

# WHITE PAPER

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## Compaq Pentium Pro Processor-Based Servers: New Possibilities For The Distributed Enterprise

### EXECUTIVE SUMMARY

The computing industry is at the threshold of a new generation of multiprocessing servers based on the new Intel Pentium Pro processor. Leveraging seven years of server expertise, Compaq is introducing a new breakthrough platform for the distributed enterprise: the Compaq ProLiant 5000, offering midrange-class performance and reliability.

Compared to its predecessor, the new Compaq ProLiant 5000 has

- 30% to 50% greater database performance, and
- 25% to 40% greater file server performance.

Customers currently deploying business-critical database applications or doing file server consolidation on a ProLiant 4500 should consider a relatively quick transition to the ProLiant 5000 based on its superior performance and value; most customers should shift to Pentium Pro processor-based systems by September, 1996. In addition, customers who are transitioning from Pentium to Pentium Pro processor-based servers should also strongly consider transitioning from EISA to PCI peripherals to take full advantage of the ProLiant 5000 I/O performance capabilities.

By designing its own Pentium Pro processor-based servers, Compaq is delivering industry-standard platforms that will meet the needs of the distributed enterprise:

- midrange-level performance of 5676 tpmC supported by up to 4GB<sup>1</sup> of system memory,
- the industry's best price:performance of \$136 per tpmC,
- the high-availability and reliability required for business-critical applications—including clustering solutions,
- comprehensive investment protection programs for Compaq servers, especially backward compatibility with the large installed base of Compaq rack-mountable servers
- robust platform integration and manageability, and
- systems-class service and support.

High-availability and reliability are key for trusting a platform to run your business-critical applications. A few examples of Compaq's attention to detail in these new systems are

- redundant Netelligent network interface controllers (NICs) that eliminate the network adapter as a single point of failure,
- N+1 redundant Processor Power Modules that guarantee power to each individual Pentium Pro processor even if one Processor Power Module fails,
- an expansion of the Compaq Pre-Failure Warranty to include Pentium Pro processors,
- optimized system signal path and air flow routing that ensures highly reliable operation under the heaviest loading conditions,
- On-Line Capacity Expansion with the SMART-2 Array Controller that allows storage capacity to be added to an existing RAID configuration without taking the server off-line,
- the new Compaq DLT Array that can back up over 200GB of data in under five hours with full RAID 5 protection,
- clustering solutions that deliver cost-effective high-availability for both file/print and database applications, and
- high levels of operating system, database, and management integration through Compaq SmartStart and Insight Manager.

These and many other features make the new Compaq ProLiant 5000—and future Pentium Pro processor-based servers to be introduced later in 1996—ideal for running business-critical applications in either the department or the data center.

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*“Lyondell Petrochemicals selected the Compaq SAP R/3 solution running Microsoft Windows NT Server and Microsoft SQL Server 6.0 because it offered the best price:performance and the ultimate flexibility of an industry-standard systems environment,” said Randy Lewis, Director of IS for Lyondell Petrochemicals. Lewis continued, “We are now in full production with this configuration and are very impressed with its stability and performance. Lyondell values the relationship between Compaq, SAP and Microsoft, and trusts them to continue delivering valuable solutions for our enterprise computing requirements.”*

## LEADING IN THE DISTRIBUTED ENTERPRISE

There is a revolution in business computing as corporations move their operations to a decentralized business and computing environment. These business and technological changes are driving the convergence of the centralized and distributed computing models.

Compaq has pioneered this *distributed enterprise*, a flexible, networked information infrastructure that delivers instant access to business-critical data and empowers decision-makers. In 1989 Compaq introduced the first industry-standard, multiprocessing x86 server, the Compaq Systempro. Soon after, in 1991, Compaq created the Compaq Systems Division to focus specifically on industry-standard server innovation. And in 1994, Compaq reinforced its commitment to serving the needs of corporate MIS by delivering the industry’s first rack-mountable x86-based servers that targeted the needs of customers deploying and consolidating servers in the data center.

Because Compaq continues to challenge traditional midrange computing paradigms, many customers are presently migrating their business-critical applications from proprietary RISC-based systems to industry-standard x86-based Compaq servers:

- Performance is comparable to the fastest RISC-based midrange systems.
- Solutions based on industry-standard Pentium platforms cost 50% to 75% less than comparable midrange solutions.
- Deployment of systems with consistent architectures allows customers to easily manage and redeploy servers depending on their changing business needs.
- High-availability options for industry-standard systems now meet or exceed those for typical midrange levels of availability.
- Rapidly increasing numbers of business-critical applications, like SAP R/3, are being ported to x86-based servers, especially under Windows NT Server, yielding outstanding performance.
- Midrange-class integration, manageability, service and support are available for industry-standard solutions.

For example, TPC-C results published earlier this year for the Pentium processor-based Compaq ProLiant 4500 5/166 clearly demonstrate that x86-based servers deliver midrange-class transaction processing performance for a total cost of ownership<sup>2</sup> that is \$500,000 to \$1,000,000 less than that of traditional midrange systems that were available at the time:

	Compaq ProLiant 4500 5/166	HP 9000 K410	IBM RS/6000 J30	Data General AViiON 5800	SNI RM 600 340
TPC-C Throughput	3849 tpmC	3809 tpmC	3631 tpmC	3406 tpmC	3921 tpmC
Price:Performance	\$161 / tpmC	\$364 / tpmC	\$289 / tpmC	\$240 / tpmC	\$495 / tpmC
Total System Cost	\$619,445	\$1,384,763	\$1,049,656	\$816,031	\$1,939,674
Number of Processors	4	4	8	7	8

With almost triple the worldwide server market share of the nearest competitor in 1995,<sup>3</sup> Compaq is uniquely positioned to forge wide-ranging partnerships that guarantee Compaq’s client/server customers integrated, highly-reliable distributed enterprise solutions. For example, the Compaq ProLiant server has emerged as the platform of choice for SAP on Windows NT Server, holding over 50% of SAP AG’s R/3 market share for Windows NT installations worldwide.<sup>4</sup> Compaq recently announced a record sales and distribution (SD) benchmark—one of the most demanding systems tests available for SAP solutions—of 350 SD benchmark users on a ProLiant 4500 running Windows NT Server.<sup>5</sup>

