The Big RISC

By Bradford T. Harrison
and Aubrey McAuley

The Ultimate Contest Among RISC Vendors May Come Down To Which Vendor Can Provide The Most Power The Fastest For The Least Money

THE PROMISE FOR RISC-based computer systems has been made very clear to the computer industry by the phenomenal price/performance leaps that workstation vendors have achieved of late. Although Hewlett-Packard pioneered the RISC market with its Precision Architecture "Spectrum" systems and is still the dominant RISC vendor, every major workstation vendor now has its own RISC platform.

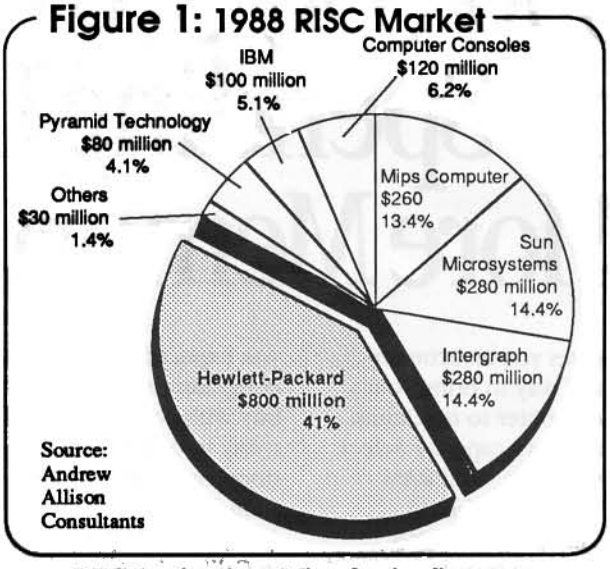
The pace at which these vendors are leapfrogging each other's existing systems and even their own systems with newer, faster and cheaper RISC systems has reached the point where it's virtually impossible to tell who's ahead anymore. These developments certainly support the argument that reduced instruction set computing (RISC) can deliver more bang for the buck than complex instruction set computing (CISC). With fewer instructions to re-engineer, pioneers such as HP claimed that more powerful processors could be built in less time and for less money. The success of the RISC strategy, coupled with increasingly standard software environments, leads to the inevitable conclusion that the question to ask of a computer vendor will soon no longer be, "What solutions can you offer?" but "How fast and cheap is your computer?" and "Is your underlying RISC architecture good enough to keep up with the market?"

Sun Microsystems' phenomenal success in the workstation market, however, has seemed to defy this assumption. Sun's success has come despite what many industry observers claim has been an overpriced and underpowered product line. Even though its RISC-based SPARC (Scalable Processor ARChitecture) systems have not compared favorably with systems from HP and Mips Computer, Sun in 1988 alone doubled in size from $500 million to $1 billion. Other RISC vendors such as Sun are beginning to crowd HP. While HP still held 40 percent of the RISC market in 1988 (See Figure 1), its share has declined from 60 percent in 1987.

Now that Sun has revamped its SPARC offerings with the addition of faster, cheaper SPARCstations, and introduced new MC68030-based systems, the company is expected to double in size again this year.

In its success, Sun has elicited strong reactions from industry giants DEC and HP. Both have launched major attacks targeting Sun's business, with HP buying Apollo and DEC buying into Mips for its first new architecture since the VAX was introduced in 1977 — the RISC-based DECstation 3100 running Ultrix, DEC's UNIX.

Figure 1: 1988 RISC Market



"DEC and HP have made it a number one priority to regain business from Sun," said Carl Flock of Dataquest, a market research firm in Sunnyvale, Calif. "That's where the RISC war is right now."

Some industry analysts believe Sun's phenomenal growth-rate will be greatly slowed over the next few years by increasingly agressive competition from HP and DEC, but Sun isn't likely to prove a standing target. Sun has already begun repositioning its product line toward the low end, specifically targeting the IBM PC and Apple Macintosh markets. Its new SPARCstation-1, a 12-MIPS, $9,000 workstation, is already being called the "SPARCintosh." Still, Sun's new high-end SPARCstation-370 appears to be competitive with HP's Precision Architecture 9000 Model 835, the current high-end HP workstation. However, Apollo's — and now HP's — high-end Series 10000 Personal Supercomputer, which handles 1-4 PRISM (Parallel Reduced Instruction Set Multiprocessor) CPUs, far exceeds the raw power of either the SPARCstation or the HP 9000 Model 835.

