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Introduction

This whitepaper provides I/O performance and CPU utilization information for the HP A7173A PCI-X Dual-Channel Ultra320 SCSI Host Bus Adapter (A7173A U320 Adapter), and highlights its significant performance increase over the HP A6829A PCI Dual Channel Ultra160 SCSI Host Bus Adapter (A6829A U160 Adapter) on HP's PA-RISC based servers. A series of tests were conducted to evaluate the overall performance, specifically I/O's per second (I/Ops) and throughput (MB/sec), of both adapters.

The test results show a remarkable performance increase when using the A7173A Ultra320 SCSI adapter, instead of the previous generation A6829A Ultra160 SCSI adapter. Also discussed, are the system setup considerations to obtain the maximum possible performance from an A7173A Ultra320 SCSI adapter installed in an HP rp4440, or equivalent sever.

This whitepaper focuses on:

- **Test results:** U160 and U320 SCSI adapter performance results including I/Ops, throughput, and CPU Utilization.
- **Service Demand:** All test results show a significant decrease in overall service demand when switching from an HP U160 Solution to an HP U320 Solution.
- **System configuration guidelines:** Learn how to optimize the configuration of HP U320 SCSI storage solutions, to achieve the maximum possible performance from A7173A dual-channel Ultra320 SCSI adapters.
- **Test details:** View the HP products, tools, and configurations used in the test environment.

Executive Summary

An A7173A Ultra320 SCSI adapter, used in an HP entry-level or mid-range PA-RISC server, is an excellent industry-leading solution for critical SCSI storage applications. The A7173A U320 adapter boasts a read throughput of 521.1 MB/sec, and an equally impressive write throughput of 364.8 MB/sec. By comparison, the previous generation A6829A Ultra160 SCSI adapter has a read throughput of 262.6 MB/sec, and an average write throughput of 248.9 MB/sec.

A7173A U320 and A6829A U160 SCSI Performance Summary

Operation		A7173A dual channel		A6829A dual channel	
		read	write	read	write
I/Ops		69,104	14,038	27,928	13,579
throughput (MB/s)	achieved	521.1	364.9	262.6	248.9
	% of Ultra320 SCSI theoretical max ²	85.4%	59.7%	43.0%	40.8%

NOTE:

¹ The performance data above was obtained by installing a single A7173A and a single A6829A adapter into two PCI-X 133MHz slots of an HP rp4440 PA-RISC Server.

² Industry standards define the Ultra320 SCSI Theoretical Maximum throughput in terms of "Mega-Transfers". A U320 SCSI Mega-Transfer is equivalent to one million transfers, or in this case, it's equivalent to 3.20×10^8 bytes/second (305.175 MB/sec).

As shown above, the HP A7173A U320 adapter offers a fifty-one percent read throughput performance increase over its predecessor, the A6829A. Additionally, the read I/Ops performance of the A7173A beats the A6829A by more than forty-percent.

Test Results

All performance data was obtained using “Diskbench” (DB), an I/O performance measurement tool. For all I/Os testing, a standard DB block-size of 1KB was used, while throughput required a standard DB block-size of 256KB. The overall throughput of a storage solution helps model large, sequential data transfers similar to a remote backup system, a multimedia file-server, or any other system which must simultaneously transfer large amounts of data. Alternately, I/Os metrics help model small, transactional I/O operations usually found in databases.

For all I/Os, throughput, and service demand tests, the test environment configuration was as follows: one A7173A dual-channel Ultra320 SCSI adapter, and one A6829A dual-channel Ultra160 SCSI adapter connected to two MSA30 SB disk storage units. Each MSA30 SB contained thirteen HP15K RPM U320 SCSI hard disks.