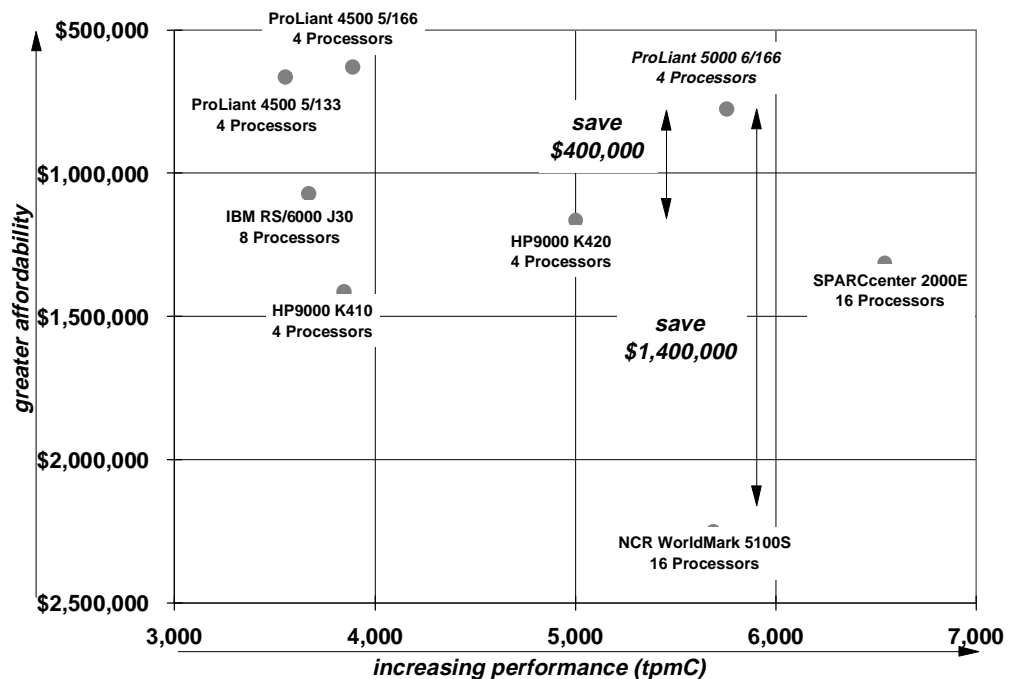
In addition, through its two-year-old Client Server Partners Program, Compaq has been working with other software companies like Computer Associates, Dun & Bradstreet Software, PeopleSoft, Platinum Software, SEER Technologies, and Tivoli to port high-end, enterprise applications to Windows NT Server on Compaq ProLiant platforms.

**THE COMPAQ PROLIANT 5000: THE NEW MIDRANGE ALTERNATIVE FOR THE DISTRIBUTED ENTERPRISE**

Leveraging its seven years of server expertise, Compaq is introducing a new breakthrough platform for the distributed enterprise: the Compaq ProLiant 5000, offering midrange-class performance and reliability.

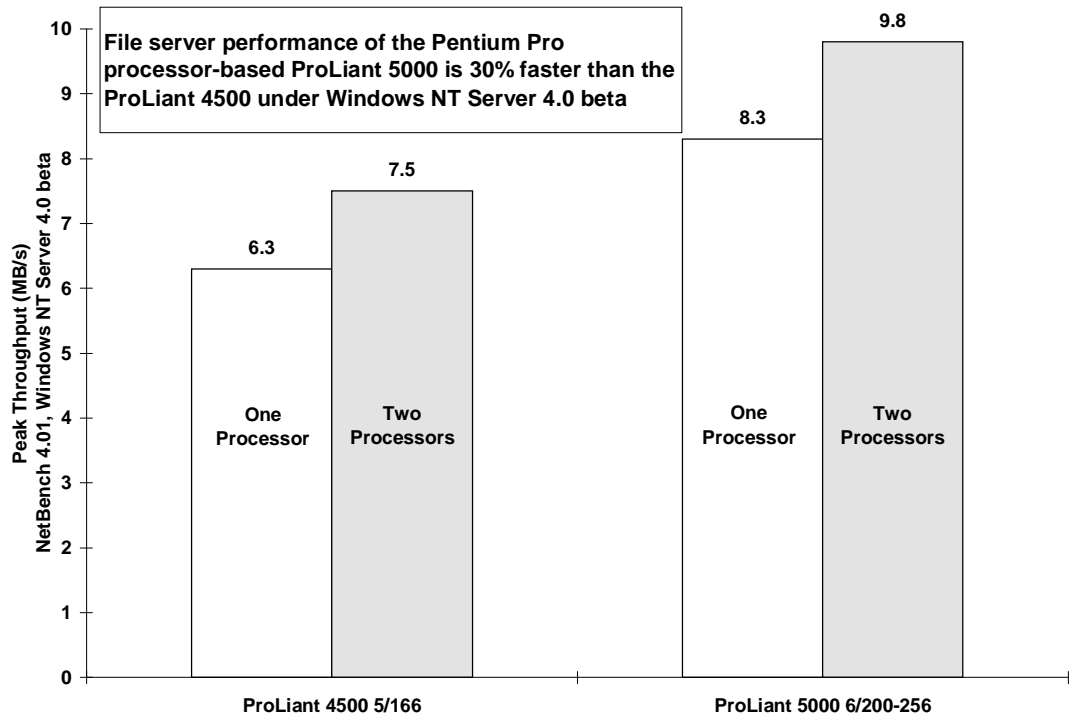
The new Compaq ProLiant 5000 has 30% to 50% greater database performance than its predecessor, the Compaq ProLiant 4500. The ProLiant 5000 also has 25% to 40% greater file server performance. Customers currently deploying business-critical database applications or doing file server consolidation on a ProLiant 4500 should consider a relatively quick transition to the ProLiant 5000 based on its superior performance and value. In addition, customers who are transitioning from Pentium to Pentium Pro processor-based servers should also strongly consider transitioning from EISA to PCI peripherals to take full advantage of the ProLiant 5000 I/O performance capabilities.

The breakthrough database capabilities of the Compaq ProLiant 5000 is dramatically illustrated by the following benchmark. With Windows NT Server 4.0 and Microsoft SQL Server 6.5, the ProLiant 5000 offers transaction performance similar to that of the leading proprietary midrange systems for a total cost that is 35% to 65% less—this translates into a total savings of \$400,000 to \$1,400,000 over a five-year period. This data also illustrates the challenge vendors such as Hewlett Packard and Sun face when their larger, more costly, proprietary systems are less and less often the best answer for their customers' applications.



	Compaq ProLiant 5000	HP 9000 K420	HP 9000 T500	IBM RS/6000 J30	NCR WorldMark 5100S	SPARCcenter 2000E
TPC-C Throughput	5676 tpmC	4939 tpmC	withdrawn	3631 tpmC	5607 tpmC	6444 tpmC
Price:Performance	\$136 / tpmC	\$232 / tpmC	withdrawn	\$289 / tpmC	\$394 / tpmC	\$200 / tpmC
Total System Cost	\$770,272	\$1,144,200	withdrawn	\$1,049,656	\$2,206,688	\$1,289,077
Number of Processors	4	4	12	8	16	16

Businesses are placing more and more performance demands on today's file servers. Network services such as messaging, security, routing, and global directory services are being added to the traditional "file server," making them more business-critical than ever before. These complex multi-function servers may require additional processor performance. Compaq servers delivering Pentium Pro performance are an excellent solution for these growing LAN environments. In addition to enhancing CPU processing power, Compaq servers also provide customers with disk and network subsystems that deliver world-class performance as illustrated by the following NetBench benchmark<sup>6</sup>. Both absolute and relative performance of the ProLiant 5000 versus the ProLiant 4500 is expected to improve with the final release of Windows NT Server 4.0.



File server performance under Novell NetWare shows a similar performance improvement when comparing a single-processor ProLiant 5000 to a similarly-configured ProLiant 4500. The bulk of the NetWare performance improvement is due to the ProLiant 5000 dual, peer PCI architecture rather than increased processor performance.

**COMPARISON WITH THE PROLIANT 4500**

The following table illustrates the similarities and differences between the Compaq ProLiant 5000 and the Compaq ProLiant 4500. Where the Compaq ProLiant 5000 has a particular advantage, that feature is *bold italicized*.

