
UNIX
3.1
NT
IBM
DOS
?

Platform souls

Windows may be the winner, but it might not suit everyone and you do have a choice of operating systems. Our experts pitch their favourite platforms.

Chances are, the last time you bought a PC, it came with Windows 98 by default. Just as Intel holds the dominant position in the processor market, so Microsoft has a near stranglehold over the operating system market.

But are you sure that Windows 98 is the best option for you? Just as you decide which specification of PC you need by considering what tasks you need to complete, so you should ideally choose an operating system by analysing what you want it to do for you.

We've lined up a number of specialists to argue the case for the best possible operating system, no matter what you need. So we have nine desktop operating systems looked at by six experts, a full review of Windows 2000, Beta 3, and we've tested server operating systems as well. And we haven't forgotten the non-PC platforms, with Mac, Acorn and handheld PC operating systems all considered.

If you get the OS bug and decide you want a range of different systems, with hard-disk prices as low as they are, there's no reason why you shouldn't buy a large hard disk and create a multiple boot system. Roger Gann shows you how in our *Hands On Workshop* on page 202.

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• ***Contributors:*** *Chris Bidmead, Ian Burley, Adele Dyer, Roger Gann, Terence Green, Cliff Joseph, Tim Nott, Mark Whitehorn*

Ratings

★★★★★ **Highly recommended**
★★★★ **Great buy**
★★★ **Good buy**
★★ **Shop around**
★ **Not recommended**

Illustration by Chris Davidson

Desktop operating systems

Hands up all those who have Windows 98 or 95 loaded on their machine. No-one can deny the popularity of Microsoft's operating system. Most users find it easy to use, it has good hardware support, and more applications are written for this platform than any other. However, just because it's popular with users and developers alike doesn't mean to say it's the best operating system, and might not even be the best choice for you, depending on what you're using your machine for.

We asked our *Hands On* columnists to look at their favourite operating systems and to argue the case for booting out Windows 98. For the sake of fairness we have allowed Windows 98 a defence, but there are some compelling reasons here for at least getting a dual-boot operating system. And if you fancy this course, take a look at our *Hands On Workshop* on page 202, this issue.

Windows 98

Although many of the improvements to Windows 95, such as FAT32, USB support and integration with Internet Explorer have been available for download, or ship with more recent OEM versions, Windows 98 not only consolidates all these improvements, but offers a faster and more stable operating system. There's support for DVD, multiple monitors and Web TV, and for programming buffs, the Windows Scripting Host offers great improvements over the old DOS-based batch language.

There are also some minor, but welcome, enhancements. The emergency boot floppy now includes CD-ROM drivers, curing the Windows 95 Catch-22 of not being able to reinstall a wrecked system. The HTML style help files are more accessible and go into greater depth. The Update system automates the applying of patches and enhancements as these become available on the Microsoft web site, and the Scheduler is now included as standard and features a Cleanup Wizard for getting rid of redundant files. The interface is now far more configurable, with options such as thumbnail previews of graphic files. Finally, as with Win95, you'll find more compatible applications and hardware than with any other operating system.

Windows 95

Windows 95 made considerable technical advances over Windows 3.11. A 32-bit operating system provided better multi-tasking, while DirectDraw and built-in digital video support meant faster display — especially important in games. Plug-and-Play took the headache out of installing new peripherals, and much-improved network support incorporated a range of hardware, clients and protocols, including dial-up networking for modem internet access. For laptop users, power management and docking profiles improved battery life and productivity, and the Briefcase provided a convenient way of synchronising files between notebook and desktop machines.

It also brought a completely new interface, by introducing a flexible system of folder windows whereby programs can be started from Shortcuts located anywhere the user chooses — including the Desktop and the cascading Start menu. Further flexibility came in the form of right-drag and right-click context menus, which provide easy ways to move and copy files, open them in different applications, or Quick View common file formats.

The same right-click technique applies to other objects: right-clicking on the Desktop, for example, provides a quick path to the display settings without having to trundle out Control Panel. Other comforts include the Recycle Bin, a safety net for deleted files.

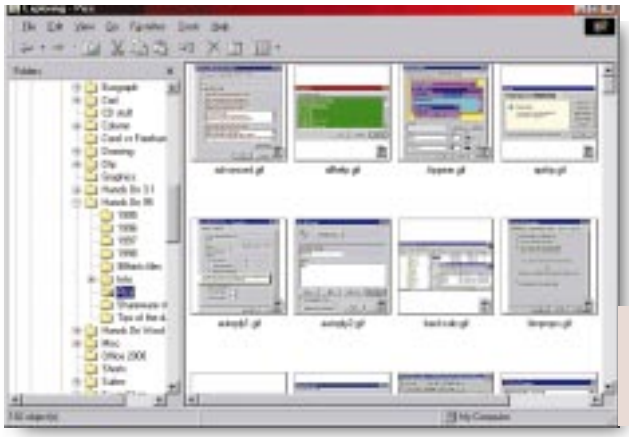
▲ THE SUMMER OF '95 – A NEW LOOK

Windows NT

Windows NT was conceived from the ground up as a 32-bit operating system with integral security and networking, and so offers a more robust, secure platform than Windows 98, and better performance (for most applications). In a corporate environment, it's the robustness that is its biggest benefit. In addition, Windows NT is much easier to control and manage in a network environment.

The installation footprint for a basic setup is 110Mb, just marginally less than Windows 98, but the minimum processor requirement is higher: a Pentium or faster, and 64Mb RAM.

Installation of Windows NT is reasonably straightforward, but adding new hardware is trickier, with no proper support for Plug-and-Play and



◄ WINDOWS 98 EXPLORER IN THUMBNAILS VIEW

USB. Power management solutions for notebook computers are available from hardware manufacturers. A wide range of hardware is supported by Windows NT, and it will support virtually all modern 32-bit applications, with the exception of some games.

