

The year of Win 2000



In a comprehensive review that takes in hardware, operating systems and next-generation CPU technology, we assess the eagerly awaited Windows 2000 and its role in small business.

The most anticipated arrival in 1999 is sure to be Windows 2000. Formerly known as Windows NT 5.0, it is certain to make waves when it hits the market.

Windows 2000 will be much more than a simple upgrade. In one sweeping move, it will remove the need for two mainstream operating systems and will sign the death warrant of Windows 9x. Windows 2000 is being pitched as an all-in-one solution for systems ranging from laptops to enterprise servers. So as well as possessing more functionality than its predecessor, Windows NT 4, it will also incorporate the best features of Windows 98.

However, the operating system is nothing without the hardware to run it on, so we also take a look at the ideal hardware platform for a graphics workstation running Windows NT and Windows 2000. As part of the process we test single-processor and multiple-processor workstations with Pentium IIs and Xeons.

We also analyse the state of the operating-system market and the potential threat to Windows 2000 from Linux. And we explore the technology behind the next-generation CPUs scheduled to come out next year, and the role of Windows 2000 in a small-business environment.

Contents

146	Future CPUs for Win2000
153	Win2000 vs Linux
160	Win2000 in business
162	Win2000 for your network
155	Mesh Elite Pro 450 PII
155	Dell Precision Dual PII WS 410
156	Armari Rage X2E-Xeon
156	HP KayakXU-Dual Xeon
164	Test results
164	How we did the tests
166	Table of features
167	Conclusion

Tested, reviewed and compiled by Ajith Ram.

Future CPUs for Win2000

Microsoft's Windows 2000 is not the only anticipated arrival this year. Coinciding with its launch, the CPU manufacturers are gearing up to introduce a host of new processors which promise better performance.

The biggest surprise entrant will be K7 from Advanced Micro Devices. AMD has for some time been aggressively targeting Intel's massive 80 percent market share. Although the K6 was a good performer in most business applications, its floating-point performance fell below Intel's Pentium. This, along with lower clock speeds, prevented it from being widely accepted in high-end systems, so instead of pitching it against the PII, AMD used it to target the price-sensitive end of the market, running it head-to-head with Intel's Celeron.

However, last year AMD managed to up the ante with the introduction of the K6-2 processor. The K6-2, with its 27 3D Now! instructions, started to reduce the gap between it and the PII, but not all applications make use of the instructions and so do not gain a performance boost. AMD has now introduced the K6-3 (for a full review of this chip, see *Reviews*, p79). With speeds in excess of 400MHz and a full-speed 256Kb L2 cache, it is the first x86 processor to truly challenge Intel's dominance in high-end systems.

Hot on the heels of the K6-3, AMD is poised to launch the K7. Despite its unassuming name, the K7 is expected to give Intel's Katmai processor, the replacement for the Pentium II, a run for its money. Until both processors are released it will be hard to say which will be the best, but many are backing AMD. In addition to support for 3D Now!, the K7 will have no less than three fully pipelined parallel floating-point units. This, along with its already superior integer unit, could well make the K7 the best x86 processor to run Windows 2000. In fact, with such impressive floating-point performance and a faster bus speed, the K7 will become the first x86 CPU to truly challenge the dominance of RISC processors.

Initially manufactured using a 0.25-micron process, the K7 will run at clock speeds starting at 500MHz. This itself positions it as a high-end processor. Secondly, the K7 will have a whopping 128Kb L1 cache running at the same clock speed as the processor core. This will be supplemented by 512Kb of L2 cache at half the core clock speed. To put this in perspective, Intel's high-end Katmai has only 64Kb of L1 cache — half that of the K7. Secondly, K7 will use the Slot A socket which AMD licensed from Digital last year. The Slot A has a front-side bus speed of 200MHz, compared to the 100MHz in Intel's architecture. This means the K7 will be the first CPU to take full advantage of higher-speed memory types like SDRAM and RDRAM. K7 will also be able to run in multiprocessor configurations needed for high-end Windows 2000 workstations and servers.

Katmai will surface next month, when we will give it a full review. It will run at a clock speed of 450 or 500MHz and is targeted at enthusiasts and mainstream high-end users. This extra speed, along with some expected minor core changes, will allow it to offer a small performance advantage over Pentium II on typical PC applications, and a large advantage on applications that use the multimedia extensions known as Katmai New Instructions (KNI).

Katmai is more than just a faster processor, and signals the convergence of new chipsets, DRAM technology, a graphics bus, MMX instruction set and graphics components. Katmai itself will have the same core as the PII and initially will be produced on a 0.25-micron process. It is expected to provide up to

512Kb of L2 cache. It will stick with a 64-bit CPU bus and rely on deeper pipelining capabilities to take advantage of wider buses and encourage the use of multiprocessing systems. Katmai will come with 70 new single-instruction, multiple-data



▲ **KATMAI (EXPECTED TO BE CALLED PENTIUM III — SEE NEWS) AND MOST RECENT PENTIUM IIS USE A NEW TYPE OF PACKAGING, SECC2 (SINGLE EDGE CONTACT CARTRIDGE 2). THE MAIN DIFFERENCE FROM THE ORIGINAL SECC PACKAGE IS THE REMOVAL OF THE THERMAL PLATE (THE 'BACK' OF THE PROCESSOR WHERE THE HEATSINK ATTACHES). THE TWO MAIN BENEFITS ARE A COST REDUCTION, AND THE REMOVAL OF THE NEED TO USE A FAN DUE TO MORE EFFICIENT HEAT CONDUCTION. KATMAI IS DESIGNED TO RUN WITH A PASSIVE HEATSINK PROVIDED THE CHASSIS PERMITS ADEQUATE AIRFLOW**

(SIMD) floating-point instructions to accelerate 3D processing. Intel's current MMX instruction set is based on SIMD integer data types. While useful for presenting certain audio, video and 2D images, they provide less precision and range for 3D geometry processing. Graphics performance will be further boosted by the 4x Accelerated Graphics Bus, which will increase the available bandwidth between the graphics controller and main memory from 528Mbps to 1Gbps.

For the very high-end user there are other options, however. Windows 2000 is expected to be widely adopted by the graphics community, traditionally the realm of Apple Macs and Digital NT workstations, and with this will come a

The K7 is expected to give Intel's Katmai a run for its money

shift away from traditional RISC-based processors such as the Alpha and the Sparc. Intel has plans to break into this market with another processor scheduled to arrive in the new millennium. The Merced is Intel's first 64-bit CPU based on a new IA-64 architecture. Touted as the best processor for Windows 2000, Merced has generated intense excitement in the industry. Many firms who currently rely on RISC processors have already announced support for Merced.

