered as a superset of SATA, and this rational approach pays multiple dividends. Not only does SAS infrastructure (via its compatibility with SATA hard drives) enable IT managers to select the most cost-effective storage solution for any task, it also vastly improves SATA's scalability.

Simply put, SAS compatibility with SATA establishes a lofty new standard for storage value by eliminating the redundancies and inefficiencies of purchasing and maintaining separate infrastructures for high-performance (SAS) and high-capacity (SATA) storage applications. And now the availability of SFF 15K-RPM SAS drives and higher-capacity, lower-power 3.5-inch 10K-RPM SAS hard drives boosts the SAS/SATA value proposition even higher by leading the migration to more space- and energy-efficient storage solutions.

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