

The Significance of 2.5” SAS Hard Disk Drives in Enterprise Deployments

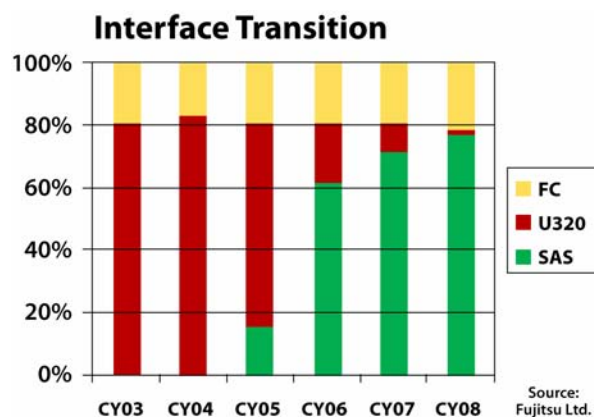
Enterprise data access and transfer demands are no longer driven by advances in processing systems alone. Beyond the sheer volume of data, data routinely consists of rich content that increases the need for capacity. High-speed networks have increased the velocity of data center activity. Networked applications 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 backwards 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 configuration on an ongoing basis. When presented in a small form factor (SFF) 2.5” hard disk drive, SAS even addresses the facility considerations of space, heat, and power consumption in the data center.

Data requirements in the enterprise fall into three broad categories: *Throughput Intensive*, characterized by large, high MB/s files requiring random 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 also enables the design of dynamic load balancing systems.

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



This compares very favorably with alternative technologies. The other Enterprise serial interface is Fibre Channel, which is usually configured in an arbitrated loop when connected to drives. The arbitration overhead increases with every drive added to the loop, and impacts the overall performance. By comparison, the point-to-point connection of SAS better enables scalable processing with dynamic load balancing.

Figure 1

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 scalability of SAS when adding drives to a system far outweighs the limited performance advantage of Parallel SCSI. SAS is therefore the logical choice if scalability is a key requirement.

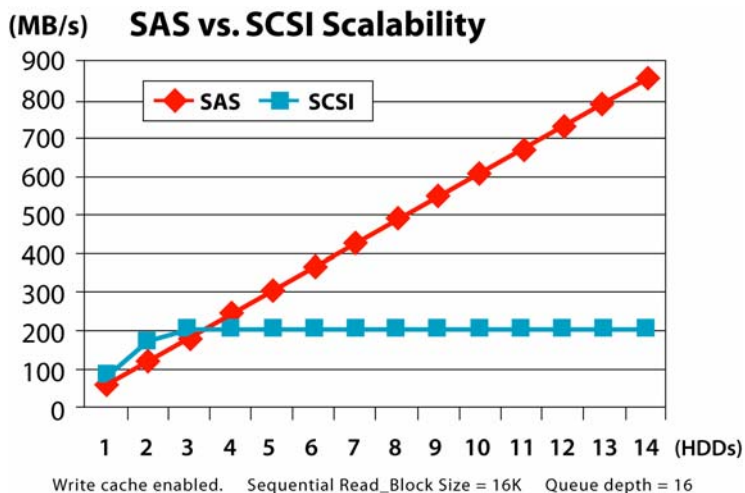


Figure 2

Fujitsu is the first manufacturer to exploit these new capabilities to their fullest, starting with the first 3Gb/second SAS enterprise hard disk drive in a 2.5” enclosure. With this smaller form-factor, a greater number of SAS hard disk drives can be installed in lieu of conventional 3.5” hard disk drives, thus increasing total capacity in the same physical location as well as improving I/O performance. The smaller form factor also reduces power consumption and heat dissipation.

Figure 3 illustrates a 398% 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 SAS 3441X HBAs and two LSI SASX12A1 expanders.

Fujitsu has demonstrated SAS interoperability with SATA hard disk drives at the University of New Hampshire InterOperability Laboratory (UNH-IOL) Plugfest. In fact, it is the only manufacturer capable of showing this kind of interoperability for its hard disk drives. Both SAS and SATA hard disk drives share the ability to do Native Command Queuing—an execution technique previously unique to SCSI and FC hard disk drives—providing faster execution of operation commands.

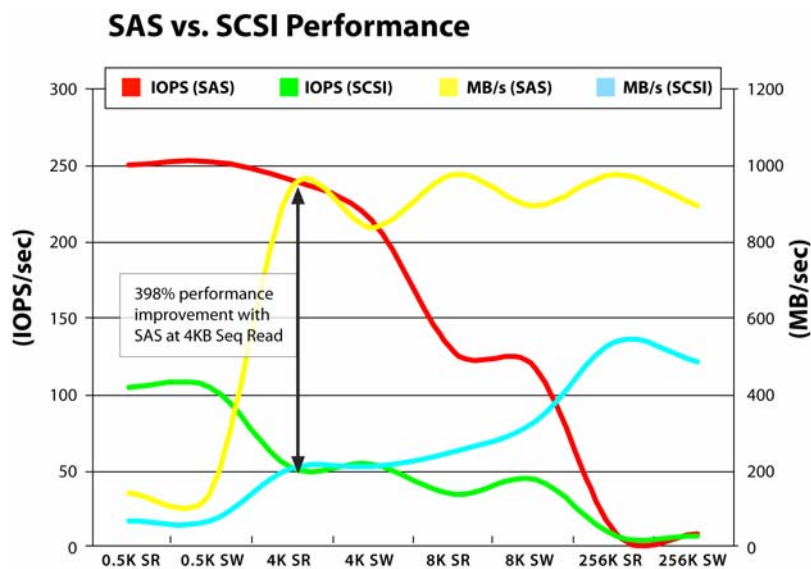


Figure 3

The current generation of Fujitsu 2.5” SFF SAS hard disk drives have capacities of up to 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. Host Bus Adapters and expanders are available from Fujitsu partners LSI Logic and AIC.

SAS vs. SCSI vs. FC

	SCSI	SAS	FC
Performance	Parallel Bus	Full Duplex	Full Duplex
	3.2Gbps	3.0Gbps	4.0Gbps
	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	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"

(IDC 2004)

Figure 4

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