

Serial Technology: Evolving Storage Performance, Scalability and Cost-Effectiveness

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Introduction

The market for storage solutions is changing dramatically. Digital media, email, e-commerce, and new government regulations are driving huge increases in information requirements for businesses of all sizes. From transaction-intensive applications to nearline storage of data that must be accessible 24/7, the latest data applications are not only changing the way storage is used, they are outstripping the capability of the parallel SCSI technology that has been the industry standard for reliable storage and connectivity for the past 20 years.

Parallel SCSI Technology

For the past 20 years, parallel SCSI has been the most widely deployed storage interface in server and storage data centers. While parallel SCSI has been a reliable standard interface, the technology has reached its highest performance level with the advent of Ultra320. *As servers are pushed to meet advancing system and application computing requirements, parallel SCSI has had to contend with signal skew and crosstalk, signal termination restrictions, cable and connector reflections, and device addressability – all of which have become barriers to next-generation throughput performance.*

The industry leaders in server and storage computing have been working together in various consortiums to overcome this throughput performance challenge. The result of the intensive investigation has resulted in transitioning parallel SCSI to a serial interface.

Serial Technologies

Serial technology transmits data in a single stream instead of the multiple streams found in parallel technology, therefore it is not tied to a particular clock speed and can transfer data at a

much higher rate (up to 30 times faster) than parallel technology. It also offers greater reliability and scalability.

Serial technology is not new. In fact, the SCSI evolution discussion was based on proven technical theory, by building on the pervasive serial networks already deployed in the datacenter. In the late 1990’s, storage utilization and growth was a critical issue facing the datacenter. The result were proposals and products that aggregated storage on a dedicated ‘storage network’. This helped IT managers to consolidate and effectively manage and grow their aggregated enterprise data pools. To successfully implement this concept, the market required a technology that provided long distance support, since storage would now be consolidated away from a server, as well as high speed with minimal latency to provide rapid access to critical information. The result was the first serial technology to gain significant momentum in the mainstream enterprise marketplace, Fibre Channel.

Fibre Channel

Fibre Channel was developed in the late 1990s to meet the need for high-speed connectivity that was being driven by exploding information volume and data-intensive applications.

It offers high performance with throughput currently at 2Gb/s, with 4Gb/s now being introduced. *Fibre Channel also offers high availability with an architecture that is inherently more reliable than Ethernet-based solutions and offers built-in redundancy.*

Fibre Channel has also enabled storage area networks (SANs) for block storage and improved storage utilization by allowing storage to be consolidated, shared, and manipulated on the fly. It enabled better management of remote storage and improved disaster recovery solutions.

However, a Fibre Channel solution is an expensive solution, requiring the construction of a completely new infrastructure, as well as specialized IT training and upgrades.

These heavy cost issues have kept Fibre Channel from becoming a universal solution. Too expensive for small and medium businesses to deploy and manage, it has primarily been deployed in enterprise data centers.

Serial ATA

In 2002, storage networks had become pervasive in the enterprise, and the industry wrestled with the next major technology requirement, a way to cost-effectively manage the exploding amount of storage content in the IT infrastructure. Most of this information was growing in response to more efficient storage networks now being utilized, and users having a perspective that all data was mission critical. This coincided with new government requirements on strict data retention policies (e.g. Sarbanes-Oxley) which meant that non-mission critical information had to be retained for a specific period of time. This meant that there was a new 'class' of storage – non-mission critical data that needed to be readily accessible in the IT ecosystem.

Cost became the principle focus. Solution vendors and industry leaders responded with the introduction of Serial ATA (SATA). *SATA serialized the low-cost, high-volume desktop-class ATA hard drives with a new interface that provided adequate reliability and performance for non-mission-critical information.* Companies with data protection expertise, such as Adaptec, responded by helping to drive best-in-class RAID technology, that when paired with SATA hard drives, provided highly available storage at a much lower cost. SATA also provided higher disk interconnect speeds of 1.5Gb/s and soon, 3Gb/s. The future is exciting for SATA, as speeds continue to increase (up to 6Gb/s in the future) and some enterprise capabilities will be enhanced, including hot swap and simplified cabling. Meanwhile, the technology will maintain the ATA family commitment of driving the lowest acquisition cost per megabyte for enterprise IT centers.

What is Serial Attached SCSI?

Finally, the most pervasive enterprise technology has come to a crossroads. Parallel SCSI is the heart of the datacenter – used as the standard interconnect and hard drive communication scheme for server and storage environments. Companies had been developing and utilizing SCSI for over 20 years as the mainstay for enterprise storage, but the technology's future was coming into question. Quite simply, the parallel interface would have to be overhauled to address next generation concerns of signal integrity, performance and reliability, right down to fundamentals like cable length.

