

Series 8E RAID Adapters

White Paper

Series 8E (12 Gbps) versus Series 6E (6 Gbps) Performance



Introduction

The Microsemi Adaptec Series 8E 12 Gbps PCIe Gen3 SAS/SATA RAID adapters deliver the robustness of hardware RAID in an entry-level solution. They offer significant performance acceleration over other 6 Gbps adapter card solutions through basic RAID 0, 1, 10, and built-in cache for cost-effective platforms that do not require the full performance, scalability, and capabilities of Microsemi's standard Series 8 RAID adapters. The 8805E, with eight internal SAS/SATA ports, is ideal for applications that require more bandwidth, as it can support up to eight storage devices. Both four- and eight-port models fit the requirements of industrial PC workstations or entry-level servers, as they support an LP/MD2 form factor. The 8405E and the 8805E support a maximum of four and eight devices respectively, as neither supports the use of expanders.

Figure 1 Series 8E RAID Adapters



The Series 8E is the entry-level solution of the award-winning 12 Gbps Series 8 RAID adapters. It is a replacement for the Series 6E, the entry-level solution of the 6 Gbps Series 6 RAID adapters. Series 8E RAID adapters can also be coupled with 12 Gbps SSDs, providing maximum read/write bandwidth and IOPS for the most performance-hungry applications. The 512 MB DDR3 (1600 MHz) built-in cache (recommended for read- and write-through caching due to lack of persistency) provides maximum acceleration. This white paper will compare the bandwidth and IOPS performance of the Series 8E against the Series 6E in different configurations utilizing two, four, and eight SATA SSDs. It will also describe some use cases where the Series 8E stands apart from other solutions.

Figure 2 Complete Series 8 RAID Adapter Family Features


Power Matters.™

Microsemi Adaptec® Series 8 SAS/SATA RAID Adapters

12 Gbps PCIe Gen 3 RAID adapters from entry-level to highest-performance, highest-density solutions for data center and enterprise servers



Entry-Level
Series 8E



Ideal price and performance for entry-level servers and workstations

True hardware RAID 0, 1, 10

4- and 8-port internal configurations

Standard
Series 8



Elevated performance and maximum connectivity

Ultra-dense solution with 16 ports 12 Gbps SAS/SATA in an LP MD2 form factor

4, 8, and 16 ports in various internal and external configurations

Premium
Series 8Q



Maximum performance and connectivity

maxCache 3.0 SSD read and write caching for application performance acceleration

16 ports in various internal and external configurations

Series 8(Z) and Series 8Q(ZQ) Features:

- >700K IOPS; 6.6 GB/s sequential reads/6.2 GB/s sequential writes
- Flash-based maintenance-free cache protection (embedded in 81605ZQ)
- Support for hardware RAID 0, 1, 1E, 5, 6, 10, 50, 60

All Series 8 Adapters Feature:

- Built-in DRAM cache acceleration for RAID and data center applications
- Common management tools, broad compatibility (including 6 Gbps ecosystem)

For more information visit www.microsemi.com

Testing Methodology

Adapter Specifications

All adapters were tested straight from the box with no modifications or upgrades. This section will describe the published specs for each adapter.

Microsemi Adaptec RAID 8805E v2 (12 Gbps)

- 8 internal native SAS/SATA ports only in an LP/MD2 form factor
- Data transfer speed: 12 Gbps per port
- Host bus type: PCIe Gen3 x8
- Two HD Mini-SAS SFF8643 (vertical mount)

- Cache memory: 512 MB DDR3-1600 MHz DRAM
- Supported RAID level: simple volume, RAID levels 0, 1, 10
- Support Pass-through and HBA mode
- Support for up to 8 SAS and SATA devices

Microsemi Adaptec RAID 6805E (6 Gbps)

