

Microsoft® Windows NT™ Server 3.51

Reviewer's Guide

*A guide to reviewing and evaluating
Microsoft Windows NT Server version 3.51*

June 1995

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Windows NT Server 3.51 Overview for Reviewers

This guide is designed to describe and explain the important new features that are included in the Microsoft® Windows NT™ Server operating system. This version of the guide includes features from Windows NT Server version 3.5 as well as features new to Windows NT Server version 3.51. The new features are distinguished from those already in version 3.5.

About the New Windows NT Products

With this latest release of the Windows NT platform, Microsoft has placed significant emphasis on optimizing the product for its typical usage scenarios—as a workstation and as a server. This release of Windows NT is comprised of two distinct products: *Windows NT Workstation* and *Windows NT Server*.

Windows NT Workstation has been optimized to provide the highest level of interactive application responsiveness. Specific workstation optimizations include overall reduction of memory usage, higher system priorities for foreground (that is, interactive) applications, and improved efficiency of both 16-bit and 32-bit desktop application operation.

Windows NT Server has been optimized to provide the highest level of network responsiveness. Specific optimizations for the server include better memory usage for caching large amounts of data, higher system priority for network users, and improved efficiency of 32-bit server application operations.

As stated, these new products correspond to their most common usage by customers, press, and industry analysts. The expression “Windows NT” will continue to refer to the overall system architecture and, occasionally, will be used as a generic term when discussing features common to both products.

Background

Microsoft Windows NT™ and Windows NT Advanced Server shipped in July of 1993. Since then, many customers have begun to build their businesses around this new operating system. Customers told us Windows NT and Windows NT Advanced Server were powerful, easy to use, and remarkably reliable. They also gave us feedback on areas where it could be improved. Microsoft is committed to customer satisfaction and has worked to identify any obstacles to adoption as well as to eliminate them in this release. These versions of Windows NT Workstation and Windows NT Server are very significant releases because of the performance improvements we have made and the important new features we have added.

Three major types of customers will benefit immediately from the adoption of Windows NT Server: customers who are downsizing from legacy systems to client-server, customers who are upsizing from file sharing systems to client-server, and Novell® NetWare® customers who want more from their server than basic file and print services. There are many improvements in Windows NT Server that benefit these users, but three areas stand out:

- **Size and performance improvements**—Version 3.51 is approximately 4 to 6 megabytes smaller than version 3.1. It is also significantly faster. Our goal has been to be comparable to NetWare 3.12 and 4.01 for file/print services and to retain or improve our edge over those two NOSs in our application server performance. We believe that we have reached that goal in the 3.5 release, and maintained this with v3.51.
- **Improved connectivity**—We’ve made a number of changes to improve connectivity in v3.5:
 - We completely rewrote the TCP/IP transport from the ground up.
 - We added two new features—a TCP/IP addressing service called “Dynamic Host Configuration Protocol” (DHCP) and a TCP/IP name resolution service called “Windows® Internet Naming Service”. These services make TCP/IP much easier to administer and more practical for dynamic, decentralized organizations.
 - We completely rewrote the IPX/SPX stack for greater performance.

- We shipped a client for Windows NT that provides access to NetWare servers to make interoperability easier for organizations that want Windows NT Server to co-exist with Novell NetWare.
 - We made many improvements to our Remote Access Service (RAS) to provide a comprehensive remote computing solution.
- **Availability of applications**—The availability of applications isn't a product feature, but it is an important prerequisite to customer adoption of any operating system. Microsoft has shipped its own server applications—Microsoft SQL Server™ for Windows NT and Microsoft SNA Server for Windows NT—and will ship others within the next few months. Many other server vendors, including Oracle, Informix, Ingres, SAP, PeopleSoft, and Platinum Accounting, have shipped versions of their products for Windows NT. Others will ship in the next few months: Lotus Notes®, IBM® CICS and DB/2®, and Computer Associates UniCenter. In short, we believe that we have achieved the critical mass of available applications that is essential to the success of any operating system.

