August 10, 1994

To: Brad Chase

From: Jeff Price

Re: A comparison of "Windows 95" and IBM OS/2

As you requested, attached is my comparison of Windows "Windows 95" and OS/2. As it is based in part on pre-release code, it will be updated as new major beta releases appear.

Executive Summary

This document compares Windows 95 with OS/2. Comparisons to the next release of OS/2 for Windows (a.k.a. the "Performance Beta" or "Warp") is provided whenever possible and relevant.

As you know, IBM has positioned OS/2 as "everything Windows 95 is except two years earlier." I'm incredulous IBM would position OS/2 this way since even a cursory comparison of the two operating systems shows this positioning is specious. To summarize:

- Based on my simple, straightforward tests, OS/2 - even Warp - is considerably slower than Windows 95, and the results are across the board - whether on 4, 8 or 16MB. And while Windows 95's performance is very close to Windows 3.1 in 4MB, Warp's is not. Benchmark data is in the Performance section.
- OS/2 is incompatible with core technologies that have been in the market for a long time, like Windows for Workgroups, VxD's and Win32 applications. Based on IBM's public statements, it will also be incompatible with Windows 95.
- Even though Windows 95 is smaller and faster than OS/2, in a raw feature-to-feature comparison Windows 95 comes out ahead. Features in Windows 95 that aren't in OS/2 include basics like:
  - An easy-to-use interface
  - Plug & Play
  - The ability to run the broad universe of existing device drivers, both MS-DOS and Windows-based
  - Built in networking, both client and peer
  - A broad API set for building rich applications - Win32, OLE, MAPI, TAPI, Winsock, RPC, etc.
  - Built-in manageability of the desktop
  - Mobile services like remote network access and file synchronization
  - Built in messaging
  - Disk compression & disk optimization

  As for OS/2 features that aren't in Windows 95, the one of note is the ability to run 16-bit Windows applications in separate sessions; however, it's turned off by default since it degrades performance. It is also a feature of Daytona. OS/2 also has better support than Windows 3.1for MS-DOS games, although not better than Windows 95 given all the MS-DOS work we've done.
- Finally, and perhaps most important, there isn't a clear future for OS/2 users. IBM pointedly won't commit to running Windows 95 or Windows 95 applications. So, aside from the few native OS/2 applications, going forward the only applications available to OS/2 users will be today's MS-DOS and 16-bit Windows applications. Since these apps most likely won't be updated once Windows 95 launches, over time the experience of the OS/2 user will become akin to eating a steady diet of stale bread.

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A quick look at beta 2 of Warp

This analysis is based on the press release IBM issued on August 9th announcing beta 2 of Warp. Since beta 2 is not yet available, all performance figures cited later in this document were gathered from beta 1.

IBM states only that they support "base Windows for Workgroups," which presumably means no support for VxDs, which means no support for the network client, peer services or 32-bit file access (a.k.a. VFAT), and so essentially means no support for Windows for Workgroups.

The top features of Warp listed in the press release, in order, are:

- Easy installation
- New look and feel, defined as animated icons
- Launch Pad, a feature that sounds like the Windows 95 Start button without the Task Bar
- Improved usability, defined as a new tutorial and mouse trails
- Play-at-Will, defined as Plug-and-Play for PCMCIA cards

Given the fundamental issues that OS/2 faces like sluggish performance compared to Windows 3.1, compatibility problems, and lack of native applications, the focus on animated icons and mouse trails as important features is curious.

I will also take this opportunity to clear up any confusion between Play-at-Will, which IBM calls plug-and-play, and Windows 95's Plug-and-Play. IBM's press release defines Play-at-Will as

> A new PCMCIA software utility, called PlayAtWill(a), [that] provides plug-and-play capabilities today. The utility automatically identifies the type of PCMCIA cards installed, including communications, modem, memory, hard disk and I/O cards, and provides a convenient graphical status on the desktop.

I have seen Play-at-Will demonstrated, and it seems to work as advertised for PCMCIA cards. However, it is limited to just PCMCIA cards, and that IBM calls it a utility pretty much says it all.

Windows 95's Plug-and-Play is a technology pervasive at all levels of the operating system. It works on all PCs rather than just those laptops that have PCMCIA slots. Windows 95's Plug-and-Play covers common desktop devices like monitors, printers, video cards, sound cards, CD-ROM drives, SCSI adapters, and modems, while Play-at-Will doesn't. Unlike Warp, the core components of Windows 95 are Plug-and-Play enabled. For example, Windows 95's Netware-compatible client is Plug-and-Play enabled and gracefully handles the dissappearance of a network connection, and a Windows 95 laptop can be hot-docked into a docking station; a Warp laptop cannot.

