

SPARCstation 1

As the high-end PC world tends more and more to have the flavour of workstations, so workstation manufacturers are styling their 'low-end' machines to tempt the top of the PC and Mac markets. In this promised follow-up to the May issue's preview of Sun's new range of workstations, Peter Jackson presents a full Benchtest of the SPARCstation 1.



Welcome To The New World' was the slogan plastered across Sun Microsystems' rather childlike publicity material for its big launch. But to the unbiased observer it looked more like a continuation of the Old World by other means, with two new ranges built around the SPARC RISC chip and Motorola's 68030, and compatible with earlier Sun 4 and Sun 3 machines respectively.

However, the new systems do demonstrate very clearly that the days of cost-no-object workstations are gone, in the face of competition from high-end personal computers with 80386 and 68030 processors driving big screens and graphical user interfaces. The SPARCstation 1 and the Sun 3/80, the two most significant new low-end workstations, both borrow PC-style design and manufacturing techniques to offer true workstation performance at prices competitive with those high-end PCs and Macintoshes.

For example, the big VME card-cage has gone like the S100 bus of yesteryear, replaced by compact singleboard designs using big low-power custom chips and surface-mount technology. This makes the machines cheaper and easier to build and test automatically — Sun has geared up to produce one SPARCstation 1, for example, every four minutes. The systems are now housed in compact desktop enclosures smaller than an 80386-based PC or a Mac II, with internal floppy and hard disks, and everything else built in.

There are actually more technological similarities than differences between the new Sun 3/80 and Macintosh IIx, and

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between the SPARCstation 1 and a fast 80386-based PC. And now that their prices for equivalent configurations are similar too, the workstation manufacturers need to change their marketing strategies to sell more machines; but they also need to support their existing users with more powerful systems, and maintain their air of superiority over the upstart PCs.

In terms of both technology and marketing, the workstation market is changing more rapidly than ever. But is there really any reason for long-standing MS-DOS and Macintosh users to jump across the increasingly blurred boundary into the mysterious world of Unix workstations, when the power of their own machines seems to be following a smooth rising curve in any case? The workstation vendors must think so, judging by the feverish activity in this segment of the market over recent months, but what precisely is it that will cause people to make the move?

In perspective

At the same time Sun launched its new range of machines, it was announced that Hewlett-Packard had agreed to take over Sun's long-standing arch-rival, Apollo Computer. Just before the launch, Businessland had announced that it was to sell the \$US10,000 NeXT workstation in its US stores. And prior to that, in turn, DEC had launched a range of workstations that set new standards in terms of a newly minted unit of measurement, dollars per mips. In other words, the workstation business is humming with activity this



The back of the SPARCstation 1 is as neat as the front, with a large range of ports well laid out and easy to reach

year as never before. And the reasons for this are not too tricky to spot.

First there is the inexorable progress of technology, particularly in the areas of RISC processing and microelectronic or architectural speed-ups for older processors. The arrival of RISC chips such as the MIPS Computer processor in DEC's new DECStation 3100, the Motorola 88000 in Tektronix's new workstation line, and faster versions of the SPARC from LSI, Cypress and Solbourne, have made it possible for manufacturers to put together workstations with a real price and performance advantage over the existing competition.

And that gives new entrants to the market a chance. While it would not be feasible to build a me-too 68020-based workstation to compete with Sun's installed base and technological experience, building a faster, cheaper machine using Sun's own SPARC RISC technology, or someone else's RISC technology, gives newcomers a real competitive chance.

This, of course, also ties in with the convergence of Unix versions and the emergence of standard graphical user interfaces — and, more importantly, application programming interfaces (APIs) — for graphics-based Unix applications. There may be two camps of Unix system vendors under the Open Software Foundation (OSF) and Unix International banners, but two standard operating systems and two graphical user interfaces for programmers to address is preferable to the previous confusion of 200 different and incompatible Unix versions.

