adaptec

SAS and SATA: Unparalleled Compatibility

The Transition to Serial

For over 20 years, the parallel bus interface has been the mainstream storage interconnect for most storage systems. But increasing bandwidth and flexibility demands have exposed inefficiencies in the two main parallel interface technologies – SCSI and ATA. The lack of compatibility between parallel ATA and SCSI – including different connectors, cables, and software – increases costs for inventory management, R&D, training, and product qualification.

While parallel technologies meet most performance requirements of today's enterprise solutions, continued demands for higher speeds, more robust data integrity, smaller designs, and wider standardization cast doubt that parallel technology can economically keep pace with increasing CPU processing power and disk drive speeds. In addition, shrinking budgets are making it increasingly difficult to sustain the costs of developing and managing multiple backplane types, validating multiple interfaces, and stocking multiple I/O connections.

Parallel technology poses still other challenges: Parallel transmissions are susceptible to crosstalk across wide ribbon cable paths that adds line noise and can cause signal errors – a pitfall that has been remedied by slowing the signal, limiting cable length, or both. Terminating parallel signals is another difficulty, requiring individual lines to be terminated, usually by the last drive, to avoid signal reflection at the end of a cable. Finally, parallel's large cable and connector size make it unsuitable for increasingly dense computing environments.

Introducing SAS and SATA

Serial technology, specifically Serial ATA (SATA) and Serial Attached SCSI (SAS), addresses the architectural limitations of its parallel counterparts. The technology draws its name from the way it transmits signals – in a single stream, or serially, compared to the multiple streams found in parallel technology. The main advantage of serial technology is that while it moves data in a single stream, it does so much faster than parallel technology because it is not tied to a particular clock speed. Serial technology wraps many bits of data into packets then transfers the packets at a much higher speed than parallel (up to 30 times faster) down the wire to or from the host.

SATA extends the ATA technology roadmap by delivering disk interconnects speeds starting at 1.5 Gbit/sec (150 MByte/sec). Due to its lower cost per gigabyte, SATA will continue as the prevalent disk interface technology in desktop PCs and sub-entry servers and networked storage systems where cost is a primary concern.

SAS, the successor technology to the parallel SCSI interface, leverages proven SCSI functionality and features while promising to greatly build on the existing capabilities of the enterprise storage connection. SAS offers many features not found in today's mainstream storage solutions such as drive addressability up to 16,256 devices per port and reliable point-to-point serial connections at speeds of up to 3 Gbits/sec. In addition, due to its small connector, SAS will offer full dual-ported connections on 3.5-inch and smaller 2.5-inch hard disk drives, a feature only previously found on larger 3.5-inch Fibre Channel disk drives. This is an essential feature in applications requiring redundant drive spindles in a dense server form factor such as blade servers.

SAS improves drive addressability and connectivity using an expander that enables one or more SAS host controllers to connect to a large number of drives. Each expander allows connectivity to 128 physical links, which may include other host connections, other SAS expanders, or hard disks. This highly scalable connection scheme enables enterprise-level topologies that easily support multi-node clustering for automatic fail-over availability or load balancing.

In one of its most significant advances, the SAS interface will also be compatible with lower cost-per-gigabyte SATA drives, giving system builders the flexibility to integrate either SAS or SATA devices and slash the costs associated with supporting two separate interfaces. As the next generation of SCSI, SAS bridges the parallel technology gap in performance, scalability, and affordability.

Multiple Layers of Compatibility

Hot-plug capability

The SAS connector is a universal interconnection that is form-factor compatible with SATA, allowing SAS or SATA drives to plug directly into a SAS environment whether for mission critical applications with high availability and high performance requirements or lower cost-per-gigabyte applications such as near-box storage.

SATA connector signals are a subset of SAS signals, enabling the compatibility of SATA devices and SAS controllers. SAS drives will not operate on a SATA controller and are keyed to prevent any chance of plugging them in incorrectly.

In addition, the similar SAS and SATA physical interfaces enable a new universal SAS backplane that provides connectivity to both SAS drives and SATA drives, eliminating the need for separate SCSI and ATA drive backplanes. This consolidation of designs greatly benefits both backplane manufacturers and end-users by reducing inventory and design costs.

Protocol layers

SAS consists of three types of protocols, each used to transfer different types of data over the serial interface depending on which device is being accessed. Serial SCSI Protocol (SSP) transfers SCSI commands, SCSI Management Protocol (SMP) sends management information to expanders and SATA Tunneled Protocol (STP) creates a connection that allows transmission of the SATA commands. By including all three of these protocols, SAS provides seamless compatibility with today's existing SCSI applications, management software, and SATA devices.

This multi-protocol architecture support, coupled with the compatibility of SAS and SATA's physical connection, allows SAS to operate as the universal interconnection for both SATA and SAS devices.

Benefits of Compatibility

SAS and SATA compatibility offers a number of benefits to system builder integrators and end users.

System builders can now leverage the universal SAS/SATA connection to deploy common backplanes and common connector and cabling devices. Upgrading from SATA to SAS will be as simple as replacing the disk drives. With parallel technologies, upgrading from ATA to SCSI means replacing backplanes, connectors, cables and drives. Other cost-saving benefits of compatibility include simpler validation and inventory management.

VARs and System Integrators will be able to easily configure custom systems by simply installing the appropriate disk drive since working with dissimilar technologies and using specialized connectors and different cabling will no longer be necessary. Moreover, the added price/performance flexibility will better enable VARs and System Integrators to differentiate their products.

For end users, SAS and SATA compatibility offers a new level of price/performance flexibility. SATA drives will suit those requiring the best price advantage for servers and storage deployments, while SAS drives will deliver the highest performance, reliability, and software management compatibility. The ability to upgrade from SATA to SAS drives without having to buy a new system will greatly simplify the purchasing decision, future-proof system investment, and reduce the total cost of ownership.

Committee Collaboration

On January 20, 2003, the SCSI Trade Association (STA) and the Serial ATA (SATA) II Working Group announced a partnership to enable SAS system-level compatibility with SATA hard disk drives.

This collaboration, as well as cooperation among storage vendors and standards committees, will further define compatibility guidelines – a move that will help system builders, IT professionals, and end users more finely tune their systems to optimize application performance and reliability and reduce total cost of ownership.

The SATA specification reached revision 1.0 in 2001, and SATA products are available today from a variety of manufactures. The SAS specification revision 1.0 is targeted for release in early 2003, with product availability in the first half of 2004.

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