I/Os

Chart 1a: I/Os

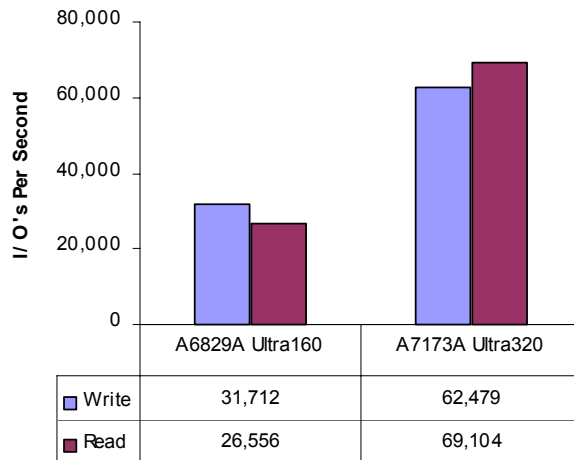


Chart 1b: CPU Utilization

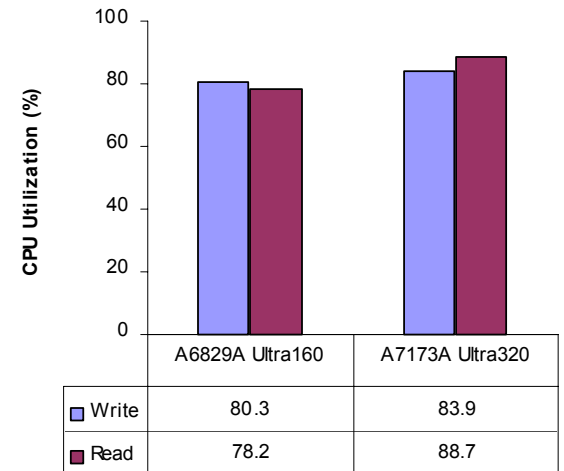


Chart 1a shows the number of I/O operations per second for 1KB reads and writes, using one A7173A dual-channel Ultra320 SCSI adapter, and one A6829A dual-channel Ultra160 SCSI adapter. The horizontal-axis represents the adapter type, and the vertical-axis represents the number of I/O operations per second.

Additionally, Chart 1b shows the CPU Utilization Percentages for the four I/Os tests shown in Chart 1a. The horizontal-axis represents the adapter type, and the vertical-axis represents the total CPU Utilization. In this case, all CPU Utilization data was gathered using HP’s GlancePlus system monitoring software.

NOTE:

CPU Utilization could not be gathered using the standard Diskbench I/O performance measurement tool due to the dual-core processor installed in the HP rp4440 PA-RISC Server. Diskbench can only be used to produce accurate CPU Utilization results on a single CPU system.

Service Demand

The A7173A U320 adapter creates a low service demand for smaller sized I/O operations. As a result, the A7173A can perform more I/Os without putting additional strain on the CPU and system resources. To illustrate the vastly improved service demand of the A7173A U320 adapter over the A6829A U160 adapter, service demand tests with both adapters were performed on an HP rp4440 with a single dual-core CPU.

Service demand is important to large storage systems, because it indicates how many I/O's per second the system can achieve versus the CPU utilization. Therefore, lower Service Demand numbers indicate better overall I/O system performance.

The following table shows single and dual port throughput, with matching CPU utilization and Service Demand results for I/O sizes of 4KB and 8KB using the **A7173A U320 adapter**:

Number of Ports	Sequential Read						Sequential Write – IR ON ⁴					
	4KB			8KB			4KB			8KB		
	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³
Single	144	69%	.466	153	72%	.461	91	66%	.706	137	69%	.495
Dual	195	72%	.362	287	78%	.267	172	80%	.453	246	84%	.332

The following table shows single and dual port throughput, with matching CPU utilization results for I/O sizes of 4KB and 8KB using the **A6829A U160 adapter**:

Number of Ports	Sequential Read						Sequential Write – IR ON ⁴					
	4KB			8KB			4KB			8KB		
	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³	Tput ¹	CPU ²	SD ³
Single	143	61%	1.454	62	60%	.946	48	64%	1.311	72	60%	.825
Dual	81	73%	.876	122	69%	.549	93	75%	.789	136	69%	.493