Aside from the their focus on beating out Sun, the next big RISC battle is destined to occur between DEC and HP — companies that are roughly the same size and have huge installed bases at the largest scientific and engineering shops in the world. These shops have been with DEC and HP for many years in corporate data processing departments and on the factory floor. But as processor power has become less expensive and therefore more available to users, these shops have seen the need for personal workstations more powerful than IBM PCs. Apollo recognized this need early on and flourished on the market it virtually created. But Sun outstripped Apollo, and HP and DEC could no longer stand idly by.

DEC and HP have responded to Sun by leveraging off their strengths in DP and the factory. Although HP and DEC have gained workstation market share at Apollo's expense, they have been unable to slow Sun.

In the face of growing success from HP and Sun's RISC architectures, DEC was forced to seek help from MIPS to provide a competitive RISC/UNIX platform. The VAX architecture is tied to the the proprietary VMS operating system, while the RISC-based DECstation leaves VMS entirely behind for Ultrix. In the meantime, HP's Spectrum RISC architecture has matured into a full-fledged family of products that offer support for as few as one or as many as 400 users.

"Right now, because of its state-of-the-art UNIX/RISC-based solutions, HP poses a bigger threat to DEC than IBM does," said Terry Shannon, International Data Corp. (IDC) DEC advisory service director. "Combined with the need to garner market share back from Sun, the (HP) Precision Architecture threat is causing DEC to move quickly to bring out a full RISC/UNIX product line."

DEC and Sun both responded to HP RISC strength by going after the low-end high-volume workstation market where HP has traditionally been the weakest. The DECstation 3100 is a non-expandable, 14-MIPS system with a base price of $12,000. DEC also announced a multi-user version of the 3100 at UniForum in February, providing the foundation for a RISC/UNIX product line that will compete with single-user RISC/UNIX systems from Sun and HP, as well as multi-user HPPA systems.

"Expect more UNIX/RISC products from DEC this summer," said Shannon. "They'll be based on the Mips R3000 and will definitely compete head-on with the HP products."

HP, however, won't prove to be a sitting target for DEC's attack. The company has announced a three-prong strategy to get VMS users to move to the HP 9000 Series rather than DEC's UNIX/RISC solution, and the company is expected to soon announce a lower-cost HPPA system.

The three-prong strategy is designed to provide DEC users with what HP calls a "RISC-free" conversion. First, the company's offering multi-user DEC VAX/VMS sites free use of a 9000 machine for three months. Second, it will help the site sell its VAXes through reseller channels. And third, it will provide all software tools required to make the port from VMS to HP-UX. HP believes that most users will, for technical and cost reasons, make the move from other operating systems and computer architectures to the UNIX/HPPA combination.

Figure 2: Entry-Level RISC Workstations

	Sun SPARCstation-1	Digital DECstation 3100	HP 9000 Model 825CH	Apollo Series 10010
Base Price	$8,995	$12,000	$34,500	$79,900
Processor	SPARC 20 MHz	R2000 16.7 MHz	HPPA 12.5 MHz	PRISM 18.2 MHz
MIPS	12.5	14	8	15-30
MFLOPS	1.4	1.6	.6	5.8
Main Memory	8 Mb (16 max)	8 Mb (24 max)	8 Mb (96 max)	8 Mb (128 max)
Display	17-In. Mono 1152 x 900	19-in. Mono 1024 x 864	16-in. Color 1280 x 1024	19-in. Color 1024 x 800
Expansion	3 SBus slots SCSI port	1 SCSI Port	5 CIO slots 5 CTB slots	6 VMEbus 4 PC/AT slots
Applications	400+	50	500+	50+
Storage	(two 104 Mb disks & 3.5-in. floppy add $3,000)	diskless	(152 Mb disk add $4,775)	348 Mb disk included

Why RISC/UNIX?

The RISC solution goes hand-in-hand with the UNIX solution, and the computer industry is moving rapidly toward both. Many industry observers say it's likely that within five years a typical "computer system" will consist of multiple networked RISC processors running under a UNIX platform, with all network operations occurring transparently to the user.

RISC architectures have been made possible by the high degree of integration available on today's chips. RISC architectures eliminate an entire machine layer that exists in complex instruction architecture computing (CISC), as shown in Figure 3.

All instructions are implemented directly in hardware and in most cases require only a single machine cycle to execute, resulting in phenomenal performance gains. The drawback, however, is that the instruction set — reduced because it would be too difficult to implement a large instruction set directly in hardware — is limited. Many more instructions are required to accomplish the same task than would be required on a conventional machine architecture. Greater emphasis is therefore put on compilers and other system software to optimize software performance.

