INFOSTOR

Serial ATA: The truth behind the hype

Beyond being a replacement for Parallel ATA (and an alternative to SCSI and Fibre Channel), Serial ATA will provide benefits in NAS/SAN configurations.

By Jin-Lon Hon and Sasha Sirisena

The major PC/server drive interfaces today include IDE/ATA, SCSI, and Fibre Channel. The predominant interface is IDE—also referred to as ATA—which is available in a variety of implementations, including ATA/ATAPI, EIDE, ATA-2, Fast ATA, ATA-3, Ultra ATA, Ultra DMA, and others. IDE/ATA is used on the majority of PCs and offers excellent performance at relatively low cost.

IDE was designed primarily for desktop PCs and notebooks. Although the interface had some success in workstations, it was not considered adequate for servers until recently, however.

SCSI is the second most popular hard-disk interface and has been the workhorse of the server and workstation markets for nearly 15 years. The interface gained popularity quickly because it defined a bus, rather than a direct connection between two storage peripherals. Therefore, several devices could be chained together and controlled from a common I/O channel controller. The bus-oriented I/O channel dramatically improved the level of storage capacity that could be supported by a single host.

The interface also became popular because it provided the first physical separation of storage devices from host computers. Because SCSI embeds intelligence by incorporating many of the instructions necessary to communicate with a host, much of the I/O commands are offloaded from the processor onto SCSI controllers. Today, the SCSI I/O command protocol is nearly the de facto choice for block data transfers in enterprise-level subsystems; however, mainstream markets have been hesitant to switch over to SCSI, mainly because it is not cost-effective enough for the typical home or desktop PC.

Comparing interfaces

Feature	FC	SCSI	ATA/IDE
Pin count	4	50/68	40
Distance	10km	18m	0.48m
Cabling	Fiber-optic/ copper wire	Ribbon cable	Ribbon cable
Maximum number of drives per channel	125	15	2
Command queuing	Yes	Yes	Limited
Maximum transfer rate	200MBps 2GBps	320MBps	100MBps (UDMA-100)
Price	Highest	High	Low

FIBRE CHANNEL

Fibre Channel is a highly reliable, gigabit-speed interconnect that allows concurrent communications among servers, storage systems, and other peripherals using SCSI and IP protocols. Fibre Channel is used in storage subsystems, hubs, switches, and adapters, providing the ability to implement storage area networks (SANs).

Though Fibre Channel certainly has a role in the enterprise market, providing long-distance connectivity (up to 10km) and connecting multiple systems, it has yet to gain widespread use in mainstream markets compared to other interfaces. This is due to the fact that, like SCSI, it is not cost-effective enough for desktops, workstations, or entry-level servers.

The table highlights some of the features and differences among Fibre Channel, SCSI, and ATA/IDE.

PARALLEL ATA ISSUES

The current IDE/ATA standard is a *parallel* interface, which means that multiple bits of data are transmitted simultaneously. The key advantage of the Parallel ATA interface is it maintains backward

Reprinted with revisions to format, from the June 2002 edition of **InfoStor**

capability with the original PC-AT interface providing high throughput with relatively easy design. However, despite its success, Parallel ATA has a number of potential drawbacks, including

- *High pin count*—Parallel ATA requires 26 signal pins per channel;
- *High voltage*—Parallel ATA requires 5-volt transceivers, which pose integration problems with new silicon processes;
- *Cabling*—The 80-conductor ribbon cable with 40-pin header connections required to support Parallel ATA is relatively expensive, unwieldy to route inside a PC chassis, and restricts airflow within the chassis; and
- *Performance*—Evolving Parallel ATA beyond 100MBps could require technology enhancements, including low voltage differential (LVD) signaling.

To succeed in the enterprise storage market, Serial ATA must have multi-vendor support and a wide range of spindle rates to offer a variety of performance levels.

INTRODUCING SERIAL ATA

Serial ATA overcomes these design limitations by requiring fewer wires, lower voltages, and smaller geometries. Serial ATA provides a serial version of ATA for attaching IDE/ATA hard drives.

Serial storage architectures support flexible configurations, enabling an assortment of system connection options that improve throughput by isolating subtasks from production tasks. Other advantages of serial interfaces include scalability and reliability.