As you are reviewing these products, we hope you'll keep in mind that we are shipping two different products that satisfy two different sets of customer needs. Windows NT Workstation is the most powerful desktop operating system for your most demanding business needs. It is tuned for workstation performance and provides great connectivity. Windows NT Server is the network foundation for the new generation of business applications. Windows NT Server supports the applications customers need to make better business decisions and to provide better customer service. It is also the easiest network to install and use, so system management and training costs are lower than ever. And Windows NT Server is a foundation that works with what customers have—now and in the future.

What's New in Windows NT Server 3.51

New Features At A Glance	
New platform support for PowerPC	Windows NT Server offers unprecedented choice in hardware platforms, adding the PowerPC™ to the currently supported platforms: Intel® x86, Pentium™, Dec™ Alpha AXP™, and MIPS® Rx400.
Licensing and License Management Tools	With the Windows NT Server 3.51 release, Microsoft extends the licensing model to include a Per Server (concurrent) licensing option. Windows NT Server 3.51 includes tools that assist network administrators in managing Client Access Licenses for Windows NT Server and all BackOffice products.
Per File and Per Directory Compression	NTFS compression on a file and directory basis improve hard drive utilization.
Remote Access Service (RAS) Compression	Added support for RAS software compression between Windows for Workgroups and Windows NT Server results in better throughput than modem compression, lowers the interrupt rate, and diminishes the risk of overruns.
Network Client Administration for Windows 95	Allows over-the-network installation of Windows 95 from server-created startup disk.
New Device Support	Drivers included on CD-ROM support more than 2,000 devices.
Improved performance	File server performance is up to 200 percent faster and uses 4-6 megabytes less memory.
New IPX stack	Multiple network and SPX II support improve performance.
Gateway Service for NetWare	Allows users to access NetWare servers without running dual stacks at the client.
Migration Tool for NetWare	Migration Tool for NetWare aids network administrators by copying user accounts and files from NetWare servers to a Windows NT Server while maintaining security.
New TCP/IP transport stack	Rewritten from the ground up, this stack is faster and smaller than the previous stack.
Dynamic Host Configuration Program (DHCP)	DHCP assigns IP addresses dynamically from a centrally managed pool of addresses. It relieves administrators of the burden of assigning IP addresses to individual workstations and maintaining those addresses.

Windows Internet Name Service (WINS)	Maps computer names to IP addresses, allowing a user to refer to a machine by a user-friendly name (e.g., mymachine), rather than by its address (e.g., 123.45.67.890).
Increased capacity for dial-in support	Increase in supported sessions from 64 to 256. Also new is the ability to use the dial-in server as a gateway to NetWare and UNIX® servers.
PPP and SLIP support in Remote Access Server (RAS)	Point-to-Point Protocol (PPP) and Serial Line Internet Protocol (SLIP) are two protocols that enable TCP/IP over asynchronous lines (modems). RAS also supports IPX over PPP for NetWare installations.
Account lockout	Allows an administrator to set a maximum number of incorrect password attempts. After the number is exceeded, the account is blocked and cannot be used to logon.
Windows NT Server administration tools for 16-bit Windows	Provides administrative facilities for administering any server on the network from a client running Windows® 3.x or Windows® for Workgroups.
Non-Directory Server	This is a server dedicated to a particular function (usually an application such as Microsoft SQL Server) that does not participate in Directory Service security. This is very useful in NetWare or UNIX environments.
Dump facility with automatic restart	If a server suffers a fatal error, it will write the contents of memory to disk. The system can be set to restart automatically.
Remoteboot (RPL)	Necessary for diskless workstations, this allows Windows 3.x and MS-DOS®-based clients to be booted from a server.
Long filenames under the File Allocation Table (FAT) file system	File and directory names on the FAT file system are no longer restricted to the 8.3 naming convention. Instead, file and directory naming rules are similar to those of NTFS – names can be up to 255 characters and case is preserved.
New plotter driver	A plotter driver for many HP plotters.
TCP/IP printing	Allows computers on a Windows-based network to access printers connected to UNIX computers or TCP/IP printers connected directly to the network.
Doc On-line	The complete server documentation is now available on-line, accessible from an icon in the Program Manager.
Network Client Administrator	This tools assists an administrator in installing MS-DOS, Windows for Workgroups, OS/2®, and RAS clients.