- 8 internal native SAS/SATA ports only in an LP/MD2 form factor
- Data transfer speed: 6 Gbps per port
- Host bus type: PCIe Gen2 x4
- Two Mini-SAS SFF8087 (horizontal mount)
- Cache memory: 128 MB DDR2-400 MHz DRAM
- Supported RAID level: Simple volume, RAID levels 0, 1, 1E, 10
- Support for up to 8 SAS and SATA devices

System Platform

- System: Supermicro X10 Super Server System 3U
- Board: Supermicro X10Dri Motherboard V1.02B
- System BIOS version: 1.1
- Build date: 04/14/2015 19:49:08
- CPLD version 02.a1.00
- CPU: (single CPU) Intel XEON E5-2680 v3
- Cores: 12
- HyperThread: enabled
- Frequency: 2.3 GHz
- Total memory: 32 GB
- Memory speed: DDR4-2133 MHz
- Operating system: Microsoft Windows 2012 R2 Datacenter Edition, 64-bit

Code Used

Adaptec RAID 8805E SAS 12 Gbps:

- Firmware: 7.4-0 B31251
- Driver: Windows 7.5-0 B41063
- BIOS version: 7.4-0 B31251

Adaptec RAID 6805E SAS 6 Gbps:

- Firmware: 5.2-0 B19176
- Driver: Windows 7.5-0 B41063
- BIOS version: 5.2-0 B19176

Results

Bandwidth Performance Comparisons

First, this white paper will discuss a comparison between the Series 8E (12 Gbps) and the Series 6E (6 Gbps) with two, four, and eight SATA solid state drives (SSDs) in RAID 0, 1, and 10 configurations. As the following illustration demonstrates, in all cases the 8805E scales up well with the number of connected devices to approximately 4500 MB/s, while the 6805E maxes out at 1900 MB/s. This can be attributed to the fact that the 8805E quadruples the bandwidth through its x8 PCIe Gen3 host interface compared to the x4 PCIe Gen2 host interface, offering 16 times the bandwidth of a 6405E. While this bandwidth comparison test used SATA SSDs, it is important to note that even high-end NVMe SSDs have only half of the bandwidth capabilities of the 8805E, as they typically only have an x4 PCIe host interface.