Windows 3.1x

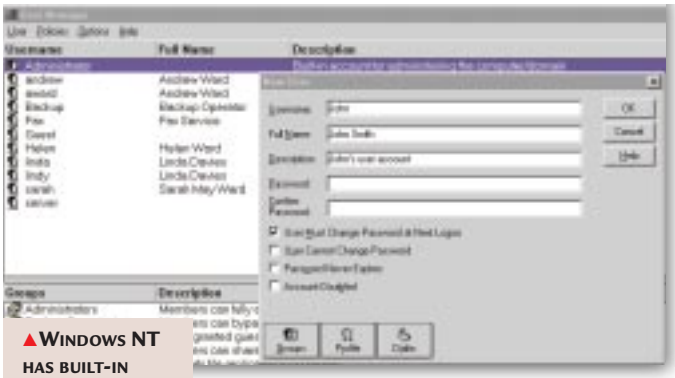
Many of the advantages of good old MS-DOS apply equally to the first version of Windows and made it sell by the truckload. Windows 3.1x gave users the simplicity of DOS plus a good GUI without the ponderousness of Windows 9x. It also has relatively modest requirements: it will happily run on a 486 with 8Mb and a 200Mb hard disk. And on better hardware, it goes like the clappers.

Like DOS, Windows 3.1x is very quick to install: the seven install disks take no more than 20 minutes to load, one-third the time of Windows 98. It's also a darn sight easier to maintain and troubleshoot than Windows 98, with its text-based configuration files — contrast editing the SYSTEM.INI file with the Registry.

Although Windows 3.0 and 3.1 were hardly paragons of stability, the final release of Windows for Workgroups 3.11 is much improved. This release is also a perfectly good network client and can do many of the tricks that Windows 98 can do. Want to surf the net? Simple. Download TCP/IP and Internet Explorer 4.0 for Windows 3.1x. Hardware support remains good and it's only support for exotica such as DVD-ROM, AGP and USB that is absent.

YOU DON'T NEED A PENTIUM III TO MAKE WINDOWS 3.1X FLY: AN OLD PENTIUM IS PLENTY

Despite the huge Windows 3.1x installed user base, Microsoft has done its best to kill off the Win16 application base. However, 16-bit solutions are still available and you can of course install Win32S, which bestows limited support for Win32 apps. And like DOS, there's an ocean of shareware still available for Windows 3.1x. Even so, most of the core apps written for Windows 3.1x aren't substantially better today: contrast the basic functionality of Word 2.0 with Word 97, they're much the same. I suspect most people don't use or need the extra 'functionality' found in current apps.



WINDOWS NT HAS BUILT-IN SECURITY, PROTECTING FILES FROM OTHER USERS

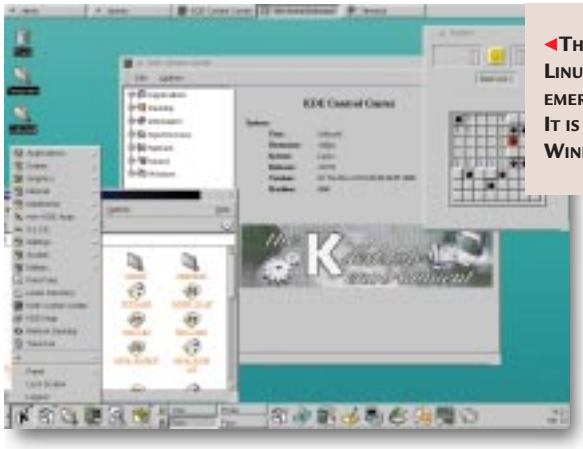
DOS

When it comes to computing, things don't last for long if they're no good; and make no mistake, the Microsoft Disk Operating System has been around for a very long time indeed. And DOS is still worth the light — you don't have to drill down too far into Windows 98 before you come across a DOS shell lurking. Indeed, Microsoft still ships DOS tools, such as FDISK, ftp and telnet with Windows 98 and installs 3Mb of DOS programs by default. And there's plenty of life left: you can still buy versions of DOS from both Microsoft and IBM, and free versions are available from Caldera (DR-DOS v7.03) and the FreeDOS project. In fact, IBM has launched a Year 2000-ready version, PC DOS 2000, with support for the Euro symbol.

OK, so DOS is a single-tasking environment. Big deal: most Windows users still don't multitask to a significant degree and generally do things one at a time. DOS uses an elegantly simple command line interface that's a more direct/quicker way of issuing commands than navigating down through a forest of sub-menus — no mouse is required.

MS-DOS 6.2 comes on just three floppies and so is incredibly quick to install (and boot!). In stark contrast to Windows 98, its hardware requirements are distinctly modest. If you do run DOS on something as 'slow' as a Pentium, you'll experience what every PC user dreams of — blistering performance. It's arguably the best games environment, too. Oh, and let me know if DOS ever hangs or crashes on you. Then tell me about Windows 98.

THE UNCLUTTERED ELEGANCE OF THE DOS COMMAND LINE INTERFACE



◀THE K DESKTOP ENVIRONMENT FOR LINUX SHOWN HERE IS ONE POSSIBLE EMERGING, STANDARD FRONT-END. IT IS DESIGNED TO BE FAMILIAR TO WINDOWS USERS

Linux

Although not eligible to be branded as such, the free operating system called Linux is Unix in everything but name. Technically, Linux is the name of the nub of code at the centre of an operating environment that includes tools and utilities from many other free software providers, notably the GNU software from the Free Software Foundation. Some say that the full name of the operating environment should be GNU/Linux.

Under any name, this is probably the ultimate Unix: a complete implementation of the design ideas of Thompson and Ritchie supplemented by the Berkeley enhancements, available in source form [*see page 159*] that has enabled Linux to be ported across to almost every known hardware platform, while remaining functionally unified in a way that commercial Unix can only envy.

As free software written by enthusiasts, Linux returns Unix to its skunkworks origins. But its rapidly widening use in commerce as a back-end server, and its support from companies like IBM and Dell, testify to the status of Linux as an industrial-strength operating system. But the majority of its estimated 10 to 12 million users run Linux as a desktop operating system.