By the end of this year there will be just two choices for Unix system vendors. One is AT&T and Unix International's System V Release 4.0 with the Open Look user interface developed jointly by AT&T and Sun. The other is OSF's OSF/1 with the OSF/motif user interface built around DEC Windows and the Presentation Manager for X Window from Hewlett-Packard and Microsoft.

The major software vendors who are not already committed to Unix - and a surprising number, including Ashton-Tate, Lotus, WordPerfect, Samna International, Borland and Microsoft already are - can now develop for a stationary target, with a user interface and operating system that will be common across a wide range of processors, performance levels and prices. That is an attractive prospect for developers, and the availability to MS-DOS-style software will be an important boost for the hardware manufacturers in their attempts to sell the concept of workstations as the natural upgrade from PCs and Macintoshes.

Another boost will be the lack of market penetration of OS/2, combined with that operating system's incompatibility with MS-DOS and its inability to fully support even the 80386, let alone a new generation of high-performance RISC processors. If MS-DOS users are being asked to make the jump to an incompatible operating system just to get more memory for applications and multi-tasking, then why not go to Unix? It is just as incompatible with MS-DOS, although it makes a better job of running multiple MS-DOS emulations simultaneously than OS/2 can, does multi-tasking, and is available on more powerful hardware than the 80386 machines that are OS/2's current pinnacle. And now, with the prospect of shrink-wrapped graphicsbased Unix applications from big-name vendors, the story looks even better as long as the workstation makers' indisputably talented engineers can deliver high performance at the right price.

In the end, that is the reason for Sun's emphasis on the SPARC concept. The SPARC chip set in its current incarnation is cheap to make — \$US100 or less for a 25MHz set from Fujitsu and is designed to be easily scaled down in size for higher speed, or to be transferred to inherently faster semiconductor technologies like bi-polar logic or Gallium Arsenide, without losing full binary software compatibility. If Sun can convert all its users to SPARC, it can offer them an indefinite growth path without having to change any of their software. And in the meantime, the low cost of the processor allows the company to create a new lowpriced entry-level machine that offers 12.5 mips performance — around twice that of a 33MHz 80386 system — at a lower price.

The excitement around the entry-level SPARCstation 1 conceals another significant entry in the shape of the Sun 3/80. This is based on the same 68030/68882 combination as the Macintosh llcx and llx, but at a faster clock speed and with RAM caching for even greater throughput. With 4Mbytes of RAM and a bigger monochrome screen than the Apple standard, the hard-diskless Sun 3/80 at \$10,500 compares favourably with both the IIx and IIcx. Indeed, even considering the recent Apple price cuts, the Sun 3/80 with its 17in monochrome display undercuts a screenless Macintosh IIx with the same RAM capacity by \$795.

However, there is less reason for Macintosh users to switch to Unix at present. There is no chance at all of a Sun system running Macintosh software, and it is the software that has allowed Apple to get away with technological conservatism and high prices of the Macintosh line so far. On the other hand, give a machine like the 3/80 a set of major graphics-based applications, combine them with the true multi-tasking that the Macintosh does not yet have, and it could be a different story.

There is no doubt that the SPARCstation 1 and the Sun 3/80 are significant machines. They bring RISC performance down to desktop PC size and price levels, and the 3/80 pits technological excellence against Apple's marketing clout. The world of workstations is getting exciting and competitive — as Hewlett-Packard's proposed buyout of a major competitor proves.

Hardware

The SPARCstation 1 shares its case design with the Sun 3/80. It measures 40.5cm square, and is only about as high as a half-height floppy disk drive, but still includes all the electronics, a



floppy drive, and one or two hard disk drives; unlike other Sun systems, the sleek lines of the system unit are not spoiled by the need for an external shoebox to hold the disk drives.

The resemblance to a diskless workstation is strengthened by the odd positioning of the single 1.44Mbyte PCcompatible floppy drive, which instead of being on the front panel is around the corner on the right-hand side. Presumably Sun does not want to encourage its use for data transfer, bearing in mind the company's 'Network is the Computer' motto.