Evaluating New Features of Windows NT Server 3.51

Installation and Setup

The Setup program in Windows NT Server, version 3.51, is faster and smoother than ever. Be sure to check the readme.wri file on disk 1 for any last-minute updates. It includes new features such as the ability to detect and correct the floating-point division error associated with some Intel® Pentium™ processors. The following is a list of specific changes in the Setup program:

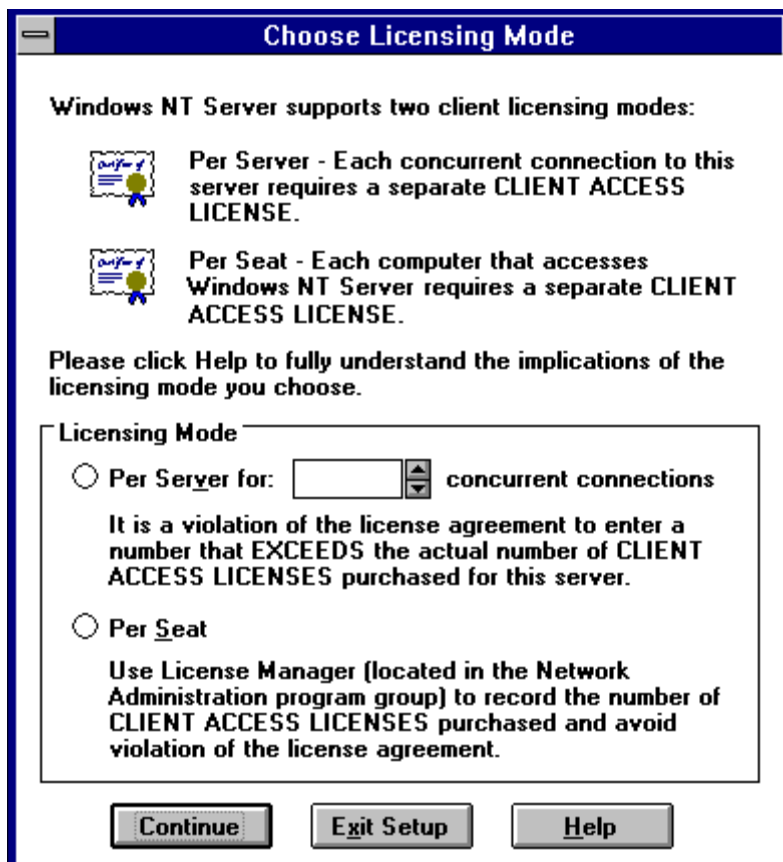
- A Choose Licensing Mode dialog box is displayed during Setup in which you must select a licensing mode, and then agree to the terms of the licensing agreement.
- 5.25 inch Setup floppy disks cannot be used.
- The Setup program can run in unattended mode.
- The floating-point division error exhibited by some Intel Pentium processors is detected and can be corrected during Setup.

You can install this version over an existing installation of Windows NT Advanced Server or Windows NT Server or on a new machine. If you install it over an existing installation, it retains all local security accounts, program groups, preferences and settings.

Install both a new system and over an existing system running Windows NT Advanced Server version 3.1 or Windows NT Server 3.5. You'll find that in installing over an existing system, this version of Windows NT Server retains all local security accounts, program groups, preferences, and settings.