Also, the problem of device installation and configuration requires a more encompassing solution than a utility. Beyond the technology in the operating system, full Plug-and-Play requires that peripheral vendors and PC manufacturers update their products to be Plug-and-Play aware, and we've had a major effort for the last year evangelizing these vendors to do so. By contrast, in Warp beta 1 Play-at-Will only supports ten specific laptop models, five of which are from IBM.

The Application Software Market

The OS/2 applications market is small and getting smaller. Windows applications now account for almost 60% of all dollars spent worldwide on applications software, with $4 billion sold in 1993. In the same period, sales of OS/2 applications have declined and in 1993 accounted for 2% of the market, or $128 million. The following is Software Publishing Association sales data for the last three years:

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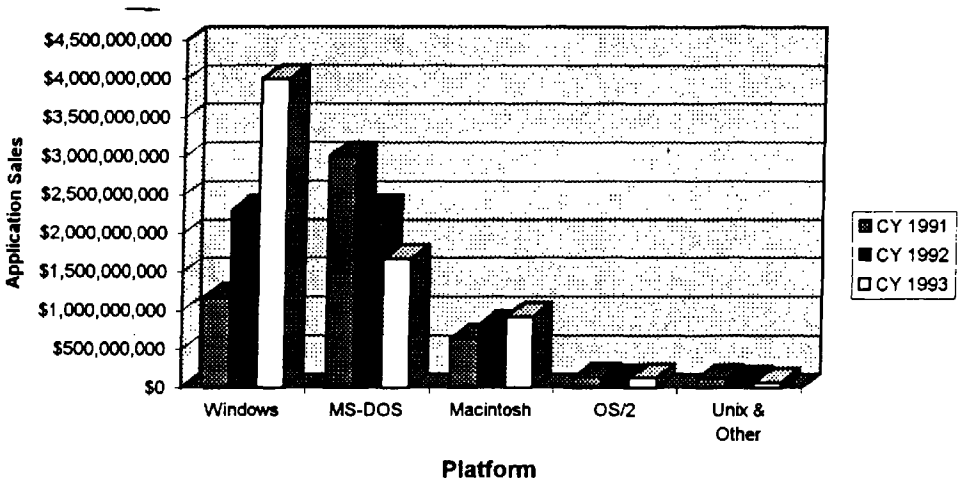
World Wide Application Sales by OS Platform 1991 - 1993



	Apps Mkt Share 1991	Apps Mkt Share 1992	Apps Mkt Share 1993	$ Sales Pct Change 91-93	% Share Change 91-93
Windows	23%	41%	59%	243%	36%
MS-DOS	59%	41%	25%	-44%	-35%
Macintosh	13%	14%	14%	43%	1%
OS/2	3%	2%	2%	-5%	-1%
Unix & Other	2%	2%	1%	-45%	-1%

Source: Software Publishing Association Reports

Given that large vendors like Corel, WordPerfect and Micrographix have announced they are abandoning OS/2, it appears inevitable the OS/2 applications market is only going to shrink more. It is also telling when a dedicated OS/2-only vendor like Describe publicly criticizes IBM's OS/2 strategy and threatens to abandon the platform.

Since IBM claims an installed base of 5 million for OS/2, or one-tenth the 50 million we claim for Windows, I was curious as to why OS/2 applications only have one-thirtieth the market share of Windows apps. One explanation is that people buy Windows applications to run on OS/2. In addition, below is some data from our monthly operating system tracking survey. It's collected from a random-digit survey into a statistically significant sample, and the market research folks tell me it's projectible, +/- 1%, to the market at large.

Question: What is the primary operating system you use day-to-day?

	4/93	5/93	6/93	7/93	8/93	9/93	10/93	11/93	12/93	1/94	2/94	3/94
OS/2	0%	1%	1%	1%	1%	1%	0%	1%	1%	0%	1%	1%

Given these numbers, it appears that there are far fewer than 5 million copies of OS/2 in actual use.

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Performance

Performance is obviously a key attribute of any operating system.

Windows 95 Performance

Windows 95's architecture builds upon the 32-bit disk and network I/O components introduced in Windows for Workgroups (WFW) 3.11, and adds 32-bit components in performance-critical areas like memory management, scheduling, communications, graphics and printing. For compatibility reasons it retains 16-bit code in less performance-sensitive areas like window management.

