White Paper

Small Form Factor (SFF) SAS

Meeting the Demanding Requirements in Specific Markets

Enterprise data access and transfer demands are no longer driven by advances in CPU processing 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 inreased 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 (HDD), 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. With SAS, connectors are smaller, cables are thinner and easier to route impeding less airflow, and the same backplane can accommodate either SAS or SATA HDDs.

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 and protect their investments in SCSI software and middleware, while allowing maximum possible connectivity of up to 16,384 devices (when deployed with edge and fan-out expanders).

SAS technology allows for scaling significantly beyond Parallel SCSI, as indicated in Figure 1. 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 hard disk 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.

AIC and Fujitsu are among the first manufacturers to exploit these new capabilities to their fullest, starting with the Fujitsu 3rd generation 3Gb/sec SAS enterprise hard disk drive in a SFF 2.5" canister, model # XC-28-SA1-2, which can host eight SFF hard disk drives in two standard 5.25" size bays. AIC also has 1U 10x and 2U 24x SFF bay server (Model # RSC-1A-SA1-2 and RSC-2A-SA1-2) while its Xtore business unit offers the JBOD version (Model #XJ-SA26-110R and XJ-SA26-224R). 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.

Proven Performance

The current generation of Fujitsu 2.5" SFF SAS hard disk drives have capacities of 36GB to 147GB, offered at either 10K (MBB series) or 15K (MBC series) RPM. 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/sec 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.

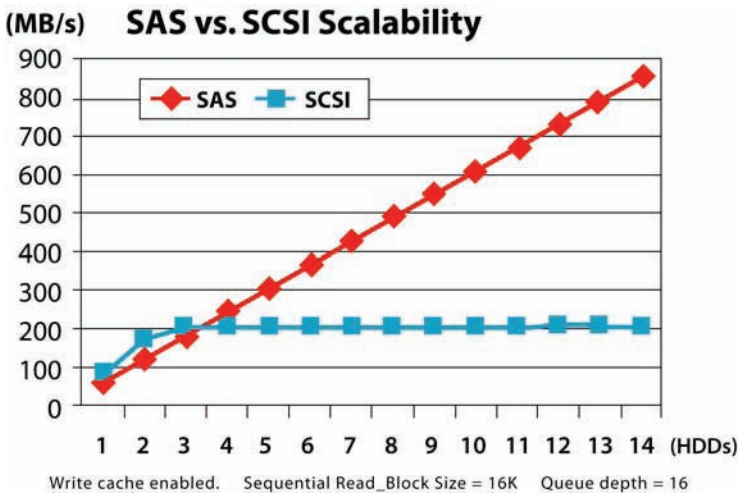

Figure 1

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.

AIC has been focusing on storage enclosures for the past five years and was one of the first vendors to team up with Fujitsu to develop 2.5" SFF SAS HD D enclosures. AIC's BR-SAS28 canister enables anyone wishing to quickly transition to SAS to simply drop this canister into existing deployed servers that have at least two open 5.25" bays. Self-contained cooling is completely server independent. For anyone with a bigger appetite, AIC also offers 1U 10xSFF bays as well as 2U 24xSFF bay server enclosures. The JBOD lines with identical configuration are offered through the Xtore business unit. RAID versions will also be available by Q2 of 2006. AIC is also a member of SCSI Trade Association.

SAS vs. SCSI vs. FC			
	SCSI	**SAS**	**FC**
Performance	Parallel Bus	Full Duplex	Full Duplex
	3.2Gb/sec	3.0Gb/sec	4.0Gb/sec
	Extensive Command Queuing	Extensive Command Queuing	Extensive Command Queuing
	No XOR Support	XOR Support	XOR Support
Connectivity	12m internal cable	>6m external cable	6m external cable
	15 devices	128 devices	>128 devices
	Arbitrated bus	Peer to peer	Arbitrated loop
	Interconnect not compatible with SAS or SATA	Interconnect compatible with SATA	Not compatible with SAS or SATA
Availability	Single port	Dual port	Dual port
	Multi initiator	Multi initiator	Multi initiator
	Hot swappable (80 pin)	Hot swappable	Hot swappable
Driver Model	Software not transparent with SAS	Software transparent with parallel SCSI	Software transparent with parallel SCSI
Form Factor	3.5”	2.5” / 3.5”	3.5”

(Source: IDC)

Market Applications

Some of the markets that have desired these higher performance SFF SAS hard disk drives include digital content delivery, medical imaging and the military. Before SAS technology was available, the majority of medical imaging storage was Parallel SCSI based. To save a typical image file of 3GB in size, it would take an average of 15 seconds or more. With scalable 3.0Gb/sec SAS technology and using 2.5” SFF hard disk drives, thereby doubling the spindles’ density (12x 3.5” HDD vs. 24x 2.5” SFF HDD in a 2U storage enclosure), performance can be greatly improved. Each 3GB file can take less than half the amount of time. This means greater turnover rate on the patients’ data/records, which helps quicken the diagnosis and subsystem treatment for patients. The end result is quicker recovery time. More patients can be seen within a certain time frame. The ROI made with this SAS technology is realized much sooner than with previous technologies and products.

For applications within the digital content delivery industry such as Video On Demand (VOD), having higher throughput due to higher spindle density means less master copies are needed to serve the same amount of viewers. The cost on the 2.5” SAS HDDs becomes relatively unimportant when compared to the huge savings realized from reduced copying expenses.

Finally, for military market, the characteristics of 2.5" SAS HDDs, such as small form factor, high availability, high performance and low power consumption, are all ideal for many of the industries' applications.

As SAS technology continues to gain a stronger foothold in the industry, markets that can take advantage of the new SFF SAS HDD technology will continue to grow.

Delivering What the Market Requires

AIC and Fujitsu have developed a solution that delivers the necessary performance needed for today's expanding market requirements. We are delivering a solution that is proven. We have been able to give these markets a solution that far exceeds anything they had been previously using – a solution that requires less power, less floor space, increased reliability and higher performance.

About Fujitsu Computer Products of America, Inc.

Fujitsu Computer Products of America, Inc. is a subsidiary of Fujitsu Limited, a leading provider of customer-focused IT and communications solutions for the global marketplace. FCPA provides innovative solutions for the U.S. marketplace. Current product and service offerings include high performance hard disk drives, Magneto-Optical drives, scanners and scanner maintenance, palm vein technology and 10Gb Ethernet switches.

About Advanced Industrial Computer, Inc (AIC)

AIC is the industry's leading designer and manufacturer of Rack-mount Server and Data Storage enclosure solutions. With over 100 years of combined experience between the mechanical, electronic and system level engineering teams, AIC leads the industry in all categories. For further information on Advanced Industrial Computer, Inc. (AIC) and its SAS server lines, please call (866) 800-0056 or visit http://www.aicipc.com. For more info on Xtore Business Unit and its SAS JBOD lines, please point your browser to http://www.xtore.com.