	<b>Compaq ProLiant 4500</b>	<b>Compaq ProLiant 5000</b>
<b>Processors</b>	4 x Pentium (133, 166MHz)	<i>4 x Pentium Pro (166, 200MHz)</i>
<b>L2 Cache</b>	runs at 66 MHz 2MB, 2-way set associative	<i>runs at processor speed (166 or 200MHz) up to 512KB, 4-way set associative ECC-protected</i>
<b>Memory</b>	64MB ECC standard, 1GB maximum	<i>64 or 128MB ECC standard, 4GB<sup>1</sup> maximum</i>
<b>Architecture</b>	64-bit processor bus @ 267MB/s  128-bit memory bus  EISA bus @ 33MB/s concurrent processor and I/O operation	<i>64-bit split-transaction, ECC-protected processor bus @ 540MB/s  256-bit memory bus  dual, peer PCI buses @ 267MB/s EISA bus @ 33MB/s concurrent processor and I/O operation</i>
<b>Expansion Slots</b>	8 EISA slots	<i>5 PCI slots 2 Shared PCI/EISA slots 1 EISA slot</i>
<b>NIC</b>	NetFlex-3 NIC installed in an EISA slot 10Mb/s upgradable to 100Mb/s Ethernet	<i>Netelligent NIC installed in a PCI slot 10/100 Mb/s standard redundant NIC functionality optional</i>
<b>Disk Controller</b>	Integrated 32-Bit Fast-Wide SCSI-2 SMART-2/E Array Controller installed in an EISA slot on some models	Integrated 32-Bit Fast-Wide SCSI-2 <i>SMART-2/P Array Controller installed in a PCI slot on some models</i>
<b>Pre-Failure Warranty</b>	hard drives and memory	<i>hard drives, memory, and processors</i>
<b>Mass Storage</b>	5 hot-pluggable drive bays in rack models; 4 hot-pluggable drive bays in tower models over 350GB total storage capacity (1H96); will increase to over 700GB (2H96)	
<b>Storage Management</b>	supports DAT, DLT, and DLT Array a single DLT Array backs up over 200GB in under 5 hours	
<b>Form Factor</b>	tower or rack-mountable	

## COMPETITIVE COMPARISONS

Performance, price:performance, and partnerships offer only a partial view of a platform's capabilities. Compaq understands the importance of maximizing the availability of application and file services to clients as well as ease-of-use features in a business-critical environment. Because of this commitment to providing customers with the utmost in system availability and usability, Compaq offers many features that are not currently offered by our competitors in their x86-based product lines.<sup>7</sup>

		Compaq ProLiant 5000	IBM PC Server 704	ALR Revolution Quad6
<b>Price:Performance Features</b>				
<b>Processor</b>	Models Available	6/166, 6/200	6/166	6/166, 6/200
	Number of Processors Supported	4	4	4
	Symmetric Multi-Processing	Yes	Yes	Yes
<b>Cache Memory Std. (KB)</b>		512 (6/166), 256 (6/200)	512	512 (6/166), 256 (6/200)
<b>Memory (MB)</b>	Standard Memory	64 to 128	64 to 128	32 to 64
	Maximum Memory (GB)	4 <sup>1</sup>	1	2
<b>Expansion Slots</b>	Dedicated PCI Slots	5	6	7
	Shared EISA/PCI Slots	2	0	1
	Dedicated EISA Slots	1	4	7
	Total PCI Slots	7	6	8
	Total Slots	8	10	15
<b>Controllers</b>	Integrated	PCI Fast-Wide SCSI-2	PCI Fast-Wide SCSI-2	PCI IDE
	Disk			
	Network Interface Controller	Netelligent 10/100TX	10/100 Mbps Std.	Optional
<b>Drive Bays</b>	Total	7 in tower, 8 in rack	17	13
	Removable Media Bays	3	5	2
	Hot-Swap Drive Bays	4 1.6" (Tower), 5 1.6" (Rack)	12 (1" high)	Optional
	3.5" Floppy	1.44MB Std.	1.44MB Std	1.44MB Std.
	CD-ROM Drive	Standard	Standard	Standard
<b>Maximum Storage Int / Ext / Total(GB)</b>		17.2 (T) 21.5 (R) / 301 / 301	25.68GB / NA	30GB/ NA
<b>Dependability Features</b>				
<b>Fault Prevention</b>	Server Environment Tracking	Standard	Standard	No
	Disk System Tracking	Standard	Standard	No
	ECC Memory	Standard	Standard	Standard
<b>Fault Tolerance</b>	Off-Line Backup Processor	Yes	No	No
	Hot-Pluggable Drives	Standard	Standard	Optional
	RAID Controller	SMART-2 Controller (PCI)	PCI Array Controller	3-channel PCI Array Ctrl.
	On-Line Spare	Yes	Yes	Yes
	Redundant Power Supply	Yes	Yes	Yes
	Uninterruptible Power Supply	Yes	Yes	Yes
<b>Rapid Recovery</b>	Standby Recovery Server	Optional	No	No
	On-Line Recovery Server (Clustering)	Optional	No	No
	Automatic Server Recovery	Yes	Yes	No
	Server Health Logs	Yes	Yes	No
<b>Server Management Tools</b>		Insight Manager		
<b>Warranty</b>	Standard	3-Year On-Site	3-Year On-Site	5-Year system, 3-Year Labor, On-Site Optional
	Processor Pre-Failure Warranty	Yes	No	No
<b>Ease-of-Ownership Features</b>				
<b>Intelligent Software Installation</b>		SmartStart	ServerGuide	No
<b>Remote Server Management</b>		Yes	Yes	No

NOTE: NA denotes "Information  
Not Available."

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## COMPAQ PENTIUM PRO PROCESSOR- BASED SERVERS: BALANCED SYSTEM PERFORMANCE

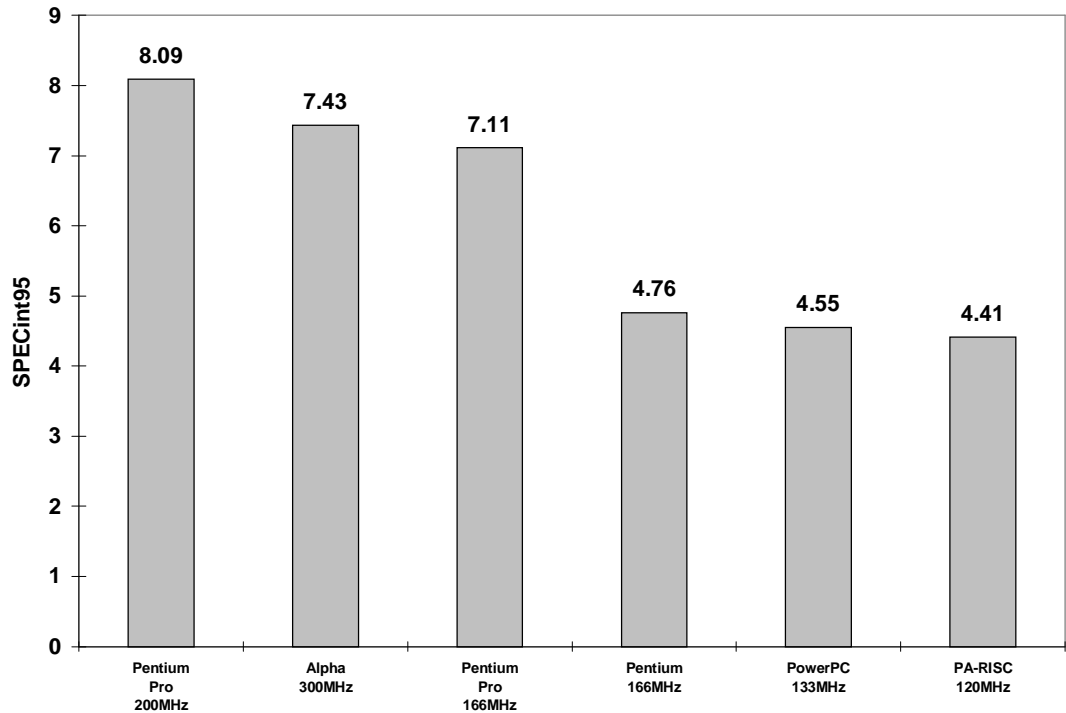
For the distributed enterprise, Compaq Pentium Pro processor-based servers deliver midrange class performance at x86 price:performance levels, surpassing both Pentium processor-based servers and most RISC-based systems. The Pentium Pro processor helps enable this performance but overall system performance is determined by more than just the processor.