Linux has undergone rapid advancement with the recent addition of graphical interfaces like KDE and Gnome. These newer user-friendly features are opening Linux up to wider use without in any way detracting from the power and flexibility of the underlying Unix — an operating environment developed over the course of nearly 30 years by some of the smartest people working in computing.

Unix

Unix is a brand name that covers a family of operating-system products stemming from a simple implementation designed by programmers Ken Thompson and Dennis Ritchie back in the early seventies as an unofficial 'skunkworks' project inside the Bell Laboratories at AT&T.

The category of operating systems branded as Unix runs across a huge variety of hardware platforms and has different product names depending on the manufacturer. Intel-based varieties include Sun's Solaris and SCO OpenServer. In 1993 Novell bought the brand name from AT&T with the intention (among others) of creating an Intel-based desktop version, codenamed 'Destiny', designed to attack Microsoft Windows. Two years later Novell backed out of the project, virtually conceding the desktop to Microsoft.

The importance of Unix among the academic, commercial, financial, manufacturing and engineering communities remains vast. Windows (particularly Windows NT) is certainly making visible dents in the commercial Unix user base, but for reach and range across multiple platforms, the flexibility, usefulness and portability of Unix is unmatched.

OS/2

IBM has played down the OS/2 desktop client to the point where it has become almost invisible. But it's still on the price list and continues to be updated because, although IBM has shifted its interest away from the client to the server, it continues to support the estimated 10 million business-users of the client.

In contrast to Windows 98, you can drop OS/2 Warp 4 onto a 100Mb hard disk with space over for a swapfile.

▲OS/2 WARP 4 IS A RELIABLE — IF NOT EXACTLY FLASHY — DESKTOP CLIENT

It runs fine on 486s and I'm running it on a Celeron 300A with 64Mb RAM, 8Gb IDE drive, ATi Rage Pro AGP card, and Creative Labs DVD drive.

In most cases OS/2 is easy to install. Warp 4 includes full internet access (V.90 modems work fine) and network clients for NetWare and Windows. Most 16-bit Windows applications run on OS/2 and there are two office suites, Lotus SmartSuite for OS/2 and Star Office which is free for personal use.

BeOS

The problem with Windows 98 is that it's carrying a lot

◀THE GUI EFFECTIVELY RUNS AS JUST ANOTHER APPLICATION. HOWEVER, AN ATTEMPT BEGUN IN 1993 TO UNIFY THE LOOK-AND-FEEL OF UNIX RESULTED IN THE 'COMMON DESKTOP ENVIRONMENT' (CDE)

◀BeOS is designed specifically for high-bandwidth applications such as video editing

of baggage, not just from previous versions of Windows but from the old days of DOS as well. Windows and DOS were never designed to cope with modern digital media such as video or 3D graphics, and it shows.

One example of this is Windows' 32-bit file system, which limits it to maximum file sizes of about 4Gb. That might sound a lot, but it's peanuts for applications such as video-editing or 3D graphics.

The BeOS, however, was designed specifically to be a 'media OS', one that was built with the demands of digital audio, video and 3D in mind. Its 64-bit file system can handle file sizes up to 18 million terabytes (one terabyte = 1000 gigabytes). It provides pre-emptive multitasking in order to support multiprocessor systems, and its multi-threading allows it to play multiple audio, video and animation files simultaneously even on single-processor systems.

Be does have its drawbacks, though. Like Linux, it can be a bit fiddly to install, and the current version is probably more suited to people with a fair amount of technical knowledge. And, like any new operating system, it's still a bit short on software support, although there are a lot of specialist audio, video and graphics programs currently in development. Hardware compatibility is also a little erratic and you'll need to check Be's web site <www.Be.com> for the latest compatibility information.

Tim Nott, Roger Gann, Chris Bidmead, Terence Green, Cliff Joseph

PCW CONTACTS

Windows 98
Price *Average upgrade £80 (£68 ex VAT)*
Contact *Microsoft Connection 0345 002000*
www.microsoft.com

Windows 95
Price *Average upgrade £80 (£68 ex VAT)*
Contact *Microsoft Connection 0345 002000*
www.microsoft.com

Windows NT Workstation
Price *£294 (£250 ex VAT)*
Contact *Microsoft Connection 0345 002000*
www.microsoft.com/uk

Windows 3.1
Price *£101 (£86 ex VAT)*
Contact *Microsoft 0870 60 20 100*
www.microsoft.com

DOS 6.6
Price *Upgrade £43 (£37 ex VAT)*
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www.microsoft.com

Open Source

For Richard Stallman, the 'free software' he's famous for pioneering is 'free as in speech, not as in beer' — we're talking about liberty, not price. But the term has often been accused of discouraging new adopters because of its ambiguity, and overtones that associate 'free' with 'amateur'.

At the beginning of 1998 this confusion worried programmer Eric S. Raymond, who was promoting the idea of 'free software' to the business sector. The key feature for Raymond wasn't so much the spirit of social justice driving Stallman's Free Software Foundation <www.gnu.org> as the practical fact that software whose source is exposed to unrestricted 'peer review' is likely to evolve more rapidly, and with many fewer bugs.

In conjunction with Bruce Perens, a leading figure behind the Debian Linux distribution, Raymond sought to drive out ambiguity, unite the communities and propel the concept into business under the term 'open source'.

To safeguard their investment in promoting open source Perens and Raymond trademarked the phrase. At a time when Linux was beginning to grab the imagination of users around the world, 'Open Source™' and the supporting material on Raymond's web page at www.opensource.org became a valuable tag to discuss the new phenomenon. At the same time, largely through Raymond's promotional efforts, Netscape announced a dramatic conversion to the Open Source philosophy. Open Source was hot.

More recently Perens and Raymond have noisily fallen out over ownership of the Open Source trademark, the squabble being highlighted by Raymond's almost single-handed endorsement of the Apple Public Source Licence (APSL), a licence judged not-quite-free by many free-software advocates, including Richard Stallman <www.gnu.org/philosophy/apsl>. Perens has gone back to using the term 'free software', and Raymond, while still claiming to be spokesperson for 'the Open Source clan', is looking somewhat isolated.