One of them is Silicon Graphics (SGI), which has a sterling reputation for building workstations for animation and image rendering. Until now, these workstations were predominantly built around SGI's own MIPS RISC processor. Similarly, HP will make the swap to Intel's processor. Merced will replace HP's own ageing PA-RISC processors.

While this is good news for Intel, the road ahead is not so clear for firms like SGI and Hewlett-Packard. The main problem will be a lack of identity in a crowded market. Until now, these companies could be easily differentiated with their unique products. But once Windows 2000 and Merced become dominant, their products will seem to the unpractised eye to have fallen out of the same mould.

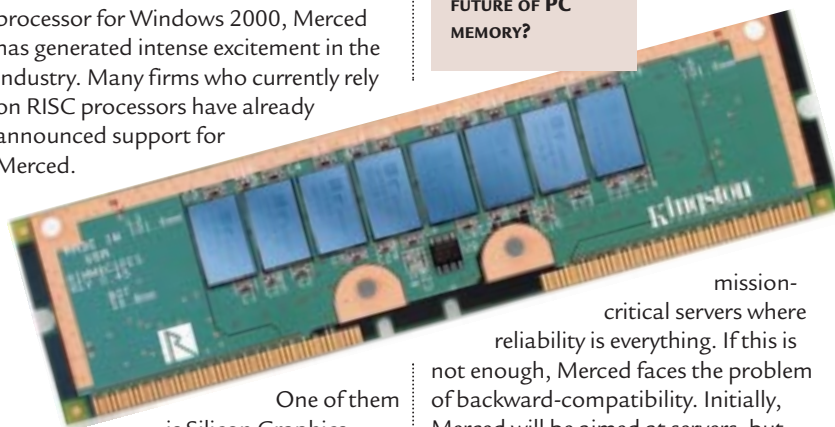
Despite the support, Merced also faces an uphill battle — partly due to its constantly slipping launch date. Originally scheduled to arrive early last year, Merced is now expected to hit the streets in early 2000. This has given other manufacturers, like Digital and Sun Microsystems, time to consolidate their positions.

Digital's Alpha processor has a strong foothold in the Windows NT workstation market. The processor is expected to attain a clock speed of 1GHz later this year. Intel's IA-64 processors will touch this speed only with the entry of McKinley, the successor to Merced. Hence, the Alpha will retain its superiority in the Windows 2000 environment even after the launch of Merced. In turn, Sun Microsystems also has aggressive plans for its 64-bit

UltraSparc processor. UltraSparc will hit 600MHz later this year and 1.5GHz by 2002. Moreover, unlike IA-64, UltraSparc has the advantage of being a tried and tested 64-bit CPU, so some

buyers may prefer to have it in their

▼ **RDRAM: THE FUTURE OF PC MEMORY?**



mission-critical servers where reliability is everything. If this is not enough, Merced faces the problem of backward-compatibility. Initially, Merced will be aimed at servers, but soon afterwards it will enter the Unix and Windows 2000 workstation arena. Any 64-bit processor running Windows 2000 needs to be backwards-compatible with literally hundreds of 16- and 32-bit applications. Merced does have a 32-bit core to run these applications in hardware, but this is likely to run only at a fraction of the clock speed of the main processor. So, many important 32-bit applications will not run any faster than on a much cheaper x86 system.

The IA-64 architecture relies heavily on its internal compiler and programmer to show increased performance. Even when Merced arrives next year, efficient compilers optimised for the IA-64 architecture will be very few. This makes creating good programs for the new architecture more difficult. Moreover, the same programs compiled using different partially tested IA-64 compilers may have bugs or may run differently on the same processor. In other words, despite the hype, the IA-64 architecture is likely to have the same evolutionary curve as the original x86. And until these problems are resolved, other processors may be the best solutions for running Windows 2000.

New CPUs and operating systems are not the only things making an appearance this year. The type of memory inside the PC is also scheduled to change. The main contender for replacing the ageing SDRAM is a

proprietary standard developed by Rambus Inc and supported by Intel.

Like Windows 2000 and Merced, RDRAM has received a lot of attention recently. This is partly due to its impressive specifications — at least on paper — and not least of these is its speed. RDRAM promises speeds as high as 800MHz, or eight times faster than existing SDRAM. However, this impressive performance and accompanying hype hide some potential problems. The first problem is caused by the brute speed of the memory module itself. Any type of RAM running at 800MHz will dissipate lots of heat. This means RDRAM will likely require extra cooling. Again, due to its high clock speed, RDRAM may require special shielding from electromagnetic interference.

Latency timings for RDRAM are actually worse than current SDRAM. This was necessary to increase memory bandwidth. Since most applications even now do not use the full bandwidth, RDRAM's increased memory bandwidth may not result in better performance. However, the biggest problem facing RDRAM is that it is a proprietary technology. This means manufacturers will have to pay a licence fee to Rambus and Intel. In effect, this turns even large RAM manufacturers like Samsung and Siemens into mere chip foundries. Also, the manufacturers have no control over future memory designs.

Fearing this scenario, memory manufacturers have countered with

The type of memory inside the PC is also likely to change

another standard, called SLDRAM. Although Intel does not support it yet, this type of memory has few of the limitations of RDRAM. An open standard, SLDRAM technology is available free to all manufacturers. Its supporters claim that it can touch speeds as high as 800MHz — the same as RDRAM. While the peak bandwidth of RDRAM is 1.6Gb/s, SLDRAM is able to achieve twice that. Its latency timings are also lower.

Recently, alongside Intel, AMD too came out in support of RDRAM from Rambus, and Intel invested around \$500m in one of the major memory manufacturers to ensure its support for RDRAM. Despite this, some memory manufacturers are not backing down from their support for its rival. Until this issue is resolved, workstations running Windows 2000 will continue to use current SDRAM.

Win2000 vs Linux

As the US Department of Justice well knows, there is no such thing as stiff competition in the operating-system market. Microsoft has over 90 percent market share, having decimated most opponents in both the PC and server markets. Unix and the Mac have been sidelined as mostly server, developer and graphics platforms, while even the traditional graphics markets are turning away from the Mac in favour of cheaper NT machines. IBM has given up on OS/2, and other proprietary OSes such as NeXT have long since bitten the dust.

Yet, until the middle of this year, there is a semblance of choice due to the presence of two mainstream desktop operating systems (albeit from the same vendor). Users can choose between the multimedia-friendly Windows 95/98 and the more robust Windows NT 4 Workstation.