The result is that Windows 95 is small and fast. It requires the same memory resources Windows 3.1 but scales much better. It will achieve the same performance on 4MB systems (almost there now with the current beta), and is faster on 8MB and higher systems.

OS/2 2.11 and OS/2 for Windows 2.11 Performance

Like Windows 95, OS/2 has a number of 32-bit components. One common misconception about OS/2 is that it is a purely 32-bit operating system. It actually includes over 40% 16-bit code, some of which is in performance-sensitive components like the file system drivers.

When a Windows application is run under OS/2, it loads both OS/2 and at least one copy of Windows 3.1, and the "Fast-load" option in Warp doesn't change this fact; it simply loads Windows during boot-up instead of at application load-time to increase perceived performance. Either way, the overhead of OS/2 running Windows applications is much higher than Windows 3.1 or Windows 95. In 4 MB RAM, Warp is not usable running Windows applications due to excessive disk thrashing.

Performance Features

Feature	Windows 95	OS/2
Minimum RAM configuration for acceptable performance running popular applications	4 MB	8 MB (version 2.11) 6-8 MB (version 2.99)
I / O device driver model	32-bit + compatibility with 16-bit drivers	16 / 32-bit
I / O subsystem	32-bit	16 / 32-bit
Graphics device driver model	32-bit	16 / 32-bit
Graphics subsystem	16 / 32-bit	16 / 32-bit

Benchmark results

The tables below show the performance of OS/2 for Windows 2.11, OS/2 for Windows 2.99 (a.k.a. beta 1 of Warp) and Windows 95 running the Winbench 4.0 disk I/O and display tests. In all configurations (4, 8, 16 MB RAM), Windows 95 easily outperforms all versions of OS/2 by a factor of 2-3. Application performance approximately follows the Winbench ratios, with the 4MB configuration being at minimum 500% slower than Windows 95.

Disk I/O Performance

Disk Winmark (higher is better)	4 MB	8 MB	16 MB
Windows 95 build 114	1,330	1,320	1,490
OS/2 Performance Beta 2.99	431	470	480
OS/2 for Windows 2.11	421	544	543

Graphics Performance

Graphics Winmark (higher is better)	4 MB	8 MB	16 MB
Windows 95 build 114	12.7	11.8	12.0

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OS/2 Performance Beta 2.99	6.8	5.5	5.5
OS/2 for Windows 2.11	5.2	5.2	5.2

Application Load Time Performance

Time to Load Word for Windows 6.0 (seconds, lower is better)	4 MB	8 MB	16 MB
Windows 95 build 114	14.4	7.3	6.1
OS/2 Performance Beta 2.99	73.0	20.7	14.1
OS/2 for Windows 2.11	102.6	23.5	15.0

73 seconds is a long time to start Word for Windows.

Ease of Use

For the purposes of this document I'm defining ease of use as the user interface, and how it applies to both novice and more proficient intermediate and advanced users.

Windows 95 Ease of Use

Our usability test data shows Windows 95 improving ease-of-use dramatically for both novices (who get up to speed about 400% faster on average) and experienced users (who are 25% more efficient on average than with Windows 3.1). It fixes problems like the fact that a user can't get anything done in Windows 3.1 without learning to double-click, and that window management (minimizing, maximizing, switching between programs) is very confusing.

The key innovations - the Start Button, the Task Bar, integrated help, wizards - will make the learning process much easier for novices. They are also good efficiency tools for proficient users along with features like shortcuts, right-button context menus, the integrated network browsing from the Network Neighborhood, and the Explorer.

OS/2 Ease of Use

OS/2 provides a unified view of programs, folders, and system tools using the desktop metaphor. Practically speaking, I don't know anyone who would give it to their mother. It relies heavily on right-button clicking, which our usability testing has found efficient only for experienced users. In Windows 95 right-clicking is strictly a shortcut - there is always a left-button way to access functionality on right-button context menus. Much functionality in OS/2 is accessible only from the right-button.

In addition, OS/2 has two separate user interfaces (Windows 3.1 and the Workplace Shell) and has no interface for accessing network resources.

