SPARCserver 490 NFS File Server Performance Brief

Comparisons with Auspex NS 5000

February, 1991

SPARCserver 490 NFS File Server

Contents

1. Summary of Results

This paper analyzes the NFS file server performance of the SPARCserver 490, Sun's high-end server system. It shows how SPARCserver 490 NFS performance increases with the addition of NFS and network accelerators. SPARCserver 490 performance is also compared to that of the Auspex NS 5000, an example of a system with a specialized architecture for NFS file service.

SPARCserver 490: Increasing Performance with NFS and Network Accelerators

The NFS throughput of the SPARCserver 490 can be increased by more than four fold by the addition of Sun Prestoserve and Interphase NC 400 Network CoProcessors.

Sun Prestoserve NFS Accelerator

- Sun Prestoserve NFS accelerator significantly improves the NFS performance of the SPARCserver 490. For example, adding the Sun Prestoserve board increases NFS throughput by 80% at a response time of 40 milliseconds per NFS operation.

Interphase NC 400 Network CoProcessor

- NFS throughput also improves significantly as more Ethernets are added. Compared to the on–board Ethernet performance, NFS performance with a single Interphase NC 400 Network CoProcessor board improves maximum NFS throughput by up to 60%.
- With two NC 400 Network CoProcessors, the NFS performance improves by 190% compared to the on-board Ethernet case.
- With four NC 400 Network CoProcessors, the performance improvement is more than four times compared to the on-board NFS throughput.

SPARCserver 490 versus NS 5000:

Benchmark results from the *nhfsstone* indicate that the SPARCserver 490 with NFS accelerators consistently outperforms the NS 5000.

- NFS throughput on a single Ethernet reveals that the SPARCserver 490 delivers 14% higher NFS peak throughput than the NS 5000 at a19% better response time. The SPARCserver 490 performs 180% better than the NS 5000 at a 20 msec response time.
- NFS performance comparison using two Ethernets indicates that the SPARCserver 490 can handle 4% more NFS throughput than the NS 5000 at a 9% better response time. The SPARCserver 490 performs 110% better than the NS 5000 at 20 msec response time.
- The test using four Ethernets indicates that the SPARCserver 490 delivers 19% higher NFS throughput at a15% better response time.

Nhfsstone is an open, published benchmark that is readily available to any interested readers.

2. Nhfsstone Benchmark

Nhfsstone* benchmark measures client-server response times and network throughput. The benchmark places an artificial NFS load on the file server. The load simulates the NFS operation mixes observed on working systems in a variety of application environments. Workload is described by the NFS operations mix and the NFS operation request rate. Nhfsstone returns file server performance in terms of the NFS request response time and NFS request throughput.

The original benchmark comes with a default NFS operations mix characteristic of a diskless client workstation network environment. All benchmarks in this paper use the default workloads. The NFS operation mix is listed in the Appendix. The reads and writes constitute 37% of the total NFS mix (see Appendix).

**Nhfsstone*, (pronounced "NFSstone") developed by Legato Systems, Inc., is a well known benchmark and a reasonable starting point in measuring NFS performance. Interested readers can obtain a free copy of the benchmark from Legato Systems by sending electronic mail to *request@legato.com* and entering "send unsupported nhfsstone" on the subject line.

2.1 Increasing SPARCserver 490 NFS Performance with Sun Prestoserve

<u>Figure 1</u>. Single Ethernet Throughput Comparison on SPARCserver 490 with and without Sun Prestoserve NFS Accelerator