However, Apple has been revising the APSL in a quest for wider approval, and this warning shot across the bows of the Open Source movement, confirming an early prediction from Stallman that the name change might be more trouble than it was worth, seems to have been heeded by all factions.

Chris Bidmead

Windows 2000 Beta 3 RC 1

Windows 2000 Beta 3 Release Candidate 1 marks the beginning of the final run to a 1999 release of Windows 2000, formerly known as Windows NT 5. There have been big changes since the last beta, almost a year ago, not least in the user interface but also in the area of administration and reliability.

In Microsoft's eyes the success of Windows 2000 Server is very much dependent on its building a better reputation for reliability than Windows NT has achieved to date. While Windows NT is widely used and the most popular server operating system in terms of unit sales, it still lacks the kudos it would gain if a worldwide organisation committed its entire enterprise to Windows NT.

Windows 2000 Professional, the client version built on the same base as Windows 2000 Server, is Microsoft's preferred client system for the business desktop. It was also intended to supersede Windows 98 but Microsoft recently announced that another round of the DOS-based client would ship next year. The worry is that they'll give it a confusing name like Windows 2000 Personal which will muddy the waters around Windows 2000 Professional.

▲ SIMPLIFIED MANAGEMENT INTERFACE, NEW STORAGE MANAGEMENT, DISK QUOTAS, DISK DEFRAGMENTER

Ideally, Microsoft should bite the bullet and split Windows 2000 Professional from Windows 2000 at the kernel level in order to allow each to develop independently. As it stands, they hamper each other. The client has to hang around waiting for server-centric features like Active Directory to be finished, while server users are irritated when desired new server features are tied to client issues like multimedia support and browsers.

Windows 2000 Professional

According to Microsoft, Windows 2000 Beta 3 RC1 is now feature-complete which means that further work will largely be devoted to testing and polishing, and adding to the supported hardware list. Many new features have appeared in Beta 3 and most of what we saw last year in Beta 2 has been enhanced. Windows 2000 Professional focuses on usability and hardware support, while Windows 2000 Server aims to be reliable and manageable with the help of Active Directory.

There have been big changes in the user interface. Because Windows 2000 Professional is aimed at a broader audience than Windows NT Workstation, feedback has been taken from Windows 98 users as well as from the Windows 2000 Beta 2 programme. Tasks which are second nature to Windows NT users — logging in, connecting to the internet, installing printers — have been subjected to extensive usability testing. The resulting changes range from mild, in the form of renamed folders which make the contents more obvious, to hot, with automatic printer detection during installation. The user interface has been subjected to a spring clean that reduces the amount of clutter on-screen: for example, the Start menu adapts to your usage pattern, showing your most-used programs at the top. It's easier to find information too: the File Find command has been extensively reworked.

Installing and removing software is easier, and configuring hardware requires less guesswork. The Control Panel has been reorganised and simplified. Every hardware control panel now has a 'Hardware' tab for easy configuration, and configuration elements such as printers and dialup networking which were scattered around the system have been brought in from the cold. Users will be pleased to find that Windows 2000 now supports most of the new hardware features promised but not implemented in Beta 2, including DVD, USB, IEEE 1394, digital cameras, and scanners. There is dynamic Plug-and-Play support for PCI, PC Card, USB, and ISAPNP peripherals, but not for EISA and non-PNP ISA peripherals.

▲ AN UNCLUTTERED INTERFACE WITH REVISED CONTROL PANEL AND EASIER PROGRAM MANAGEMENT

Mobile users at last have a version of Windows NT with generic support for their laptops, but the full gamut of Plug-and-Play support won't work with every laptop. There'll be a lower level of support for legacy [ISA] systems, old docking bays with ISA peripherals, lots of PCMCIA cards (as opposed to PC-Card), and systems which don't fully support the

▼ NEW SUPPORT FOR PLUG-AND-PLAY, POWER MANAGEMENT, AND USB AND DVD DEVICES

Advanced Configuration and Power Interface [ACPI]. Windows 2000 is the first operating system to fully support ACPI, allowing the operating system to handle power management and Plug-and-Play device configuration as opposed to the less efficient APM [Advanced Power Management] interface which is controlled by the PC BIOS. Officially, ACPI is supported by Windows 98, but it isn't enabled by default because all sorts of problems arise when ACPI has to deal with BIOSes and device drivers which don't fully support it. Windows 2000 does a much better job of weeding out the incompatibilities and dealing with them so that ACPI works better than in Windows 98.

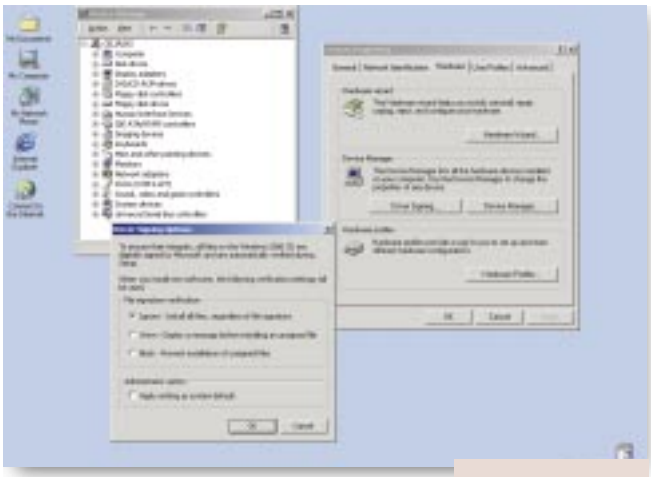
Mobile users also benefit from new usability features such as the Synchronization Manager which replaces the useless 'My Briefcase', and the Make New Connection wizard which makes it easier to run multiple network connections. Synchronization Manager is a local cache manager. Users can work offline with their files and with applications such as Outlook Express, Internet Explorer and SQL Server. An Offline Files wizard helps users to set up the offline cache.

