



Workstation
Server
Enterprise

Overview of Windows NT Workstation and Windows NT Server

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About Chapter 1

This chapter explores the basics of Windows NT Workstation 4.0 and Windows NT Server 4.0, and explains how each operating system fits into the overall Microsoft Windows 4.0 operating system family. Ever wondered which operating system to choose for a given situation? Or whether to choose a workgroup or a domain model? These questions are fully explained and answered in this chapter.

Next, this chapter discusses the architecture of Windows NT. Several key NT concepts, such as modular architecture and the virtual memory model, are introduced. Even if you don't aspire to be an NT guru, a basic understanding of this terminology and how Windows NT is structured will serve you well.

Finally, a tour of the Windows NT 4.0 user interface is presented. All of you Windows 95 users will be happy to know that the Windows NT 4.0 interface looks and feels just like the Windows 95 interface.

No matter which of the three Windows NT 4.0 Microsoft Certified Professional exams you're preparing for, you'll want to read this chapter. It provides basic information about Windows NT Workstation 4.0 and Windows NT Server 4.0 that will be invaluable in your exam preparation.

Microsoft Windows 4.0 Operating Systems

This overview of Microsoft Windows NT Workstation and Windows NT Server begins by examining how these operating systems fit into the big picture, the picture that portrays the entire Microsoft Windows 4.0 operating system family. The Microsoft Windows 4.0 operating systems include: Windows 95, Windows NT Workstation, and Windows NT Server. These three operating systems share a common user interface, many common features and utilities, and all are 32-bit operating systems.

Although there are similarities between the three operating systems, each was designed for a different purpose. Allow me to introduce you to each of the three Microsoft Windows 4.0 operating systems.

Windows 95

Windows 95 is a 32-bit desktop operating system. This operating system requires the least amount of hardware of all the Microsoft Windows 4.0 operating systems. The minimum hardware required to run Windows 95 successfully consists of: an Intel-based computer with a 386DX/20 processor, 8MB of *random-access memory* (RAM), 40MB of available hard disk space, and a VGA graphics card. Windows 95 is the only Windows 4.0 operating system that fully supports Plug and Play architecture.



in the
real world

I know the product documentation says that you only need 4MB of RAM to run Windows 95, but it's been my experience that you need at least 8MB of RAM to achieve any performance at all.

Windows 95 is compatible with many existing software applications. It supports 16-bit and 32-bit Windows-based applications (including legacy applications designed to run on previous Windows operating systems) and MS-DOS-based applications. You can also run applications that require direct access to the hardware on the Windows 95 operating system.

Windows 95 does not support multiple processors for true multiprocessing. However, it does support preemptive multitasking for Win32 and MS-DOS-based applications.

The Windows 95 operating system provides some, but not a high level of, security. It does not support a local user account database. It does, however, support server-based validation of the logon process.

Windows NT Workstation

Like Windows 95, Windows NT Workstation is also a 32-bit operating system that is optimized to run as a desktop operating system. It can also be used on personal computers that are networked in a peer-to-peer workgroup configuration, or on a workstation computer that is part of a Windows NT Server domain configuration.

Windows NT Workstation, however, supports fewer hardware platforms than Windows 95 and requires more powerful hardware to run. The minimum hardware required to successfully run Windows NT Workstation consists of an Intel-based computer with a 486/33 processor, 12MB of RAM (16MB recommended), 117MB of free hard disk space, and a VGA graphics card. In order to assure operational success, all hardware must be on the Windows NT *Hardware Compatibility List*

(HCL) that is shipped with the product. Windows NT Workstation provides only minimal support for Plug and Play.

Windows NT Workstation supports most MS-DOS-based applications, most 16-bit and 32-bit Windows-based applications, POSIX 1. *x* applications, and most OS/2 1. *x* applications. It does not support applications that require direct hardware access because this could compromise Windows NT Workstation's security. It also does not support software applications that require a *terminate-and-stay-resident* (TSR) program or a virtual device driver.

Windows NT Workstation is a high-end, powerful operating system that supports multiple processors for true multiprocessing. As with Windows 95, it also supports preemptive multitasking for all software applications that will run on Windows NT Workstation.

