A New Technology Hits the Enterprise Market: Serial Attached SCSI (SAS)

A New Interface Technology Addresses New Requirements

Enterprise data access and transfer demands are no longer driven by advances in CPU processing power alone. Beyond the sheer volume of data, information routinely consists of rich content that increases the need for capacity. High-speed networks have increased the velocity of data center activity. Networked applications have increased the rate of transactions. Serial Attached SCSI (SAS) addresses the technical requirements for performance and availability in these more I/O-intensive, mission-critical environments.

Still, IT managers are pressed on the other side by cost constraints and the need for flexibility and scalability in their systems. While application requirements are the first measure of a storage technology, systems based on SAS deliver on this second front as well. Because SAS is software compatible with Parallel SCSI and is interoperable with Serial ATA (SATA), SAS technology offers the ability to manage costs by staging deployment and fine-tuning a data center’s storage configuration on an ongoing basis. When presented in a small form factor (SFF) 2.5” hard disk drive, SAS even addresses the increasingly important facility considerations of space, heat, and power consumption in the data center. The backplanes, enclosures and cabling are less cumbersome than before. Connectors are smaller, cables are thinner and easier to route impeding less airflow, and both SAS and SATA HDDs can share a common backplane.
Getting this new technology to the market in a workable, compatible fashion takes various companies coming together. Various components need to be designed, tested, and validated as interoperable. These components include HBAs, hard disk drives, backplane and enclosure. Companies such as Fujitsu and LSI have taken the necessary steps in order to supply the market with the necessary products to capitalize on this new technology.

Data requirements in the enterprise fall into three broad categories: Throughput Intensive, characterized by large, high MB/s files requiring large block read/writes (like audio, video, and graphics); Transaction Intensive, involving high-velocity calculation and high volume random small block read/writes (like financial and commercial transactions); and Reference Systems, utilizing fixed or archival data handled in large block sequential read/writes (like imaging).

SAS technology satisfies requirements in all these categories. Its full duplex architecture allows simultaneous bi-directional data and command transfers, effectively doubling throughput. Its wide port capabilities allow multiple high-speed physical links to be combined into a single faster high-speed port to aggregate the bandwidth of those physical links. SAS dual porting capability and the ability to support I/O requests from more than one controller at a time (multi-initiator) also enables the design of dynamic load balancing systems and redundant path configurations to further increase performance and reliability.

As a result, IT managers can use SAS to achieve the enterprise-class storage and network performance they need, protect their investments in SCSI software and middleware, and provision as they choose with desired hard disk drives (SAS or SATA)—for the optimal mix of high-performance and low cost per GB storage required by the unique requirements of their own environment—while allowing maximum possible connectivity of up to 16,384 devices (when deployed with edge and fan-out expanders).

SAS technology compares very favorably with the Fibre Channel interface technology, which is the other Enterprise serial interface. Fibre Channel is usually configured in an arbitrated loop when connected to drives. The arbitration overhead increases and overall performance decreases with every drive added since the loop effectively results in all hard disk drives relying on a shared bus to communicate with the host system. By comparison, the point-to-point connection of SAS better enables scalable processing with dynamic load balancing. Through the use of SAS expanders (effectively high-speed switches) within the enclosures each drive is allowed a dedicated connection to the host making arbitration unnecessary and resulting in vastly improved performance.

SAS technology allows for scaling significantly beyond Parallel SCSI, as indicated in Figure 2. Even though U320 SCSI technology has a higher nominal throughput vs. SAS on a single
drive basis, the shared bus limitation imposes a bottleneck on system performance. The performance scalability of SAS when adding drives to a system far exceeds the minimal bandwidth advantage of Parallel SCSI. SAS is therefore the logical choice if scalability is a key requirement.

LSI and Fujitsu are the first manufacturers to exploit these new capabilities to their fullest, starting with the first 3Gb/second SAS enterprise hard disk drive in a SFF 2.5", LSI Logic’s SAS3442X HBAs and SAS expander ICs. With smaller form-factor hard disk drives, a greater number of SAS hard disk drives can be installed in lieu of conventional 3.5" hard disk drives, thus increasing total capacity and spindle density in the same physical area as well as improving I/O performance. Everything becomes smaller! The smaller form factor also reduces power consumption and heat dissipation. LSI Logic’s expanders and HBAs allow for fast and highly reliable data flow across all connections.

Proven Performance

Figure 3 illustrates a 443% increase in performance (4KB sequential read) when implementing the SAS interface technology vs. traditional SCSI. The system components used for this data were 16 Fujitsu 2.5" SAS hard disk drives, two LSI Logic SAS3442X HBAs and four LSI SASx12 expanders.

The current generation of Fujitsu’s 2.5" SFF SAS hard disk drives have capacities of 36.7GB (MAV2036RC) and 73.5GB (MAV2073RC). They log a mean-time-between-failure (MTBF) of 1,400,000 power-on hours. The hard disk drives are hot pluggable, so they can be inserted or removed without harming the data or the system while the entire system is still powered on. The vastly simplified SAS four-wire interconnect also makes hot plugging easier. The 3Gb/s SAS interface of the Fujitsu hard disk drives allows customers to take advantage of the increased performance associated with Serial Attached SCSI, while at the same time providing lower heat dissipation, lower acoustics and lower power.

As a leader in storage technology globally, Fujitsu has been a leader in development of the SAS standard and is a member of the SCSI Trade Association.
LSI Logic helped define the SAS standard and actively works with industry-leading partners like Fujitsu to assure the highest level of interoperability for its full line of SAS controllers, expanders, and HBAs. LSI Logic’s first generation of SAS HBAs will be available in four and eight port options with a wide variety of internal and external connector configurations to support any application.

### SAS vs. SCSI vs. FC

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**Delivering What the Market Requires**

LSI and Fujitsu have taken on the challenge now facing the enterprise market. We are delivering a total solution that is tested and proven. We have answered the call to deliver a total solution that will require less power, less floor space, increased reliability, and higher performance.

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