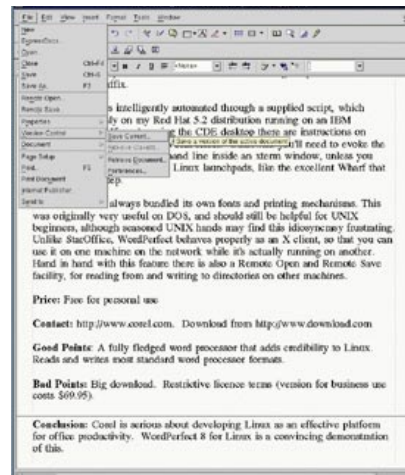
With the introduction of Windows 2000 even this limited choice disappears as both varieties of Windows are merged into one. There will also be a new range of Windows 2000 server OSes released at the same time, which will present a real challenge to competitors in the server market.

A full 32-bit OS, Windows 2000 will run systems ranging from NCs through laptops and desktops, on to workstations and finally enterprise-level servers. On the desktop it will have Windows 9x's plug-and-play and an increased driver base, but at the same time will provide enhanced manageability

Advocates would argue that Linux is more stable than Windows

features like an active directory for system administrators (see p160).

However, just as Microsoft is consolidating its stranglehold on the OS market, other OSes are beginning to gather attention. Chief among these is Linux, an open-source code OS renowned for its stability and performance. Originally coded by Linus Torvalds in 1991 as an undergraduate project, Linux was originally part of a Unix development project led by MIT. From the very beginning, it has had one great attraction — that the code is freely



**▲ COREL
WORDPERFECT FOR
LINUX, REVIEWED IN
THIS ISSUE [P91]**

available to anyone to use and to modify, the only stipulation being that those modifications be made public. From the time it was posted, over 200 developers have contributed code to the kernel and over 1,000 have added patches or bug fixes. So the kernel has grown from around ten thousand lines of code to around 1.5 million lines, and from being a piecemeal kernel to an OS run on servers and desktops by around 7.5 million users. And Linus Torvalds still has an interest in the project, often having the final say in what is or not accepted into the kernel code.

Commercial developers of Linux do exist: Red Hat and Caldera have done very nicely out of commercial Linux products, providing not just the product itself but also a support infrastructure. As developers are obliged to make their source code public, they are forced to innovate faster to stay ahead of the game. This also meant that Linux developed faster and is, as advocates would argue, a more stable server OS than Windows.

While it has slowly been growing in popularity, Linux recently gained a great deal of publicity thanks to Microsoft itself. Two internal Microsoft memos (dubbed the 'Halloween' memos) were leaked to a prominent open-source developer who annotated them and published them on the web. You can read the two long memos on the Open Source Software site <www.opensource.org>.

The memos' author talks of the rapid development cycle of Linux and indeed other open-source software and suggests Microsoft should take note. The first memo admits that Linux looks a more promising server OS than NT and that in the short term, Microsoft should watch its back. The second memo is more damning, as it considers Linux to be a very real threat, even in the desktop environment. And Microsoft has good reason to worry.

Part of the reason is Linux's low system requirements. Windows 2000 on the desktop will need a PII300 with 64Mb of RAM, yet at present Linux will quite happily run a DNS server on an old 486. It is also at home on x86 processors from Intel, Cyrix and AMD as it is on PowerPC, Alpha, MIPS and SPARC.

Nor can you throw at Linux some of the criticisms justifiably levelled at it a few years ago. While there are not as many applications available for Linux as there are for the Windows environment, there are enough to be going on with, and not all are server/web based. Corel has a free downloadable version of WordPerfect for Linux (see p91), and there is even a basic image editor. Fast development times are also possible due to the shared and open code and APIs, allowing new applications to be developed and ported to different platforms very quickly. Linux developer Red Hat has developed a versatile GUI, and the author of the Halloween memo admits that many users could quickly become accustomed to its peculiarities.

Many large, specialist firms such as ISPs are happy to run Linux as it is stable but at the same time they have the resources to employ Linux hackers to put right any problems. Here again, the open source code is a major advantage as in-house staff can correct any bugs immediately, rather than having to wait for large software vendors to correct them in the next product refresh.

Yet even with these advantages, Linux faces an uphill struggle. The main reason for this is the popularity of Windows itself. Over 90 percent of PCs run Windows and therefore most users, and more importantly corporate buyers, are likely to stick with what is familiar to them.

Mesh Elite Pro 450 PII

Intel always pushes its most powerful processor as a workstation chip, whether manufacturers take note of this or not. However, once a 400MHz version of the Pentium II was launched, it has become a viable alternative in some high-end workstations. This is mostly due to its powerful floating-point unit. Although nowhere near as powerful as those in RISC processors like Digital's Alpha, it still



provides good value for money. The single processor in the Mesh system rests on an Asustek motherboard built around Intel's 440BX chipset. Since the motherboard is capable of housing two processors, the Mesh workstation is easily upgradeable. It has 256Mb of RAM in two 128Mb modules. Two other DIMM slots are left free. SCSI devices are mandatory for performance workstations, providing high bandwidth. Like the drive in the Dell system, the Alpha's 9.1Gb UltraWide SCSI hard drive may prove too small for some applications. Mesh has thoughtfully included an Iomega Jaz drive. Capable of holding 2Gb of data, this is a much better option for a workstation than the smaller-capacity Zip drive.

The graphics card in the Elite Pro is the Millennium G200 from Matrox. Built around the G200 chipset, this card is usually more common in high-end PCs. Although it has a high fill rate and an excellent feature set, the Millennium G200 lacks full OpenGL

support. Therefore, an accelerated preview window is not available for Lightwave 3D. However, since Lightwave relies only on the processor for actual rendering, overall system performance is not affected. The performance of the Mesh system is a good pointer to the value of an ordinary Pentium II.

PCW DETAILS

Price £2,466.33 (£2,099 ex VAT)

Contact Mesh Computers
0181 208 4706

www.meshplc.co.uk

Good Points Fast SCSI hard drive.
Iomega Jaz drive.

Bad Points Modest-size hard drive.

Conclusion Easily upgradeable.
Excellent value for money.