The security Windows NT Workstation is capable of providing is greater than the security provided by Windows 95. User logon and authentication are required in order to use the Windows NT Workstation operating system and in order to access local or network resources. Windows NT Workstation supports a local user account database. Alternatively, Windows NT Workstation can be tied into a domain user account database. Windows NT Workstation has been certified for use in C2 secure environments.

Windows NT Server

Windows NT Server is a powerful 32-bit operating system that is optimized to run on a network file, print, or application server.

Windows NT Server has the most demanding hardware requirements of the three Microsoft Windows 4.0 operating systems. The minimum hardware required to run Windows NT Server consists of an Intel-based computer with a 486/33 processor, 16MB of RAM, 124MB of free hard disk space, and a VGA graphics card. It does not support Plug and Play.

Windows NT Server supports the same software applications as Windows NT Workstation. In addition, Windows NT Server is the operating system of choice for the Microsoft BackOffice products, including SQL Server, Exchange Server, and SNA Server.

An NT Server computer can support several processors to provide powerful multiprocessing capability.

Windows NT Server is a high-security capable operating system. Like Windows NT Workstation, user logon and authentication is required. Security is controlled and administered via a domain directory database.

Of the three Microsoft Windows 4.0 operating systems, Windows NT Server is the only operating system that is optimized for server performance. Its client/server platform provides far more powerful network features than either Windows 95 or Windows NT Workstation.

Choosing a Desktop Operating System

So which desktop operating system should you choose for a given situation? You would normally *not* choose Windows NT Server as a desktop operating system because it is optimized as a *server* operating system. That leaves you with a choice of either Windows 95 or Windows NT Workstation for your desktop operating system.

The choice you make will be ultimately based on the hardware available to you, software compatibility, and your security needs.

If the hardware available to you is older, not very powerful, or not on the Windows NT Hardware Compatibility List (HCL), you will probably choose Windows 95. However, if you have newer, more powerful hardware that is on the HCL (or if the cost of buying new equipment is not an issue), and if you don't have any software compatibility conflicts, then Windows NT Workstation is the preferred choice.

In terms of software compatibility, the most important fact to determine is whether the applications you plan to use are supported by Windows 95 or Windows NT Workstation. You should test the software you plan to use on both products (or otherwise satisfy yourself that the applications actually work on the operating system you want to use) before you make a decision. If you plan to use older, legacy applications that require direct hardware access, you should choose Windows 95 for your desktop operating system.

If high security is important to you, consider choosing Windows NT Workstation. As long as your hardware is up to it (or if high security is more important to you than the cost of buying new equipment) and the applications you plan to run are compatible, the preferred choice in a desktop operating system, in terms of overall performance, reliability, and security is Windows NT Workstation.

Workgroups Versus Domains

Before this overview of Microsoft Windows NT (from here on referred to as simply Windows NT or NT) can progress much further, it's important that you get good and comfortable with two key concepts: workgroups and domains.

 **Throughout this book, except where differences are noted, Windows NT refers to *both* Windows NT Workstation and Windows NT Server.**

Workgroups and domains are two prevalent methods of grouping networked computers for common purposes. Computers and their users may be grouped based on common usage requirements or on departmental or geographical traits. For example, all the members of an accounting department or all the computers on the third floor of a building may be grouped together.

Workgroups

A *workgroup* is a logical grouping of networked computers in which one or more of the computers has one or more shared resources, such as a shared folder or a shared printer.

 **The terms *folder* and *directory* are synonymous in the wonderful world of Windows NT. The NT user interface does not use these terms consistently. Sometimes the interface refers to a folder, and sometimes it calls the same (or similar) item a directory.**

In a workgroup environment, the security and user accounts are all maintained individually at each separate computer. Resources and administration are distributed throughout the computers that make up the workgroup. In a workgroup configuration there is no centrally maintained user accounts database, nor any centralized security. Figure 1-1 illustrates how security is distributed throughout a workgroup environment. Notice that security is maintained individually at each separate computer in the workgroup.

Typically, all of the computers in a workgroup run desktop operating systems, such as Windows 95 or Windows NT Workstation.