Chart 2a: Dual Port Read Service Demand

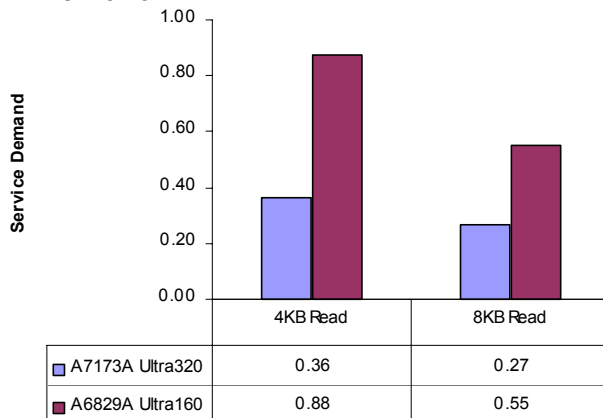
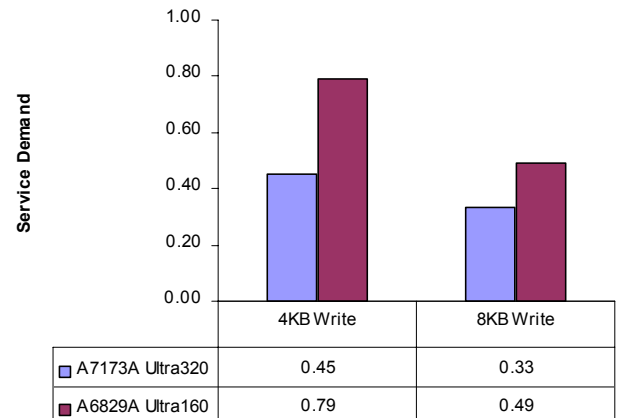


Chart 2b: Dual Port Write Service Demand



NOTE:

¹ Throughput in MB/sec

² Dual-core CPU utilization numbers gathered using HP's GlancePlus performance measurement tool.

³ Service Demand is calculated using the following equation: $(\% \text{ CPU Utilization} / \text{Throughput in KB/sec}) * 1,000$

⁴ To achieve maximum throughput over the SCSI bus, Immediate-Reporting (IR) was enabled for the Sequential Write tests. I-R, more commonly known as disk caching, allows hard disk drives to temporarily cache I/O requests before the data is written to the disk. As a result, overall SCSI performance is dramatically improved.

Throughput

As previously mentioned, the A7173A U320 adapter boasts 521.1 MB/sec dual-channel read throughput to power the most demanding applications. However, the most impressive performance difference is highlighted within the A7173A U320 adapter's CPU Utilization. As shown below, the A7173A U320 adapter can increase throughput by fifty-one percent over the A6829A, while increasing CPU Utilization less than five percent. The A7173A U320 adapter dramatically increases SCSI bus throughput, without adding undue strain on the CPU and other system resources.

Chart 3a shows the throughput in MB/sec for 256KB sequential reads and writes, using one A7173A dual-channel Ultra320 SCSI adapter, and one A6829A dual-channel Ultra160 SCSI adapter. The horizontal-axis represents the adapter type, and the vertical-axis represents the throughput.

Chart 3b shows the CPU Utilization Percentages for the four throughput tests shown in Chart 3a. The horizontal-axis represents the adapter type, and the vertical-axis represents the total CPU Utilization. All CPU Utilization data was gathered using HP's GlancePlus system monitoring software.