Application servers make extensive use of all the key subsystems: processor, memory, and I/O subsystems such as the disk and NIC. A powerful engine doesn't necessarily make a fast car; the same holds true for computers. The rest of the architecture must be tuned and optimized for highest performance.

### Raw Processor Performance

Application servers are very processor-intensive and, therefore, will benefit much more from the increased performance of the Pentium Pro processor than will traditional file/print servers. In fact, the integer performance of the Pentium Pro processor actually *surpasses* that of all popular RISC processors.<sup>8</sup> This means

that applications that make heavy use of a processor's integer instruction set, such as databases, will significantly benefit.



The Pentium Pro processor's outstanding performance is due in part to the incorporation of a number of *dynamic execution* features borrowed from the leading RISC processors:

- superscalar architecture,<sup>9</sup>
- register renaming,<sup>10</sup>
- speculative execution,<sup>11</sup> and
- out-of-order execution.<sup>12</sup>

Complex new processors, such as the Pentium Pro processor, are expensive to design, debug and produce. The high volume of x86-based product sales, driven by high-volume market leaders such as Compaq, ensures that Compaq can continue to fund the research and development needed for innovation in overall server design and that Intel can continue to fund future generations of very complex chip development comparable to the Pentium Pro processor effort.

## Memory

In an application server, system memory capacity is directly related to overall performance because this memory is used to cache the hard disk and database records. The hard disk is typically the slowest part of the system, so moving as much data to memory as possible results in higher overall system performance. For example, typical installations of SAP R/3 on a Compaq ProLiant 4500 running Oracle and Windows NT Server require 1GB of memory for the highest performance; performance could be further improved by increasing memory. New Compaq ProLiant 5000 servers will support up to 4GB<sup>13</sup> of memory, one of the largest capacities of any system.

In order to most cost-effectively deliver the largest memory capacity, most Pentium Pro processor-based systems, including those from Compaq, will use new, higher-density, industry-standard Dual Inline Memory Modules (DIMMs). DIMM technology offers numerous customer advantages over SIMM technology including:

- 4GB<sup>13</sup> system capacities using only 16 DIMMs;
- 33% less power consumption resulting from use of 3.3V logic, the same voltage levels used by the Pentium Pro processor and memory controller; and
- more cost-effective and flexible memory upgrades.<sup>14</sup>

## Maximizing I/O Performance

For compatibility with the broadest range of peripherals, Compaq Pentium Pro processor-based servers feature industry-standard PCI buses as well as an EISA bus for backward compatibility with the large installed base of EISA option boards.

Compaq has engineered the PCI bus implementation to precisely match the needs of different classes of applications. The Compaq ProLiant 5000 uses *dual, peer* PCI buses that provide total I/O throughput capability of 267MB/s, throughput necessary to ensure maximum, balanced performance of four-processor systems deployed in the most demanding business-critical environments. By contrast, a *bridged* PCI bus implementation is a more cost-effective means of delivering a throughput of 133MB/s and is typically more suitable for two-processor systems.

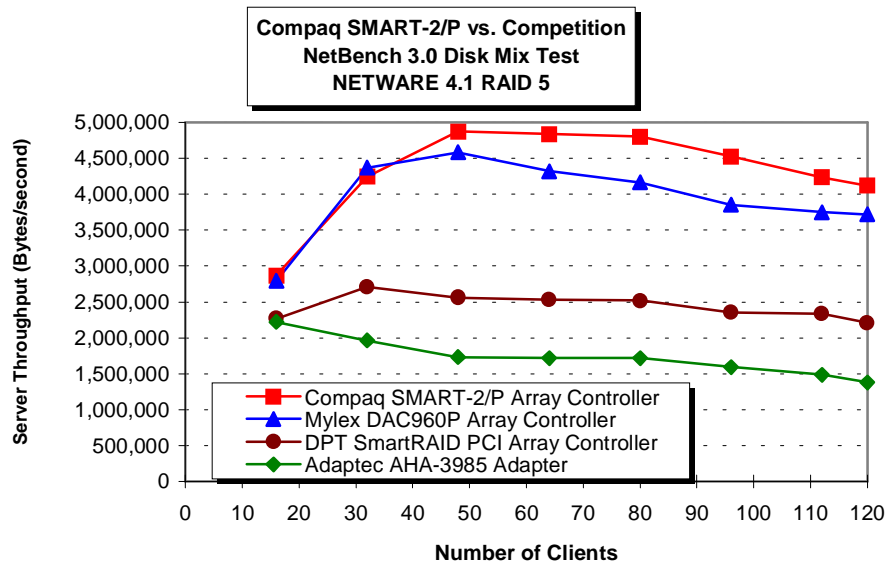
Each subsystem in Compaq Pentium Pro processor-based servers has been fine-tuned for high performance using state-of-the art hardware technology and driver optimization. For example, to ensure high-performance access to critical network data, the new SMART-2 Array Controller is standard in some models of Compaq ProLiant 5000. Compaq was the first company to introduce disk array controllers to the network server marketplace in 1989; the SMART-2 Array Controller represents Compaq's fifth generation of intelligent array controllers.

Each SMART-2 Array Controller features

- a total bandwidth of 40MB/s using two Fast-Wide SCSI-2 channels (20MB/s per channel),
- an enhanced Array Accelerator with 4MB of ECC-protected read/write cache,
- a hardware-based RAID engine,
- On-Line Capacity Expansion that allows storage capacity to be added to an existing RAID configuration without taking the server off-line,
- a high-performance processor optimized to manage full-featured drive arrays, and
- a 32-bit PCI bus-master host interface for maximum data burst performance.

With database applications typically doubling in size every year, SMART-2 Array Controller technology enables support of very large databases: over 350GB today, using 4GB drives; more than 700GB by second half of 1996, using 9GB drives; and terabytes of storage in 1997 using next-generation controllers based on Fibre-Channel technology.

