

Unleashing the Power of 6Gb/s SAS with Adaptec by PMC Series 6 Controllers



Introduction

The first-generation Serial Attached SCSI (SAS-1) interface, introduced in 2005 as an improvement over the parallel SCSI protocol, shared parallel SCSI's reliability and robust command set, but represented a major step forward in the storage ecosystem. Boasting data transfer speeds of up to 3Gb/s, SAS also introduced support for wide ports, dual-port SAS drives, multiple simultaneous point-to-point connections, aggregated bandwidth, and full-duplex data transmission while at the same time maintaining compatibility with the SCSI protocol.

The introduction of point-to-point connectivity was a major breakthrough for SAS. While parallel SCSI supports 320MB/s on a shared bus (approximately 3.2 Gb/s), the shared bus topology can severely bottleneck the system because one underperforming device can negatively impact the performance of all connected devices. The serial point-to-point connectivity of SAS, on the other hand, is not subject to such limitations.

Over the years, as the need for higher drive counts, higher drive density, better security and flexible scalability increased, SAS technology proved to be far superior to parallel SCSI technology for direct-attached storage in server applications, and quickly displaced its aging predecessor in enterprise environments.

But, thanks to the proliferation of multimedia streaming, social networking, banking and financial services, and cloud computing, storage demands have continued to escalate and have begun pushing the limits of 3Gb/s. Faced with stagnant or even shrinking budgets, data centers are being asked to do more with less infrastructure, prompting the storage industry to build upon the success of 3Gb/s SAS and develop the next-generation protocol.

The industry has responded with the introduction of 6Gb/s SAS — a new standard based on the SAS-2 specification, which, according to the SCSI Trade Association (STA), offers “more bandwidth per connection, greater scalability, and enhanced features” compared to 3Gb/s.

In traditional direct-attached applications (such as internal server storage), 6Gb/s-enabled devices provide better performance, flexibility and value than 3Gb/s devices. The faster data rates of 6Gb/s allow for more storage capacity per server and larger storage topologies. Overall system performance is improved as well, as 6Gb/s allows a server's I/O requests to be distributed across a greater number of devices.

In fact, the performance of an end-to-end 6Gb/s SAS storage solution could easily rival that of a Fiber Channel solution at a fraction of the cost.

Reaching these new heights required several key enhancements to the SAS standard, as outlined in the next section.

6Gb/s SAS vs. 3Gb/s in the Enterprise

The great news for enterprises is that the 6Gb/s standard is compatible with existing SATA- and SAS-based architecture. Quoting again the STA: “3Gb/s SAS usage models will be preserved in 6Gb/s SAS along with the retention of 1.5Gb/s and 3Gb/s SAS/SATA compatibility. There are many other targeted improvements beyond first generation 3Gb/s SAS, assuring enterprise storage users that SAS technology will continue to meet their needs.”

Highlights

6Gb/s Benefits

New standard based on SAS-2 specification

- Delivers greater performance, flexibility, and value than 3Gb/s
- End to end 6Gb/s solutions rival Fiber Optics at a fraction of the cost

Full compatibility with existing SATA- and SAS-based architecture

- No need to rebuild storage infrastructure from scratch

Double performance vs. 3Gb/s plus additional enhancements

- Standardized zoning
- Expander self-discovery
- Longer cable allowance

Adaptec Series 6 Benefits

Designed for 6Gb/s

- Built upon PMC-Sierra's market-leading multi-core SRC 8x6G RAID-on-Chip

Proven compatibility with existing ecosystems

- Tested with more than 300 third-party devices

Advanced features

- ZMCP eliminates BBUs
- IPM reduces storage energy and cooling consumption
- Hybrid RAID support for SSDs and HDDs

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While the doubling in performance is the most obvious benefit of the 6Gb/s SAS standard, it also offers additional benefits and opportunities for enterprise storage applications compared to 3Gb/s, including:

- **Standardized zoning:** The enormous scalability of the SAS-1 standard (up to 128 expanders, each supporting up to 128 SAS devices) required the practice of separating large groups of storage devices or subsystems into zones. Unfortunately, since there was no zoning standard set by SAS-1, different vendors have implemented it in different — often incompatible — ways, which can lead to inaccessible storage. The SAS-2 specifications standardize zoning to provide improved multi-host support and security.
- **Expander self-discovery:** With SAS-1, the host controllers are charged with the task of discovering new devices and other topology changes, generating increased traffic between the hosts and the expanders, which requires more time to configure systems. SAS-2 shifts the detection function to the expanders themselves, allowing for faster discovery (as the expanders can discover in parallel), and increased scalability. At the same time, any vendor-specific proprietary solutions are also eliminated.
- **Longer cable allowance:** 3Gb/s SAS allows a maximum cable length of 6 meters. 6Gb/s SAS stretches the limit to 10 meters — a 67% increase — to allow network-attached storage expansion to multiple racks. To facilitate reliable transfers over the expanded cable length, 6Gb/s SAS introduces Decision Feedback Equalization (DFE) technology. DFE reduces signal interference to allow the use of longer cables with no loss in signal integrity.
- **Spread Spectrum Clocking (SSC):** The high data frequencies of 6Gb/s increase the chances of creating electromagnetic interference (EMI). SSC oscillates the clock signal of the data frequency to reduce EMI emissions, making it easier for OEMs and integrators to meet FCC requirements. SSC is required for 6Gb/s implementations, but not for 3Gb/s generation installations.
- **Connection multiplexing:** This protocol allows companies to protect their existing infrastructure investments by enabling a faster server to accommodate multiple logical links. For example, a 6.0Gb/s server can communicate with two 3.0Gb/s devices simultaneously.
- **Mini-SAS connectors:** 6Gb/s SAS does away with expensive InfiniBand connectors in favor of mini-SAS (also known as iPass) connectors for both internal and external connectivity. These connectors are compatible with 3Gb/s devices and are becoming commonplace in the data center.

- **Tiered storage options:** Connecting high-capacity SATA Hard Disk Drives (HDDs) with high-performance SAS HDDs is becoming commonplace in many storage environments. 6Gb/s SAS offers a range of tiered storage options that allow data centers to mix and match various SAS and SATA devices and interfaces to meet their desired cost, performance and capacity goals.

These enhancements are rapidly being adopted by supporters of the 6Gb/s SAS ecosystem — including OEMs, semiconductor suppliers, board suppliers, drive manufacturers and RAID card manufacturers — and are expected to help the 6Gb/s SAS protocol move beyond blade storage and shareable DAS and into new applications.

6Gb/s Opportunities

The arrival of 6Gb/s SAS into the mainstream opens up incredible opportunities for data centers looking to expand their current 3Gb/s storage infrastructure without rebuilding it from scratch and without compromising interoperability and compatibility.

Data centers immediately benefit from the backward compatibility offered by 6Gb/s SAS devices because it ensures they can add the newest technology to their storage networks without needing to remove older SATA and 3Gb/s SAS components.

On the larger scale, any data center faced with the challenge of accommodating more users, more traffic, and more data in the face of shrinking budgets, shrinking staffs, and shrinking infrastructure availability will benefit from making the move to 6Gb/s SAS. 6Gb/s SAS is easy to deploy into existing infrastructure and offers flexibility and scalability to grow as the company grows. A few sample industries that will benefit from 6Gb/s SAS include:

- **Online retailers:** Nothing frustrates a retailer more than when potential customers drop off because of a laggy website. Faster data transactions mean fewer lost sales.
- **Financial institutions:** As banks and financial institutions continue to promote online transactions and services for their customers, their inventory of data will continue to grow and challenge their systems to keep up.
- **Medical offices:** Hospitals and doctor offices must process large medical imaging files and electronic patient records.
- **Government:** All government entities process huge amounts of paperwork and must adhere to strict record-keeping and archiving requirements.

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Moreover, some common applications that will see immediate improvement from 6Gb/s SAS include:

- Data centers
- Web hosting
- Video editing
- Cloud-based storage systems
- Streaming on-demand video
- Database and email servers
- File, web, OLTP and desktop servers

Adaptec Series 6 RAID Controllers

Designed for the 6Gb/s ecosystem, the Adaptec by PMC Series 6 is a family of low profile MD2 form factor Unified Serial RAID controllers designed to deliver performance, scalability and the highest level of maintenance-free data protection offering great value for customers and reduced operating costs.

The Adaptec by PMC Series 6 features PMC-Sierra's industry-proven, multi-core SRC 8x6G RAID-on-Chip (ROC), 512MB DDR2 667MHz cache to deliver up to 60% higher sustained sequential throughput than previous generation Adaptec controllers and over 2GB/s sustained data transfer rate to a host of applications that require high bandwidth. At peak performance, this solution offers 4.8GB/s through up to eight SAS 2.0 interfaces and 4GB/s through the eight-lane PCIe Gen2 host interface.

The Adaptec by PMC Series 6 offers internal and external connectivity for SATA and SAS storage. With four to eight internal ports and up to four external ports using mini SAS connectors, it supports up to eight direct connected devices and up to 256 SATA/SAS devices using SAS expanders.

Any company looking to “go green” will be inspired by the technology innovations offered by the Adaptec by PMC Series 6, such as Intelligent Power Management and battery-free backup through Zero Maintenance Cache Protection. In addition, Adaptec by PMC has introduced a streamlined product package sleeve for the Series 6 products which will help to reduce the waste created by excessive product packaging.