Build Quality	★★★★
Performance	★★★★
Value for Money	★★★★
Overall Rating	★★★★

Dell Precision Dual PII WS 410

The Dell runs dual Pentium II 450 processors. Like Unix and Linux, Windows NT supports symmetric multi-processing, or the ability to use more than one processor to perform tasks. However, for symmetric multiprocessing to work properly, the application must also be multi-threaded. Lightwave 3D, which we used in our tests, is multithreaded and so the results clearly showed



up the advantages of multiple processors. With its dual Pentium II 450 processors, this Dell workstation outclassed the costlier Xeon systems. And as Windows 2000 will have better support for multiprocessing, performance is likely to increase further. As befitting a high-end workstation, the Dell system has 256Mb of RAM on two DIMM slots. The memory can be upgraded to a maximum 512Mb if the remaining two slots are also used. The 9Gb hard drive and CD-ROM are both SCSI versions. However, the hard drive, at 7200rpm, is not the fastest. Also, its size might prove too small while handling large files.

Wisely, Dell has chosen the Diamond FireGL Pro 1000 graphics card. Based on the Permedia2 chipset from 3DLabs, it has excellent DirectX and OpenGL support. Its performance is on a par with other professional graphics cards costing much more. Again highlighting its high build-quality, the Dell system has a 64-bit

PCI slot which is more prevalent in servers. This high-bandwidth slot is occupied by a RAID card with 16Mb of RAM on-board. The system's performance does not benefit from its presence, as there is no second hard drive, but it does make for straightforward upgrading.

PCW DETAILS

Price £3,783.50 (£3,220 ex VAT)

Contact Dell 0870 152 4850

www.dell.co.uk

Good Points 64-bit PCI slot.
RAID card.

Bad Points Modest hard drive. No second drive to utilise the RAID card.

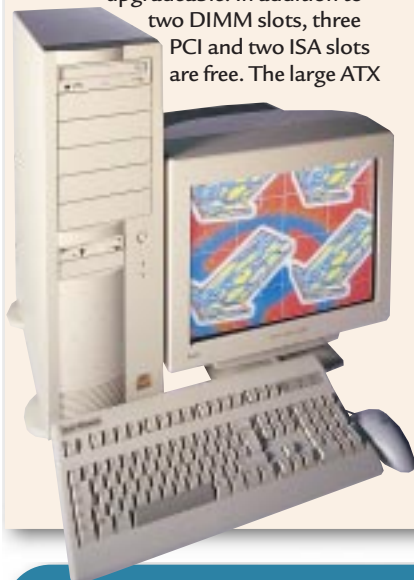
Conclusion A good workstation for running Windows 2000.

Build Quality	★★★
Performance	★★★★
Value for Money	★★★★
Overall Rating	★★★★

Armari Rage X2E-XEON

The Armari system is an outstanding example of a well-built workstation. The first thing you notice about it is the large ATX case. The interior is very spacious despite the huge heat sink on the Xeon processor. The heat sink itself has a handle, so it is easier to remove it along with the CPU without affecting other components. The Rage system is easily

upgradeable. In addition to two DIMM slots, three PCI and two ISA slots are free. The large ATX



case also provides a lot of free drive bays. Armari has chosen an Oxygen GMX graphics card from 3DLabs. Unlike the Millennium G200 and Permedia2 graphics cards, Oxygen GMX is a true workstation card with a whopping 96Mb of RAM. It also has a dedicated Glint geometry processor. This lessens the load on the CPU during geometry-intensive modelling sessions in applications such as Lightwave 3D. However, the graphics card makes no difference to the actual rendering itself. Both the hard drive and the CD-R are SCSI models and the on-board SCSI chip saves a PCI slot. The Armari system does not have a RAID card, but since there is no second hard drive, this does not hamper performance. The motherboard cannot hold a second Xeon processor.

The Xeon itself is being marketed as both a workstation and a server processor: its large, full-speed cache comes in handy for systems with heavy strain on their I/O buses, such as servers. As workstation applications rarely strain the I/O, we

were not surprised that this Xeon workstation shows only the same performance as a normal Pentium II. Armari itself was only able to see a speed increase when running multiple video streams on the Xeon.

PCW DETAILS

Price £4,929.13 (£4,195 ex VAT)

Contact Armari 0181 810 7441

www.armari.co.uk

Good Points Excellent construction. Easily upgradeable. High-quality components.

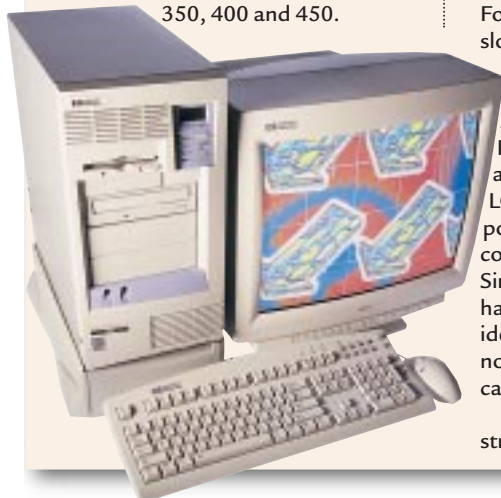
Bad Points Understandably disappointing performance from the Xeon.

Conclusion A well-constructed workstation with high-quality components.

Build Quality	★★★★★
Performance	★★★
Value for Money	★★★
Overall Rating	★★★★

Hewlett-Packard KayakXU-Dual Xeon

The Kayak range of systems from HP is one of the most well-known workstation brands on the market. The system included here has dual Xeon processors. Each Xeon runs at 450MHz and has 512Kb of cache running at the same clock speed. The Kayak's motherboard uses Intel's GX chipset based on the Slot 2 architecture employed by Xeon. However, its front-side bus speed is the same 100MHz that you find on the faster Slot 1 processors, the PII 350, 400 and 450.



The board has four PCI and one ISA slots free, and the SCSI controller is built on to the motherboard. The Kayak case, while not as large as the Armari's, has sufficient drive bays free for upgrading. Although the 4.5Gb hard drive is fast, it is much, much too small for a workstation. The Kayak came with only 128Mb of RAM. Although adequate for running most NT applications, it might prove insufficient for animation packages like Lightwave. Fortunately, the three free DIMM slots provide ample room for upgrading.

A unique feature of the Hewlett-Packard system is a small blue box attached to its front panel. An LCD panel located here identifies possible hardware and software conflicts within the workstation. Since Windows NT 4.0 does not have plug-and-play for hardware, identifying hardware conflicts is not easy. At such times, this gizmo can come in handy.

The Kayak did not work well straight out of the box, but we were

able to resolve the problem by reinstalling all the four NT 4.0 service packs. Despite the presence of two expensive Xeon processors, the Kayak produced only average results. Its performance in the Lightwave tests was not as good as the dual Pentium II Dell system, again due to the low I/O demands of the test.