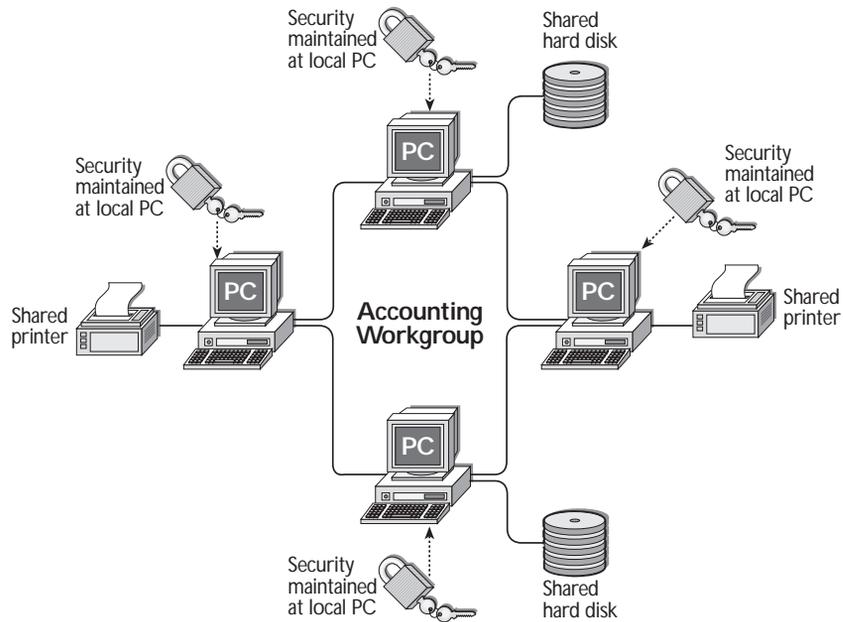


FIGURE 1-1 Security in a workgroup environment

Domains

A *domain* is a logical grouping of networked computers in which one or more of the computers has one or more shared resources, such as a shared folder or a shared printer, *and* in which all of the computers share a common central domain directory database that contains user account and security information.

One distinct advantage of using a domain (or *domain model*, as it is sometimes called), particularly on a large network, is that administration and security for the entire network can be managed from a centralized location. Figure 1-2 illustrates how security is centralized in a domain environment. Note that the security of all the shared printers and hard disks is maintained at the domain controller.

In a Windows NT domain, at least one of the networked computers is a server computer that runs Windows NT Server. The server computer is configured as a *primary domain controller* (PDC), which maintains the domain directory database. Typically, there is at least one additional server computer that also runs Windows NT Server. This additional computer is usually configured as a *backup domain controller* (BDC). The other computers on the network normally run Windows NT

Workstation or Windows 95 (although they may utilize other operating systems). These non-server computers can share their resources (such as hard disks and printers) on the network, but these shared resources are secured by the domain directory database that is maintained by the PDC.

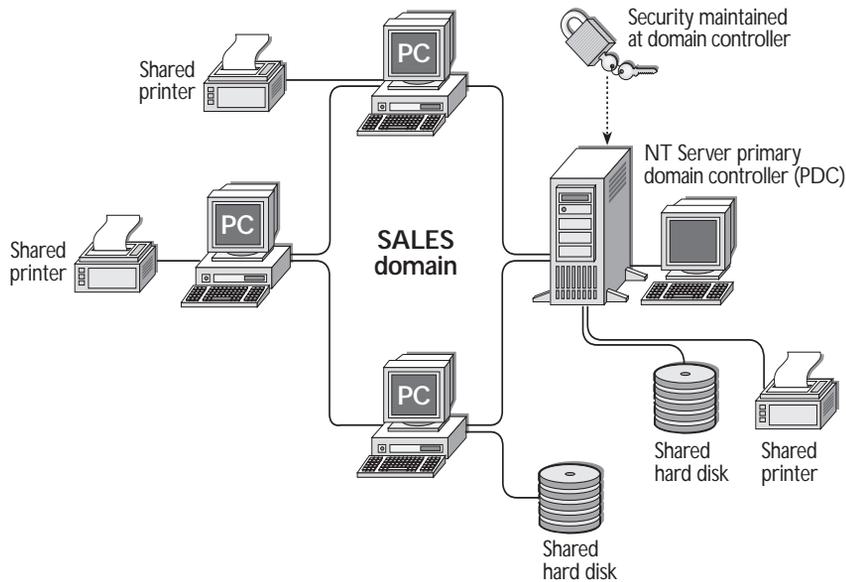


FIGURE 1-2 Security in a domain environment

Choosing Between the Workgroup and Domain Models

Choosing the appropriate model of grouping computers and managing shared network resources depends upon the size and security needs of the network.