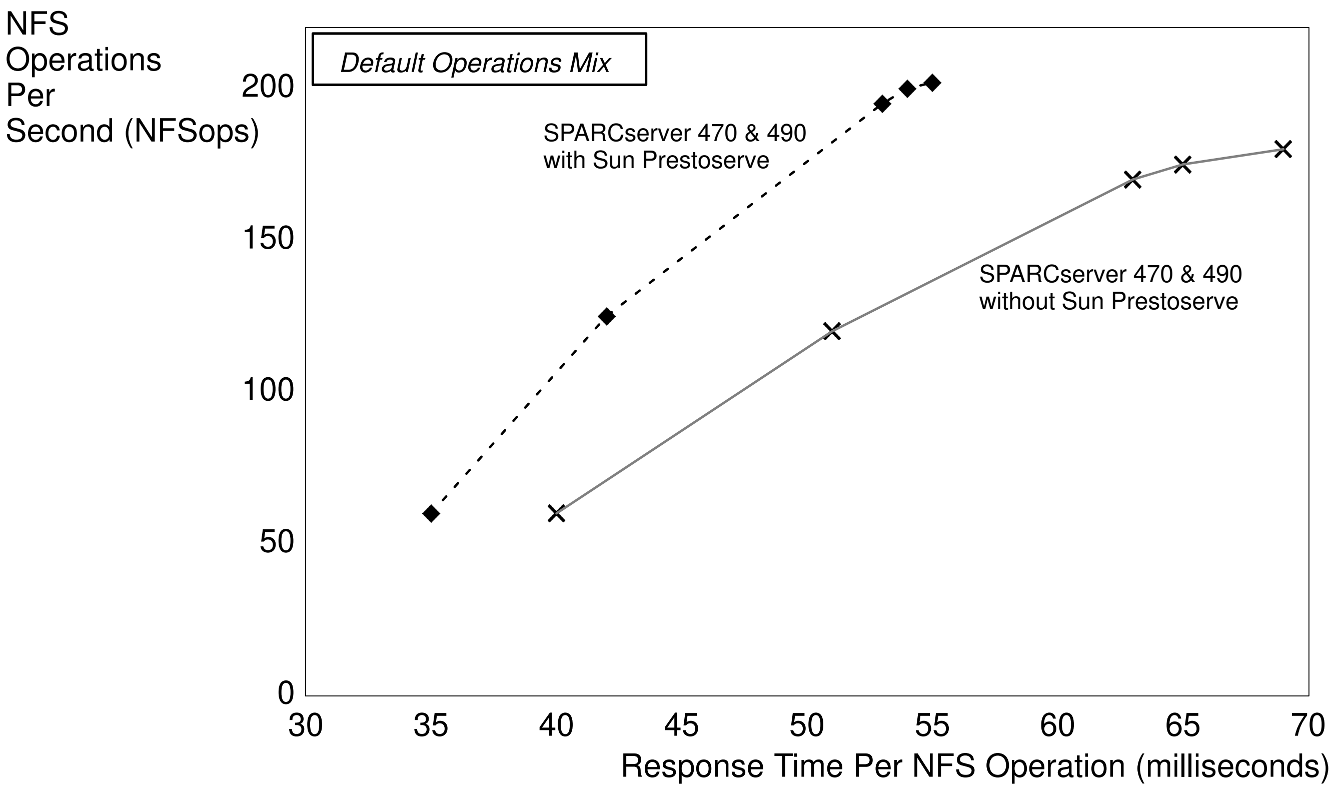