PCW DETAILS

Price £6,932.50 (£5,900 ex VAT)

Contact HP 0990 474747

www.hp.com/go/kayak

Good Points Excellent construction. Troubleshooting module

Bad Points Small hard drive. Low RAM.

Conclusion An expensive but well-specified workstation.

Build Quality	★★★★★
Performance	★★★
Value for Money	★★★
Overall Rating	★★★

Win2000 in business

For years, it has been Microsoft's stance that businesses wishing to effectively manage their networks should adopt Windows NT rather than Windows 3.1 or Windows 95. There are some sound reasons for this.

To begin with, Windows NT is a full 32-bit operating system, unlike its counterparts. It was designed to be a network operating system from the beginning. Like Novell's NetWare, Windows NT provides enhanced security features. For system administrators, NT provides better manageability. In contrast, the Windows 9x family was firmly intended for the home user and small-business user. However, this clear delineation between corporate and consumer operating systems will end with the launch of Windows 2000. The entry of the new operating system will see the end of the line for Windows 98.

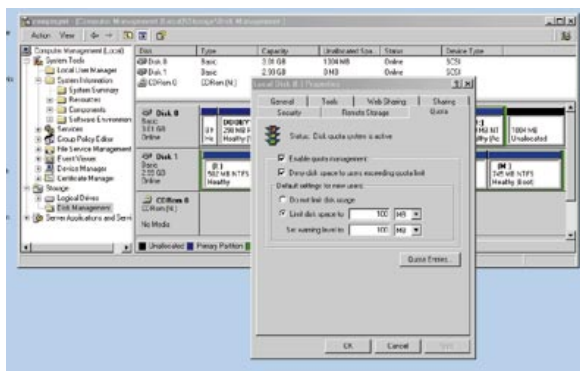
Windows 2000, although built on the NT 4 foundation, will be very different from its predecessor. As the only operating system designed to carry Microsoft's name into the next millennium, it will incorporate the best features of NT 4 and Windows 95/98. Like Windows 95, Windows 2000 will have plug-and-play support for hardware. Microsoft did not incorporate this in Windows NT due to security considerations. But this later caused tremendous problems for system administrators.

Windows NT also lacks support for Microsoft's own DirectX 5 API. With the phenomenal increase in multimedia

The new OS will see the end of the line for Windows 98

applications, this has proved to be a major handicap. Many high-end animation and design packages were not modified to run on NT. Therefore, many businesses continue to use Windows 95/98 on individual PCs while using NT only for servers. Windows 2000 will rectify this problem with built-in support for DirectX 6. Moreover, it will have support for new technologies like DVD which is lacking in NT.

Compared to its predecessors, Windows NT provides excellent



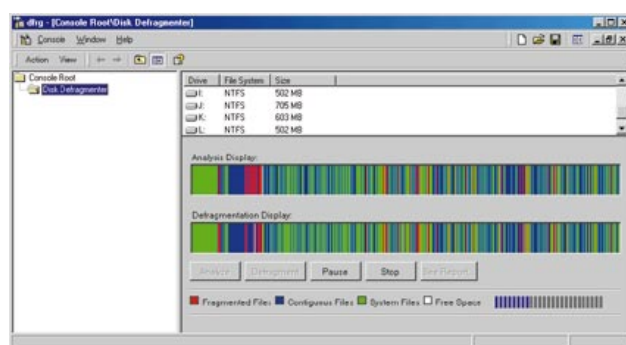
◀ **DISK QUOTAS CAN LIMIT THE AMOUNT OF STORAGE USERS CAN OCCUPY**
 ▼ **FOR THE FIRST TIME IN WINDOWS, A DISK DEFRAGMENTER WILL BE INCLUDED IN WIN2000**

manageability features for system administrators. However, it still lags behind other network operating systems, so small businesses have to rely on expensive third-party utilities. Microsoft promises to address this more comprehensively in Windows 2000.

Unlike Windows NT, Windows 2000 will come bundled with 'lite' versions of third-party utilities like Diskkeeper for defragmenting hard drives. The Windows Directory Services in NT 4.0 will have its counterpart in Windows 2000; the Active Directory in Windows 2000 (see p162) is more versatile than its predecessor.

With the massive increase in internet use and the virtual explosion in corporate intranets, security has become the primary concern for most businesses. Since its launch, several security bugs in NT 4.0 have been identified. Although Windows 2000 will provide better protection, it is unlikely to be bug-free. In fact, due to the addition of new features like plug-and-play, some analysts doubt whether it is the best solution for small networks with limited firewall protection. Small businesses that harbour such concerns might be better off remaining a bit longer with NT 4.0.

Reliability is another critical issue. Although Windows 2000 is much more robust than 95/98, its core features are the same as NT. System administrators still complain that NT is nowhere as dependable as 64-bit operating systems like Unix or even Linux. Therefore, until the reliability of the new operating



system is proved, it might be prudent to run mission-critical applications on other OSes.

By Microsoft's own admission, upgrading old laptops to Windows 2000 will not be easy. A typical laptop today with 32Mb of RAM upgraded to Windows 2000 may not run very efficiently. The whole system may come to a standstill if memory-intensive applications like Photoshop are used. Laptop components and drivers also differ greatly from desktops: Windows 2000 may conflict with many legacy hardware drivers.

Driver conflicts are a possibility not just in laptops: old NT 4.0 drivers will not work with Windows 2000. Therefore, early in 1998, Microsoft moved hardware vendors to the new Windows Driver Model (WDM) for Windows 98. WDM drivers also work under Windows 2000, but the truth is that WDM drivers will not be available for many legacy components. Although users can theoretically upgrade from old OSes like Windows 3.1, retaining the legacy hardware is a different matter. Even without driver conflicts, Windows 2000 will require more resources than Windows 95 or Windows NT 4. Microsoft is currently suggesting a PIII300 with 64Mb of RAM.

Win2000 for your network

Windows 2000 will be a major evolutionary step from earlier versions of NT.

In addition to running desktops and laptops, Microsoft is hoping that the new operating system will challenge the dominance of Unix and NetWare on large enterprise-level servers.