Often, small- to medium-sized networks (two to twenty computers) can be managed fairly easily by using the workgroup model, with the user of each computer controlling the security to the specific resources that are shared by that user's computer.

In a larger network environment, administration and security become harder to manage; thus, the domain model, which provides centralized account administration and greater security, is usually the preferred choice.

Architecture of Windows NT

An overview of Windows NT wouldn't be complete without discussing its architecture. If you develop a basic understanding of the operating system's architecture now, you'll have a framework on which to "hang" all of the concepts and facts you learn throughout the rest of this book.

Windows NT uses a modular architecture. This means each component (or module) within the architecture has sole responsibility for the function it is designed to provide. In addition, no other module repeats the functions performed by another. Figure 1-3 illustrates the modular architecture of Microsoft Windows NT 4.0. Notice that the operating system has two pieces, or modes: user mode and kernel mode.

User Mode

Applications and their subsystems run in *user mode*. This mode is referred to as a less privileged processor mode because it does not have direct access to hardware. User mode applications are limited to assigned memory address spaces and can't directly access other memory address spaces. User mode uses specific *application programming interfaces* (APIs) to request system services from a kernel mode component.

The purpose of separating the applications in user mode from the hardware, of restricting the memory address spaces that applications can access, and of forcing the applications to run all requests for system services through the kernel mode, is to protect against the possibility of an application crashing the system, and also to protect against unauthorized user access.

Examine Figure 1-3 again, and notice that there are several subsystems within user mode. You're now set to explore these subsystems.

User mode subsystems

There are four main subsystems in user mode: the Win32 Subsystem, the OS/2 Subsystem, the POSIX Subsystem, and the Security Subsystem.

The *Win32 Subsystem* is the primary application subsystem. All 32-bit Windows applications run in the Win32 Subsystem.