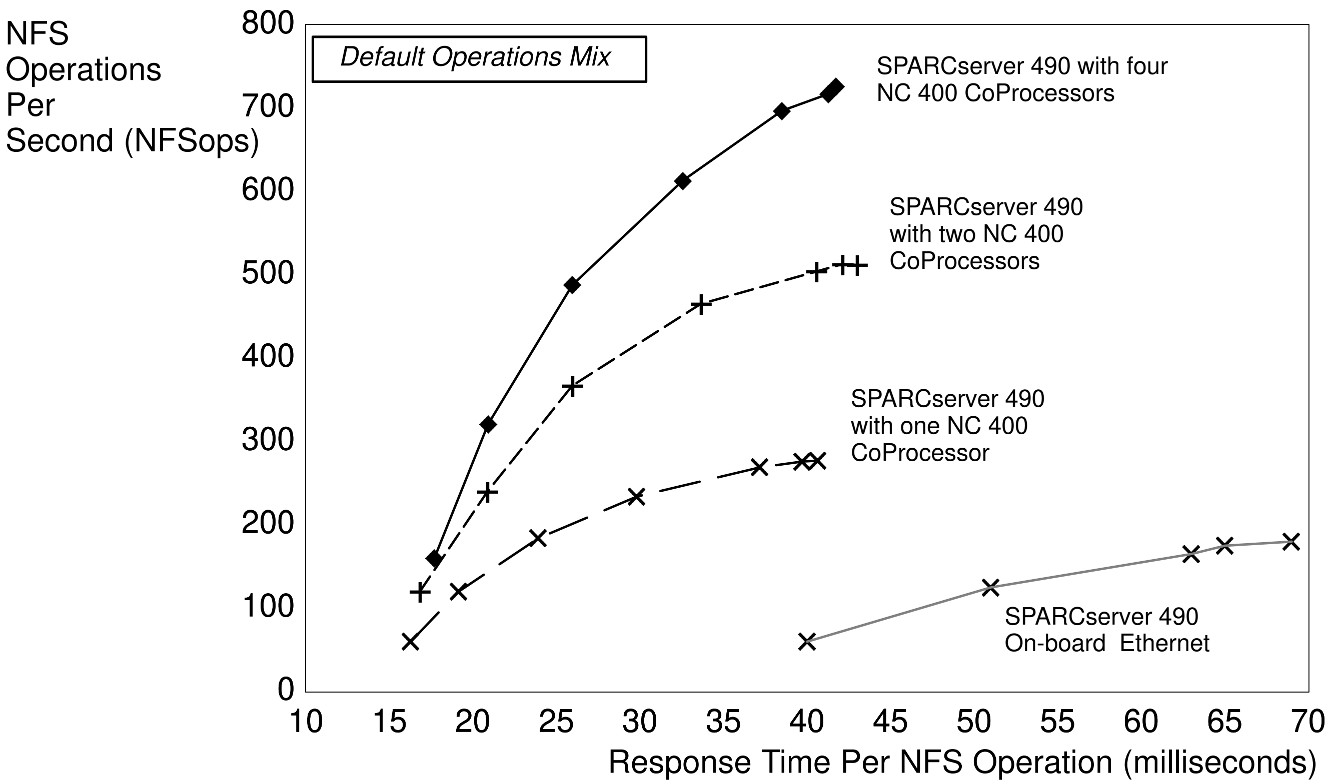