Chart 3a: Throughput

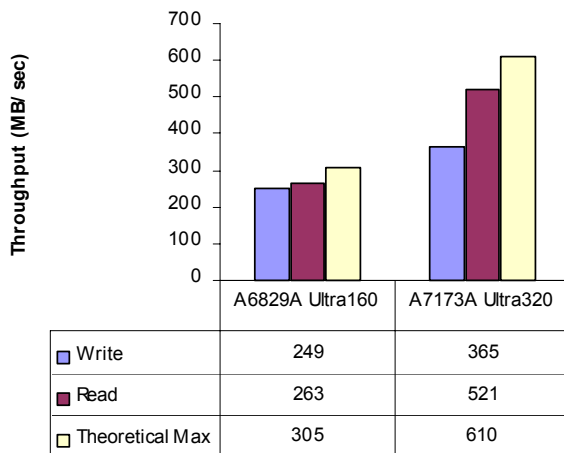


Chart 3b: CPU Utilization

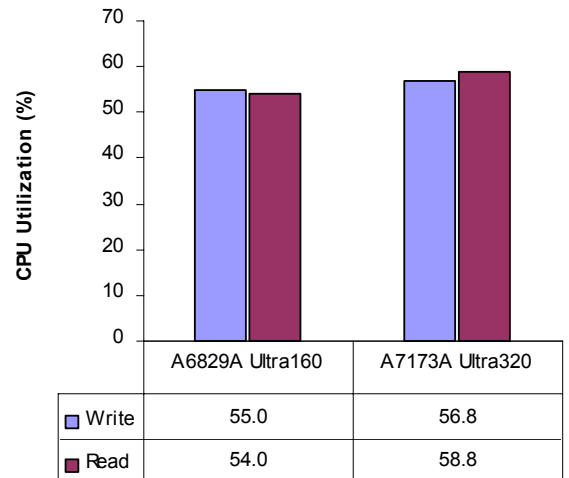
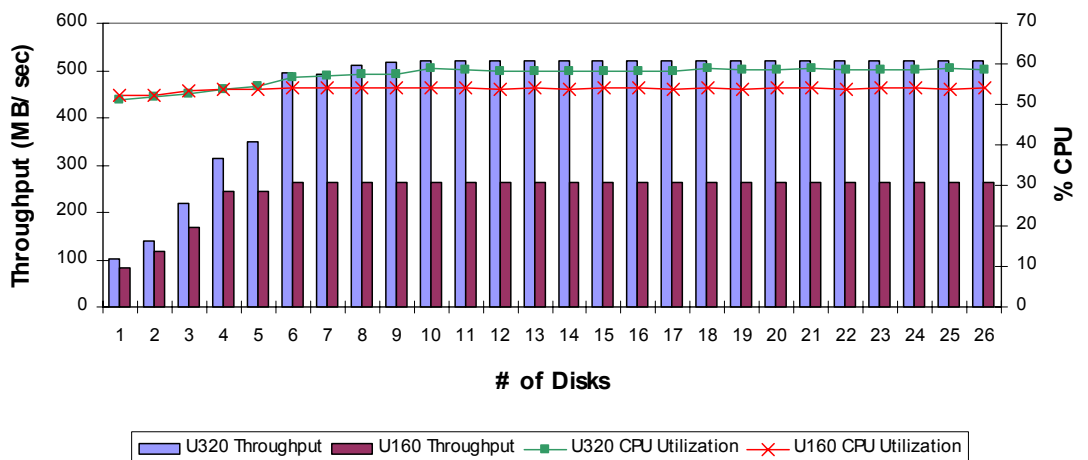


Chart 3c highlights the powerful throughput performance of one A7173A adapter versus one A6829A adapter. The A7173A dual-channel Ultra320 SCSI adapter can significantly boost throughput, without impacting other critical system resources allocated for your demanding HP-UX applications. For each test shown in this chart, an equal number of disks were balanced across both SCSI channels. For example, ten disks total is tested as five disks on SCSI channel one, and five disks on SCSI channel two.