To illustrate Compaq's commitment to performance excellence within each server subsystem, the SMART-2 Array Controller was tested using the NetBench 3.0 Disk Mix Test<sup>15</sup> along with competitive array controller products.



In a NetWare 4.1 environment, the Compaq SMART-2 Array Controller delivers

- up to 156.8% higher throughput than the Adaptec AHA-3985 PCI RAID Adapter,
- up to 76.9% higher throughput than the DPT SmartRAID PCI SCSI Disk Array Controller, and
- up to 9.4% higher throughput than the Mylex DAC960P PCI Array Controller.

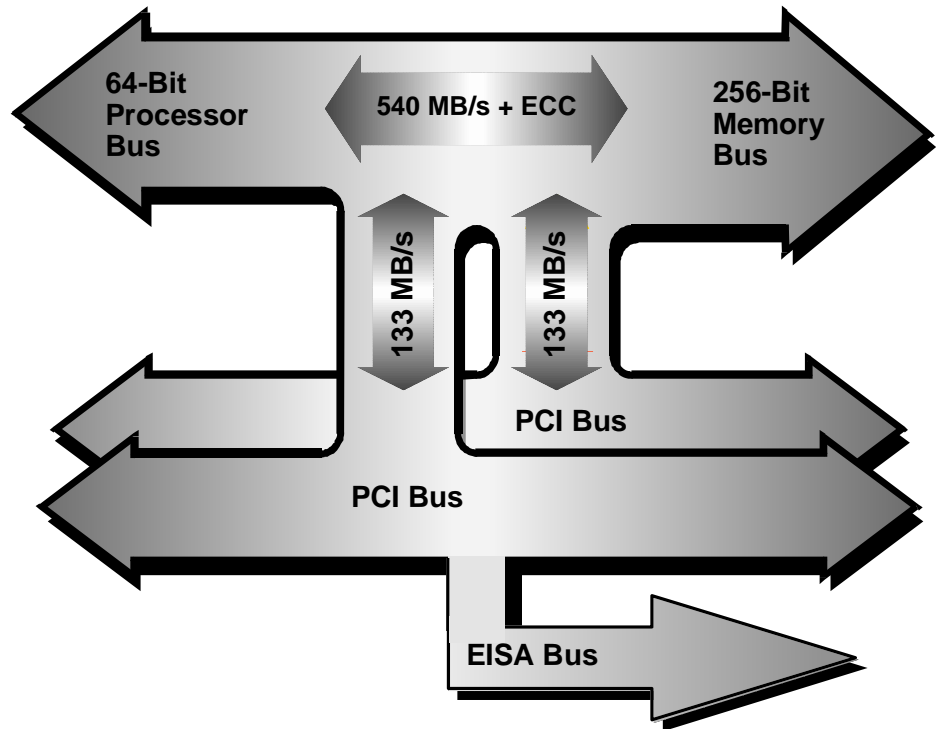
For high throughput off the network, the Netelligent 10/100TX NIC features software drivers that are optimized for all major operating systems. The Dynamic Auto-Sensing Device Drivers will allow Netelligent users to automatically switch from 10Mb/s to 100Mb/s operation to ensure the highest performance for the future.

### Compaq ProLiant 5000: An Architecture Tuned for Performance

The architecture of the Compaq ProLiant 5000 is dramatically different from that of the Compaq ProLiant 4500 in order to take advantage of the full performance and unique characteristics of the Pentium Pro processor as well as the latest in high-performance options.

The Compaq ProLiant 5000 features:

- a 66MHz ECC-protected processor bus with a throughput of 540MB/s;
- four-way set-associative<sup>16</sup> L2 cache, up to 512KB per processor, that is accessed at full processor speed through a separate, dedicated processor-to-cache bus;
- split transactions that allow processors to request data from slower I/O peripherals without tying up the Pentium Pro bus until data is available;<sup>17</sup>
- a 256-bit wide memory bus;
- dual, peer PCI buses delivering a total available I/O bandwidth of 267MB/s; and,
- like the Compaq ProLiant 4500, fully concurrent cache, memory and I/O buses to optimize performance for CPU- and I/O-intensive applications such as databases.<sup>18</sup>



## HIGH-AVAILABILITY

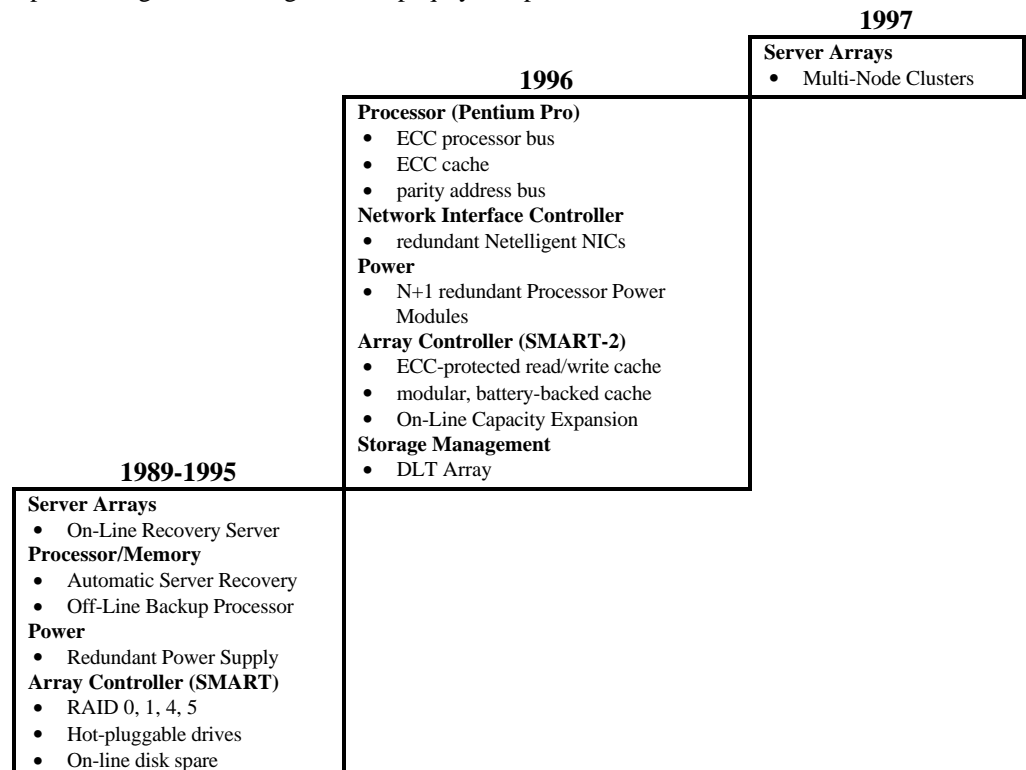
Compaq understands that a company's application servers manage its most critical data, that they contain the heart of their business and are their lifeline to operations and productivity. Compaq's goal is to meet or exceed the levels of availability to which corporate customers were accustomed with proprietary midrange solutions, but at more cost-effective price points. With that goal in mind, Compaq is continually searching for new ways to deliver high-availability solutions to protect business-critical data in the most cost-effective manner.