Figure 1 illustrates the number of NFS operations per second handled by the file server as a function of the response time per NFS operation. The above results indicate that the NFS performance of the SPARCserver 490 improves dramatically with the Sun Prestoserve NFS accelerator board. Adding the Sun Prestoserve turns a general purpose SPARCserver 470 and 490 into a high performance file server. At 40 milliseconds response time, NFS throughput improves by 80% with the Sun Prestoserve board.

This test used the default NFS operations mix (default mix). For a given number of diskless clients, the server response time per NFS operation is significantly better with the Sun Prestoserve than a server without it, particularly if, (i) the server supports a large number of clients (especially diskless), and (ii) the mix of NFS write operations is greater than 5% of the total.

2.2 Increasing SPARCserver 490 NFS Performance with Intelligent Network CoProcessors*

Figure 2. One, Two and Four Ethernet Throughput Comparison on SPARCserver 490



The above results clearly indicate the NFS performance scaleability of the SPARCserver 490. The SPARCserver 490 delivers 190% more NFS throughput with two Ethernets, and over four times more NFS throughput with four Ethernets compared to a single on-board Ethernet case. The SPARCserver 490 can deliver 725 NFS Operations Per Second (NFSops) at a low 40 millisecond response time per NFS operation.

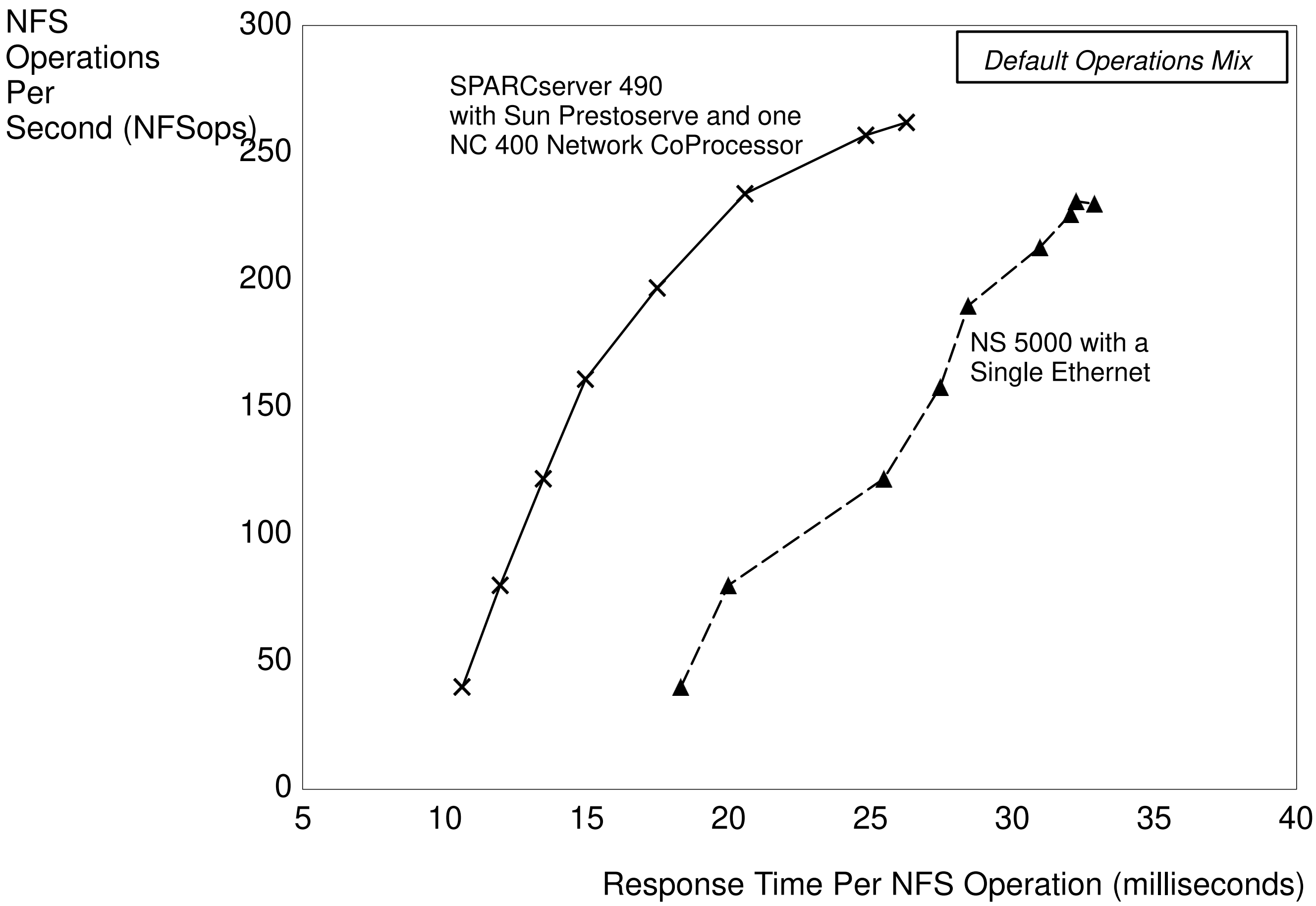
* NC 400 Network CoProcessors are "intelligent" Ethernet boards and optimized NFS software that off-load the CPU from network and NFS processing activities. The NC 400 Network CoProcessors are available from Interphase, Inc. for SPARCserver 470/490.

3. Benchmark Comparisons: SPARCserver 490 vs. NS 5000

The following section contains nhfsstone benchmark results of the SPARCserver 490 and the NS 5000. Each graph shows results obtained from an identically configured network and benchmark parameters for the two file servers. All benchmarks in this section use the default workloads. The SPARCserver 490 benchmark runs covered in Section 2 of this paper were performed at Sun. Results presented in this section were obtained by running benchmarks at a Sun customer site which had an Auspex NS 5000 system for evaluation purposes. Configuration details and NFS operations mix for each benchmark run are listed in “Test System Configurations” section.