Selecting a Licensing Mode

Windows NT Server 3.51 Setup presents a Choose Licensing Mode dialog box. It also allows access through Help to online versions of the Microsoft Client Access License and Server License agreements. You will be required to select a licensing option and accept the terms of the license agreement for Setup to complete. In this dialog box, you must indicate whether you want Windows NT Server 3.51 to be installed in the Per Server or Per Seat licensing mode. (For more detailed information about and an exact description of either the Per Server or Per Seat licensing modes, see section titled *Licensing and License Management Tools*.)



Alternatives to Using 5.25 Inch Setup Floppy Disks Update Information for Version 3.51

Formerly, when you installed or upgraded Windows NT Server on an x86-based computer, you were provided with or were required to supply three blank, formatted, high-density 3.5 inch or 5.25 inch Setup floppy disks. In Windows NT Server 3.51, 5.25 inch Setup floppy disks cannot be used.

Note: If the 3.5 inch drive on your computer is the drive from which your computer starts, you can continue to use 3.5 inch Setup floppy disks.

Instead of using 5.25 inch Setup floppy disks, you can perform a Setup without using floppy disks. Or, if you have both a 3.5 inch drive and a 5.25 inch drive, you can alter your computer to start from the 3.5 inch drive. For more information about performing Setup without using floppy disks, see the next section. For more information about altering your computer to start from a 3.5 inch drive, consult your hardware documentation.

Running Setup in Unattended Mode

The unattended setup mode allows you to install or upgrade Windows NT Server without being present. It also eliminates the need for Setup floppy disks because the necessary files are temporarily copied to your computer during Setup. Therefore, you may need to free additional space on the computer's hard disk.

Unattended Setup mode saves time when performing new installations of Windows NT Server on five or more computers or when upgrading Windows NT Server on one or more computers.

To run Setup in unattended mode, the answers to all Setup questions, including the questions asked about accepting the license agreement, must be provided in an answer file that you create before running Setup.

For more information about installing Windows NT Server using the unattended Setup mode, see the UNATTEND.TXT file on the Windows NT Server CD-ROM in the \I386, \ALPHA, \MIPS, or \PPC directories.

Note that floating-point division error detection is not performed during an unattended Setup. To determine if your system exhibits the floating-point division error, run the pentnt utility after Setup completes. For more information about the pentnt utility, see the following section.

Detecting and Correcting the Floating-Point Division Error

The Setup program also has been changed to automatically detect the Intel Pentium processor's floating-point division error. If the error is detected on your system, Setup prompts you to indicate whether you want to disable the floating-point hardware on the processor. If you choose not to have the floating-point hardware disabled during Setup, you have the option of doing so after Windows NT Server is installed using a command-line utility called pentnt. For more information about using the pentnt utility type the pentnt /? command at the command prompt.

New Platform Support

Windows NT 3.51 includes support for the PowerPC architecture. The PowerPC architecture further extends the platform independence of Windows NT to this processor architecture supported by IBM, Motorola, and others. Developers who seek the broadest hardware support for their applications will continue to see the greatest leverage from supporting Windows NT.

Licensing and License Management Tools

With the Windows NT Server 3.51 release, Microsoft extends the licensing options available to customers by adding a concurrent use option, also called Per Server. This is the same concurrent use option that is available to SQL Server customers today. With this release, customers have the flexibility to choose the option that best meets their needs and can have servers licensed in both modes on the same network.

The Per Seat option requires a Client Access License for each computer that will access Windows NT Server. Once a computer is licensed it may access any Windows NT Server on the network, at no additional charge. For customers whose clients tend to access more than one server, such as a home server and another department server, the Per Seat option will be most efficient.

With the Per Server option, a customer licenses a server for a specific number of client computers to access that server at the same time. One Client Access License is purchased for each concurrent connection. Customers who want to use Windows NT Server for communications, such as remote access services, Internet or other more specialized uses, may find the Per Server option more efficient. In addition, small organizations or departments which only have one Windows NT Server will find this option to be simple to administer. There is a one-time option to change only from Per Server to Per Seat configuration.