Compaq delivers value-add availability features and programs for its entire Compaq ProLiant server line that are especially critical for solutions likely to be built on Compaq Pentium Pro processor-based servers:

- Fault-tolerant subsystems and rapid recovery features ensure that stand-alone Compaq ProLiant servers have industry-leading system availability.
- Compaq Server Array products allow customers to cluster these servers to create even more highly-available platforms. Cost-effective, two-node Server Arrays (next-generation clustering) serve the needs of branch offices and replicated sites, while multi-node Server Arrays will provide additional solution scalability for the data center.
- Compaq servers undergo extensive pre-production testing by Compaq, by its industry partners, and by its customers. This testing ensures that Compaq Pentium Pro processor-based servers are reliable and compatible with the large installed base of applications; it also ensures that customers' transition from Pentium to Pentium Pro will be smooth.

### The Utmost in Single-System Availability

The following chart illustrates the evolution of high-availability features that Compaq began implementing with the original Compaq Systempro in 1989.



Six examples of unique, new Compaq features that maximize availability are

1. **Redundant NICs.** This high-availability operating mode for Netelligent NICs allows a hot, standby Netelligent NIC to become the active network controller in case of a primary failure.
2. **N+1 Redundant Processor Power Modules.** Intel Pentium Pro processors have stringent input voltage requirements; therefore, each Pentium Pro processor requires its own independent power. An optional, N+1 redundancy scheme supports up to three Processor Power Modules for every two processors; if one fails, there is a seamless, on-line backup.
3. **Expanded Pre-Failure Warranty.** Compaq is also broadening the scope of its Pre-Failure Warranty by now including the Pentium Pro processor. Pre-Failure Warranty ensures that when customers using Compaq Insight Manager receive notification that a critical server component may fail, the component is replaced for free under Compaq's three-year, onsite warranty. System administrators can proactively schedule downtime for maintenance and not interrupt critical business operations that rely on these enterprise-class servers.
4. **Optimized system signal path and air flow routing.** By designing its own systems from the ground up, Compaq has leveraged its seven years of server design experience to uniquely ensure highly reliable operation under the heaviest electrical and thermal loading conditions.
5. **On-Line Capacity Expansion.** The SMART-2 Array Controller allows new storage capacity to be added to an existing RAID configuration without taking the server down.
6. **DLT Array.** The new Compaq DLT Array can back up over 200GB in less than 5 hours. This high-performance backup capability is ideal for Compaq application servers with Pentium Pro processors because they will typically store large amounts of critical data. With RAID 5 redundancy, one tape drive can fail and backup or restore can continue interrupted.

### Compaq Server Arrays

In 1995 Compaq announced phased delivery for clustering Compaq servers that will result in cost-effective high-availability and scalability. This plan allows customers to grow their computing platforms as their applications grow, in a cost-effective manner. The delivery of these products began in mid-1995 with On-Line Recovery Server for Windows NT Server.

Compaq quickly followed up by driving the establishment of a new industry standard for Windows NT Server clustering. In October, 1995 Compaq, Microsoft and Tandem announced an alliance with other industry partners to grow the support base for new cluster-aware applications that will take advantage of this new Windows NT Server clustering platform.

Compaq's Server Array products will provide customers with the components they need to build robust database solutions for both the branch office and data center at cost-effective, industry-standard prices.

#### High-Availability for the Branch Office

With the introduction of On-Line Recovery Server, many more customers are choosing to deploy business-critical, branch office or replicated site applications on industry-standard Compaq platforms. On-Line Recovery Server minimizes cost of ownership and increases availability for Windows NT Server customers by allowing either server in this two-node Server Array to take on the work load of both servers in the unlikely event of a failure. Because it automates the process for detecting and recovering from a server failure, On-Line Recovery Server eliminates the need for an immediate service call, making it ideal for branch offices or replicated sites where the support staff may not always be on site.

On-Line Recovery Server is the first high-availability, clustering solution to be supported under Microsoft SQL Server 6.5.

**Clusters for the Data Center**

Clustering used to mean cost-prohibitive, proprietary hardware and software. The Compaq, Microsoft, and Tandem initiative is focused on achieving the highest levels of availability and scalability in a cost-effective, industry-standard solution for Windows NT Server platforms. For its multi-node Server Arrays, Compaq will use Tandem's highly-reliable ServerNet technology as the standard server interconnect. With high-availability intrinsic to its approach, ServerNet delivers high-bandwidth with low-latency, ensuring good scalability as nodes are added to the cluster. ServerNet-based solutions will also benefit from low entry and incremental costs.

**Ensuring Tested Transitions To Pentium Pro Processor-Based Systems**

Compaq takes no chances with server reliability. Exhaustive application testing, third party hardware testing, stand-alone testing and network testing on Compaq hardware is extensive. For example, the Compaq plan for Pentium Pro processor-based servers calls for over 16 machine-years, 95 man-months, and thousands of hours of testing with all major operating systems.

Compaq has supplemented this in-house testing by taking a leadership role in working with major software vendors and integrators, and with Intel, to bring Compaq ProLiant servers, Pentium Pro processor technology, and third-party applications together to ensure confident deployment of business-critical applications on this platform. These programs ensure that not only are Compaq Pentium Pro processor-based systems compatible with applications on the market, but also that these and future applications are optimized to run on Compaq ProLiant servers.

**DAVINCI**

In a series of business strategy workshops and technology demonstrations, Compaq and Andersen Consulting, Intel, SAP AG and Bay Networks are demonstrating line-of-business solutions based on industry-standard environments. These DAVINCI workshops demonstrate a working model of a virtual corporation that illustrates how new, best-of-breed technologies enable businesses to deploy industry-standard, business-critical solutions in a multi-vendor environment. These workshops feature Pentium Pro processor-based servers and desktops from Compaq running a three-tier SAP R/3 application on Microsoft Windows NT Server.

**Pacesetter '96**

With the Pacesetter '96 program, Compaq and Intel have placed Compaq ProLiant 5000 systems with ISVs and integrators so that these companies can gain insight into optimization and integration techniques that are invaluable for providing a well-integrated platform for deploying business-critical applications. Some of the companies participating in Pacesetter '96 include:

- Andersen Consulting
- Arbor Software
- Dun & Bradstreet Software
- Baan
- BMC
- Informix
- ISOCOR
- Lotus
- Oracle
- Price Waterhouse
- SAP
- SHL
- Sybase
- Tivoli
- ViewStar

**Server Evaluation Program**

Compaq and Intel have also initiated the Pentium Pro Server Evaluation Program (SEP) to validate the Pentium Pro processor-based Compaq ProLiant 5000. Compaq is choosing representative customers such as Carl Karcher Enterprises, Countrywide Home Loans, MCI, and SmithKline Beecham from a variety of industries to ensure that Pentium Pro-based solutions are integrated successfully in customers' "real world" environments. By the time it becomes generally available, the ProLiant 5000 will have hundreds of hours of testing in some of the most demanding multiprocessor server environments to ensure that solutions based on the Compaq

ProLiant 5000 platform are  
reliable, robust and ready  
to be deployed in today's  
business-critical  
environments.





## INVESTMENT PROTECTION

Compaq has always recognized investment protection as a key customer requirement. Traditionally, Compaq has focused on delivering the correct balance of introducing new technologies to the market as soon as possible, while at the same time maintaining investment protection for the large installed base of Compaq servers. To smooth customer transitions, Compaq has offered processor board upgrades which allow customers to receive credit for their existing processor boards towards the purchase of newer processor boards. As Compaq continues to move into the larger, more demanding, midrange market, a new and expanded Compaq Investment Protection Program will better protect customers' investments and offer more flexible, more cost-effective upgrade options.