3.1 SPARCserver 490 vs. NS 5000 Comparisons: Single Ethernet Performance

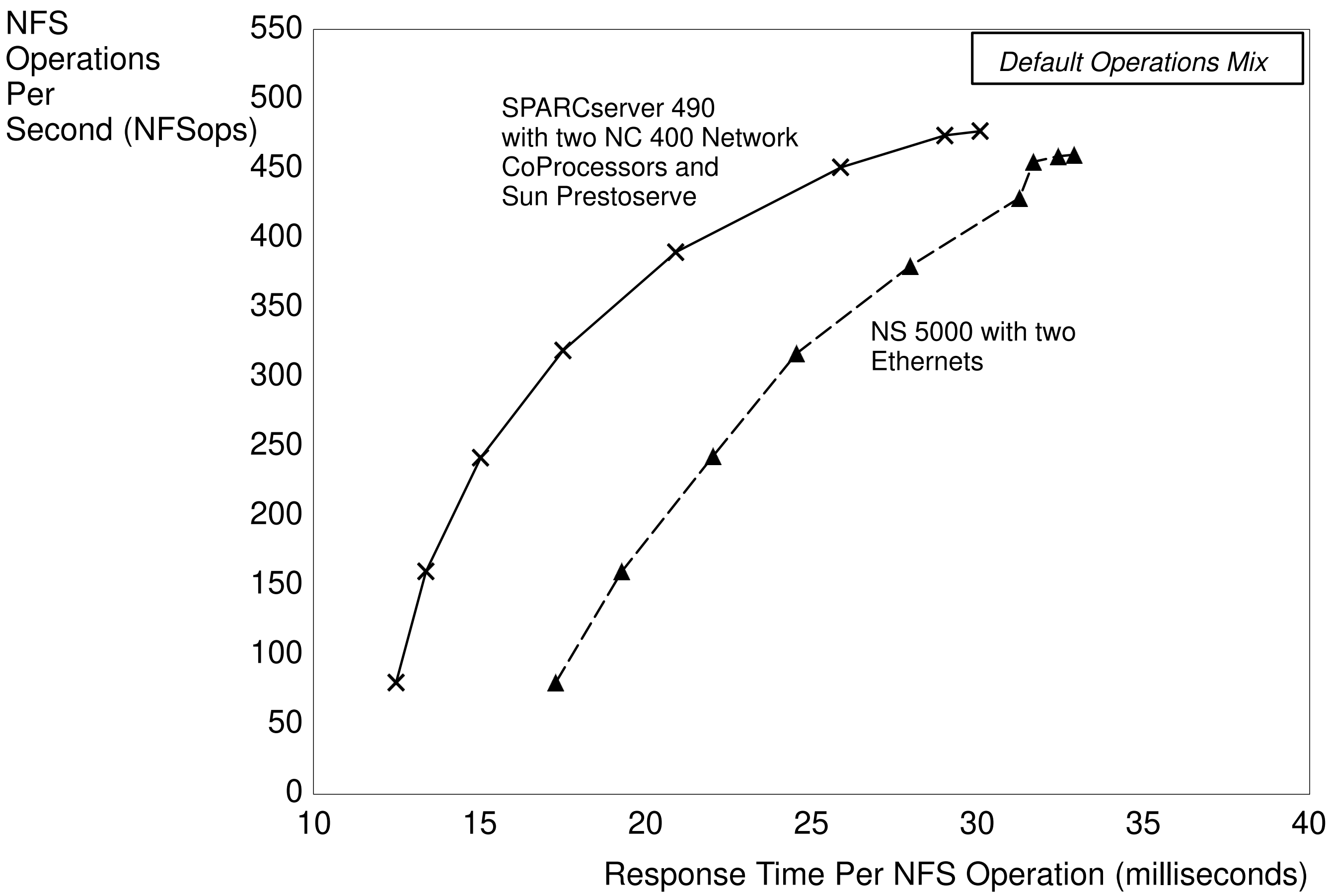
Figure 3. *Single* Ethernet Throughput Comparison: SPARCserver 490 with Sun Prestoserve vs. NS 5000



The above figure illustrates the nhfsstone benchmark results with the default (diskless) operations mix load. The SPARCserver 490 was configured with one NC 400 Network CoProcessor and Sun Prestoserve board. The SPARCserver 490 delivers 14% higher performance of 260 peak NFS Operations Per Second (NFSops) versus 230 peak for the NS 5000, at a 19% better response time (26msec vs. 33 msec). At 20 milliseconds response time, the SPARCserver 490 can support over 230 NFSops; the NS 5000 can support around 80 NFSops. The SPARCserver 490 has almost 180% performance advantage for the single Ethernet case at a 20 millisecond response time (225 NFSops vs. 80 NFSops).