Windows 2000 Server

Wizards are much in evidence throughout Windows 2000, not only in the Professional client but also in Windows 2000 Server. Feedback from Beta 2 convinced Microsoft that the Microsoft Management Console [MMC] needed to be considerably easier to use. The MMC co-ordinates all of the setup, configuration, and management tools in Windows 2000 Server, but it was less than friendly in Beta 2.

MMC 1.2, which ships with Beta 3, cuts through the confusion with a much-simplified, task-based UI which is easier to customise for specific roles. Subsets of the management tools, user administration for example, can be delegated to departments while still being controlled by policy set by the network administrator.

The simplified management user interface shows up from the time Windows NT Server is first installed and the user is given the option to set up a particular type of server, for example a file server, web server, or Active Directory Server. The setup script automatically configures the server for the specific task, explains the process, throws up wizards when applicable, and generally guides the user through the process. This level of assistance is intended for small- to medium-sized organisations which want their server to 'just work', but apart from easier management, which helps everyone, most new features in Windows 2000 Server are specifically targeted at large organisations.



▲ **Greater reliability with driver signing of Microsoft-verified device drivers**

There are three server versions — Server, Advanced Server, and DataCenter Server, with increasing levels of robustness and scalability. Windows 2000 Advanced Server supports two-node failover, large memory space for applications, and four-way SMP. DataCenter Server adds kernel optimisation for enterprise applications and a 16-way SMP licence.

An updated version of Windows Terminal Server multi-user services has been integrated into all Windows 2000 Server versions and they all support new storage services with dynamic volume resizing, hierarchical storage management, and disk quotas.

Much effort has been applied to reliability and scalability. Device drivers and applications that mess with the system directories are responsible for many Windows NT crashes, so Microsoft has introduced system file protection and driver signing. Vital system files are protected from being replaced with older versions by applications, and Microsoft now verifies the stability of device drivers and digitally signs them. You can install an unsigned driver but you'll be advised of the implications. The number of unnecessary reboots caused by hardware and software installation and configuration has been cut to a minimum.

Microsoft's clustering strategy has moved on since the Wolfpack days and now comprises a set of load-balancing services in addition to two-node failover. All Windows 2000 servers support new Network Load Balancing Services [NLBS] (recently released as Windows Load Balancing for Windows NT 4). NLBS enables the load on a front-end web, FTP, or proxy server to be distributed among a cluster of up to 32 web servers. Windows 2000 servers also support load balancing over multiple servers for applications based on Microsoft COM+ distributed components.

There isn't enough space here to describe all the new features in Windows 2000 Server, let alone the enhancements since Beta 2, but it's safe to say that everything revolves around Active Directory. Installation, management, applications, security, clustering, web services — there's nothing that Active Directory doesn't touch.

If Microsoft gets it all right and it works first time out of the gate, it will be the first in the history of computing. Knowing Microsoft, however, they'll keep at it until the customers are satisfied. Being bigger than any previous operating system and promising more, Windows 2000 is going to need a lot of testing. That starts this summer with a wide public release of Beta 3, not only from Microsoft direct, but also pre-installed on PCs from major vendors.

Windows 2000 Professional is less of a worry and will prove itself much faster than Windows 2000 Server thanks to the power management, multimedia, and Plug-and-Play support which makes it a viable option for laptop users, small businesses, and home users who might previously have gritted their teeth and stuck with flaky old Windows 9x.

Terence Green

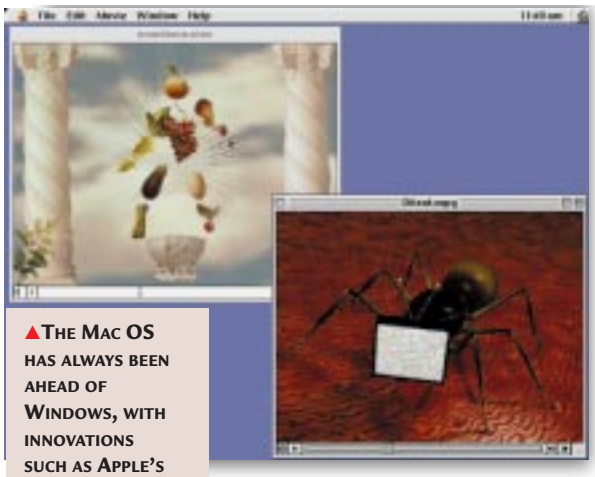
Alternative platforms

There are no end of operating systems out there for PCs — that is, those machines based around x86 processors. But just because they don't run on a PC, you shouldn't discount the Mac OS and Acorn's RISC OS. Apple still has a large installed base, notably amongst graphics professionals, while Acorns still have the lion's share of the schools market. Here we take a closer look at these two operating systems.

Mac OS 8.5

Windows 98? 'More like Mac 84', is the response of most Mac users. After a decade of copying the Mac OS, Windows still can't match the sheer ease of use of the Mac interface. Even PC companies such as Dell admit that Apple's iMac can teach them a thing or two about ease of use.

Microsoft likes to boast about Windows features such as Plug-and-Play, but it was Apple that invented Plug-and-Play back in the eighties. It beat Microsoft with other new technologies as well, such as digital video. Microsoft's Video For Windows was merely a 'me-too' copy of Apple's QuickTime, and Apple continues to innovate with new technologies such as FireWire, which is built into all new Power Mac systems but is still an optional extra for Windows PCs.



▲THE MAC OS HAS ALWAYS BEEN AHEAD OF WINDOWS, WITH INNOVATIONS SUCH AS APPLE'S QUICKTIME VIDEO SOFTWARE

The Mac's chief strength has always been its interface, though. In fact, it was only Apple's ludicrous decision to license elements of the Mac interface to Microsoft that allowed Microsoft to develop Windows in the first place. Most of the weaknesses of Windows, such as the awful Explorer, came about because Microsoft had to avoid copying the Mac desktop too closely. Ultimately, it was Microsoft's marketing rather than any technical superiority that allowed Windows to conquer the world.