Ease of Use

Feature	Windows 95	OS/2
Single click launches programs, documents	✓ Start Button	
Easy to start, switch between multiple applications	✓ Start Button, Taskbar always available	Apps can be hidden by full screen sessions, minimized apps do not appear on the desktop by default
Easy to find and use help	✓ Unified help system, always available on Start Menu, shortcuts directly to system functions	Multiple system help files
Plug and Play	✓	
Assistance for installation, configuration of devices	✓ Wizards	
Backwards compatible with Windows 3.1 Program and File Managers	✓	✓ Only for Windows applications, not OS/2 applications

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Easy to setup	✓ Automatic detection, installation, and configuration of devices during setup and dynamically there after via Plug & Play	Limited to detecting some graphics adapters and CD-ROM devices. No dynamic detection. Play at Will provides limited PCMCIA plug & play capabilities in future versions
Consistent facilities for customization and tuning of system configuration	✓ All accessible via Start Button, Control Panel	Facilities distributed across several locations
Integrated network browsing	✓ Network Neighborhood	
Single view of all local and network resources and information	✓	
Shortcuts for efficient and flexible access to programs and data	✓	✓
Property sheets for objects	✓	✓
Dynamic display resolution switching	✓	

Application and Device Support

I considered the following criteria important:

- Does the OS provide broad support for existing hardware and associated MS-DOS and Windows-based device drivers?
- Are devices easily recognized, installed, and configured by the operating system?
- Does the OS support running existing MS-DOS and Windows-based applications?
- What kind of support does the OS provide for future applications?

Windows 95 support

Windows 95 runs existing hardware and software. It supports existing MS-DOS applications, 16-bit Windows applications, real-mode drivers and protect-mode drivers (VxDs). Windows 95 also provides a platform for 32-bit applications - Win32 - as well as a rich set of API's for messaging applications (MAPI), telephony applications (TAPI), Internet applications (Winsock) and a mini-driver model that eases the writing of device drivers for printers, modems, displays, etc.

If a user buys a hot new video card, they can be assured Windows 95 will run it.

OS/2 support

OS/2 runs some existing hardware and software. It supports existing MS-DOS applications. It only partially supports real-mode drivers (for example, OS/2 doesn't support the Superstor/DS compression IBM's includes in PC-DOS) and doesn't support VxDs at all. It partially supports 16-Windows applications - applications that use VxD's, for example, aren't supported. OS/2 provides a platform for 32-bit applications, but not the broad API set of Windows 95, and has no mini-driver model. IBM has also not committed to any inclusion of Win32 API support or any of the other new API's in Windows 95.

If a user buys a hot new video card, they may or may not be able to run it with OS/2. There may or may not be a driver available.

Device and Application Compatibility

Feature	Windows 95	OS/2
MS-DOS applications	✓	✓
MS-DOS Device Drivers	✓	Supported in MS-DOS sessions only
16-bit Windows applications	✓	✓ As long as application doesn't require VxDs

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Windows Device Drivers	✓	Display drivers only, and only if run in "non-seamless" session
Virtual Device Drivers ("VxD")	✓	
Plug & Play installation and dynamic configuration of devices	✓	PCMCIA devices only
32-bit Windows applications	✓	
OS/2 applications		✓
Mini-driver model	✓	
Object support	✓ OLE	
Support for distributed applications	✓ RPC	
Messaging API	✓ MAPI	
Telephony API	✓ TAPI	
Internet applications API	✓ Winsock	
Multimedia API	✓ Video for Windows	✓ MMPM/2

Networking and Connectivity

Since PCs are increasingly connected to one another as well as to servers and hosts via LANs, in Windows 95 we had to respond to customer demands for much better integration of the client OS with the network, as well as easier setup and administration. The important points to look at are:

- Does the OS have built-in, native support for popular networks?
- Does the OS include support for a wide range of popular network transports (TCP/IP, IPX/SPX, Netbeui), and industry-standard communication protocols (DCE RPC, named pipes, Netbios) and existing network device standards (NDIS, ODI)?
- Does the OS provide a simple, consistent user interface for accessing and using network resources?
- Does the OS support an open architecture to allow third-parties to add connectivity and application support?

Windows 95 support for networking and connectivity

Windows 95 includes built-in network clients for Netware and Windows Networks such as Windows NT Server, built-in TCP/IP, IPX/SPX and Netbeui protocol support, as well as built-in file-and-print sharing for both Netware and Windows Networks. All clients and protocols are 32-bit, high-performance, and Plug-and-Play aware.

Windows 95 also provides a single model for accessing all network resources, regardless of vendor or source, and integration of network resources into the shell. It secures all shared resources on the PC via user-level security integrated with Netware and Windows NT Server. Windows 95's open connectivity architecture also allows other network vendors to provide similarly integrated connectivity and security.