3.2 SPARCserver 490 vs. NS 5000 Comparisons: Dual Ethernet Performance

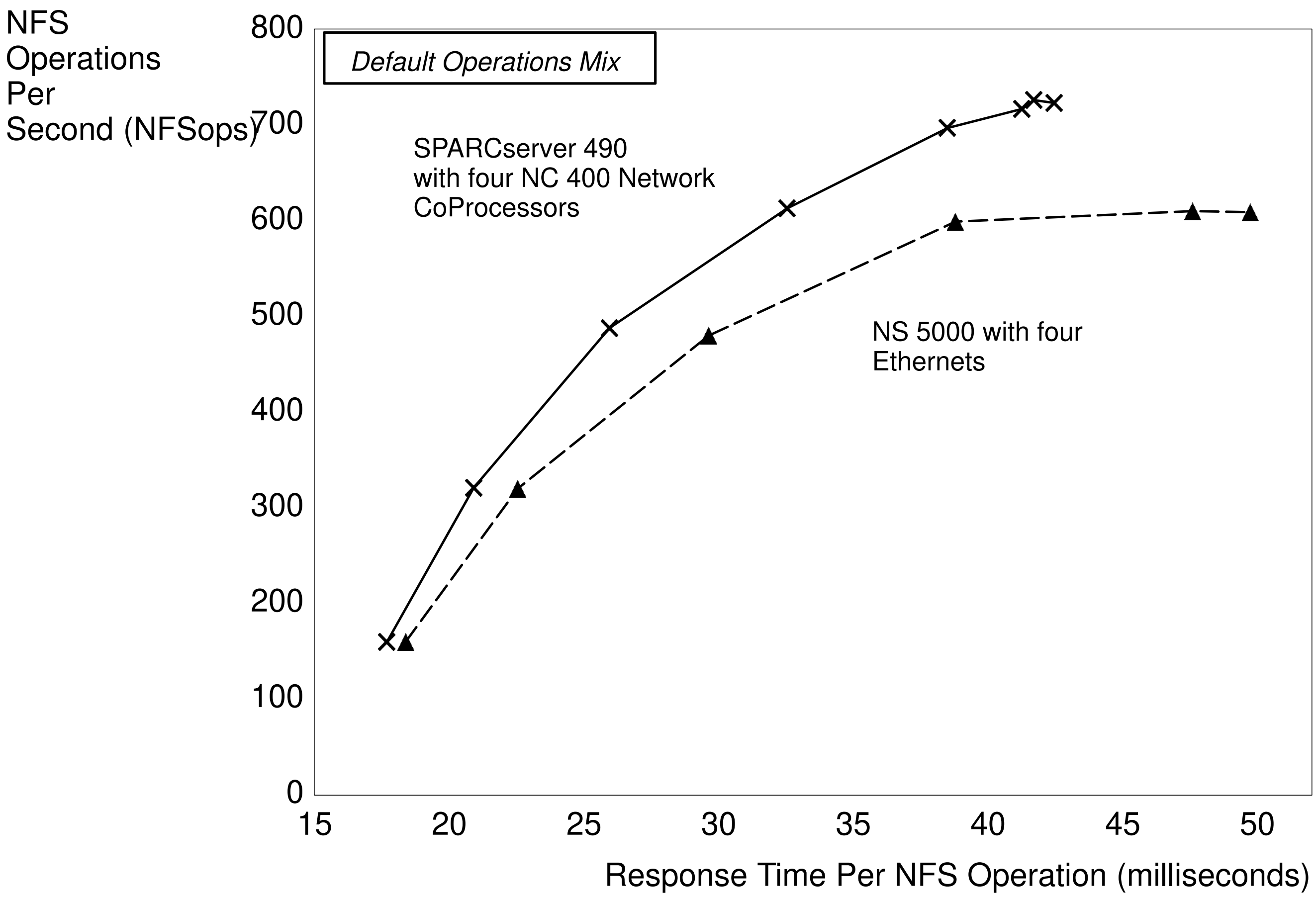
Figure 4. *Dual* Ethernet Throughput Comparison: SPARCserver 490 vs. NS 5000



The NFS throughput of the SPARCserver 490 increases dramatically with the addition of a second Ethernet controller, providing over 470 NFSops or 4% more NFS peak throughput than the NS 5000. At 20 milliseconds response time, the SPARCserver 490 delivers over 110% better NFS throughput performance than the NS 5000 (375 NFSops vs. 175 NFSops).

