Technical
BRIEF

3ware®

# Serial ATA—
# Enterprise Strength Storage at Low Cost

## Serial ATA Basics

The vision for Serial ATA (SATA) is that its low cost, high reliability, and scalable connectivity will create a huge market for inexpensive, networked storage solutions enabling new applications for RAID protected data. For the first time, the advantages of RAID will be realized across the entire corporate data set.

Serial ATA comprises a revolutionary storage solution that is now available at mainstream computing prices. To understand the significance of Serial ATA, it is useful to examine its key features.

**Software Compatible** – To system software, a Serial ATA device is indistinguishable from a legacy UDMA/ATA device

**Serial Cable** – Serial ATA devices connect to systems using an inexpensive cable that provides compact connectors compatible with high-density server requirements. This allows Serial ATA to reduce the required number of signals from the 26 signals parallel ATA uses to 4.

**Single Device per Cable** – Serial ATA abandons the Parallel ATA Master/Slave concept and only allows one device per cable which systems view as a Master ATA device.

*3ware® combines an advanced switched RAID architecture (StorSwitch) with SATA drives to deliver a premium performance, high-availability storage solution.*

**Serial Transmission** – Serial ATA uses 8B/10B serial transmission to transfer data over the serial cable. This high data-integrity scheme is widely accepted as the reigning de facto serial transmission scheme and is used in numerous technologies including Gigabit Ethernet and Fibre Channel.

**Low Voltage Differential Signaling** – Serial ATA uses low voltage differential signaling (LVD) consistent with low power and cooling requirements.

**10 Year Growth Road Map** – Serial ATA roadmaps specify three generations that transfer data at 150 Mbytes/sec, 300 Mbytes/sec, and 600 Mbytes/sec device burst rates.

Resourceful product developers are racing towards product introductions that exploit Serial ATA technology. SATA disk drives will be used to develop innovative enterprise storage offerings deploying RAID data protection in applications that could not previously be reached due to higher integration costs.

It has always been argued that enterprise disks have features – such as scatter-gather DMA support, command coalescence and command queuing to accelerate disk operations and hot-plugging – that were absent in parallel ATA drives. The good news is that these features can be implemented through driver software and controller firmware and do not need to be in the disks themselves.

## Why design with SATA?

Without a doubt, both Parallel SCSI and Parallel ATA have proven to be venerable workhorse technologies for the storage industry. The problem is that any parallel transmission requires increasingly tricky (expensive to design) coordination and timing compensations at progressively higher transmission rates. Serial ATA will run at 1,500 MHz, 3,000 MHz, and 6,000 MHz over three generations.

Using serial technology with 8B/10B byte encoding completely bypasses the parallel transmission problems. 8B/10B encoding provides the essential embedded timing and significant data integrity checking provisions that high-speed transmission requires. Combined with 32-bit CRC checking at a data block level, the data integrity protection level far exceeds that of Parallel ATA and is comparable to higher-end disk interface technologies, including SCSI and Fibre Channel.

The challenge the storage industry faces is to continue increasing Interface bus transfer rates beyond current maximums while delivering value priced economy solutions for a broader vertical market segment. The current SCSI interface transfer speed of 320Mbyes/sec took significantly longer to develop than the industry had anticipated. With the challenging design requirements necessary to reach transfer rates greater than 320MB/s the SCSI industry is now considering Serial Attached SCSI (SAS) as a speed salvation. In other words, the SCSI industry is following Serial ATA's lead and is considering discarding the shared parallel bus architecture by providing dedicated cables to each hard drive – just like Serial ATA offers today.

With the demand for ATA disk drives outpacing SCSI by 10:1, it was critical to focus technology improvements on ATA drives to increase reliability and maintain competitiveness. Consequently, for the last half decade, technology now first appears on UltraDMA disks and then moves to other interface technologies. Specific examples include CRC, Dual Edge clocking, GMR heads, and multi-segment CAM assisted caching (Content Addressable Memory cache search accelerators).

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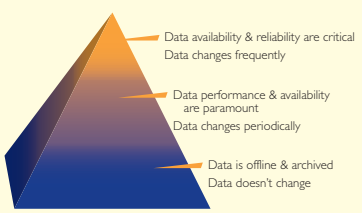
Some enterprise storage observers note that SCSI disks are more reliable than ATA disks. This may indeed be true, partially as a consequence of the impossibility of burning in 100's of millions of ATA disks prior to shipping them. However, the extremely competitive nature of the ATA drive market makes the ATA disk drive manufacturers develop much better manufacturing methods for ATA drives resulting in many ATA drives reaching hundreds of thousands of hours MTBF (mean time between failure).

Today, many entry Network Attached Storage (NAS) products and entry servers found within enterprises use ATA drives. Moreover, there are numerous applications such as backup and near-line storage for which ATA drives are proving to be a ubiquitous solution component, not to mention bandwidth applications such as video surveillance, video manipulation, near-line storage, and high bandwidth back up and recovery procedures that use disks instead of tape.

**STORAGE HIERARCHY**




An optimal Serial ATA solution would have the following characteristics:

- *A compact, efficient host driver that coordinates motherboard requests with a powerful, intelligent host bus adapter*
- *A host bus adapter that provides high performance hardware RAID using a cost-effective dedicated on-board processor and firmware that provides intelligent drive management for a plurality of dedicated Serial ATA disk drives and all RAID functions.*
- *An on-board processor that handles all disk commands and directs data flow for reliable RAID operation, independent of the host CPU and O/S*
- *A dedicated port for each disk drive, providing greater system reliability through individual drive and cable fault isolation*
- *A PCI bridge chip*
- *Efficient memory buffer to speed match collective device transfer rates to the system bus and minimize RAID 5 I/O transfer activity*
- *Switched architecture that interleaves sector fragments, thereby providing service level guarantees to individual disk connections*
- *Multiple, minimum cost, on-board support chips that each handle the voltage required to support four disks*
- *Support for a total of four to sixteen Serial ATA connections*
- *Microsoft® Win 2K and Red Hat Linux SCSI device driver support, possibly followed by Solaris, Open BSD, etc.*
- *Compatible with low-power, single mobile Pentium/AMD processor motherboards and blades as well as systems with up to N-processors*
- *Special systems unit case to house up to 32 UDMA disks with motherboard and ancillary adapters*
- *Simultaneous I/O operations on different adapters and disk connections*
- *Optional host bus adapter system boot support*

## Serial ATA RAID – Affordable and Reliable

Serial ATA represents a significant storage breakthrough for the enterprise:

- Native Serial ATA configurations can generate significantly lower-cost, scalable attachment alternatives that exhibit high levels of performance and usability.
- Serial ATA enables applications beyond native motherboard disk subsystems. Serial ATA's low-cost disks will also dramatically expand the application of RAID technology within numerous existing arenas such as video editing, NAS, and security applications that require cavernous capacities and voracious sustained bandwidths.
- With virtually no motherboard impact, well planned system-perspective designs blending software, firmware, and hardware can enhance the performance features of existing Serial ATA disk drives, closing the gap with SCSI disk drive performance and features at a fraction of the cost. These features include command queuing, elevator-seek acceleration and dynamic sector repair that contribute to data availability and robustness.

Serial ATA provides innovative system integrators and VARs an opportunity to develop highly differentiated storage solutions. With a Serial ATA point-to-point architecture, performance scales linearly, allowing for much greater price/performance in the enterprise. The benefits of price/performance and the emergence of RAID in diverse new vertical applications will surely put Serial ATA offferings at the forefront of the storage solutions landscape.

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