Proven compatibility

To ensure compatibility and interoperability in the channel, the Series 6 family of RAID controllers is tested with more than 300 host systems, enclosures, Hard Disk Drives (HDDs) and Solid State Drives (SSDs). PMC-Sierra uses a two-staged approach to test new storage and server components for interoperability. During validation and product launch, Adaptec by PMC tests more than 300 components with all supported controller platforms. In addition, PMC-Sierra's Interoperability Test Lab (ITL) can test components introduced outside of

product launches and add them to the compatibility list. Continuously refined and optimized, our advanced testing methods include automated processes to rapidly qualify new Solid State Disks (SSDs) in order to keep pace with the market requirements.

Advanced Data Protection

The Adaptec by PMC Series 6 features Adaptec RAID Code (ARC) to deliver maximum reliability with RAID levels 0, 1, 1E, 5, 5EE, 6, 10, 50, 60 and JBOD. ARC also offers RAID Level Migration (the ability to easily migrate RAID levels), Online Capacity Expansion (expand capacity without powering down the server), and Copyback Hot Spare (when a failed drive has been replaced, data is automatically copied from the hot spare back to the restored drive).

Zero-Maintenance Cache Protection

RAID controllers typically employ battery backup units (BBUs) to protect cached data during power loss, but BBUs require constant monitoring and preserve data for a maximum of 72 hours during power loss. With the optional AFM-600 kit, the Adaptec by PMC Series 6 is the first 6Gb/s Unified Serial RAID controller family to offer Zero Maintenance Cache Protection (ZMCP), a revolutionary advancement that solves BBU deficiencies by providing full protection to cached data with no installation, monitoring, maintenance, disposal, or replacement costs.

Featuring 4GB of SLC based NAND flash memory with super capacitor technology (available as a separate Kit), Series 6 controllers instantly save cache contents in the event of system power loss. On a power failure, the data is copied from the high performance DRAM cache of the controller to the NAND flash memory while the super capacitor provides enough energy to support this process and power the controller for approximately 60 seconds. Unlike a BBU, the data is protected for years when copied to the flash memory.

Adaptec Intelligent Power Management

Included with every Adaptec by PMC Series 6 controller, Adaptec Intelligent Power Management lets you configure every storage drive on your network into one of two energy-saving modes:

- 1) **Normal operation** – full power, full RPM
(rotations per minute)
- 2) **Standby** – low power mode spins disks at lower RPM
- 3) **Power-off** – disks not spinning

Intelligent Power Management is ideal for applications with idle time, such as disk-to-disk backup/VTL, email archives, and file/print servers.

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Hybrid RAID

With Hybrid RAID 1 & 10, the Adaptec by PMC Series 6 controllers offer maximum performance and reliability by combining SSDs and HDDs in a single array. By performing read operations from the faster SSD and write operations on both the SSDs and HDDs it offers tremendous performance gains over standard HDD RAID arrays. By combining SSDs and HDDs it offers the benefits of both technologies and allows a better cost per GB ratio than comparable SSD only RAID arrays.

Broad Operating System Support

The Adaptec by PMC Series 6 supports all major operating systems, including Windows, Linux, VMware and FreeBSD.

Reliability and Customer Support

The Adaptec by PMC Series 6 controllers are backed by a 3-year warranty and the company's legendary technical support.

One-view Storage Management

The Adaptec by PMC Series 6 operates under Adaptec Storage Manager™, a one-view tool that centralizes management of all Adaptec RAID products.

Conclusion

Data centers face the daunting challenge of providing continuous uptime for ever-growing levels of data and traffic while keeping costs under control. As the newest data transfer standard, 6Gb/s SAS helps enterprises prepare for the future by doubling the bandwidth available from previous generation 3Gb/s devices. 6Gb/s maintains backward compatibility with 3Gb/s and ushers in a host of new standards that will help drive adaption of the new technology into legacy infrastructures.

Building on three decades of leadership in the RAID controller industry, Adaptec by PMC Series 6 controllers are primed for the 6Gb/s revolution, offering companies an easy and cost-effective upgrade path for current 3Gb/s customers. Adaptec by PMC Series 6 controllers are the only controllers on the market designed to save data centers thousands in operating costs with advanced features like Intelligent Power Management and ZMCP.

Series 6 Controller Options to Meet Your Needs

Adaptec RAID	6405	6445	6805
Order Part Number	2271100-R (kit) 2270000-R (single)	2270200-R (single)	2271200-R (kit) 2270100-R (single)
Form Factor	MD2 - Low Profile	MD2 - Low Profile	MD2 - Low Profile
Ports	4 internal	8 (4 int / 4 ext)	8 internal
Connectors	1 SFF-8087 (int.)	1 SFF-8087 (int.) / 1 SFF-8088 (ext.)	2 SFF-8087
Bus Interface	8-Lane PCIe Gen2	8-Lane PCIe Gen2	8-Lane PCIe Gen2
Processor	PM8013	PM8013	PM8013
Cache	512MB	512MB	512MB



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