Serial Attached SCSI: The Universal Enterprise Storage Connection

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Trending Toward Serial

The move to serially connected storage devices, primarily disk drives, is irrefutable. While today's installed base is relatively small and consists of a few million Fibre Channel drives, new interfaces that service a greater percentage of the storage market promises to change all of that. The number of serially connected storage devices deployed over the next four years could be well in excess of 100million drives!

VLSI integration and the advances of high-speed serial transceiver technology are rapidly driving the industry toward these versatile connection schemes. The advantages of these serial connections are many: smaller form factors, more flexible and thinner cabling, less weight, more predictable/reliable signaling mechanisms, and topologies that promise to scale with the needs of the end-users.

Serial ATA

Serial ATA (sATA) is one of these emerging storage connections that promises to change the way the world connects its storage devices. sATA is expected to be a replacement for parallel ATA (pATA) and, as such, will be focused on bringing the best "cost-per-gigabyte" drives to the market. With market volumes in the desktop PC space exceeding 150M units per year, cost will be the driving force behind the manufacturing of these devices.

The serial connection scheme used to interconnect these drives within the host is much more flexible and does less to restrict the airflow inside of desktop enclosures. Because of this, OEMs have the ability to support a wide variety of systems with essentially a common drive connection cable, something rarely achievable with the pATA implementations. With integrated circuit providers, system manufacturers and drive suppliers focused on delivering sATA, it promises to make significant market in-roads over the next two years.

In addition to the desktop market, sATA is also finding reception in the NAS and SAN markets. Enterprises struggle to provide cost-effective storage solutions to support high performance backup, infrequently accessed data, or write-once/read mostly types of data. Disk drives have become increasingly more competitive with other back-up storage technologies such as tape, and have proven to be faster when backing up the huge amounts of data required in today's data-center applications. sATA promises to play an important role in these "near-line" storage segments of the market, due to its low-cost-per-megabyte focus.

The Changing Data Center

 The data center has a variety of storage requirements. Some applications are more focused on transaction processing performance, while others are more concerned with low-cost, high availability, or system scalability. Cost-per-gigabyte, and cost-per-I/O, balanced by various degrees of data availability and scalability have historically dictated substantially different storage solutions, depending upon the user's primary application needs.

Parallel SCSI has been the dominant enterprise storage interface for much of the past two decades. While parallel SCSI will continue to service standard high-volume servers and storage subsystems over the coming decade, it's clear that evolving enterprises will require more from this venerable storage interface.

Serial Attached SCSI

Serial Attached SCSI is the latest generation of this enterprise storage connect and promises to greatly expand upon the existing capabilities of parallel SCSI. Serial Attached SCSI intends to leverage the 20 years of proven SCSI legacy middleware/software that is entrenched in the enterprise, as well as deliver a powerful small form factor connection scheme, capable of achieving substantially more functionality than we have seen from SCSI heretofore.

Unlike parallel SCSI, Serial Attached SCSI offers a full, dual-ported connection that supports the most stringent of high-availability requirements. In addition, Serial Attached SCSI will extend drive addressing up to 4032 devices per port, well beyond parallel SCSI's limit of 15. As with sATA, Serial Attached SCSI is a high-speed, point-to-point technology initially designed to operate at speeds up to 3Gb/sec. (can we say 3Gb/s for sATA at this time?)

System designers have found that point-to-point serial connections are inherently more reliable than shared bandwidth serial connections. As a result, point-to-point serial connections have become the preferred method for implementing high-availability systems. Historically, the scaling of serial device connections was accomplished by using a shared loop topology. While this is an effective way to scale, it does offer some challenges in high availability systems in terms of requiring high-speed shared bandwidth connections at each device connected on the loop. It also creates challenges for providing effective means fault isolation and simplifying the process for initializing the loop.

In order to accomplish the scalability required for large storage systems using point-to-point connections, the ability to integrate multiple-ported serial connections on a single VLSI device is required. These VLSI advances enable a new generation of integrated circuits that provide multiple point-to-point drive connections within a single device.

Serial Attached SCSI takes advantage of these VLSI advances to enable a highly scalable connection scheme and to allow the connection topology to grow through the use of "expanders." Expanders provide the necessary fan-out to create large enterprise-worthy configurations while maintaining legacy compatibility with today's proven SCSI software.

But perhaps the most significant of all the additions being offered by Serial Attached SCSI is the ability to provide OEMs and end-users something unique and that is the ability to offer customer choice. By enabling OEMs and end-users with the ability to deploy a diverse range of system capabilities through a common storage connection interface, Serial Attached SCSI promises to dramatically change the way we think about serving the storage market.

As we have seen in the networking world, standards like Ethernet are capable of supporting a wide variety of connection-oriented protocols. Serial Attached SCSI was architected at its inception to support three separate protocols. The Serial SCSI Protocol (SSP) is used to leverage the volumes of existing SCSI software. The Serial Management Protocol (SMP) is used simply for managing the new serial point-to-point topology, while the sATA Tunneling Protocol (STP) allows Serial Attached SCSI to interface seamlessly with sATA devices. (See Figure 1) This multi-protocol support, coupled with sATA-compatible signaling and a physical mating scheme capable of directly connecting sATA drives, offers a powerful construct for deploying storage systems that deliver a wide range of storage value.