Chart 3c: Read Throughput versus Number of Disks and CPU Utilization

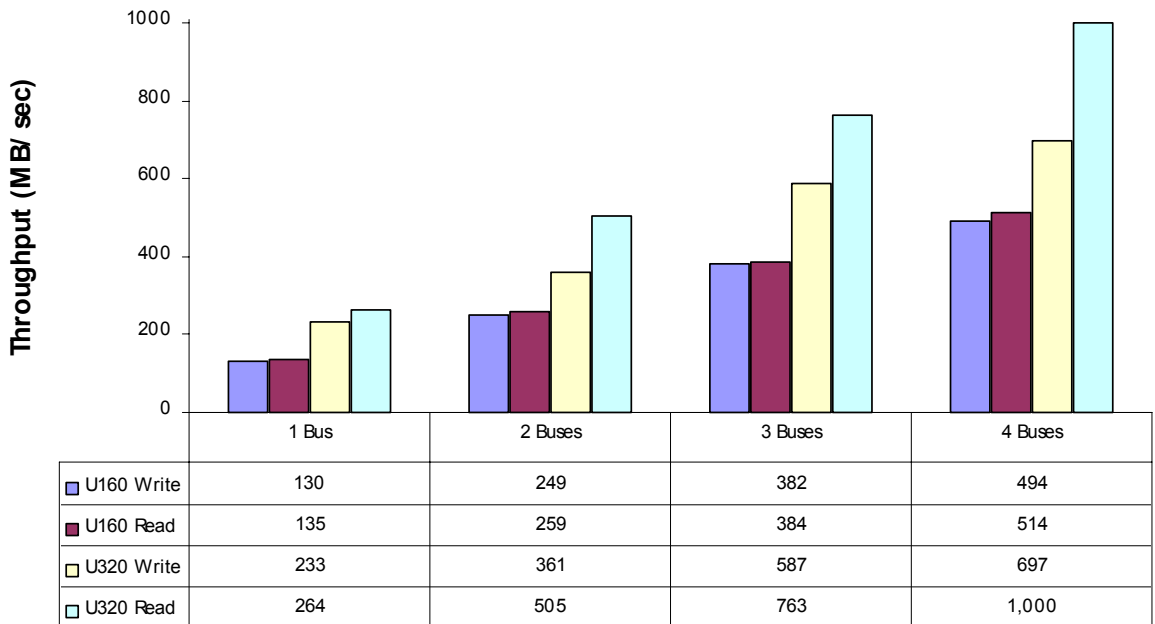


Scalability

The A7173A dual-channel Ultra320 SCSI adapter offers an impressive level of linear scalability for the most intense SCSI storage systems. Using two A7173A dual-channel Ultra320 SCSI adapters in non-shared PCI bus slots can dramatically increase your SCSI read-throughput to over 1000 MB/sec; equivalent to approximately eighty-two percent of the Four-Bus U320 SCSI Theoretical Maximum.

Chart 4a shows the sequential-read throughput performance of multiple A7173A and A6829A adapters installed in an HP rp4440 PA-RISC Server. The horizontal axis represents the number of utilized SCSI buses, while the vertical axis represents the overall throughput in MB/sec.

Chart 4a: 256KB Sequential Read and Write Throughput



NOTE:

Each dual-channel SCSI adapter provides two SCSI buses with a maximum of 15-devices per bus.

System Configuration Guidelines

To get the best performance from an HP Ultra320 SCSI products, it's important to follow a few simple guidelines.

Adapter Firmware

Firmware is the embedded system that controls data operations on the SCSI bus. Be sure that the A7173A dual Ultra320 SCSI adapter is operating with the latest firmware available from HP. Keeping the adapter firmware up-to-date helps ensure data integrity and overall adapter performance.

Adapter Drivers

Component drivers allow a peripheral device to communicate directly with the Operating System and other devices. To ensure the stability of an HP Server or Workstation, always install the latest HP drivers for the A7173A Ultra320 SCSI adapter.

Disk Storage


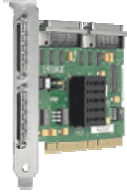



The A7173A adapter is a powerful solution for critical SCSI applications. To achieve the maximum performance from an A7173A adapter, HP recommends using HP 15K RPM Ultra320 SCSI hard disks with HP storage units.

To achieve the highest levels of throughput and I/Ops performance with an A7173A adapter, HP recommends using as many disks as possible per channel, balanced across both adapter channels.

Test Details

The performance results presented in this paper were obtained with one A7173A dual-channel Ultra320 SCSI adapter, and one A6829A dual channel Ultra160 SCSI adapter install in a single HP rp4440 PA-RISC Server.