Figure 3 8805E vs. 6805E Bandwidth Performance Comparison

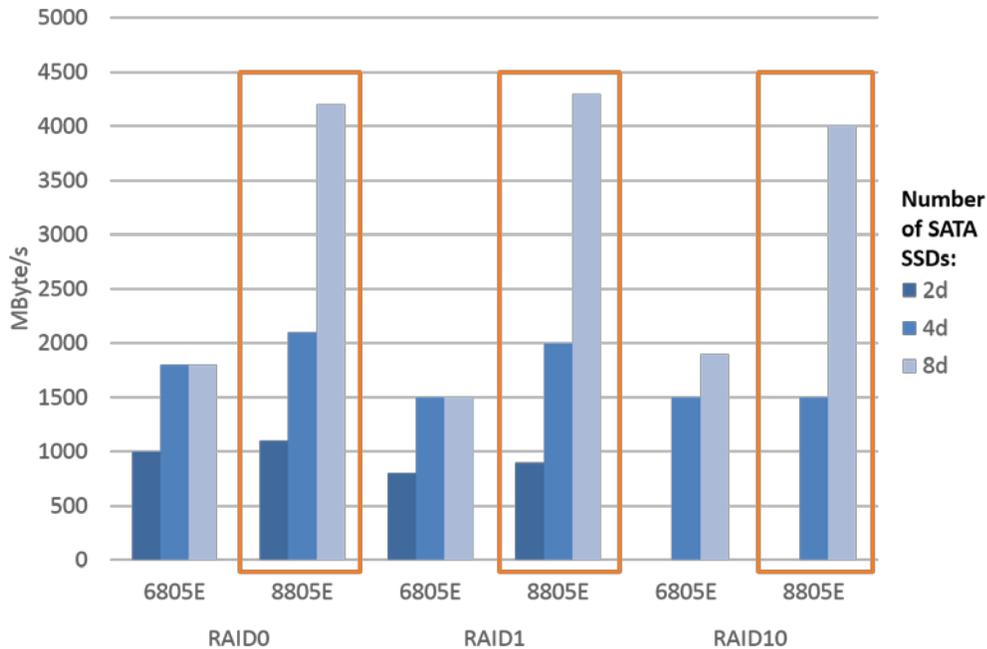


Table 1 Bandwidth Performance Comparison Between 6805E and 8805E

SSD Count	RAID Level					
	RAID0		RAID1		RAID10	
	6805E	8805E	6805E	8805E	6805E	8805E
2	1000 MB/s	1100 MB/s	800 MB/s	900 MB/s		
4	1800 MB/s	2100 MB/s	1500 MB/s	2000 MB/s	1500 MB/s	1500 MB/s
8	1800 MB/s	4200 MB/s	1500 MB/s	4300 MB/s	1900 MB/s	4000 MB/s

IOPS Performance Comparison

Next, this section will examine IOPS comparisons between the Series 8E (12 Gbps) and the Series 6E (6 Gbps) with two, four, and eight SATA SSDs in RAID 0, 1, and 10 configurations. As the following illustration shows, in all cases the Series 8E scales up to approximately 500K IOPS, while the

Series 6E maxes out at 40K IOPS. This is due to enhancements in Microsemi’s RAID-on-Chip (RoC) technology between the two production generations. When the Series 6 was introduced back in 2010, it was designed to accelerate enterprise hard disk drives (HDDs), whereas Series 8 RoC silicon is optimized for both HDDs and flash-based SSDs.

Figure 4 8805E vs. 6805E IOPS Performance Comparison

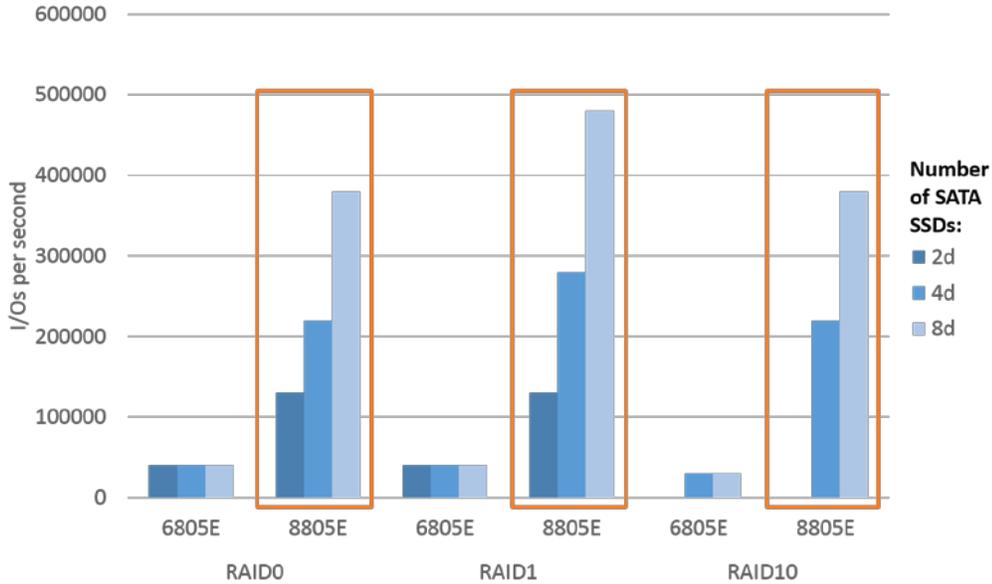


Table 2 IOPS Performance Comparison Between 6805E and 8805E

SSD Count	RAID Level					
	RAID0		RAID1		RAID10	
	6805E	8805E	6805E	8805E	6805E	8805E
2	40,000 IOPS	130,000 IOPS	40,000 IOPS	130,000 IOPS		
4	40,000 IOPS	220,000 IOPS	40,000 IOPS	280,000 IOPS	30,000 IOPS	220,000 IOPS
8	40,000 IOPS	380,000 IOPS	40,000 IOPS	480,000 IOPS	30,000 IOPS	380,000 IOPS

Use Cases

The performance data in the previous sections demonstrates why Series 8E RAID adapters are ideal for specific applications that take advantage of their documented bandwidth and IOPS performance.