The Mac's still hanging on though, and despite a distinctly wobbly patch a couple of years ago, it's still going strong. There are plenty of applications available for the Mac, and Office 98, the current Mac version of Microsoft Office, is more advanced than Office 97 for Windows.

The main area where Windows has a real software advantage is with games — 3D games in particular. However, Apple has recently licensed OpenGL, which is encouraging developers such as id Software to produce Mac versions of their latest games. There's also a major OS upgrade due later this year, called OS X, which promises to keep the Mac OS as far ahead of Windows as ever.

◄NINETY PERCENT OF RISC OS USERS ARE CHILDREN IN SCHOOLS, SO IT HAS TO BE ROBUST

Acorn RISC OS

Acorn's RISC OS is a survivor. Financial uncertainty at Acorn nearly sounded the death knell on RISC OS last year, its tenth birthday. Now, however, RISC OS's future is much more secure: it's been handed over by Acorn to the independent organisation, RISCOS Ltd, for development and maintenance.

RISC OS is wedded to the ARM RISC processor, which Acorn originally invented. It has some limitations: it doesn't offer multi-threaded pre-emptive multi-tasking, but as a co-operative multi-tasker it's pretty good. RISC OS is also relatively robust — well, it has to be when 90 percent of its users are kids in schools! The other ten percent are die-hard enthusiasts all around the world.

Among the other things RISC OS fans will tell you is wonderful about their operating system is the pretty graphical user interface, which takes the drag-and-drop-metaphor much further than anyone else. Jaggy-less anti-aliased fonts are also taken for granted. Plug-and-Play hardware expansion pre-dated Windows 95 by seven years, too.

Multimedia has always been a strength of RISC OS and some applications, like the Optima professional off-line video editing suite from Eidos (yes, the same company which brought you Lara Croft) just have to be seen to be believed. Many of the movie sequences in Eidos games were created using RISC OS applications.

RISC OS used to be completely ROM-based, which meant ultra-fast boot-up times and no need for a hard disk. ROMs are now supplemented by disk-based routines for the most advanced implementations of RISC OS, but RISC OS-based ROM-only workstations and thin clients continue to be valuable to third-party manufacturers.

Approaching a million machines have been built using RISC OS in over a decade, which is a substantial achievement for a UK-developed product in this market. Since the inception of RISC OS Ltd, this operating system is undergoing something of a renaissance. RISC OS can be addictive!

CLIFF JOSEPH, IAN BURLEY

PCW CONTACTS

Mac OS 8.5
Contact *Apple UK 0800 127753*
www.apple.com
Acorn RISC OS
Price *£120 (102 ex VAT)*
Contact *RISCOS 01222 492326*
www.riscos.com

PDA operating systems

Handhelds, PDAs, call them what you will: they may be tiny, but they're perfectly formed computers and, as such, need an operating system. However, not even Microsoft, which seems to regard Windows as the default answer to every question, would suggest that Windows is suitable for PDAs.

Conventional operating systems are far too large for a machine that may have as little as four megabytes of RAM. In addition, many of the features found in Windows are wasted on a PDA — support for multiple users, for example. As the final clincher, PDAs require specific features, such as application synchronisation to a PC, that are not found in Windows. So, what PDAs require are totally new operating systems. Note the plural there: there is enough differentiation between PDA types to ensure that one OS cannot cover all of the hardware that's out there.

PDAs fall neatly into two camps. First, there are palm-type machines like the Palm III. These have no keyboard, just a touch-sensitive screen that can be used for both data viewing and data entry. Then there are the Psion, Phenom and Jornada that are like a tiny laptop with a keyboard and possibly a touch-sensitive screen.

So, given two types of PDA, we have two PDA operating systems? No. Microsoft has produced a new operating system called Windows CE. This tries to look as much like Windows as possible, but that's purely cosmetic; the OS is fundamentally different, as indeed it should be for these very different machines. But whether Windows CE will dominate the PDA marketplace is by no means a foregone conclusion.

▼THE WINDOWS CE INTERFACE LOOKS AND FEELS JUST LIKE WINDOWS...

Palm OS

The first palm-type machine to take off was originally called the PalmPilot (it has since, confusingly, been renamed the Palm). This has a purpose-built operating system called Palm OS. The installed base for this OS is huge, about 2.5 million. The user interface is pen-driven and the operating system is heavily biased towards supporting contact-type applications, so there are excellent contact managers, diaries, etc. In addition, there are about 12,500 developers churning out new applications.

Windows CE for palm devices

When the PDA market became large enough to catch the attention of Microsoft, that organisation developed an operating system called Windows CE (to annoy Microsoft, this is often shortened to WinCE and pronounced 'wince'). Microsoft now licences a version of Windows CE for palm devices to hardware manufacturers, such as Philips which in turn produce PDAs like the Nino.

Currently, Windows CE on this platform has a smaller user base than Palm OS, but the range of machines that run Windows CE will probably ensure that the differential is rapidly eroded. Windows CE on this platform makes strenuous efforts to look like Windows: the task bar is there and the icons look hauntingly familiar.

EPOC

The story for keyboard-driven PDAs is much the same. In the beginning was Psion. This company produced a range of machines, the most recent of which runs Psion's own OS called EPOC. EPOC has a huge installed user base that tends to be stronger in Europe than in the States.

Windows CE for keyboard PDAs

The cosmetic similarity to Windows is even more striking in this Windows CE version. The only major difference is that you can usually drive the interface with the touch-sensitive screen.

This brings us to a crucial difference in philosophy that will probably be the pivotal point around which Microsoft succeeds or fails in the PDA arena. Microsoft believes, quite simply, that people will buy a PDA if it looks like Windows. Companies like Psion believe that an operating system for a PDA has to be designed specifically for that platform and that the user interface is a crucial part of that work. A PDA is a very different device and therefore needs a very different user interface.