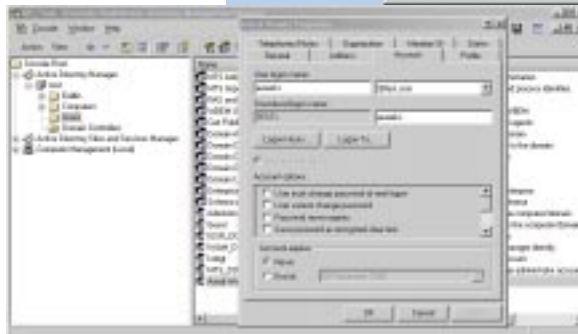
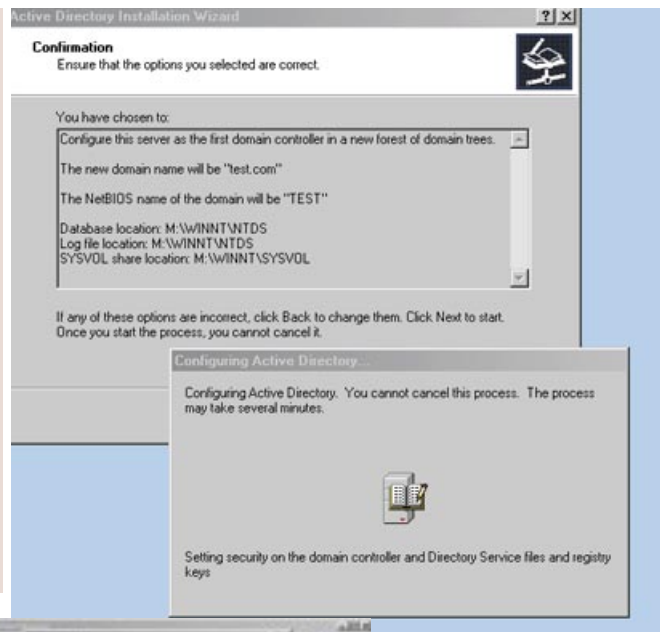
Unix has the advantage of being a full 64-bit OS which is extremely stable and scalable. Its security features are so far unrivalled. NetWare, meanwhile, provides excellent manageability to system administrators. To effectively compete with or replace these two incumbents, Windows 2000 must possess all these features and much more.

One of the key features of Windows 2000 is the Active Directory. A directory service provides a way to locate and identify the users and resources available in the system, a bit like a phone directory. Given a name for a person or a resource, it provides the information necessary to access that person or resource. For the system administrator, this is obviously vital information. Active Directory is a big step towards a more comprehensive directory service for large organisations. Microsoft hopes that Active Directory will be used not just for managing files or printers, but for a company's networking needs. This puts it in direct competition with NetWare Directory Services.

If you have both NetWare and Windows 2000, you have to choose between the directory services offered by the two. Microsoft is betting on the hope that administrators will choose Active Directory for the sake of convenience. Also, with the introduction of Active Directory, Microsoft has taken the opportunity to revamp its security structure. Unlike the proprietary security protocol in NT 4.0, Windows 2000 uses an open standard called Kerberos. Originally developed by MIT, Kerberos is the same protocol used in Unix environments. Therefore, unlike NT 4.0, even non-Windows users can be routed to a Windows 2000 server for verification. This also reduces the need to maintain non-Windows servers.

The integration of more features in Windows 2000 has implications not just for individual administrators concerned about ease of use. Entire corporations

▶ **THE ACTIVE DIRECTORY SETUP WIZARD IN ACTION**
▼ **MANAGING USER ACCOUNTS WITH ACTIVE DIRECTORY**



concerned about rising IT costs may have something to look forward to. TCO (total cost of ownership) is a phrase bandied about by all players in the IT industry, and is something Microsoft cannot afford to ignore. As a means of lowering TCO, network computers (NCs) were mooted. An updated version of the dumb terminal, NCs were meant to keep all applications and extraneous functionality away from the user and safely on the server. However, these NCs do not run Windows — an understandable cause for concern to Microsoft.

In response, Microsoft came up with the Net PC specification. Net PCs process some of the data locally on low-powered machines, while depending on the server for most functions. Windows 2000 is expected to take this Net PC concept further. But all is not rosy in the Net PC realm. From the outside, the vastly reduced hardware needs of Net PCs seem like a good idea. But in reality, the TCO of Net PCs and normal PCs may

not be very different. One critical factor is Microsoft's licensing strategy. Microsoft charges a licence fee for every end-user of Windows. So even though Net PCs require only one installation of Windows 2000 on the host server, companies

must pay a licence fee for each of their employees sitting at a Net PC. A second unseen cost is increased networking hardware. Net PCs depend on the main server to perform most jobs; this increases network traffic manifold.

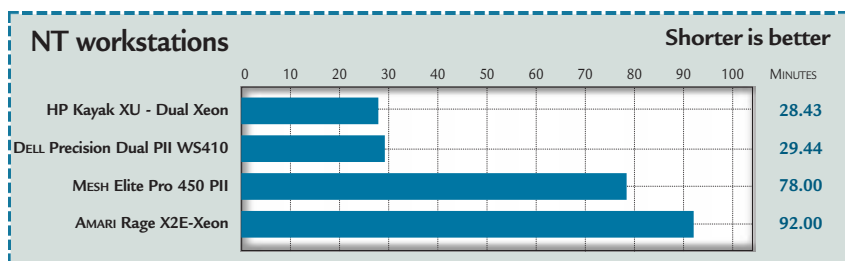
Lastly, Net PCs using Windows 2000 will inevitably result in greater support

Windows 2000 is expected to take the Net PC concept further

from the systems administrator. Users will depend on the administrator to change even minute settings, there will be far more traffic to oversee, and the server will have to be watched closely as it will cause major disruption if it falls over.

All this means that TCO for Net PCs may not be very different from normal systems running Windows 2000. Businesses should evaluate the benefits before jumping on the Windows 2000 Net PC bandwagon.

PCW Labs Report



These results are measured in minutes and seconds. Lightwave is a multithreaded application, capable of handling up to 1024 CPUs. When using a system with just one processor, whether Xeon or Pentium II, Lightwave took over an hour to render a single frame at film resolution (2480 x 2080 pixels). However, our results show a tremendous jump in performance when two CPUs are used: typically around half an hour to render the frame. This substantial increase in performance can be attributed to many factors. When only a single processor is used, it has to handle the operating system and monitor the I/O buses and the floating-point intensive rendering. When a second CPU is added, it is almost completely dedicated to the rendering process. Thus the performance is more than doubled.