License Manager

Windows NT Server 3.51 includes two new administrative tools that help reduce the costs associated with managing licenses and tracking compliance:

- The Licensing Option in Control Panel.
- The License Manager application in the Network Administration program group.

After the initial setup process, an administrator can use the Licensing option in Control Panel to increase or decrease the number of concurrent connections for that server. The administrator can also change the licensing mode on that local computer from Per Server to Per Seat (a one-time only option.)

To increase or decrease the number of concurrent connections, double-click on the License Icon in Control Panel and type the new number of connections.

With Per Server licensing, once the specified limit of concurrent connections is reached, Windows NT Server will not allow more computer connections to the server. An administrator is considered one of the numbered concurrent connections until the limit is reached. At that time, though, the administrator is allowed to connect to manage the lockout situation. When the limit is reached, the client will receive an error message and the administrator will also be alerted in the Application log in Event Viewer.

Administrators can use the License Manager application to obtain a centralized view of Per Seat and Per Server Licenses across the organization, manage the purchasing or deleting of licenses on networks servers over which they have administrative rights, and view usage statistics per user. License tracking can be local, by domain, or across an entire organization or enterprise.

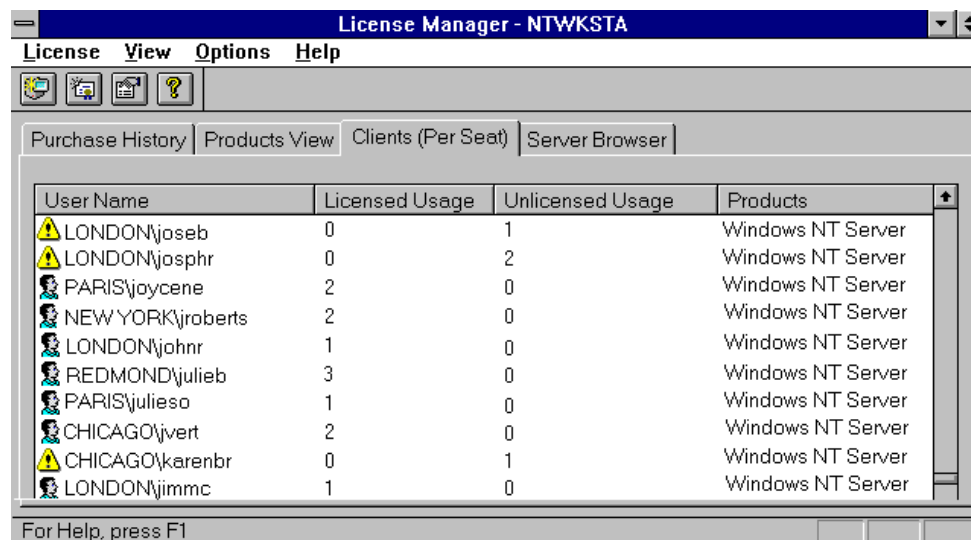
Administrators can monitor license usage and compliance through one of two views:

Products View

Products View allows the administrator to view Per Seat licensing information for all BackOffice products in the domain or enterprise including which users are using a product and how many Client Access Licenses have been allocated. When the number of licenses allocated to client computers approaches the number of Client Access Licenses that have been purchased, a warning icon appears to alert the administrator that more client access licenses may need to be purchased. Likewise, for Per Server mode, administrators can view the highest number of current connections for that server that has been reached to date. In addition, the Server Browser lists all the domains and servers in the enterprise and allows an administrator to view and edit server and server product licensing information. Representative icons precede the names to aid in easy identification of the level of reached and the licensing mode of the products.

Clients View

Administrators can also view licenses on the user level. Clients (Per Seat) view provides information on a list of clients (or users) that have used the products in that domain or enterprise.