A brief look at the rear shows that the overall size has been reduced by dumping the traditional VME card-cage of other Sun machines and going for a singleboard design. The main external interfaces for the system (comprising a SCSI daisychain socket, an Ethernet interface, two standard 25-pin RS-232 ports, DIN sockets for the keyboard and for sound input and output, and a standard sound output jack) run along the base of the back panel in typical single-board computer style. Above this, however, is space for a second tier of three connectors, two covered by blanking plates and one holding the video output for the monitor. The SPARCstation 1 may be a single-board computer at bottom, but there are obviously some complications.

Opening up the case reveals a neat and simple internal arrangement. The single main circuit board, about the size of an A4 sheet of paper, sits at the rear of the case behind the floppy drive and the hard disk bays, and these drives plug into sockets on the opposite side of the main board from the external connectors. The power supply is behind the floppy drive on the right-hand side, and the whole arrangement fits together like tiled windows on a screen.

The reason for the second row of rearpanel socket holes also becomes clear at a glance; the SPARCstation 1's expansion slots run end-to-end across the centre of the main circuit board, and the video board occupies one of these sockets in a way that allows it to lie horizontally on top of the main board in an electronic sandwich. This is like the expansion board layout in a Macintosh SE, but the SPARCstation 1's boards are smaller — postcard-sized at 12.7cm by 7.5cm — and the system can take three of them to form a second deck of circuitry.

In a sense, this layout mirrors what happened to personal computers. The early machines used the S100 cardcage approach, the processor being just another board in a slot, and manufacturers only went for cheaper singleboard designs with proprietary on-board expansion slots as chip hardware improved. Now Sun has abandoned the bulky VME card-cage for this entry-level machine, and has done the same for the 68030-based Sun 3/80, launched at the same time.

The A4-sized circuit board is a typical example of the state of the hardware designer's art as we approach the 1990s. There are almost no simple 'glue' logic chips or conventional components; the chips are surface-mounted and direct-soldered rather than socketed, and thick-film resistors are attached to the underside of the board where necessary so as not to clutter up the top surface with the familiar striped cylinders of old-fashioned carbon resistors.

The SPARC processor and its com-

	Specifications
Processor:	LSI-built SPARC RISC processor, 20MHz
Coprocessor:	Weitek 3167, customised for SPARC
RAM:	64k 25ns static cache RAM; 8Mbytes main RAM expand- able to 16Mbytes
Mass storage:	Single 1.44Mbyte 3.5in floppy drive; one or two 104Mbyte 3.5in SCSI/2 hard disks
Keyboard:	94 or 113 keys, without or with numeric keypad
Mouse:	Three-button optical
Display:	1152 by 900 in 256 colours or shades of grey; optional GX accelerator; 16, 17 or 19in monitor
Standard interfaces:	Two RS-232 serial ports, Ethernet interface, SCSI/2 inter- face, sound I/O and sound output jacks, keyboard
Expansion:	Three internal proprietary SBus slots, external SCSI disk box
Operating software:	SunOS 4, including Open Look, SunView, X.View, X.11/NeWS, NFS, TCP/IP; Sun Desk Set utilities

panion numeric coprocessor, a custom 'SPARC-aware' version of Weitek's single-chip 3167 Abacus, occupy one corner of the board. On the sample board the SPARC chip was a Fujitsu S25 package labelled at 25MHz, although the production models will have the LSI Logic implementation running at 20MHz and the faster 25MHz SPARCstation 300 will use a SPARC chip set from Cypress. The special Weitek coprocessor in the SPARCstation 1 runs at the same 20MHz speed as the integer processor, and actually includes the SPARC floating-point controller hardware alongside the usual 3167 numeric hardware. The appearance of this custom chip from Weitek, just to support Sun and other SPARC-based products, shows the market significance of RISC in general and SPARC in particular.

