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

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

- 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>
<thead>
<tr>
<th>SSD Count</th>
<th>RAID Level</th>
<th>6805E</th>
<th>8805E</th>
<th>6805E</th>
<th>8805E</th>
<th>6805E</th>
<th>8805E</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>RAID0</td>
<td>1000 MB/s</td>
<td>1100 MB/s</td>
<td>800 MB/s</td>
<td>900 MB/s</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAID1</td>
<td>1800 MB/s</td>
<td>2100 MB/s</td>
<td>1500 MB/s</td>
<td>2000 MB/s</td>
<td>1500 MB/s</td>
<td>1500 MB/s</td>
</tr>
<tr>
<td>8</td>
<td>RAID10</td>
<td>1800 MB/s</td>
<td>4200 MB/s</td>
<td>1500 MB/s</td>
<td>4300 MB/s</td>
<td>1900 MB/s</td>
<td>4000 MB/s</td>
</tr>
</tbody>
</table>

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**

![IOPS Performance Comparison Chart]

**Table 2  IOPS Performance Comparison Between 6805E and 8805E**

<table>
<thead>
<tr>
<th>SSD Count</th>
<th>RAID0</th>
<th>RAID1</th>
<th>RAID10</th>
</tr>
</thead>
<tbody>
<tr>
<td>6805E</td>
<td>40,000 IOPS</td>
<td>130,000 IOPS</td>
<td>130,000 IOPS</td>
</tr>
<tr>
<td>8805E</td>
<td>40,000 IOPS</td>
<td>130,000 IOPS</td>
<td>130,000 IOPS</td>
</tr>
<tr>
<td>6805E</td>
<td>40,000 IOPS</td>
<td>220,000 IOPS</td>
<td>280,000 IOPS</td>
</tr>
<tr>
<td>8805E</td>
<td>40,000 IOPS</td>
<td>280,000 IOPS</td>
<td>30,000 IOPS</td>
</tr>
<tr>
<td>6805E</td>
<td>40,000 IOPS</td>
<td>480,000 IOPS</td>
<td>30,000 IOPS</td>
</tr>
<tr>
<td>8805E</td>
<td>40,000 IOPS</td>
<td>380,000 IOPS</td>
<td>380,000 IOPS</td>
</tr>
</tbody>
</table>

**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 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 SDDs.

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)
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

<table>
<thead>
<tr>
<th>Performance</th>
<th>Series 8E</th>
<th>Series 6E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum bandwidth</td>
<td>Approximately 4500 MB/s</td>
<td>1900 MB/s</td>
</tr>
<tr>
<td>IOPS</td>
<td>Approximately 500K</td>
<td>40K</td>
</tr>
</tbody>
</table>

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.
Microsemi makes no warranty, representation, or guarantee regarding the information contained herein or the suitability of its products and services for any particular purpose, nor does Microsemi assume any liability whatsoever arising out of the application or use of any product or circuit. The products sold hereunder and any other products sold by Microsemi have been subject to limited testing and should not be used in conjunction with mission-critical equipment or applications. Any performance specifications are believed to be reliable but are not verified, and Buyer must conduct and complete all performance and other testing of the products, alone and together with, or installed in, any end-products. Buyer shall not rely on any data and performance specifications or parameters provided by Microsemi. It is the Buyer's responsibility to independently determine suitability of any products and to test and verify the same. The information provided by Microsemi hereunder is provided “as is, where is” and with all faults, and the entire risk associated with such information is entirely with the Buyer. Microsemi does not grant, explicitly or implicitly, to any party any patent rights, licenses, or any other IP rights, whether with regard to such information itself or anything described by such information. Information provided in this document is proprietary to Microsemi, and Microsemi reserves the right to make any changes to the information in this document or to any products and services at any time without notice.

About Microsemi
Microsemi Corporation (Nasdaq: MSCC) offers a comprehensive portfolio of semiconductor and system solutions for aerospace & defense, communications, data center and industrial markets. Products include high-performance and radiation-hardened analog mixed-signal integrated circuits, FPGAs, SoCs and ASICs; power management products; timing and synchronization devices and precise time solutions, setting the world’s standard for time; voice processing devices; RF solutions; discrete components; enterprise storage and communication solutions; security technologies and scalable anti-tamper products; Ethernet solutions; Power-over-Ethernet ICs and midspans; as well as custom design capabilities and services. Microsemi is headquartered in Aliso Viejo, California, and has approximately 4,800 employees globally. Learn more at www.microsemi.com.