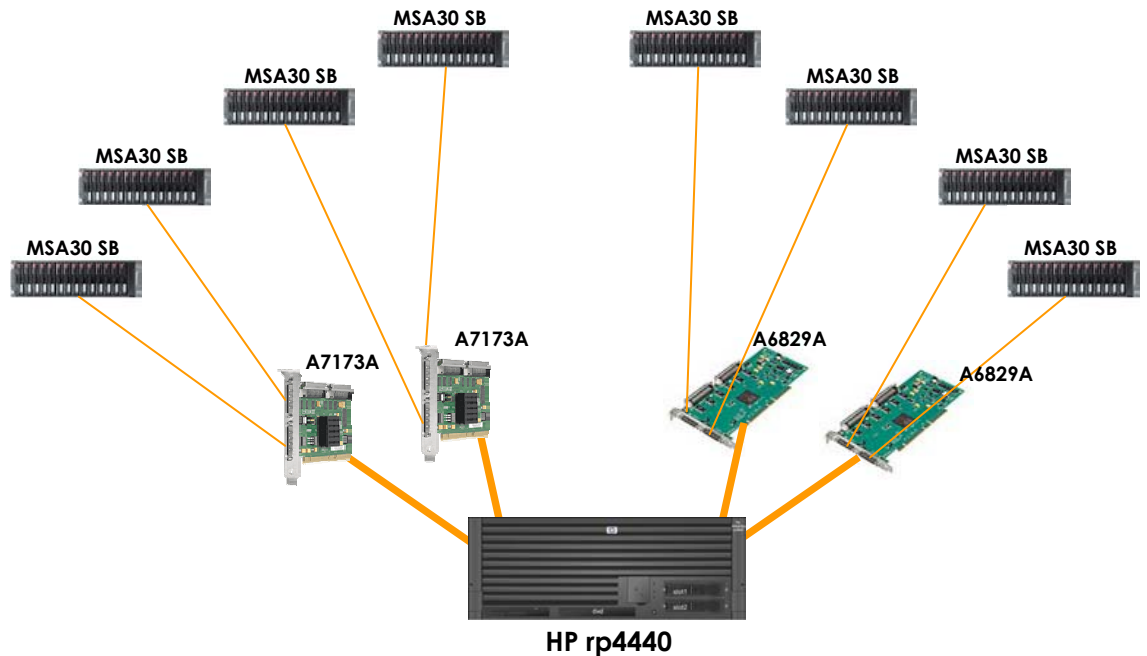
Products Used in Testing

products used for performance measurement		
		<p>HP 9000 rp4440 PA-RISC Server</p> <ul style="list-style-type: none"> • Single PA-8880 Dual-Core Processor • A7173A U320 SCSI Driver (Version B.11.11.01) • 2GB System Memory • HP-UX 11.11
		<p>A7173A HBA</p> <ul style="list-style-type: none"> • PCI-X dual-channel Ultra320 SCSI Adapter • 33/66/100/133 MHz-64bit PCI or PCI-X Capable • Firmware Version: 1.03.35.64
		<p>A6829A HBA</p> <ul style="list-style-type: none"> • PCI-X dual-channel Ultra160 SCSI Adapter • 33/66 MHz-64bit PCI-X Capable
Software		<p>Diskbench (DB) is the I/O performance testing application which generated all test results. HP's GlancePlus performance measurement tool was used to gather all CPU Utilization results.</p>
MSA30 SB		<p>HP MSA30 SB SCSI Disk Storage Unit</p> <ul style="list-style-type: none"> • 13-disks per MSA30 SB • All disks used in the test environment were HP 15K RPM U320 SCSI hard disks. • Single-Bus

Test Configurations

General Test Configuration

The general test configuration consisted of a single HP 9000 rp4440 PA-RISC Server attached to multiple HP MSA30 SB storage units via multiple A7173A and A6829A dual channel SCSI adapters. Each MSA30 SB contained thirteen HP 15K RPM Ultra320 SCSI hard disks.



Additional Information

For more information about the HP A7173A Ultra320 SCSI Adapter please visit <http://www.hp.com>.

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