OS/2 support for networking and connectivity

OS/2 includes no network support, although certain Warp packages may offer network clients. The customer obtains the network client software from the network operating system vendor and installs it separately. Once installed, network clients works differently. Only two network clients (LAN Server and NetWare) integrate into the WorkPlace shell; others are command-line only. No support for peer-to-peer networking is provided, although a peer product has been in beta for some time.

Networking features

Feature	Windows 95	OS/2 & OS/2 for Windows
Network clients in the box	Microsoft, NetWare-compatible	

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Network protocols in the box	Netbeui, IPX/SPX, TCP/IP	
Plug & Play automatic and dynamic network configuration	✓	
Peer services (file, print sharing)	✓	
Single model for accessing network resources	✓	Each client is different

Manageability and Administration

Our users are demanding that the operating system be easier and less costly to manage. Most importantly:

- Does the OS provide a platform for supporting existing industry management mechanisms such as SNMP, and provide flexibility to accommodate future standards such as DMI.
- Does the OS provide tools and mechanisms for system managers and administrators to manage, customize and control the configuration and capabilities on the desktop locally and remotely?

Windows 95 support for manageability and administration

Windows 95 provides a full set of administration utilities including user profiles, administration policies, local and remote configuration and monitoring, disk and tape backup, support for an SNMP agent (+ MIB, MIB 2), DMI agent, registry-based remote system management, network backup, system security policies, better support for LAN installs of the OS, remote boot, and user-level security. Windows 95 also stores all hardware, software and user information in one structured repository, the Registry, that can be accessed remotely.

OS/2 support for manageability and administration

Since OS/2 has no network support in the box, it also no manageability or administration tools. Some of the above functionality is available from LAN Server and other products like Netview, but none is integrated with the operating system. OS/2 configuration information is scattered across several configuration files.

Manageability and Administration Features

Feature	Windows 95	OS/2
Multiple users can share one system and each have a separate configuration	✓	
A single user can rove from PC to PC and have their configuration follow them	✓	
Administrators can set system policies for each PC and user, and control what OS functionality a user can access	✓	
Remote administration of user profiles and policies	✓	
System performance monitor	✓	
Remote performance monitoring	✓	
Tape & disk backup application	✓	
Clients for server-based backup	✓	
SNMP support	✓	
DMI Support	✓ (may follow initial release)	
Local network access monitor	✓	
Remote network access monitor	✓	

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Reliability and Robustness

By reliability and robustness, I mean the ability of an operating system to tolerate errant applications while protecting the operation of the OS itself and other applications running at the same time.

Windows 95 Reliability/Robustness

Windows 95 improves on Windows 3.1 by offering better local reboot (ending hung applications gracefully), tracking and cleanup of system resources after process termination, and addition of parameter validation for device drivers. Windows 95 also offers better protection for virtual machines, and separate address space and message queues for Win32 applications. Windows 95's mini-driver model allows for the bulk of device driver code to be written and tested by Microsoft, leaving a much smaller amount of code for the device vendor to write and test, resulting in more robust drivers.

In addition, Windows 95 dramatically increases system resource limits over Windows 3.1. Unlike OS/2, it does this without having to resort to running each application in a separate copy of Windows, which means you don't pay the penalty of substantial memory overhead and performance degradation for each application.

OS/2 Reliability/Robustness

IBM cites "crash protection" as a major benefit of OS/2, and they implement it via the option to run each Windows application in a separate address space. IBM doesn't turn this option on by default presumably because it requires an additional 1.5MB of RAM per application, penalizes performance severely, and creates compatibility problems like breaking OLE. Windows NT offers this same feature, but, unlike OS/2, makes no pretensions to running well on 4-8MB systems, and it supports OLE.

Windows applications run under OS/2 are subject to the same resource limitations as under Windows 3.1 unless run in separate address spaces.

Unlike Windows 95, OS/2 uses a single system message queue that leaves it vulnerable to one application not reading its messages and freezing the system; this limitation maybe removed in Warp although it wasn't in beta 1. Device drivers for OS/2, especially for graphics cards, are not parameter validated and are typically less reliable than their Windows equivalents.