3.3 SPARCserver 490 vs. NS 5000 Comparisons: Four Ethernet Performance

Figure 5. *Four* Ethernet Throughput Comparison: SPARCserver 490 vs. NS 5000



The NFS file server performance results used four Ethernets in both systems. The SPARCserver 490 was configured with four NC 400 Network CoProcessors only (that is, Sun Prestoserve board was not used). The results indicate that the NFS throughput and response times for the SPARCserver 490 is consistently better than the NS 5000. The SPARCserver 490 attains maximum NFS throughput of 725 NFSops at a response time of 36 milliseconds with four Ethernets, 19% better than the NS 5000 peak throughput of 609 NFSops at 50 milliseconds response time.

4. Auspex's Benchmark Results

During the last few months, there have been several Performance Notes from Auspex Systems, Inc., that have compared NFS performance of the SPARCserver 490 versus the NS 5000. The Auspex performance papers have the following fundamental problems:

- The Auspex internal benchmark typically compares a Sun 4/280 and a SPARCserver 490. Unfortunately, results reported on Sun's servers usually do not incorporate the latest hardware and software products from Sun which would otherwise contribute to improved NFS performance. Sun Prestoserve NFS accelerator, Interphase NC 400 Network CoProcessors, and SunOS 4.1 are just a few of the many recently delivered server product enhancements from Sun not included in the Auspex tests.
- The proper SunOS kernel configuration and allocation of buffer cache can increase NFS throughput by as much as 35% with no additional hardware. It is possible, in fact likely, that the SPARCserver 490 used by Auspex for benchmarking was configured with a generic kernel rather than one configured to achieve high NFS throughput.
- The Auspex "Performance Notes" use a proprietary Auspex-devised NFS benchmark called the Traffic Generator. Auspex has not made this benchmark available to evaluate the validity of this benchmark and its results.

APPENDIX I
Value of General Purpose Systems

Performance is only one of several factors to consider when purchasing a network server. Another critical factor to weigh is the relative merits of general purpose versus special purpose servers. Specialized servers sometimes provide higher performance for a specific task, but general purpose systems offer many other advantages—

1. Flexibility
Most servers today provide a number of network services. In fact, a recent survey of Sun customers indicates that 75% of installed SPARCservers simultaneously provide at least two major services (e.g. file and compute). General purpose servers offer the flexibility to provide several services to network users, while special purpose systems must be dedicated to a specific task. General purpose systems are better suited to meet the varied computing demands of today's network environments and have the flexibility to be redeployed for other uses as needs change.

2. Functionality and Special Purpose Accelerators
General purpose servers are sold in much greater volume and by much larger companies than special purpose servers. General purpose systems benefit from substantial engineering investments made by large computer companies and by a large number of independent add-on hardware and software vendors. As a result, these systems support a much richer set of application software, system software and options, and third-party add-on devices (e.g. the Sun Catalyst catalog has over 2100 SPARCware solutions). The wealth of solutions and add–ons available for popular general purpose systems is a significant part of the value these systems offer to users. Among the options available for SPARCservers are special purpose accelerators that can provide performance comparable to specialized system architectures without sacrificing the benefits of a general purpose solution.

3. Rate of Performance Improvement
At any point in time, a company can design a specialized architecture that outperforms a general purpose architecture at a specific task. Examples include specialized word processors, artificial intelligence systems, database engines, and now NFS file servers. However, general purpose systems can usually incorporate new software and hardware technology advancements more readily than specialized architectures. As a result, over time the performance and price/performance of general purpose systems improves much more quickly than specialized systems, to the point where general purpose systems become faster even for specialized tasks. This trend has led many companies building specialized architectures (those that survived) to adopt general purpose systems or become software companies.

Special purpose servers may look attractive today for certain applications. However, their advantage is usually short lived. Furthermore, general purpose systems may be able to achieve comparable performance when configured with special purpose accelerators.