Serial ATA addresses the demand for increased data rates, while resolving many issues that prevent Parallel ATA from being widely used in the enterprise storage market. Serial ATA also provides hot-plug capability, signal integrity, reduced pin count, low voltage, and improved cable and connector layouts for smaller form-factor drives.

Unlike its parallel predecessors, Serial ATA is a point-to-point interface protocol designed for improved scalability. Devices are directly connected to the host via a dedicated link so that each device has the entire bandwidth dedicated to it. There is no interaction between devices. This means that software can be streamlined, eliminating the overhead associated with coordinating accesses between master and slave devices sharing the same cable.

The Serial ATA architecture changes only the physical interface. It conforms to the ATA-PI command set, which is the standard used in today's IDE/ATA drives. It maintains register and software compatibility with Parallel ATA. No device driver changes are necessary, and the Serial ATA architecture is transparent to the BIOS and operating system.

Eventually, Serial ATA drives are expected to be priced about the same as IDE drives, which is significantly less than SCSI or Fibre Channel drives. In addition to direct-attached storage for notebooks, desktops, and servers, Serial ATA drives can be extended into networked storage.

The first generation of Serial ATA runs at a data rate of 150MBps, with products due this year. The second generation of Serial ATA specifies a 300MBps transfer rate and is expected in 2004, followed by 600MBps in the 2007 timeframe.

SERIAL ATA CHALLENGES

However, Serial ATA presents a number of challenges. To succeed in the enterprise storage market, Serial ATA must have multi-vendor support and a wide range of spindle rates to offer a variety of performance levels.

To rival SCSI and Fibre Channel drive quality, Serial ATA needs to provide

- *Unified enclosure management*—A Serial ATA storage subsystem or RAID controller should have the ability to support disk enclosure management, including the monitoring of temperature, fan, power supply, and drive status. SAF-TE and SES are standardized in SCSI and Fibre Channel drive enclosures. An enclosure management standard for Serial ATA-based enclosures will facilitate compatibility between multiple vendors;
- *Robust error handling/reporting*—Reporting SMART features for device failure prediction will give an early warning for drive replacement and prevent drive failure from occurring, thus maintaining performance and fault-tolerance levels;
- *Hot -plug capability*, or the ability to connect and disconnect storage subsystems without turning the system off;
- *Tagged command queuing*, in which the host adapter, driver, and disk drive work together to increase performance by reordering requests from the adapter to minimize head switching and seeking. This allows multiple commands to be queued between the controller and drive, as well as parallel processing and reduced command latency;
- *Dual-path capability*, which reroutes I/O to an alternate path in case of hardware failure (e.g., cable or controller). The benefit is that there is no single point of failure between the server and storage device. Currently, Fibre Channel is the only interface that addresses this function via dual-ported drives; and
- *Price parity* with competing interfaces.

BENEFITS FOR NAS/SAN

The Serial ATA interface was designed to be used inside the server, with limited expandability. But its point-to-point connection, high bandwidth, hot-plug capability, and potential cost advantages may make it attractive for SAN and network-attached storage (NAS) implementations. However, a protocol translator or RAID controller is required to combine multiple drives for the front-end interface.

To take full advantage of Serial ATA's point-to-point architecture and high bandwidth, a RAID controller needs to have a drive/port switching fabric design. A switching fabric is required to provide near non-blocking transfer to multiple servers. It could also be used to cascade multiple Serial ATA drives into a single storage unit for RAID and hot-spare redundancy.

OEMs and systems integrators will be able to integrate Serial ATA-based disk/RAID controllers with their own backplane designs to build SAN-ready Serial ATA subsystems. This simplifies SAN deployment because the subsystem is seen as direct-attached storage, but with SAN benefits such as scalability.

Serial ATA subsystems could also be used with a NAS head to provide a scalable, high-performance NAS system connected to a back-end SAN storage pool. As such, Serial ATA subsystems could play a major role in the convergence of NAS and SAN. ❑

Jin-Lon Hon is senior director of strategic development, and Sasha Sirisena is a technical marketing engineer, at Ario Data Networks (www.ariodata.com) in San Jose, CA.

251573-001