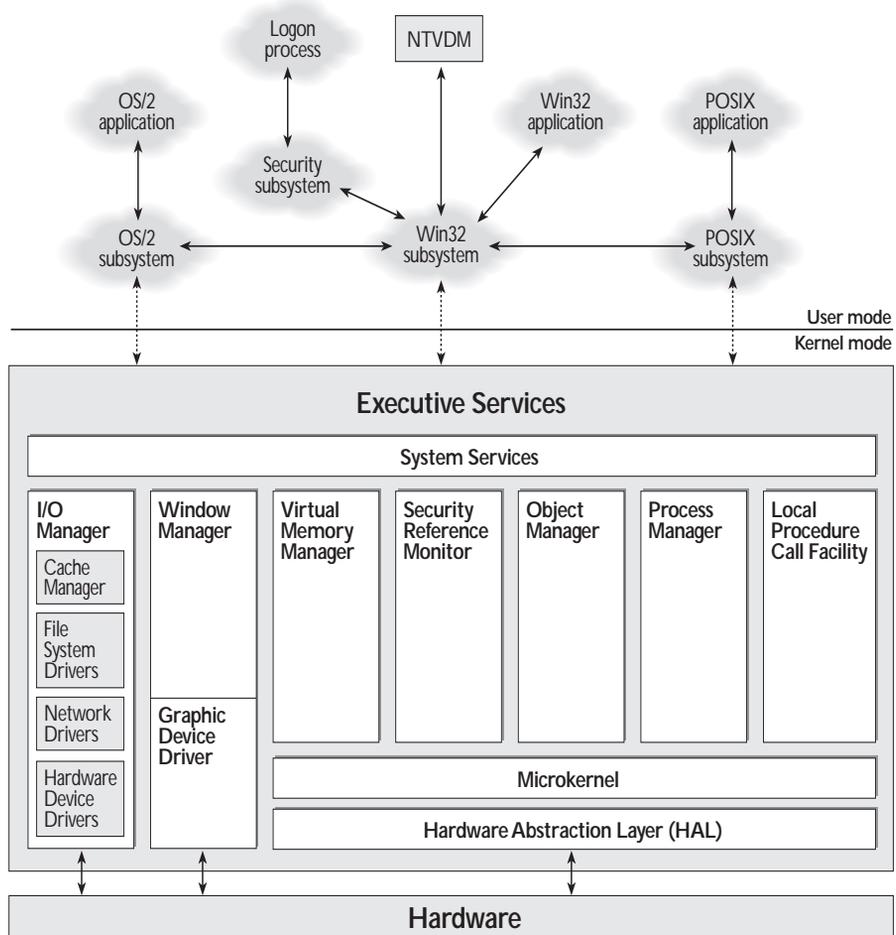


FIGURE 1-3 Microsoft Windows NT 4.0 modular architecture

The *OS/2 Subsystem* is required to run OS/2 1.x compatible applications. The OS/2 Subsystem obtains its user interface and its screen functions from the Win32 Subsystem, and requests Executive Services in kernel mode to perform all other functions for it. (Executive Services is covered in the next section of this chapter.)

The *POSIX Subsystem* is designed to run POSIX 1.x compatible applications. It functions very much like the OS/2 Subsystem. The POSIX Subsystem uses the Win32 Subsystem to provide all of its screen and graphical displays, and it requests Executive Services in kernel mode to perform all other functions for it.

Finally, the *Security Subsystem* supports the logon process. The Security Subsystem also communicates with the Win32 Subsystem.

In addition to the four formal subsystems, an *NT Virtual DOS Machine* (NTVDM) is a feature of user mode. Its function is to run MS-DOS-based and Windows 3.x-based (all 16-bit) applications.

Kernel Mode

Kernel mode refers to a highly privileged mode of operation. It is called “highly privileged” because all code that runs in kernel mode can access the hardware directly, and can also access all memory. A process running in kernel mode is not restricted to its own specific address space as is an application running in user mode.

The entire set of services that comprise kernel mode is called Executive Services (or sometimes the Windows NT Executive). Executive Services provide kernel mode services as requested by applications in user mode.

Notice how Figure 1-3 graphically presents the pieces of kernel mode. Observe how they fit together and interact with the hardware and user mode components. Allow me to now introduce you to the components of kernel mode.

Kernel mode components

Kernel mode is made up of numerous components integral to the Windows NT major operating system functions.

The *I/O Manager* is responsible for all input and output to disk storage subsystems. As it manages input and output, the I/O Manager also serves as a manager and supporter of communication between the various drivers. The I/O Manager can communicate directly with system hardware if it has the appropriate hardware device drivers. Subcomponents of the I/O Manager include a *Cache Manager*, various *file system drivers*, and *network drivers*. Another subcomponent of the I/O Manager is the *hardware device drivers* that perform direct hardware access.

Window Manager is responsible for providing all of the graphical user interface. Window Manager communicates directly with the *graphics device drivers*, which in turn communicate directly with the hardware. In Windows NT 3.51, Window Manager and the graphics device drivers were a part of user mode. The developers of Windows NT 4.0 moved this component from user mode to kernel mode. This change enabled faster access to the graphics device drivers and elimi-

nated the need for user applications to switch back and forth between kernel mode and user mode for calls for graphics services.

There are five other kernel mode subsystems: the *Virtual Memory Manager*, the *Security Reference Monitor*, the *Object Manager*, the *Process Manager*, and the *Local Procedure Call Facility*. Each one of these subsystems communicates directly with the Microkernel. The *Microkernel* is the very heart of the NT operating system. It handles interrupts, schedules threads, and synchronizes processing activity. The Microkernel, in turn, communicates with the *Hardware Abstraction Layer* (HAL). The HAL is designed to hide the varying characteristics of hardware so that all hardware platforms appear the same to the Microkernel. As a result, only the HAL, and not the entire Microkernel, needs to address each and every hardware platform. The HAL can communicate directly with the computer's hardware.

Now that you've been introduced to user mode and kernel mode, you're ready to move on to the last major architecture topic: the NT memory model.

NT Memory Model

Windows NT uses a virtual memory model. *Virtual memory* is the physical space on a hard disk that NT treats as though it were RAM. Virtual memory can also be thought of as an extension of RAM, or "fake" RAM.

The virtual memory model used by NT is a demand-paged system based on a flat, linear, 32-bit address space. Through the use of virtual memory, each application is given access to what *appears* to be 4GB of memory address space. 2GB of the 4GB are reserved for application data, and the remaining 2GB are reserved for NT operating system data.