Next to the SPARC is an array of 25ns static RAM chips acting as a RAM cache, with a custom Sun-labelled cache controller chip nearby. The SPARCstation 1 has 64k of cache RAM in total, speeding up access to the main banks of RAM that occupy around a third of the total board area. There are 16 slots for single-in-line memory modules (SIMMs) altogether, which can provide up to 16Mbytes of RAM using current technology. When 4Mbit chips are available to replace the 1Mbit chips used on the eight SIMMs that form the SPARCstation 1's standard 8Mbytes of RAM, that maximum capacity will rise to 64Mbytes.

The other three large custom chips are a buffer controller for the expansion bus, a DMA controller and a memory management unit, but there are two other commercial VLSI chips that have also helped to reduce the board size. The NCR 53C90 SCSI controller chip (the same one as that used in the NeXT workstation) and the AMD 7990 Ethernet controller make up the set.

The 53C90 is significant because it implements the SCSI/2 standard — unlike the older 53C80 chip used in every Macintosh from the Plus to the IIx — and offers much higher data transfer rates. For example, the theoretical maximum transfer rate of the Sun implementation is 4.8Mbytes per second, compared with the 1.5Mbytes per second offered by the 53C80 but never achieved even by the Macintosh IIx.

Other standard circuitry implements the serial ports - it is nice to see that Zilog's 8330 SCC design is still getting some use, albeit in different packaging - and the sound hardware. The addition of sound input and output, along with a built-in loudspeaker, is another major change in the SPARCstation 1 design and another way in which the overall concept of this machine (and even more obviously the 68030-based Sun 3/80) recalls the Macintosh IIx raised to a higher power. Sun points to such developments as voice mail, where verbal messages can be attached to electronic ones passing over a mixed voice and data network, but as with the Macintosh IIx the demonstration software only plays digitised music at present.

The expansion bus in the SPARCstation 1 is a new one called SBus, not compatible with VME or with the miniature P4 bus introduced in the Sun 4/110 to give expansion boards — and particularly video boards — direct access to the processor. At least one of the three slots is taken up by the necessary video board, or 'frame buffer' in Sun terminology; the basic graphics board takes up one slot, while the accelerated GX version takes up two.

Interestingly, the slot nearest the

SPARC processor is labelled 'Slave Only', indicating that the other slots can accept 'bus master' boards just as IBM's Micro Channel architecture and Apple's NuBus can. This should raise hopes of sophisticated coprocessor network controllers and other intelligent boards that can share system resources with the SPARC.

The basic video hardware fits on one of the tiny postcard-sized SBus boards. It comprises a single AMD 81458 graphics processor, a megabyte of 64k by four dedicated video RAM chips mounted in single-in-line packages, and a custom bus controller and buffering chip. This custom chip, simply labelled S4 CACHE with a Sun copyright notice, will be made available along with the full SBus specification to any third-party manufacturer who wants to produce an expansion board for the machine. Again, this is similar to Apple's approach of supplying the basic hardware required for any NuBus expansion board to communicate with the bus, making board design a lot simpler.

With either graphics system in place, the SPARCstation 1 drives a variety of monitors at the usual Sun resolution of 1152 by 900 in up to 256 colours or shades of grey. One new monitor, a 17in grey-scale model, has been added to the existing range of Sun monitors, which comprises 16 in colour and 19 in monochrome and colour models. All the monitors have the same resolution and the same 66Hz non-interlaced refresh rate, and can be used unchanged with any Sun video board.

The main circuit board has connectors for the floppy drive and for two internal SCSI hard disks, and also provides power supply sockets for all the drives. This means that the power for the whole system, apart from the monitor, is routed through the circuit board. However, since the main board only consumes 12W, and a complete system with two hard disks and a power-hungry graphics accelerator only consumes 85W, that is not too risky.

The actual hard disks supplied are 3.5in half-height drives built by Quantum and hold 104Mbytes each, for a total internal storage capacity of 208Mbytes. And adding a three-button optical mouse built by MSC, and one of Sun's standard 94-key or 113-key keyboards, completes the SPARCstation 1 system.