Servers and Workstations with SSDs

SSDs have become a common component of today’s server configurations. This specific application uses an entry-level server with a Microsemi Adaptec 8405E and two SSDs running in a RAID 1 configuration for boot. Almost every server requires a redundant boot device that that has to be started independently from the OS and any RAID SW application, and can boot from any remaining device. Hardware RAID provides this perfectly on the Series 8E. This configuration can now either be expanded to a RAID10 when more bandwidth or IOPS are needed on that same storage device, or complemented by a second RAID1 that runs independently and hosts data for an application such as a web server or database.

The benefits of utilizing the 8405E RAID controller in this application include the following:

- Maximum performance for entry-level servers and higher-end workstation
- Redundant hardware RAID that is independent of the operating system
- Support for all popular server and workstation operating systems
- Acceleration through DRAM cache
- Leverages existing AACRAID Linux drivers built into most popular Linux kernels and distributions (open source)
- Ease of use with maxView™ Enterprise management tool
- Expand to RAID10 using RAID level migration to enhance capacity and performance through striping

Figure 5 Entry-Level Server with 8405E and Two SSDs Running in a RAID1 Configuration



Video-Editing Applications

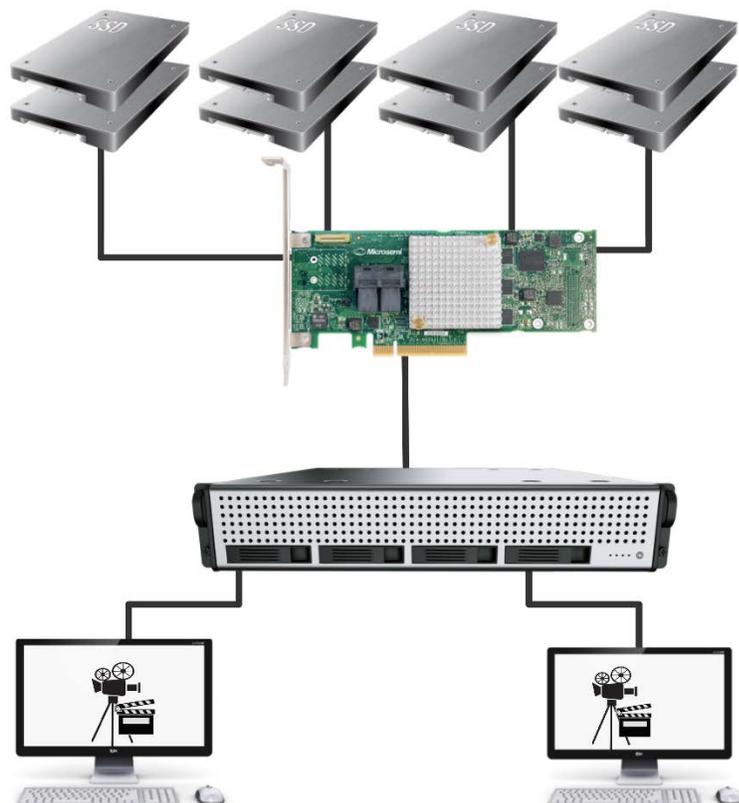
When it comes to bandwidth, video-editing is one of the most performance-hungry applications, especially on a server that supports editing through multiple workstations and users. Every change made to a video can result in hours of rendering if the workstation's performance is suboptimal. In this example application, several video-editing workstations are connected to a server with an 8805E and multiple HDDs or SSDs in a striping array. This configuration is ideal because it scales bandwidth to up to 4800 MB/s with SATA SSDs, or up to 6600 MB/s with SAS SSDs. The Series 8E provides more performance and bandwidth than any other entry RAID solution without requiring host CPU cycles or memory bandwidth. It scales to higher performance levels than most enterprise SSDs with a x4 PCIe host interface.