By using this scheme, the operating system is able to allocate more memory to applications than is actually contained in the computer. The advantage of this is that users can run more applications at one time than the computer's RAM would otherwise physically permit.

The Virtual Memory Manager manages memory in the Windows NT environment by using demand paging. (You may recall that the Virtual Memory Manager is a kernel mode component. It is included in Figure 1-3.) Here's how the Virtual Memory Manager (and demand paging) works: When the Virtual Memory Manager receives a request from an application to retrieve specific pages of memory, it redirects this request to the actual physical location where those pages are stored. This location could be in RAM, or it could be in virtual memory stored in a paging

file on the hard disk. If it is in a paging file on the hard disk, the Virtual Memory Manager will move some pages of memory that have not recently been used from RAM to a paging file on the hard disk. It will then recover the pages that were requested by the application from the paging file on the hard disk and move them back into RAM, where the application can access them.

The 32-bit flat addressing scheme used by the NT memory model makes NT compatible with many popular processors, including the MIPS R4000, the PowerPC, the Intel, and the DEC Alpha AXP.

Windows NT 4.0 Interface

If you're familiar with the Windows 95 user interface, you can probably skip this section. The Windows NT 4.0 interface looks and feels just like the Windows 95 interface.

If this is your first exposure to the Windows 4.0 operating systems, Figure 1-4 shows how the desktop interface looks.

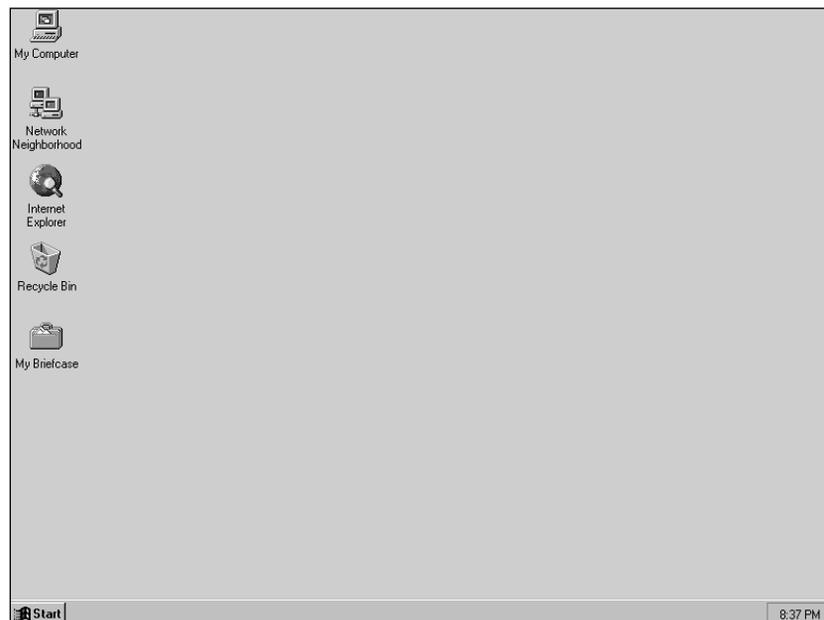


FIGURE 1-4 The Windows NT 4.0 desktop

The following is a brief explanation of the Windows NT 4.0 user interface, including the desktop and Windows NT Explorer.

The Windows NT 4.0 Desktop

After your computer boots Windows NT 4.0, the screen displayed is the desktop. The desktop replaces the Program Manager interface from earlier versions of Windows and Windows NT.

You can create shortcuts to programs you use frequently and place them on the desktop. You can also configure the display properties, such as icon size, background color, screen saver, display resolution, and so on, by right-clicking anywhere on the desktop and then clicking Properties.

There are several icons on the desktop, as well as a taskbar and a Start button.

My Computer

Double-clicking the My Computer icon displays the My Computer dialog box. This dialog box graphically represents every drive on the computer (including network drives, if any), as well as the Control Panel and the Printers folders. If you double-click any icon in the My Computer dialog box, another dialog box is displayed showing the contents of the drive or folder you clicked.

Network Neighborhood

The Network Neighborhood icon is only displayed if you are using a network. If you double-click the Network Neighborhood icon, a dialog box is displayed that contains an icon for your computer and an icon for the entire network. You can expand the icons in this dialog box to show all computers, shared folders, and shared printers on your network.