Compaq ProLiant customers will continue to benefit from the flexible board-level upgrades to next-generation processor technologies that Compaq has traditionally offered. In addition to offering these board-level upgrades, Compaq will offer ProLiant 4500 customers the option to upgrade their servers to include Pentium Pro and PCI technologies.

- One of the many reasons Compaq designed its own system board for the Compaq ProLiant 5000 is to allow customers that have rack-mountable Compaq ProLiant 4500 servers a flexible board-level upgrades that deliver 100% of the performance they would expect from a Pentium Pro processor/PCI-based server from Compaq.
- Compaq ProLiant 4500 tower customers can also migrate to the ProLiant 5000.
- And, of course, Compaq ProLiant 1500 customers can upgrade their current systems to the Pentium Pro processor with processor board upgrades available later in 1996.

In all cases, the level of investment protection from Compaq is even greater today than it has been in the past. As market share leader, Compaq servers are providing business-critical service to thousands of the world's largest businesses. Expect a continued commitment to investment protection as Compaq continues to deliver more exciting possibilities for the midrange market.

### Note on Intel XXpress Upgrades

Competitive four-processor Pentium systems based on the Intel XXpress architecture, such as those from HP, DEC, NCR and Dell, may be limited in their upgradability to Pentium Pro processors. The XXpress processor bus, designed for Pentium processors, does not have the bandwidth to support multiple Pentium Pro processors if they are interfaced directly with that processor bus. If the existing XXpress system board is kept, upgradability will be limited to two Pentium Pro processors. To upgrade an Intel XXpress-based Pentium system to a system capable of supporting four Pentium Pro processors May require an entire system board swap or complete system exchange.

## **PARTNERSHIPS FOR INTEGRATION AND COMPATIBILITY**

Compaq servers are the best choice for business-critical solutions because there's a lot more to a platform than just the hardware. Compaq maintains seamless partnerships with other leaders in the industry, such as Microsoft, Novell, Oracle, and SAP, that result in optimized integration of leading software products running on Compaq servers. And Compaq management tools help assure the high availability and reliability that business-critical applications require.

### **Microsoft**

Compaq and Microsoft are working together to accelerate the acceptance of client/server solutions using Windows NT Server on industry-standard platforms. One example of a Windows NT site is USF&G, a property and casualty company. USF&G is building its next-generation business-critical applications around Windows NT, Sybase SQL Server, Replication Server and OmniSQL Gateway running on Compaq ProLiant servers. The company uses this industry-standard solution to create business-critical policy-writing systems that underwrite and issue new policies to businesses they insure. To address the requirements of Windows NT Server customers requiring a high-availability, multiprocessing server, Compaq introduced the ProLiant 4500 models featuring tight integration and performance optimization for BackOffice, Microsoft's client/server solutions, using Compaq SmartStart.

### **Novell**

Compaq's long-standing partnership with Novell means that the two companies not only work together on a technical, product level but also in many other areas, including service and support. If a customer has a problem installing, integrating or running a Compaq server with NetWare, Compaq will take responsibility for the problem and come back to the customer with a solution after working with Novell. Client/server customers require this level of partnership and Compaq is one of the few companies that can provide this service.

### **Oracle**

In 1994 Oracle established a Compaq Products Division. The first tangible result was support for and integration of Oracle 7 via SmartStart. At the Intel Pentium Pro processor press conference, Oracle, Novell and Compaq demonstrated the first parallel database server technology running on industry-standard platforms. Four Compaq ProLiant servers, each with four Pentium Pro processors, ran Oracle 7 Parallel Server and Novell's UnixWare Cluster Management System. The demonstration showed a performance increase of at least 80 % each time a server was added to the cluster. In the second half of 1996 Oracle and Compaq plan to bring resilient parallel server solutions to branch offices and distributed departments at unprecedented prices and also to optimize Oracle's Enterprise and Workgroup InterOffice software solutions for Compaq servers.

### **Compaq SmartStart**

Instead of requiring the use of on-site technicians (which the customer ultimately ends up paying for) to install a network operating system and ensure it is configured for maximum performance, Compaq developed SmartStart. SmartStart is a software tool on CD-ROM that provides the same level of integration and expertise at a fraction of the cost of a technician. SmartStart provides instant access to thousands of hours of Compaq integration testing, tight partnerships with the leading software vendors, and intimate knowledge of Compaq hardware.

Compaq SmartStart is an intelligent, CD-ROM-based method for configuring, installing, integrating, and optimizing network operating systems, relational databases and other

client/server-related software on Compaq servers. While Compaq now offers an advanced version of SmartStart that has evolved since its introduction over two years ago, competitors such as IBM and HP have attempted to follow Compaq's efforts in this area by introducing first-generation imitations that don't deliver the level of integration value provided by today's SmartStart.

For more information on SmartStart, see SmartStart 2.50 QuickSpecs, the SmartStart Catalog and the Compaq SmartStart 2.3/IBM ServerGuide 2.0 Competitive Analysis.

### **Compaq Insight Manager**

Compaq Insight Manager, standard with all Compaq servers, is an easy-to-use, standards-based application that allows network administrators to remotely manage and maintain Compaq servers. Together with Compaq Insight Management Agents and the management capabilities built into Compaq Servers, Insight Manager maximizes the effectiveness of network support staff while increasing network dependability.

As a pioneer in server management, Compaq realizes the need to incorporate servers into a multivendor networking environment as seamlessly as possible. That's why Insight Manager supports a wide variety of network operating systems and incorporates management standards that allow integration with the leading network management platforms including Microsoft SMS, SunNet Manager, IBM NetView for AIX, HP OpenView for Unix and Novell's ManageWise.

Among the many features it offers, Compaq Insight Manager provides in-depth monitoring, analysis and control of the fault, performance and configuration aspects of Compaq servers locally or remotely, on or off the network. These capabilities allow confident and cost-effective deployment of Compaq servers for business-critical networks. And Insight Version Control updates lower the cost of managing a customer's network by consistently providing the latest drivers and firmware from Compaq.

For more information on Insight Manager, see Insight Manager 2.61 QuickSpecs, the Compaq Insight Manager 2.4/IBM NetFinity 2.01 Competitive Analysis and the HP NetServer Assistant 2.0 Competitive Analysis.

### **COMPAQ GLOBAL SYSTEMS-CLASS SERVICE AND SUPPORT**

Compaq provides the services that customers require for their critical distributed enterprise environments, reaching a class traditionally reserved for midrange computer companies. Strong partnerships with established leaders in service and support, infrastructure investments in three worldwide Technical Support Centers, and utilization of Compaq tools and technology ensures customers access to comprehensive service and support when and where they need it.

With its systems-class service providers and programs, Compaq provides a tight linkage of service and support structures. In North America, for example, the System Service Provider (SSP) program selects service providers from within the indirect channel who have invested in the capability to provide enterprise levels of service. Compaq supports these service providers in meeting customers' enterprise-level service and support needs through dedicated account management, specialized training, and priority access to spare parts and technical support. Compaq's relationships with its SSPs and Global Service and Support Provider (GSSP), offer customers many alternatives for obtaining service and support, ranging from basic repair warranty service to multinational enterprise-level value-added services.