▲...WHILE THE EPOC INTERFACE CAN DO ITS OWN THING

All of these operating systems come with a set of basic applications which are on the same chip as the OS. Supplying the OS 'blown' into the hardware in this way has several big advantages — the machine boots instantly, and the operating system and applications are protected from damage. This doesn't mean that the operating system can't hang, but if it does, a reset should see the machine up and running again. The down side is that upgrades, even if supported, cannot be performed in software: you have to get the toolkit out.

MARK WHITEHORN

Network operating systems

When we want to hook up a bunch of computers in a network, we start looking for a network operating system like NetWare, Windows NT or Unix. They run on powerful computers capable of supporting many connected client computers.

But the term 'network operating system' is actually a misnomer stemming from the 1980s when PCs began to be used as cheap servers, first by NetWare, and then with Unix and OS/2. In those days a PC-based network server simply provided file and print services, but now they're the least of the services they offer alongside messaging, groupware, systems management, intranets, extranets, database servers, applications servers...

The hardware reference points have changed too. PCs are much more powerful, but the proprietary Unix hardware against which they compete is a lot cheaper. PCs have also picked up a lot of Unix technology to meet the demand for reliability and scalability. Multiprocessor systems, clusters, ECC memory, drive arrays, redundant systems and hot-pluggable devices have all filtered down to the PC with the net result that it's no longer a given that a PC solution will work out cheaper in either acquisition or running costs.

This brings us back to where PCs started and the mantra was, 'choose the applications, then the hardware'. For a while it changed to 'choose the PC because it costs less' but the wheel has turned and we're back to putting applications first. Nothing exemplifies this return to common-sense more than Linux which is experiencing explosive growth and has received the seal of approval from major names such as Intel, Dell, SAP, Netscape, and Sun.

Linux

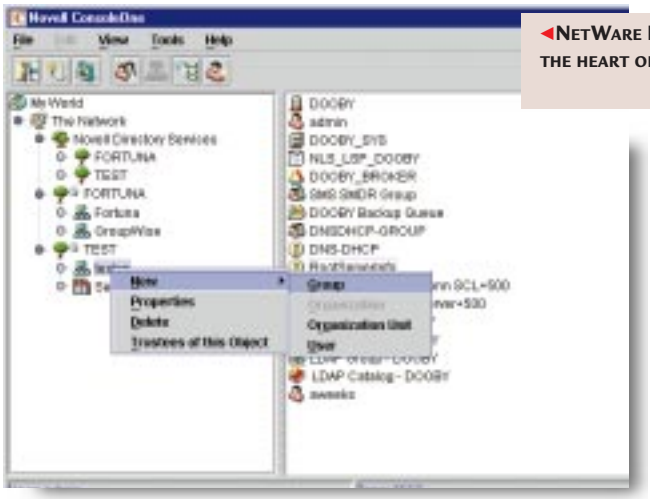
Linux runs on many different architectures but is best known on Intel. It is freely distributed. Anyone can download it for free, order a CD for £2 or buy a CD plus manual for under £50. By making the server operating system free, an incidental cost on top of the hardware, Linux restores applications to pre-eminence over the platform. As a result, companies make money from Linux through service and support for applications.

Red Hat has been most successful at marketing this sea-change but the professionals are piling in. IBM and Hewlett-Packard (HP) now offer worldwide support for Linux, HP has a two-hour, 24x7 offering, and the top three PC vendors — Compaq, HP, and IBM — have committed to Linux despite having their own commercial Unix interests.

Linux isn't the only free Unix-like operating system, there are several, but it has major visibility on the internet where it runs a third of web sites. Linux is closely associated with the Apache web server that powers over 50 percent of web sites and it's very effective. MP3.COM, shifting 500Gb of data, uses 20 Linux servers to provide a 24x7 service. Linux can also do duty as a messaging server, a file server for Windows clients via the Samba server, and a database server. Oracle, IBM, Sybase and Informix have all made their databases available on Linux.

Novell NetWare 5.0

Novell used to lead the market in PC LANs but the company dropped the ball in the mid-90s and fell behind Windows NT Server in terms of unit sales. Since Eric Schmidt took over in 1997, however, Novell has bounced back and in 1998 NetWare sales were only a few hundred thousand behind Windows NT. NetWare's recovery is almost entirely based on clever exploitation of the NetWare Directory Service (NDS) which has been shipping since 1994. NDS maintains a directory of network resources and limits access to authenticated users only. It's available to most platforms including Windows NT, and appropriate to organisations of any size, right up to the biggest such as NTT and Deutsche Telekom which use it to authenticate IP logins.



◂NetWare Directory Service, the heart of NetWare 5.0

NDS is especially useful in an internet-connected world. Network applications and services such as messaging, groupware, system management, and software distribution can be offered on a per user, per group, per client-type basis.

NetWare's weak point has always been applications, but the inclusion of pure IP networking and Java in NetWare 5.0 has gone some way to resolving this problem. IBM recently agreed to ship its WebSphere applications development and deployment on NetWare 5.0. NetWare's forté

▾Windows NT database server with Microsoft SQL Server

remains its robust file and print service which has been much enhanced for NetWare 5.0.

As NetWare only runs on Intel hardware, scalability and availability is an issue for larger organisations. SMP support is now built into NetWare 5.0 and clustering is an option.

Microsoft Windows NT 4.0 Server

Windows NT took off slowly after its 1993 début and didn't really catch on until Windows NT 4.0 was released in 1996. The following two years saw rapid growth, as it took off in the departmental application server arena with messaging applications based on Exchange Server and database servers backed by SQL Server.

Microsoft's driving ambition is to make Windows NT the server of choice for mission-critical enterprise applications, but here it has been less successful. Despite alliances with enterprise suppliers such as HP, Data General and Unisys, major corporations have been reluctant to commit the entire enterprise to Windows NT, mainly due to issues of scalability and availability as Windows NT only runs on Intel and Alpha hardware. Microsoft began to address these matters in 1997 with an improved SMP kernel and failover support in Windows NT Enterprise, but the promised multiserver clustering has not yet been released.