The result of three years of industry discussions and technological investigation is Serial Attached SCSI (SAS), the next standard in enterprise server and storage technology. SAS is a high-performance solution that leverages proven SCSI

functionality, and builds on the enterprise expertise of multiple chip, board, drive, subsystem, and server manufacturers throughout the industry. It provides better performance and flexibility than the serial technology, Fibre Channel, at a lower cost and with the same, or ever better, reliability.

Key SAS Features Include:

- SAS and SATA drive support provides customers an unprecedented level of choice in the enterprise – the flexibility of integrating either SAS and/or SATA devices in common server or storage solutions, providing customization to meet cost or performance needs in customers' unique environments
- reliable point-to-point connections at 3Gb/s – or 16,256 addressable devices in a per port
- full dual-ported connections for performance or failover capabilities, delivering robust data protection and reliability right to the hard drive
- enterprise features including native command queuing, support for LUNs greater than 2TB
- available in multiple hot swappable disk drive performance and form factor configurations including high value 3.5" 10k rpm drives, high performance 3.5" 15k rpm drives and emerging 2.5" high density drives for performance server and specialized high performance storage applications
- thinner cabling than SCSI and ATA which delivers new cooling metrics and more efficient airflow – critical in a dense computing environment where low profile servers are racked and stacked with multiple external storage chassis. Effective heat management and cooling schemes remain a top priority for IT managers today, delivering enhanced uptime and reliability guarantees in application sensitive environments

SAS delivers the high performance, scalability, and reliability required for bandwidth-hungry mainstream servers and enterprise storage. SAS lends itself to the high-frequency, immediate random data access required for transactional data applications such as online purchases and bank transactions and provides the performance and security required for mission-critical applications which demand data redundancy.

Choosing the Right Connectivity Solution

IT managers today cannot risk deploying the wrong class of storage solution. Today, server or storage solutions represent finite choices – you must choose early on whether you want a SATA-optimized server or storage solution, or whether you will pay more up front for a parallel SCSI-optimized server or storage solution. If you deploy a low-cost SATA solution, but the performance and reliability metrics fail to meet internal user expectations & uptime service guarantees, the choice is straightforward – pick a weekend, forklift upgrade the application and storage infrastructure, and hope that you can redeploy a new SCSI-based solution before the weekend is through.

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Serial Attached SCSI breaks these barriers. By deploying standard servers and storage chassis based on SAS architecture, IT managers will become very comfortable with the characteristics of the ‘heart of the datacenter’. It makes it easy to purchase and maintain service spares by leveraging common components (power supplies, memory, etc.), and ensures that the IT staff is up to speed and very comfortable with the server and storage solution.

The most compelling part of SAS is that the datacenter manager can now customize the type of storage inside their infrastructure and have the flexibility to address high-end, mid-range and low-end requirements with only a single architecture, as shown in Figure 1. If the application is not mission critical or consumes capacity at an unmanageable pace, SATA hard drives can be deployed into the SAS ecosystem, which is able to auto-negotiate with both SATA and SAS hard drives. If needs change and performance and reliability become the dominant requirement, the IT manager can simply begin migrating existing SATA hard drives to more robust SAS hard drives, then redeploy the SATA technology into another server or storage farm. All this can be done without having to forklift upgrade or disrupt the application server or storage chassis.

Applications	Disk Drive Type
High-end	Fibre Channel
Mid-range	SCSI
Low-end	SATA

} SAS

Figure 1: SAS provides the flexibility to address a broad range of storage requirements with a single technology.

Adaptec is Leading the Transition to Serial Attached SCSI

As the worldwide leader in SCSI technology, Adaptec is bringing its 24 years of expertise in development and continual improvement of SCSI to SAS. We are developing one

of the industry’s broadest families of SAS and SATA products, based on our Flexible Storage Architecture (FSA). FSA allows our customers to mix and match drives easily and seamlessly, creating storage solutions that offer the right balance of cost, performance, and connectivity for any network, infrastructure, and storage opportunity.

We deliver SAS ASIC, HBA, RAID, and storage system products that will provide you with everything you need to easily build reliable, highly-available, cost-effective SAS-based solutions

Conclusion

Over the past three years, Serial Attached SCSI (SAS) has been unveiled as the next evolution of the SCSI standard – featuring increased performance, scalability, and reliability, while maintaining ease-of-use and the SCSI feature set that has made SCSI the de facto standard in enterprise computing environments. The first SAS products are becoming available, and represent the first step in making SAS a widely adopted technology standard.



Figure 2: SAS will become the technology of choice for most storage needs, while coexisting with FC and SATA for very high end, or very cost-conscious requirements.

For the foreseeable future, Fibre Channel, SATA, and SAS will co-exist (as shown in Figure 2), with SCSI, SATA, and Fibre Channel addressing the left and right ends of the spectrum. Although full adoption of the SAS technology will not occur overnight, it is going to become the pervasive connectivity technology in the \$13 billion dollar storage marketplace. So, even though you may not be ready to switch to SAS just yet, it is to your advantage to start preparing for this transition.



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