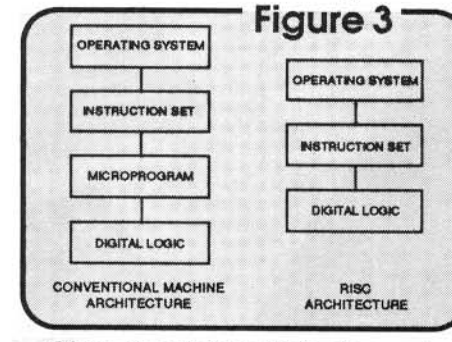
At the same time, however, it's easier to port systems and applications software between RISC architectures because, with fewer instructions, there are fewer unique "hooks" between software and hardware. RISC provides more of a generic interface to the software. This is where RISC provides an excellent fit with UNIX.

UNIX, written mostly in C, is the most portable of all operating systems. All that's required is a good C compiler and some amount of customization. Organizations such as the Open Software Foundation and UNIX International promise to extend UNIX standards to the point where "shrink-wrapped" software can be bought off the shelf and run on any vendor's machine. Use of such industry standard software and "simple" but fast architectures across which this software is easily ported implies an environment where the co-existence of different computers will be the most important concern in large shops.

The multi-vendor environment

Currently, the one of the most important activities in the standards world is the cooperation occurring between HP, DEC, IBM and a host of other companies in the development and implementation of the X Window network display standard. For file sharing, the industry standard Network File System (NFS) is rapidly becoming the de facto standard. Going beyond NFS, Apollo's Network Computing System (NCS) provides the ability to distribute applications over the network with remote procedures.

Figure 3



Given these kinds of developments, it does not seem unreasonable to go along with HP's Cooperative Computing Environment vision, where most interoperability differences between machines and manufacturers will be eliminated by highly generic UNIX-like operating systems and net-

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works. In this "computer system" of the future, powerful specialized processors, from virtually any standards-compliant vendor, will connect directly to the network and run all the same software that's already there. The underlying processor power will, for the most part, be RISC, though other architectures — such as vector processors from Cray — will take part on the network as well since they are well suited to a limited range of applications that RISC may have trouble addressing.

What, then, will be the criteria used to select a workstation if the differences between manufacturers are few?

Choosing RISC workstations

Figures 2 and 4 compare workstations from HP, Apollo, DEC and Sun. All have similar MIPS performance ratings, but vary dramatically in price and features. All come with excellent UNIX operating systems and compilers. How should customers choose between them? The unit MIPS (millions of instructions per second) has become a commodity unit like pounds or quarts. Users are starting to ask vendors how many 32- or 64-bit MIPS they'll get for "x" amount of dollars. To be sure, MIPS ratings are highly unreliable as a measure of overall system performance, but a wide range of initiatives are underway to establish more reliable performance benchmarks.

Still, according to Jeff McNair, product marketing manager for workgroup clusters in the workstation group at HP, MIPS ratings can provide some measure of performance if taken within the context of the other features of the system. "Floating point performance, graphics capability, and the completeness of software solutions are equally important," said McNair. "Fortune 500 customers want power, but they also want a complete standards-based method of implementing an application that will suit their needs. In many cases, these companies do no application development in-house."

This is where HP is making its greatest challenge to DEC, according to McNair — DEC has for many years concentrated on providing a proprietary (VAX/VMS) solution to customer needs, and now it must provide the same in the world of standards-based computing. "The introduction of the DEC-

Figure 4: High-End RISC Workstations

	Sun SPARCstation-370	HP 9000 Model 835CH	Apollo Series 10040
Base Price	$40,900	$51,500	$139,900
Processor	SPARC 25 MHz	HPPA 15 MHz	PRISM 18.2 MHz
MIPS	16	14	60-120
MFLOPS	2.6	2.02	23.2
Main Memory	8 Mb (56 max)	8 Mb (96 max)	8 Mb (128 max)
Display	19-in. Color 1152 x 900	16-in. Color 1280 x 1024	19-in. color 1024 x 800
Expansion	3 SBus slots SCSI port	5 CTB slots 5 CIO slots	6 VMEbus slots 4 PC/AT slots
Applications	400+	500+	50+
Storage	327 Mb disk 150 Mb tape inc.	(152 Mb disk, add $4,775)	348 Mb disk included