In 1998 Microsoft acquired Valance for its high-availability web server clustering software and made it available on Windows NT 4.0 as Windows Load Balancing Services. The Valance product, renamed Network Load Balancing Services, will be incorporated into the high-end versions of Windows 2000 along with application load balancing services managed by Active Directory. Wolfpack multiserver clustering will follow some time after Windows 2000 ships.

Windows NT 4.0 makes an excellent departmental applications server and, with extra effort, an enterprise server, but the big push for Windows NT in the data centre is predicated on the Active Directory which ships with Windows 2000 later in 1999.

▲ THE MONTEREY PROJECT AIMS TO DELIVER A UNIFIED UNIX FOR INTEL

Unix

When the going gets tough, people turn to Unix because the technologies now being added to NetWare and Windows NT — clustering, SMP, storage — all come from the Unix world where they have been proven in the enterprise over many years.

Where Unix suffers in comparison with newcomers such as Windows NT however is in perceived ease of use, and cost. Of these, the cost of Intel hardware versus proprietary Unix hardware is the most important differentiator. But Intel's 64-bit Merced architecture is set to level the playing field between Unix and Windows NT. Several Unix vendors are finally coming together to build a unified Unix for IA-64. The Monterey Project from SCO, IBM, Sequent and Compaq with the backing of Fujitsu/ICL, Data General and Unisys combines IBM AIX and Sequent technology with SCO UnixWare 7 in a unified Unix that scales from inexpensive IA-32 systems up to mainframe levels.

We've only addressed some of the most popular server operating systems. Others worth checking out are IBM's OS/2-based servers for e-business and the network computing WorkSpace On-Demand server. Apple too is doing interesting things with servers these days.

TERENCE GREEN

PCW DETAILS

Linux
Price *£2 (+ VAT and postage) for a CD, £40 (inc VAT and postage) for CD plus manual*
Contact *Linux Emporium 01491 837010*
www.polo.demon.co.uk/

NetWare 5.0
Price *10-user licence £815.45 (£694 ex VAT)*
Contact *Novell (01344) 724000*
www.novell.com

Windows NT Server 4.0
Price *10-user version £903.58 (£769 ex VAT)*
Contact *Microsoft 0870 60 20 100*
www.microsoft.com

Servers for applications

The only criterion for choosing any server should be the application. Everything that sits on top of the basic plumbing that connects clients and servers is an application. File and print services is an application. So is email and its fancy cousin, messaging. These are infrastructure applications.

On top of these come applications development and deployment environments of which there are too many to list — Microsoft Office, Lotus Domino, SAP and Progress are just a few.

When you're choosing a server, don't pay much attention to sales patter: 'Unix is unfriendly', 'Windows NT is unreliable'. It's not about the server, it's about the applications. It isn't possible to pick out one particular operating system and say, 'this is what you need, now what do you want to do with it?' The server you buy for web serving may not be the one you want for file and print. The mail server may not be the right choice for a database. You're likely to end up with several servers and they may not all be based on the same OS. Even if they are, you'll still have to consider how to manage the whole. The real expense in running servers comes from managing them and what they do. Learning how to do that, or buying in the expertise, is where your money goes.

Final **analysis**

Microsoft has a strong hold on the operating systems market: you only have to look at the number of Microsoft products in just about every category from desktops, with a total of five operating systems, through server OSes and on to Windows CE for handheld devices. Nor can there be any doubt that on its release, Windows 2000 will be the operating of choice, almost by default, for most PC buyers and a large proportion of existing PC owners.

Microsoft's position is partly a result of some clever manouverings in the old days — snatching the OS contract for the first IBM PCs from under the nose of Gary Kildare, then licensing vital code from Apple to create Windows. Partly it has been because of Microsoft's great collaboration with Intel. However, it has also been because it provided what the customer wanted at the right time.

Despite the might of Microsoft, this group test proves there are some extremely good alternatives to Windows 98 — and not just from Microsoft. Some of the desktop alternatives we've looked at may be a little esoteric, BeOS being the prime example. But they do fill a gap in the market and were developed with a specific aim in mind, giving the user the chance to choose not only the best hardware platform and applications for the job, but also the best operating system.

BeOS scores highly because it is built specifically for audio and video editing and can handle enormous files. Linux is also gaining acceptance and popularity because for the enthusiast it serves certain purposes very well. For example, if you have an old 486 in the cupboard, you can, with a little effort, build a cheap and reliable Linux mail server.

However, the real threat to Windows comes not from one particular piece of code as much as from a way of *developing* code. Open Source, which makes the source code freely available to use and modify, whether it's charged for or not, has produced in Linux some rapid developments in a relatively short space of time. The Microsoft Halloween memos (available to view on www.opensource.org) highlighted the frustrations of many developers even within commercial organisations such as Microsoft where developers aren't given access to the code they need. However, the memos also praised the fast development times and the stability of the code produced. The memos were especially forthright in their praise for Linux as a server OS, and recognised the threat to Windows on the desktop. Even Apple, once a company whose jealous guarding of licences almost brought it down, has now taken on some, if not all, of the lessons of Open Source with its Apple Public Source Licence.

But while the future of the operating system could lie in one of a number of directions, for the time being Windows 98 remains at the top of the pile for one reason and one reason alone: support. It runs more applications than any other OS, and has readily available support for more hardware than any other OS. Sure, you can download shareware and drivers for hardware for other operating systems, but Windows saves you the bother. Even what were considered to be Mac-only applications, such as Quark XPress and Photoshop, now ship in Windows versions simultaneously with the Mac versions.

Just because you can't afford to throw out Windows yet, doesn't mean that you have to stick with Windows alone. Hard disks are now ridiculously huge and ridiculously cheap — you can get a 17Gb hard drive for as little as £160 ex VAT. This will be more than enough to store several operating systems, and opens up the choice of creating a multiple boot system, giving you the very best of several worlds and the choice of the right OS for the job. And setting this up needn't be too difficult: see our *Hands On Workshop* on page 202 to see how to go about it.

ADELE DYER