The benefits of utilizing the 8405E RAID controller in this application include the following:

- Maximum performance for video-editing systems using multiple HDDs/SSDs in a striping array
- Aggregate performance up to 6600 MB/s with high-performance SAS SSDs, or up to 4800 MB/s using 8 SATA SSDs
- RAID0 if maximum bandwidth is required and redundancy is not a concern

- RAID10 if maximum bandwidth and redundancy is required
- Robust Hardware RAID

Figure 6 Video-Editing Application with an 8805E and Multiple HDDs/SSDs in a Striping Array



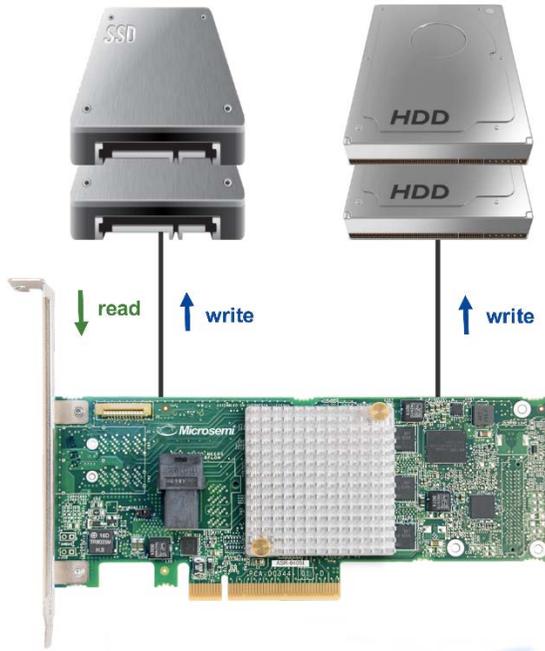
Hybrid RAID Configuration

Microsemi pioneered Hybrid RAID to deliver maximum performance and cost-effective redundancy. Hybrid RAID arrays of SSDs and HDDs offer tremendous performance gains over standard HDD RAID arrays by performing read operations from the faster SSD and write operations on both the SSD and HDD. The result is a higher number of read operations per second with no degradation of write I/O performance, and complete transparency to the operating system and all running applications. Compared to an SSD-only RAID1, Hybrid RAID configuration provides lower costs at higher capacities, highlighting the cost-to-GB advantage of HDDs over SSDs.

The benefits of utilizing the 8405E RAID controller in this application include the following:

- Use Hybrid RAID with a cost-efficient HDD as a mirror device for an SSD
- Mirror an HDD to an SSD to get SSD read performance and a cost-efficient solution for redundancy
- RAID stack will always read from fast SSDs in Hybrid RAID setups (instead of balancing read requests to both mirrored devices in a setup with equally performing devices)

Figure 7 Hybrid RAID Implementation with 8405E in Read/Write Configuration



Conclusion

The Series 8E is the entry-level solution of the award-winning 12 Gbps Series 8 RAID adapters. It is a replacement for the Series 6E, which is the entry-level solution of the 6 Gbps Series 6 RAID adapters. Series 8E RAID adapters can also be coupled with 12 Gbps SSDs, providing maximum read/write bandwidth and IOPS for the most performance-hungry applications. The 512 MB DDR3 (1600 MHz) built-in cache (recommended for read- and write-through caching) provides maximum acceleration.

Table 3 Comparison Between Series 8E and Series 6E Overall Performance

Performance	Series 8E	Series 6E
Maximum bandwidth	Approximately 4500 MB/s	1900 MB/s
IOPS	Approximately 500K	40K

In addition, three specific use cases are highlighted where the Series 8E is an ideal solution for entry-level servers and workstations because of its robust Hardware RAID, performance acceleration, and entry-level price.

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