Internet Explorer

When you double-click the Internet Explorer icon, Microsoft Internet Explorer starts. You can use this application to browse Web pages on the Internet.

Recycle Bin

The Recycle Bin icon is a politically correct '90s version of the Macintosh trash can icon. When you delete files, the files are moved from their original location

into the Recycle Bin folder. When you delete items in the Recycle Bin, the items are removed permanently from your computer. Remember to periodically empty your Recycle Bin!

My Briefcase

My Briefcase is a special type of folder that enables you to keep files synchronized between two computers, such as your laptop and your desktop computer.

Start button

The Start button is located on the left side of the taskbar. Clicking the Start button opens a menu that enables you to quickly access programs, recently used documents, settings (such as the Control Panel and Printers folders), and Help. The menu also enables you to run applications from a command line, find a document, and shut down your computer.

Taskbar

The taskbar at the bottom of the desktop contains the Start button, a button for each program that is currently running, and a clock. You can quickly switch between applications by clicking the button that represents the application you want to access. You can configure taskbar properties by right-clicking anywhere on the taskbar, and then selecting Properties. You can easily set the time and date by double-clicking the clock in the taskbar.

Close, minimize, and maximize buttons

At the upper right-hand corner of every window is a button, marked with an X. This button is called the close button and is used to close the window and exit the application.

Many windows have two additional buttons located adjacent to the close button: the minimize and maximize buttons. The minimize button looks like an underscore on a button. Clicking this button will minimize the application to its icon on the taskbar. The maximize button looks like either a single box with a dark line across the top, or like two overlapping boxes, each with a dark line across the top. Clicking the maximize button switches between a small view of the window and a full screen view of the window.

Windows NT Explorer

You can access any file, folder, printer, or application on your computer or on the network in Windows NT Explorer. Windows NT Explorer replaces File Manager from earlier versions of Windows and Windows NT. Windows NT Explorer is a useful tool for copying, moving, and deleting files.

To access Windows NT Explorer, select Start » Programs » Windows NT Explorer.

Key Point Summary

This chapter covered the basics of the Windows 95, Windows NT Workstation, and Windows NT Server operating systems. You also learned which Windows operating system to choose based on your particular requirements and resources. Chapter 1 also covered several key components of the Windows NT architecture, and the Windows NT user interface.

- *Windows 95* is the best choice for a desktop environment with less sophisticated hardware when backward compatibility for certain legacy applications is required and when minimal security is acceptable. *Windows NT Workstation* is the operating system of choice if you have the hardware platform to support it and don't have any software conflicts, if a high degree of security is important, or if you desire a more powerful desktop operating system. If you want an operating system optimized to function as a server, *Windows NT Server* is the preferred choice.
- A *workgroup* is a collection of networked computers in which administration of user accounts and security of resources are maintained individually, on each separate computer. A *domain* is a group of networked computers in which administration and security for the entire network is managed from a centrally located domain directory database that contains user account and security information.

- The architecture of Windows NT is separated into two modes: *user mode* and *kernel mode*. Applications run in user mode. User mode applications are only able to access their assigned address spaces, and cannot access hardware at all. Code running in kernel mode, in contrast, has direct access to all of memory and direct access to hardware. The NT memory model features a virtual memory system that utilizes demand paging. The Virtual Memory Manager is the kernel mode component that is actually responsible for performing demand paging.
- The *Windows NT 4.0 user interface* looks and feels just like the Windows 95 interface. Several icons appear on the desktop: My Computer, Network Neighborhood, Internet Explorer, Recycle Bin, and My Briefcase. There is also a taskbar at the bottom of the desktop that contains the Start button, a button for each program that is currently running, and a clock. In Windows NT 4.0, Windows NT Explorer replaces File Manager from earlier versions of Windows and Windows NT.



exam
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pointer

The Key Point Summaries in this book are excellent exam preparation tools. After you read each one, ask yourself if you have a sound working knowledge of the topics covered. If you don't, go back and reread the section(s) on which you're not clear. Then proceed to the questions in the Instant Assessment section.