How we did the tests

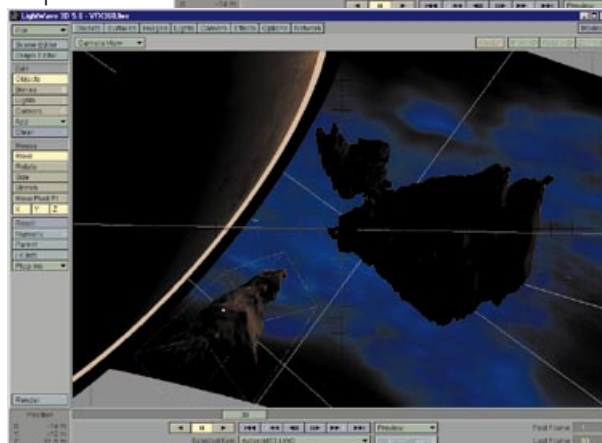
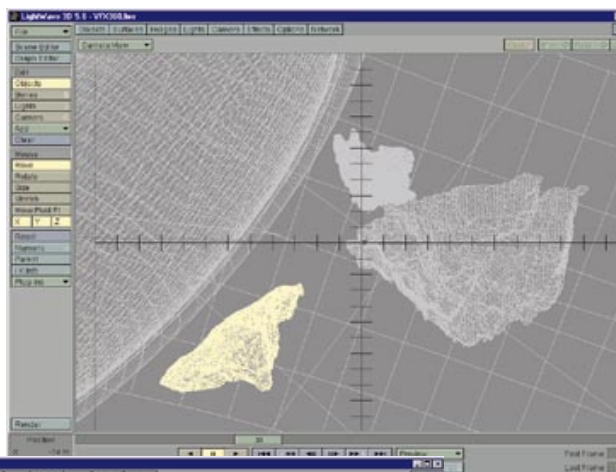


For this workstation group test, we decided to use Lightwave 3D for benchmarking purposes. Lightwave 3D is the animation package used to create the special effects in Hollywood movies like *Terminator2*

and *Titanic*. As these machines are, after all, graphics workstations, the main concentration of the test was on the Lightwave 3D tests.

Lightwave 3D has numerous advantages in such tests. Being multithreaded, it is able to take advantage of more than one processor. However, it also depends on the CPU to provide almost all the muscle when rendering 3D objects, rather than relying on the graphics card to make up the difference. As we were looking specifically at the performance of each processor configuration, Lightwave 3D was the perfect choice. For our Lightwave tests, AMG FX, the animators behind many of the special effects in the recent movie *Lost in Space*, kindly provided us with a file containing the model of an asteroid. We loaded the file into Lightwave 3D and timed the rendering of the asteroid. All rendering tests were run three times to ensure consistency.

The Lightwave 3D results were not a shock to us, especially the poor results of the Xeon machines. When we first came to look at Xeon in the December '98 issue of PCW, we were told by many manufacturers that they had been a little perplexed by Xeon's speed results. While the Xeon is equipped for fast handling of I/O, making the chips an obvious choice for servers, its core is so similar to the PII that very little performance increase could be seen. Only when running multiple video streams, where the data throughput is very high, did the Xeon truly perform.



▲ THE ASTEROID MODEL FROM *LOST IN SPACE* THAT WE USED IN OUR LIGHTWAVE TESTS ON THE WORKSTATIONS



Table of features



MANUFACTURER	MESH	DELL	ARMARI	HP
MODEL	ELITE PRO 450 PII	PRECISION WS 410	RAGE X2E-XEON	KAYAK XU-XEON
Price (ex VAT)	£2,099	£3220	£4195	£5900
Price (inc VAT)	£2,466.33	£3783.50	£4929.13	£6932.50
Telephone	0181 208 4706	0870 152 4850	0181 810 7441	0990 474747
Web address	www.meshplc.com	www.dell.co.uk	www.armari.com	www.hp.com/go/kayak
HARDWARE SPEC				
Processor	Intel Pentium II 450MHz	Dual Intel Pentium II 450MHz	Intel 450MHz Xeon	Dual Intel Xeon 450MHz
RAM supplied	256Mb	256Mb	256Mb	128Mb
RAM type	SDRAM	SDRAM	SDRAM	SDRAM
DIMMs occ/free	2/2	2/2	2/2	1/3
HD size	9.1Gb	9Gb	9.1Gb	4.5Gb
HD access time	6.3ms	8ms	5.6ms	7.5ms
HD interface	Ultra2 SCSI	Ultra2 SCSI	Ultra2 SCSI	Ultra2 SCSI
MOTHERBOARD COMPONENTS				
Motherboard	Asustek P2B-D	Dell Precision Workstation 410	Supermicro S2DGO	HP Kayak XU
Chipset	Intel 440BX	Intel 440BX	Intel 440GX	Intel 440GX
L2 cache/max	512Kb/512Kb	512Kb/512Kb	512Kb/512Kb	512Kb/512Kb
EXPANSION AND I/O				
Free 5.25in bays	1	2	4	2
Free 3.5in bays	1	3	3	2
PCI/ISA/Shared slots	3/2/1	4/0/1	4/2/1	4/1/1
USB/ser/par/PS/2	2/2/1/2	2/2/1/2	2/2/1/2	2/2/1/2
MULTIMEDIA				
CD-ROM manufacturer	Teac	Dell	Yamaha	HP
CD-ROM model	CD532-S		CRW 4416S	
CD-ROM speed	32X	32X	16X	32X
CD-ROM interface	SCSI	SCSI	SCSI	SCSI
Sound card manufacturer	Creative Labs	Crystal 3D	Diamond Multimedia	Aztech
Sound card model	64V PCI	Cs4237B	S90	A3D
Speakers	Yamaha YST-M20 DSP		Yamaha YST MS25	
GRAPHICS AND MONITOR				
Graphics card manufacturer	Matrox	Diamond Multimedia	3D Labs	Elsa
Graphics card model	Millennium G200	FireGL Pro 1000	Oxygen GMX2000	Gloria Synergy
Graphics interface	AGP	AGP	AGP	AGP
Graphics RAM/Max RAM	8Mb/16Mb	8Mb/8Mb	96Mb/96Mb	8Mb/8Mb
BUNDLED EXTRAS				
Other hardware		64-bit RAID controller		
Other software			Nero CD burning software	
Standard warranty	1 yr on-site	3 yrs on-site	12 months on-site	1 yr on-site
	2 yrs RTB labour only			2 yrs parts only
Warranty options	up to 5 yrs on-site	up to 4 yrs	3 yrs on-site	3 yrs on-site
Technical support	0181 208 4795	0870 152 4850	0181 810 7441	0800 848 8199

Conclusion

You may be forgiven for thinking that the current trend for 'bloatware' applications requires the maximum in computing power. But when you move on to consider applications for such tasks as rendering high-end graphics for animation or computer aided design, a workstation with the maximum computing power is necessary. So we decided to put Intel's fastest processors under the spotlight to see how they performed in workstations.