For customers who require services which are unavailable from local SSPs—due to geographic or capability constraints—Compaq has developed Compaq-branded Service and Support Offerings (CSSO). These offerings are provided by our Global Service and Support Provider, Digital Multivendor Customer Services.

### Integration and Implementation Services

- **Installation Services** ensure the most efficient and cost-effective implementation of your Compaq systems. Compaq experts that understand your IT environment install and ensure proper integration of your Compaq hardware, software, and networking solutions.
- **Interoperability Services** offered by Compaq provide distributed enterprise customers error-free integration of Compaq systems in a multivendor hardware and software environment.
- **Technical Consulting Services** are available to customers to complement their internal knowledge and expertise with specialized information as they integrate and implement new Compaq systems into their IT environment.

### Maintenance Services

- **Onsite Hardware Maintenance** offers custom-tailored service agreements that meet customers' specific availability requirements. Customers can select from a range of flexible service coverage, response time, and delivery methods. Options include 2 or 4 hour response, 7x24 coverage including holidays, and a resident engineer.
- **Enhanced Software Support** provides up to 7x24 comprehensive remote support to customers who require assistance in resolving complex problems as they apply to CSSO-supported Network Operating Systems, Database Management Systems products, Application Server products, and Network Management products.

### Maximizing and Optimizing Services

- **LAN Management Support** allows customers to cost-effectively augment their internal resources by having Compaq experts assist with LAN monitoring and administration support.
- **Remote System Management** Customers benefit from day-to-day monitoring of system activity to identify potential problem areas.
- **System Management Support** helps not only monitor and manage day-to-day activities, but also helps focus on operations review, performance analysis and tuning, security assessment, and implementation of System Healthcheck recommendations.
- **System Healthcheck** services help customers uncover potential trouble spots before they cause any performance degradation. Compaq will provide expert recommendations for addressing problems and optimizing performance.

Compaq's service and support partnerships and comprehensive programs make Compaq servers among the best supported industry standard platforms for deploying business-critical applications.

### CONCLUSION

The computing environment is rapidly changing. And customers are moving from proprietary systems onto industry-standard platforms. No longer locked into expensive, proprietary single-vendor solutions, companies can mix and match industry-standard components to create extremely cost-effective, business-critical solutions. New Pentium Pro processor-based solutions from Compaq not only deliver the performance and price:performance you would expect, but also feature the high-availability, scalability, and management attributes of midrange solutions.

It takes more than just hardware to deliver a complete solution. Compaq's leadership in forging strong, strategic partnerships with key industry players dramatically enhances the value of award-winning Compaq servers. Because of this leadership, customers can trust Compaq for an integrated, reliable, high-performance Compaq server solution—now and in the future.

### NOTES

- <sup>1</sup> The Compaq ProLiant 5000 supports 4GB architecturally; system configurations of more than 2GB will be possible when future memory technology becomes available; availability is currently expected to be in late 1996 or early 1997.
- <sup>2</sup> The Transaction Processing Council defines the total cost of ownership to include all hardware and software costs to support the benchmark as well as all service and support costs to cover a five year maintenance period.
- <sup>3</sup> Market share data are from International Data Corporation, February 1996: Compaq = 36%; IBM = 14%; HP = 12%.
- <sup>4</sup> Market share data are from SAP AG.
- <sup>5</sup> SD benchmark was run with a 3-tiered client/server architecture using Microsoft Windows NT Server 3.51, Microsoft SQL Server 6.0, and SAP R/3 v.2.2F.
- <sup>6</sup> The full disclosure report on the NetBench benchmark can be found in the ProLiant 5000 Performance Brief (Document number 123A/0696). System configurations were  
ProLiant 4500
  - One or two 5/166 processors; each with 2MB L2 cache
  - One NetFlex-3/E NIC
  - One SMART-2/E array controller
  - Six 2GB Fast-Wide SCSI-2 drivesProLiant 5000
  - One or two 6/200 processors; each with 256KB L2 cache
  - One Netelligent 10/100 TX PCI NIC
  - One SMART-2/P array controller
  - Six 2GB Fast-Wide SCSI-2 drives
- <sup>7</sup> Based on data as of February, 1996.
- <sup>8</sup> SPECint95 benchmark data for Alpha, PowerPC, and PA-RISC processors were found on the SPEC Web page as of April 29, 1996. The Intel processor data is from Intel.
- <sup>9</sup> A processor with a superscalar architecture has the ability to execute multiple instructions per clock cycle. The Pentium Pro processor can schedule as many as five instructions simultaneously due to the dual integer execution units, the dual address generation units, and the single floating point execution unit.
- <sup>10</sup> Register renaming is required to support the execution of concurrent instructions. For example, two instructions, which have no outstanding dependencies, might use the same programmer-visible register. Internal to the processor, however, the registers will be dynamically renamed to allow the instructions to execute simultaneously rather than executing them serially.
- <sup>11</sup> The Pentium Pro processor, via its branch target buffer, supports speculative execution of branches. By predicting the correct branch most of the time, the number of instructions that are available to be scheduled at any particular time is increased, thus increasing the potential number of instructions that can be executed out of order.
- <sup>12</sup> The Pentium Pro architecture fetches and decodes a large number of instructions that are then sent to an *instruction pool*. These instructions are then evaluated by the dispatch/execute unit for dependencies on prior instructions. If there are no dependencies, the instruction is scheduled and executed, even if it is "out of order". This minimizes the impact of cache misses

· **NOTES (CONTINUED)**

· since the processor can potentially continue to execute code while memory services a cache miss.

· <sup>13</sup> The Compaq ProLiant 5000 supports 4GB architecturally; system configurations of more than 2GB will be possible when future memory technology becomes available; availability is currently expected to be in late 1996 or early 1997.

· <sup>14</sup> DIMMs are added in groups of four for the ProLiant 5000; SIMMs would require the less flexible addition in groups of eight.

· <sup>15</sup> All controllers were configured for RAID 5 with six 2.1-GB hard drives and 4MB of controller cache; controller were installed in a ProLiant 1500 with one 133-MHz Pentium processor and one Netelligent/P Controller. See the SMART-2 Array Controller Performance Brief (document number 034B/0296) for more details.

· <sup>16</sup> Four-way set-associativity allows four memory blocks within the same cache line to be cached simultaneously. In typical applications such as databases, and with all other factors equal, this results in an effective cache size that is double that of a two-way set-associative cache (such as that found on the Compaq ProLiant 4500). For example, a 512KB 4-way cache effectively behaves like a 1MB 2-way cache.

· <sup>17</sup> While the I/O peripheral is assembling its data, the Pentium Pro bus can be used for other memory or I/O transfers. Only when the peripheral is ready to return data to the requesting processor does that I/O peripheral again require access to the Pentium Pro bus.

· <sup>18</sup> Concurrency allows independent operation of the I/O bus and the CPU. Bus master devices transfer data to and from memory simultaneous with CPU accesses through use of multi-level buffers that control the data flow and perform burst operations to maximize the memory and I/O bandwidth. High throughput I/O devices, such as the SMART-2 Array Controller, achieve full performance without interfering with CPU execution.