Applying What You've Learned

Now it's time to regroup, review, and apply what you've learned in this chapter. The questions in the following Instant Assessment section bring to mind key facts and concepts. In addition, some of the questions also give you a chance to analyze situations and apply your knowledge of Windows NT to that particular situation.



Take time to answer the questions in the Instant Assessment section at the end of each chapter. They will help you learn to apply the concepts to which you've just been introduced. Keep in mind that your investment now will pay off later when you take the exams!

Instant Assessment

1. Your computer has a Pentium processor and 32MB of RAM. It needs to be optimized as a workstation and also capable of true multiprocessing and full 32-bit compatibility. You do *not* have any legacy devices or applications that must be supported. Which Microsoft Windows 4.0 operating system should you choose for your computer?
2. Which Microsoft Windows 4.0 operating system should you choose when you need an operating system that is optimized as a server operating system?
3. You are planning a small network (four computers) for your company. You want the administration and security of the network to be distributed equally among the users of the four computers. Which method of logically grouping computers should you use?
4. Which method of logically grouping computers should you use when you need centralized administration of the network's security and shared resources?
5. Which mode of the Windows NT operating system has direct access to hardware, user mode, or kernel mode?
6. What type of memory model does Windows NT use?
7. Figure 1-5 is a partially filled in model of the Windows NT 4.0 modular architecture. Fill in the missing titles in the chart to solidify your understanding of the Windows NT 4.0 architecture.

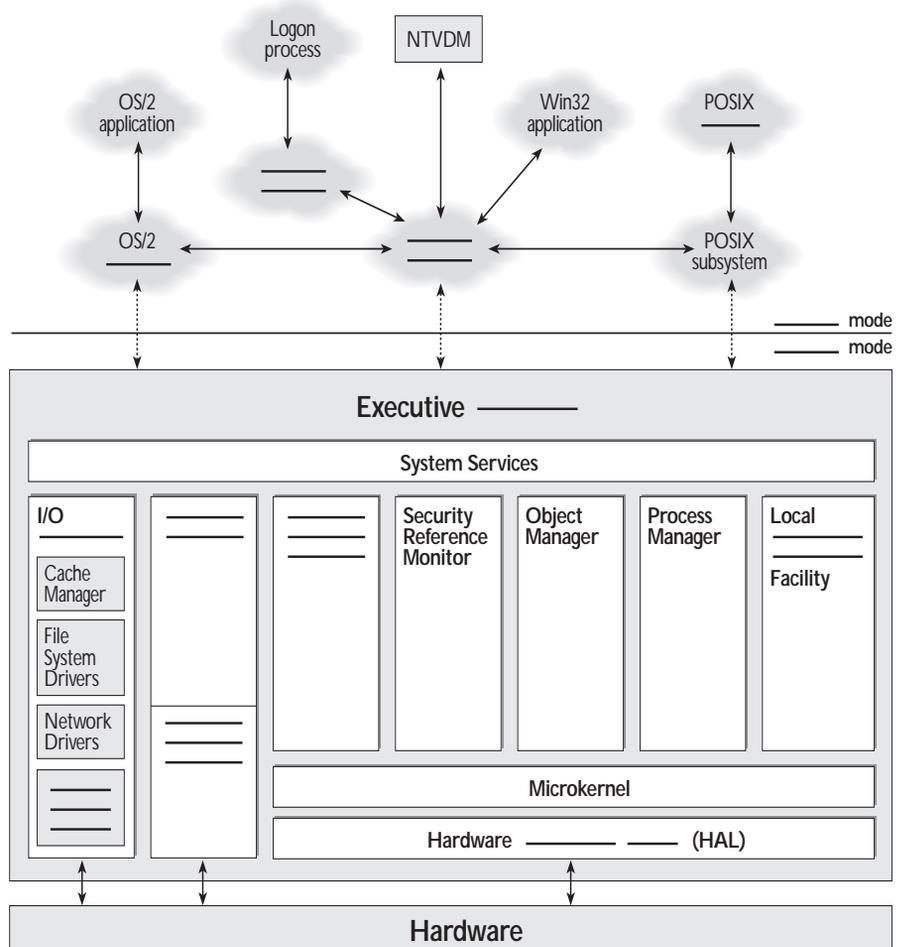


FIGURE 1-5 Microsoft Windows NT 4.0 modular architecture activity



For answers to the Instant Assessment questions see Appendix D.