Our test results highlighted a few home truths about the current Intel processors. The Xeon is priced many times higher than the Pentium II. It also has a full-speed cache, running at the core speed of the processor compared to half the core speed in the Pentium II. However, the integer and floating-point units in both types of CPUs are identical.

In an application like Lightwave 3D which supports multiple processors, the floating-point unit is used extensively. Since most of the data being processed is stored in the ample RAM rather than in the cache, the higher-speed cache in the costlier Xeon makes little difference to overall system performance in pure rendering

conditions, or indeed when running less high-powered applications. So the single Pentium II machine proved slightly faster than the Xeon-based system. Even in multiple processor configurations, the Pentium II and Xeon produced almost identical scores.

When running applications which require a very fast data throughput, Xeon's faster I/O would have kicked in. In short, Xeon proved, as we had expected all along, to be a good server chip, but not one that is going to cut the mustard in a graphics workstation.

If you need multiple processors, however, you are faced with a Hobson's choice. Currently, Intel makes the only x86 processors able to run in multiple configurations. Therefore, users who want more than two CPUs have to use

Intel's costly Xeon or RISC processors like Digital's Alpha. But this will change soon with the arrival of AMD's K7. Our test results also prove that cheaper multiple Pentium II processors provide almost the same performance as costlier multiple Xeons. As a result, it might be better for buyers to opt for a cheaper processor and invest that extra money in other components.

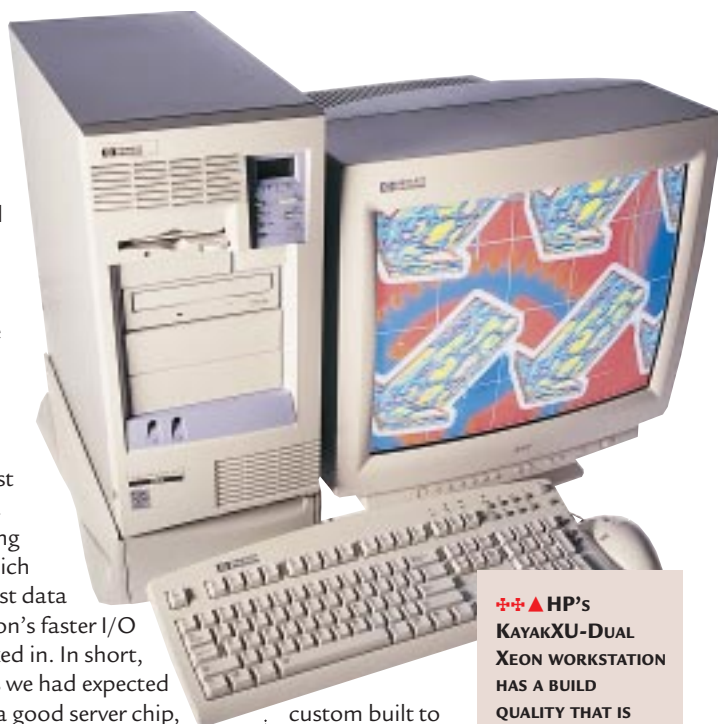
Graphics workstations must have high-quality components to achieve peak performance.

So, while SCSI is a luxury in ordinary business PCs, it is an absolute necessity in workstations. Also, unlike PCs, most workstations need to be

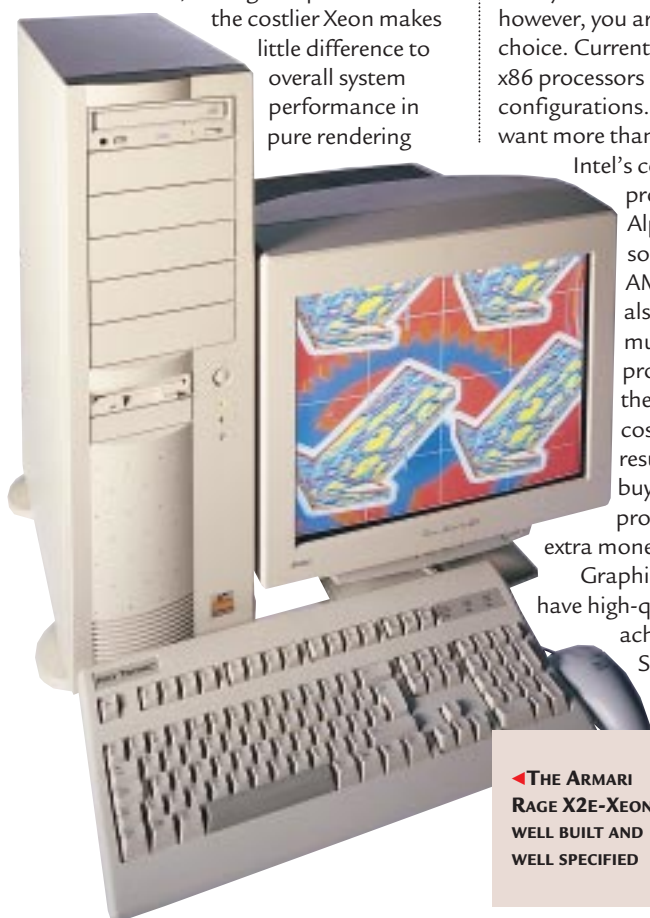
custom built to suit their uses.

A workstation meant for video editing needs to have a fast SCSI hard drive. A RAID card like the one in the Dell workstation is useful if you intend to add multiple hard drives — and is even more useful when you give up on Xeon as a workstation and turn the PC into a server. To dramatically improve rendering performance, users of animation packages like Lightwave may be better off with a graphics card that supports RenderGL.

All the workstations in our group test were well built. In addition to having good components, all of them are easily upgradeable. The Armari and Hewlett-Packard workstations deserve special mention. Both manufacturers had the unenviable task of building machines with processors that would prove little more effective than their much cheaper PII competitors, but both came up with superb offerings. While the quality of the Armari system is immediately evident, the crowded interior of the Hewlett-Packard workstation is rather misleading: it appears crowded only because of the numerous cooling fans and purpose-built trays for holding the internal components. It is, in fact, one of the best-built machines we have seen for some time. □



▲ HP's
KAYAKXU-DUAL
XEON WORKSTATION
HAS A BUILD
QUALITY THAT IS
SECOND TO NONE



▲ THE ARMARI
RAGE X2E-XEON IS
WELL BUILT AND
WELL SPECIFIED