System software

The operating system for the SPARCstation 1 is SunOS4, the same variant of Unix first seen on Sun's initial SPARC-based machine, the Sun 4, and the 80386-based 386i.

As with the 386i implementation, the operating system comes fully loaded and ready to go on the SPARCstation 1, featuring Sun's new and excellent hypertext help system as well as 'friendly' error and information messages that make getting started with Unix less of a pain than usual.

The usual collection of industry-standard operating system components, including the SunView graphical interface, X.View, the Display PostScript-based X.11/NeWS, and NFS and TCP/IP networking, are all there. New additions are Open Look itself and a set of Open Look applications called the Sun Desk Set. These are utilities that perform file management, electronic mail, text and icon editing, and performance measurement functions, as well as providing an on-screen clock and a screen snapshot program.

So far, the user interface to the operating system is the familiar SunView, although when System V Release 4.0 finally appears in a few months this can be expected to move more towards Open Look. In any case, the Open Lookbased tools — particularly the file manager — carry on the good work done initially by building an icon-based file manager into SunOS on the Sun 386i.

In use

As ever in the workstation field, it has to be said that the SPARCstation 1 was something of a disappointment when it came to performance. It was certainly slower in window handling and refreshing than a theoretically much slower Macintosh IIx, and any application that required disk access also seemed slow by the same comparison.

However, it must always be remembered that a Unix system has a lot to do, and that the performance of an application tends not to change as extra applications are loaded onto the system.

Moreover, in a typical system where the workstation is networked to an array of similar or bigger machines, network support always needs to be there in the background; those other machines might well steal some processing time from the machine you are using if they need to. That is what distributed processing is all about, after all.

At review time it was not possible to spend a lot of time with the machine to try out its applications, particularly the new Open Look-based packages like SunPaint, SunWrite and SunDraw. However, the MS-DOS emulator worked well in the limited tests we could perform, the audio output sounded as tinny on the machine's internal speaker as it does on a Macintosh II. There was an overall feeling of solidity to the system just as well, given the longevity of SunOS in all its variants.

The rest is detail. The new 17in screen is excellent; the 113-key keyboard has a good feel but the usual crowded Sun layout that makes mistyping inevitable; the optical mouse is as good as such things usually are, which is very good indeed.

On the whole, though, it was hard to avoid the feeling that a 12.5 mips machine should have been more impressive in the speed stakes. For those used to single-user service from a 80386based PC (or even a fast 80286-based one) or a Macintosh II or IIx, the SPARCstation 1 is nothing special.

Prices

The entry-level price for a SPARCstation 1 with 8Mbytes of RAM, a single 1.44Mbyte floppy drive, a standard 1152 by 900 video board and a 17in greyscale screen is \$12,760, while a system with two 104Mbyte hard disks and the same video board driving a 16in 256 colour screen costs \$19,800. With two hard disks, a 19in colour screen and the GX graphics accelerator, the price goes up to \$42,550.

Conclusion

The SPARCstation 1 represents quite a departure. After all, an entry-level RISC machine has been something of a contradiction in terms in the past. But Sun has produced a neat package with a lot going for it, including around 500 SPARC-based applications already available out of the 2000-odd applications produced for the Sun range overall.

Existing users of Sun 4 machines will find the SPARCstation 1 doing a similar job at a much lower price, and will jump at the machine; but those contemplating a move into Unix from MS-DOS or the Macintosh may find the blind faith required to enter Sun's SPARC scenario, even with a soon-to-be-standard operating system, rather too much.

The SPARCstation 1 is well thoughtout, well designed, well built and ready for mass production. The masses, though, may well find the Motorolabased Sun 3/80 not only cheaper but safer in terms of available applications and the security of an installed base of something over 100,000 machines. As usual, now we find ourselves in the New World it is not clear what we ought to make of it.

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