Reliability & Robustness Features

Feature	Windows 95	OS/2 & OS/2 for Windows
Application address space	MS-DOS apps: separate Win32 apps: separate Win16 apps: shared	MS-DOS apps: separate Win32 apps: not supported Win16 apps: shared or separate; shared by default OS/2 apps: separate
Multitasking	MS-DOS apps: preemptive Win32 apps: preemptive Win16 apps: cooperative	MS-DOS apps: preemptive Win32 apps: not supported Win16 apps: cooperative or pre-emptive; cooperative by default OS/2 apps: preemptive
Message queues	MS-DOS apps: separate Win32 apps: separate Win16 apps: shared	MS-DOS apps: separate Win32 apps: not supported Win16 apps: shared OS/2 apps: shared
API parameter validation	✓ including validation of VxDs (device drivers)	only as provided by Windows 3.1
Increased system resource limitation	✓	

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Messaging and Communications

People want integrated support so they can easily transmit electronic mail and other. To summarize:

- Does the OS support high-speed communications and background multitasking?
- Does the OS provide support for current communications hardware plus support sharing of communications devices, unified device configuration, emerging communications technology?
- Does the OS support remote access to the key services or information stored on network servers?
- Does the OS provide industry-standard messaging services?

Windows 95 Messaging and Communication

Windows 95 supports high-speed, background communications. It also has the InfoCenter, a universal client for sending, receiving, and storing electronic mail, fax, and other messaging information. Windows 95 supports automatic installation and dynamic configuration of most network and communications devices. Facilities are provided for remote network access, sending and receiving fax messages, and connecting to on-line services including the Internet.

OS/2 Messaging and Communication

OS/2 supports high speed, background communications. OS/2 includes no electronic mail, remote network access, or fax capabilities. The only communications capability provided is an asynchronous terminal package.

Messaging, Communications Features

Feature	Windows 95	OS/2 & OS/2 for Windows
Unified configuration of telephony and modem devices	✓ TAPI, Unimodem	
Plug & Play automatic and dynamic modem configuration	✓	PCMCIA modems only
Unified facility for accessing/sending/receiving mail, fax, documents	✓ mail, fax, server data access integrated with local and network resources	
Local and remote e-mail client	✓	
Send/Receive Fax	✓	
Facilities for accessing on-line services and the Internet	✓ TCP/IP, async + SLIP, PPP protocols included	✓ async terminal only
Personal information store (database)	✓	

Mobile Services

The goal of mobile services is to allow users to remain productive and in communication at the office or on the road.

Windows 95 Mobile Features

Windows 95 includes features that makes it easy for users to work in a dynamic environment on mobile and desktop PCs. The system automatically determines the current configuration and available devices including PCMCIA cards, printers and networks. Windows 95-optimized laptops will support hot docking. Windows 95 also includes support for power management in battery operated devices, deferred printing, file synchronization between a multiple PCs and built-in, 32-bit disk compression.

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OS/2 Mobile Features

Warp will have limited plug & play of PCMCIA devices via "Play-at-Will" technology. It will not support hot-docking. OS/2's larger memory requirements make it less suitable for laptops, and it does not provide disk compression.

Mobile Services

Feature	Windows 95	OS/2 & OS/2 for Windows
Facilities for dialing in/out for remote network access	✓	Available in separate "LAN Distance" package
Support for detection of docked/undocked status and dynamic device configuration	✓	
Plug & Play PCMCIA Support	✓ 32-bit, auto-installation, dynamic configuration	✓ no Plug & Play; limited device support via Play-at-Will
Disk compression	✓	
Power management	✓	✓
File synchronization between multiple PCs	✓	
Deferred printing	✓	

MultiMedia Services

Windows 95 MultiMedia Features

Windows 95 includes features improvements in numerous areas:

Ease of Use: Windows 95 will be far easier to use. Headline new features include PnP and Autoplay. Windows 95 customers will be able to buy and easily install PnP CD-ROM drives, sound cards, video capture boards, etc etc. Additionally, Windows 95 titles can be autoplay enabled so that all a user needs to do is stick the CD-ROM in the drive and the system runs the title (or whatever else is the right thing to do) automatically.

Games: We introduced WinG and DCI and took the game community by storm in April of this year. These two technologies add the fast graphics required by todays hotest games to the Windows platform.

Industry Support: Windows is the leading platform for multi-media titles and sports the support of the leading tool vendors such as Macromedia (Director) and Adobe (Premier)

Power & Speed: Windows 95 sports a new 32bit CD ROM file system. Windows 95

OS/2 Multimedia Features

IBM's has followed Microsoft's strategy in Multimedia too. Subsequently to our WinG announcement they they announced DIVE scheme to try and match our efforts. Unlike WinG and DCI, DIVE is not shipping. In addition, Kodak shipped a photo CD kit for Windows over a year ago and Photo CD has been supported in popular Windows applications like Publisher for some time now. IBM is finally delivering something equivalent in the upcoming OS/2 for Windows.

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