In this picture, you see which users have accessed Windows NT Server legally and which have done so illegally. For example, jroberts of the New York domain has accessed Windows NT Server twice. The person icon that appears next to his name indicates to the administrator that jroberts is properly licensed to access Windows NT Server. Also included in this view are several individuals who have accessed Windows NT Server without the proper license. For example, joseb of the London domain has accessed Windows NT Server once without a license. The warning sign that appears next to his name indicates to the administrator that joseb is in violation of the licensing agreement. The administrator can rectify this violation simply by purchasing another client access license for joseb and increasing the licensed users for Windows NT Server accordingly.

While in this screen, you can also add new Client Access Licenses. To add a Client Access License, the administrator merely needs to click on the second of the four icons, titled New License. A dialogue box will appear called Add a New Client Access License. Simply scroll through the products list until you find the product you want to access the user for, highlight it, and then increase the number of licenses for that particular product. However, simply performing this task does not mean that the user is licensed to use that particular product. A Client Access License for that product must still be purchased from Microsoft. What this task allows the user to do is access the product without forcing the administrator to be in violation of Windows NT Server's License Manager.

Cuse

While in this screen, you can also do the following activities:

-
- Open the sele
- View or edit existing lice

- Refresh the screen display to update the second of the four icons, titled New License. You find the product you want to access the user for, highlight it, and then increase the number of licenses for that particular product. However, simply use the License Manager.

Replication

Licensing information can be tracked by local server, domain or enterprise. Administrators can designate a server to which all licensing information will be replicated, called the Master Server. They can also set how frequently replication will occur from a minimum of every 6 hours to every 72 hours.

- Purchase History – This tool provides an historical overview of licenses purchased and deleted to date. You can add new licenses from this screen.
- Products View – Products View contains licensing information on BackOffice products in the domain or the entire enterprise. This screen shows, for Per Seat Mode, how many licenses have been purchased for those products and how many licenses have been allocated to users' computers for all products. For Per Server mode, it shows the total number of licenses that have been purchased for each product on all servers in the domain or enterprise with the product on them. It also shows the maximum number of concurrent connections to date reached on those same computers. Additional views let you see individual product properties including which users are using a product and the date last used, as well as individual servers the product is installed on and the highest number of current connections for that server that has been reached to date.
- Clients (Per Seat) – This tool provides information on a list of clients that have accessed the product in that domain or enterprise. It also shows the list of products they are licensed to use, as well as those they have used without a license.

In addition, the Server Browser lists all the domains and servers in the enterprise and allows an administrator to view and edit server and server product licensing information. Representative icons precede the names to aid in easy identification of the level reached and the licensing mode of the products.

- During installation, the administrator is asked to choose the licensing mode. If you choose the Per Server mode, you will be asked to enter a number that should be able to concurrently connect to that server.*
- To increase or decrease the number of concurrent connections for a server, double-click on the Licensing icon in Control Panel and type the new number of users. You can also change from Per Server to a Per Seat configuration using this tool.*

File Compression

Another new feature in Windows NT Server 3.51 is file compression capability. This feature brings mainstream file compression technology to NTFS, the Windows NT native file system. Common, text-oriented application files show approximately 50 percent reduction in size, while executables are approximately 40 percent smaller than their original size.

Files can be compressed and uncompressed on NTFS partitions in three different ways using File Manager:

1. You can select the file(s) and then select Compress or Uncompress from the File menu.
2. You can select or deselect the Compressed check box in the Attributes box of the Properties dialog box. Compression is an attribute that can be set just as the Read Only, Archive, Hidden, and System attributes can be set.
3. You can also select the Properties option to view the compressed size and compression ratio of a selected file.