The Serial Attached SCSI connector is form-factor compatible with sATA. sATA drives will plug directly into Serial Attached SCSI connectors and if supported in the system, will be able to perform as expected. The SSP protocol has the facility to query the device and determine if the drive is a Serial Attached SCSI drive or a sATA storage device and respond accordingly. (See Figure 2) On the other hand, Serial Attached SCSI drives provide a "bump" on the connector that prevents Serial Attached SCSI drives from being inappropriately plugged into a sATA connection.

It's expected that many of the early Serial Attached SCSI connections will support dual porting. By taking advantage of the space between the sATA power connector and the sATA data connector, Serial Attached SCSI cleverly maintains form-factor compatibility with sATA, while allowing for the addition of the second port. This dual-ported functionality is an important aspect in making Serial Attached SCSI robust enough to span a broad range of applications.

The market for parallel SCSI has traditionally been within servers (in the box), close to the server (near-box) or deployed within externally connected NAS and SAN storage subsystems. By offering a replacement interface capable of preserving legacy SCSI software, Serial Attach SCSI offers a viable migration path for existing SCSI users. In addition, the capability of supporting sATA drives through a common connection scheme, allows systems to be deployed that can use either Serial Attached SCSI drives, for their high performance and high-availability characteristics, or sATA drives that will provide a low-cost-per-megabyte alternative in near-line application settings.

Systems implemented using this universal connection scheme can leverage common backplanes and common connector/cabling schemes, which span the range of enterprise storage system needs. Serial Attached SCSI enables a new breed of storage systems by consolidating the infrastructure required to deliver the functionality, compatibility and capability to make it truly a universal connection for the enterprise.

Serial Attached SCSI is well into the standardization process and systems are expected to be shipping in 2004. More information on Serial attached SCSI may be found at www.t10.org or at www.scsita.org
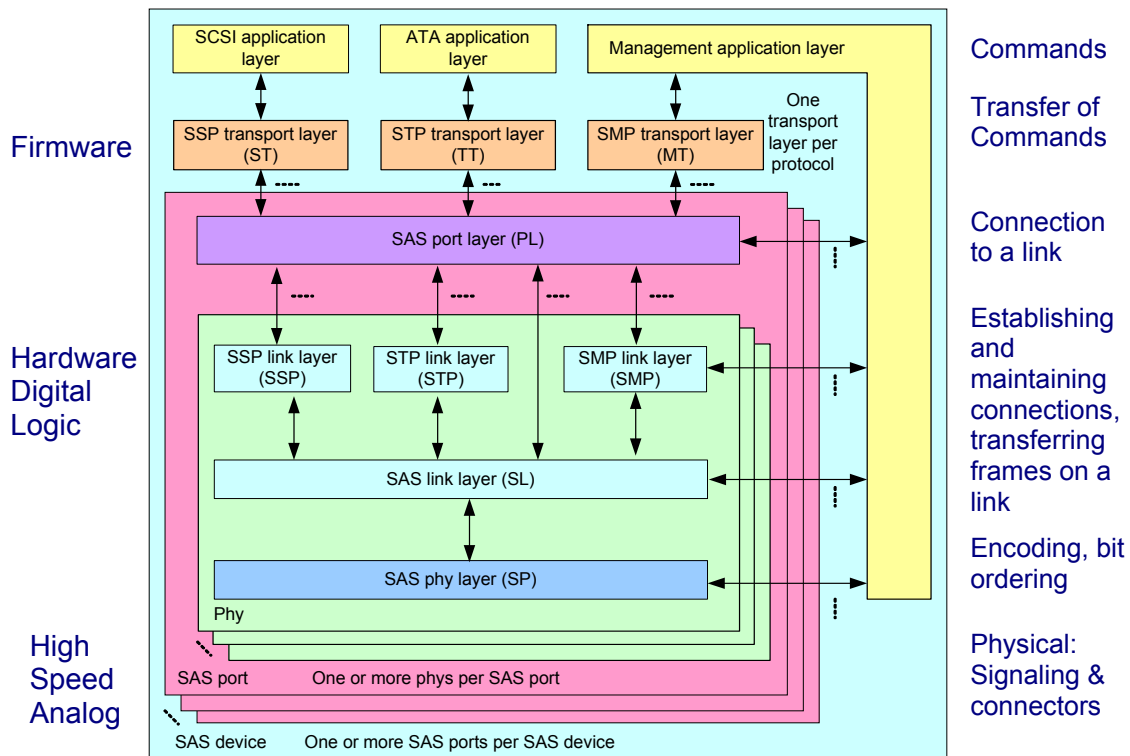
Figure 1; Serial Attached SCSI Multi-protocol Connection Support

Figure 2; Serial Attached SCSI Connections are sATA Compatiable and Support Dual-ported Connections as well. (Coutesy of Molex)

SAS Port 1

Power

SAS Port 2 (on backside)

Serial attached SCSI

Serial ATA

SAS Backplane

Power

SATA/ SAS Port 1

SAS Port

Note: SATA backplane connectors will NOT accept SAS drives