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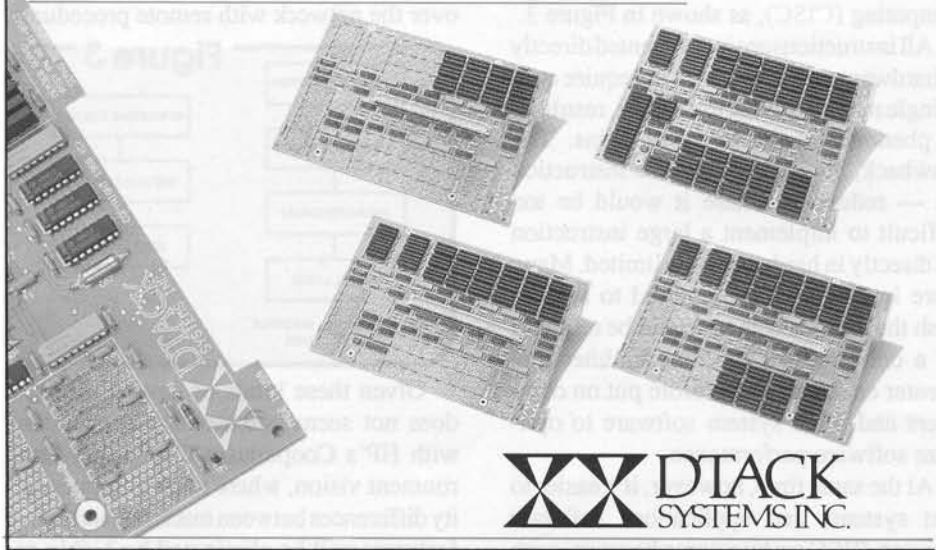

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station 3100 is an admission by DEC that proprietary architectures are becoming less competitive," said McNair. "But the 3100 is only a technology entry. There's a lot more that DEC must do."

HP has a head-start of at least four years in providing the customer with complete solutions within the standards-based environment, according to McNair. HP's Spectrum already supports more than 500 applications, a number rivaled only by Sun's more than 400 applications on SPARC. DEC and Apollo's RISC platforms so far-support about 500 applications each.

This gives HP a tremendous window of opportunity to exploit. "Both DEC and Sun have brought out some excellent technology," said McNair. "Now let's see how well they do in implementing solutions that make effective use of that technology.

But according to Charlie Giorgetti, workstations product marketing manager at DEC, the company already has the solutions. "You can't simply break solutions into two groups — industry standard and proprietary. Any computer environment is a combination of both. Digital fully supports the multivendor environment and standards-based computing, and with the X Window platform, differences in machine architecture are no longer the issue."

Giorgetti says that the new products from DEC are the beginning of a product line developed to fully implement industry standard computing and to integrate with existing DEC products. Meanwhile, he says, DEC's VAX/VMS technology is being modified to adhere to the industry standards that are developing. "All of Digital's products, including DECnet and VMS, will be modified to be fully OSF and OSI compliant as those standards are solidified."

Apparently, then, the goal across companies is a completely standardized industry where the only differentiation made between products will be at the price/performance level. "And price/performance is exactly what we have right now in the RISC workstation world," said Giorgetti, echoing DEC's familiar slogan that "Digital has it now." "HP doesn't," he added.

Still, HP is betting that many DEC customers faced with the task of moving away from VMS, will chose to move to a "tried and true" RISC/UNIX solution such as the Series 800 instead of going with DEC's new system. And despite whatever lead HP may have gainedover DEC with its early introduction of HPPA, Sun is not so far behind and now offers the lowest entry price for a RISC system.

HP claims its Precision Architecture, with its $500 million design price tag, will prove more powerful than SPARC or MIPS in the future. But Apollo's PRISM already offers near-supercomputer power and new processors such as the MC88000 and the i860 are gaining speed.

Competition is gradually being narrowed down to which RISC vendors can pump the most speed out of their systems the fastest. Who will ultimately win that contest is any one's guess. d&a

Brad Harrison is a freelance writer based in Fort Collins, Colo. He has worked in the computer industry for five years. Before becoming a free-lance writer, he worked as a hardware writer at Control Data Corp., then as senior technical editor for the DEC-oriented Hardcopy magazine.

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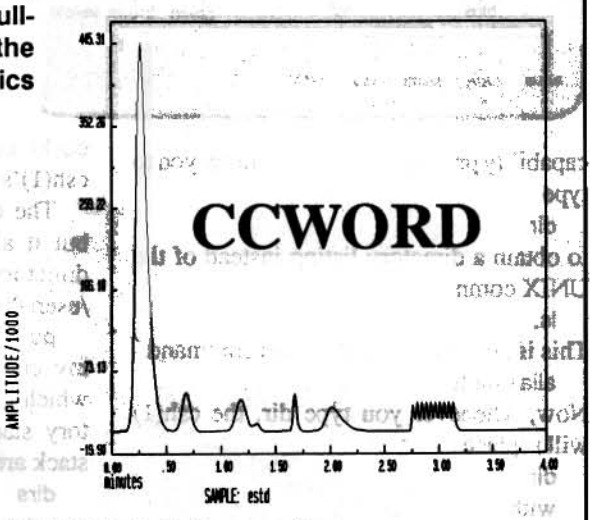

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