You can compress or uncompress one file, several files, directories, and sub-directories. However, directories and sub-directories are not actually compressed. When you elect to compress a directory or sub-directory, you are indicating that you want any files added to the directory or sub-directory after you have compressed it to be compressed automatically. With its high-performance, incremental, read-ahead design, compression shows negligible impact on applications which read from the file system. Performance is roughly twice that of DoubleSpace for these tasks. Files do

not have to be individually decompressed and then opened for editing, as with other file servers' technology. NTFS makes this fact transparent to the user and application. Users can exploit the flexibility of the system by compressing their application directories as well as those files they access less frequently instead of archiving them.

Update to Network Client Administrator for Windows 95

Building and connecting clients to a new network is made easy with the Network Client Administrator that is built into Windows NT Server. The Network Client Administrator is automatically installed in the Program Manager's Network Administration group during the Windows NT Server installation. This utility enables an administrator to install the programs and tools contained on the Windows NT Server CD-ROM quickly. With Windows NT Server 3.5, administrators could create a set up disk from the server, install that disk in a client machine, and bootstrap on to the server to download Windows for Workgroups 3.11. Windows NT Server 3.51 extends this functionality to include Windows 95 when it becomes available.

Prior to using the Network Client Administrator, you first need to copy the directory \CLIENTS to Windows NT Server. Next, place the Windows 95 CD in the CD ROM drive and execute a batch script that will automatically copy files from the Windows 95 CD ROM (in the \WIN95 directory) to your Windows NT Server installation (in the \CLIENTS directory).

To add Windows 95 installation files to your Windows NT Server 3.51 \CLIENTS directory, follow these steps:

- Execute INSTALL.CMD located on your Windows NT Server 3.51 \CLIENTS\SUPPORT directory.
- With the INSTALL.CMD batch script, be sure to use \WIN95 (from your Windows 95 CD ROM) as the source directory and \CLIENTS (from your Windows NT Server 3.51 installation) as the target directory.
- The syntax is as follows: `install sourcedrive:\Win95 targetdrive:\Clients`

Once you have successfully executed the INSTALL.CMD batch script, you can use the Network Client Administrator to create a Network Client diskette for Windows 95. Follow the same steps required to create a Network Client diskette for Windows for Workgroups 3.11. For information on this procedure, see *Creating a Network Installation Startup Disk* in the *Installation Guide* in the Microsoft Windows NT Server documentation.

Windows NT Server 3.5 Features

Performance Improvements

One of the primary efforts of the Windows NT Server development team has been to reduce memory usage and improve system performance. As a result, this version of Windows NT Server uses less memory and is dramatically faster.

Microsoft's internal testing has shown the following:

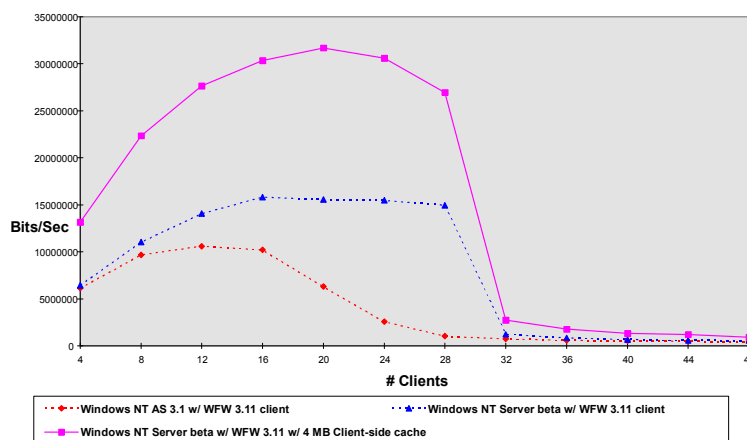
- The size of the working set needed by Windows NT Server has been reduced by 4 to 6 megabytes. This means that the operating system is functioning more efficiently in the same amount of system memory.
- On server systems with comparable configurations, this version of Windows NT Server completes many test scenarios 20 to 30 percent faster than version 3.1.