APPENDIX II
Sun's SPARCservers: General Purpose Value and Special Purpose Acceleration

Sun offers a broad family of general purpose SPARCservers to meet the needs of small and large network computing environments. SPARCservers have the flexibility to provide a number of network services simultaneously (for example, file and compute service), or can be configured to provide very high performance for a dedicated task.

1. Balanced Performance for High System Throughput and General Purpose Flexibility
SPARCservers provide balanced CPU, I/O and networking performance features so that they deliver high system throughput in a variety of application environments, including NFS file service, database management, and computation. For example, the SPARCserver 490 delivers 57.2 database transactions per second (TPC–B benchmark, running Sybase RDBMS), giving the SPARCserver 490 the best database price/performance in its class. The SPARCserver 490 can also deliver very high NFS operations per second and excellent compute performance.

2. Special Purpose Acceleration
Sun offers special purpose accelerators that allow customers to customize SPARCservers for particular applications. For example, customers can convert a general purpose SPARCserver 490 into a high throughput NFS file server simply by adding the Sun Prestoserve NFS accelerator. For extremely large network environments, additional network throughput can be achieved by adding Interphase NC 400 Network CoProcessors. By providing special purpose acceleration, Sun allows customers to achieve the performance they require without sacrificing the benefits of purchasing a general purpose system from a well-established computer vendor.

3. Performance Growth Path
The performance of SPARCservers can be increased over time as performance requirements increase. SPARCserver performance can be "scaled" by the following means:

- Adding more memory (up to 768 Mbytes on the SPARCserver 470/490)
- Adding more IPI disk controllers or SCSI host adapters
- Adding more high-speed disk drives
- Adding special purpose database and/or NFS acceleration
- Upgrading to multi-processing (later in 1991)

4. SPARCserver Software for High Availability, System Administration, and Performance
Sun offers "SPARCserver Software" that reduces system downtime, eases system administration, and increases system performance. For example, SPARCserver Manager provides data redundancy through disk mirroring and system administration tools with an easy-to-use graphical user interface. Another SPARCserver software product, Sun Database Excelerator, increases database transaction performance and the number of simultaneous database users.

APPENDIX III
Test System Configurations

SPARCserver 1+

CPU:	25 MHz MB86901 IU
FPU:	25 MHz WTL3170 FPU
Main Memory:	16-Mbytes
Disk Subsystem:	1 104 MB internal SCSI drive
Operating System/Compilers:	SunOS 4.1

SPARCserver 490 configuration

CPU:	33 MHz CY7C601 IU
FPU:	CY7C608 FPC, 33 MHz ACT8847 FPP
Main Memory:	32-Mbytes of ECC memory
Disk Subsystem:	
	one Ethernet case: 3 6-MB/s IPI drives, 2 ISP-80 controllers
	two Ethernet case: 6 6-MB/s IPI drives, 3 ISP-80 controllers
	four Ethernet case: 8 6-MB/s IPI drives, 4 ISP-80 controllers
Operating System/Compilers:	SunOS 4.1.1
Other Hardware:	Sun Prestoserve NFS Accelerator Board (where specified)
	1 to 4 Interphase NC 400 network CoProcessor Boards
NFS Load Generators:	Benchmark tests in Figures 1 and 2 used 3 clients and 3 disks per client for one and two Ethernet performance tests. All other tests used 2 clients per net and 2 disks per client.

NS 5000 configuration

CPU:	Sun3E120 processor
Main Memory:	32 Mbytes
Disk Subsystem:	8 SCSI controllers; 8 1–GB SCSI disks
Operating System/Compilers:	SunOS/Auspex Release 1.1 system software
Other Hardware:	4 Ethernet Dual Processors
	1 File Processor
	1 Storage Processor
NFS Load Generators:	2 SPARCstation 1+ clients per Ethernet and 2 disks per client.

Appendix IV
NFS Operations Mix

	Nhfsstone (diskless)
null	0%
getattr	13%
setattr	1%
root	0%
lookup	34%
readlink	8%
read	22%
wrcache	0%
write	15%
create	2%
remove	1%
rename	0%
link	0%
symlink	0%
mkdir	0%
rmdir	0%
readdir	3%
fsstat	1%

Rounded off to whole numbers.

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