These improvements are most evident when using Windows NT Server's preferred client, Windows for Workgroups. Windows for Workgroups 3.11 supports the 32-bit protected mode networking components used to communicate with the Windows NT Server. These networking components include 32-bit network protocols such as NetBEUI and an IPX/SPX compatible transport, as well as a 32-bit protected mode network redirector. If an NDIS 3 network card driver is available for your network adapter card, the use of the 32-bit network card driver provides a 32-bit code path from the network card to the network redirector resulting in improved performance over MS-DOS-based solutions, while consuming only 4-KB of conventional memory.

Windows for Workgroups 3.11 also supports the use of a client-side cache. A new feature in Windows for Workgroups 3.11 called "32-bit File Access" provides a 32-bit protected-mode replacement for the MS-DOS-based SmartDrive disk cache program. The caching routines provided as part of 32-bit File Access differ from that offered by SmartDrive in the following ways:

- 32-bit File Access caching routines are implemented as 32-bit protected-mode code, thus reducing the need to transition to real mode to cache disk information.
- 32-bit File Access read-ahead routines work on a per-file basis rather than on a per-sector basis, resulting in a higher probability that information read into the disk cache will be used.
- 32-bit File Access caching routines share cache memory with the protected-mode network redirector (VREDIR.386), thus reducing the memory overhead for maintaining multiple cache buffers.

Use of this cache for many real-world activities greatly increases speed, as seen in the Netbench test below.



As you can see, Windows NT Server 3.51 is much faster than Windows NT Advanced Server 3.1. You can also see that using a client-side cache can result in substantially better performance. The 4-MB cache represents the recommended size for Windows for Workgroups machines that have 12-MB or more of physical memory. The combination of performance improvements and reductions in hardware pricing makes Windows NT Server even more cost-effective to deploy as a network operating system.

- ✓ *If you do any testing, please use Windows for Workgroups 3.11 as the client and make sure that 32-bit File Access is enabled. To turn on 32-bit File Access, double-click the 386 enhanced icon in the Control Panel, and choose the Virtual Memory button. The disk status section of this dialog box should show that it is using both 32-bit Disk Access and 32-bit File Access. If not, change it using the Change>> button.*
- ✓ *We recommend that you test both LAN protocols (like IPX or NetBEUI) and WAN protocols (like TCP/IP) When comparing Windows NT Server performance against NetWare, we'd recommend comparing our performance using IPX against NetWare's performance with the same protocol, and the same apples-to-apples comparison with TCP/IP.*

Effect of Multiple Processors on Performance

There has been some confusion in the marketplace regarding the ability of Windows NT Server and Microsoft SQL Server for Windows NT to scale well on multiple processors. Some vendors who have not released any multi-processing support have made claims that Windows NT Server does not scale well. Furthermore, they claim that their forthcoming products will scale much better—a claim that is unproven and difficult to disprove.

Windows NT Server provides thread scheduling that allows dynamic load balancing across multiple CPUs. Customers can purchase the retail version of Windows NT Server that supports up to four processors. If a customer wants a system that supports more than four processors, that customer should contact a Hardware Manufacturer to purchase the Windows NT Server version that is optimized for his or her particular hardware platform needs and can scale to more than four processors. *No operating system, however, provides application performance that increases linearly by a factor of the number of CPUs installed.* There are several reasons for this, including hardware designs, the application itself, performance limits caused by physical input and output, and the overhead associated with the operating system's management of multiple CPUs.

What Makes a System Scaleable

Scalability depends on the overall architecture of the entire application server. The three critical components of a scaleable system are:

- Operating system
- Application software
- Hardware

No one element by itself is sufficient to guarantee scalability. High performance server hardware is designed to scale to multiple processors, providing specific functionality to ease disk and memory bottlenecks. Applications and operating systems in turn must be able to take advantage of multiple CPUs. All three components are equally important.

Operating System

A well-designed server operating system can exploit properly designed and configured multiprocessing servers. The architecture of the operating system should provide applications portability across processor types, multiprocessor architectures, and advanced I/O devices.

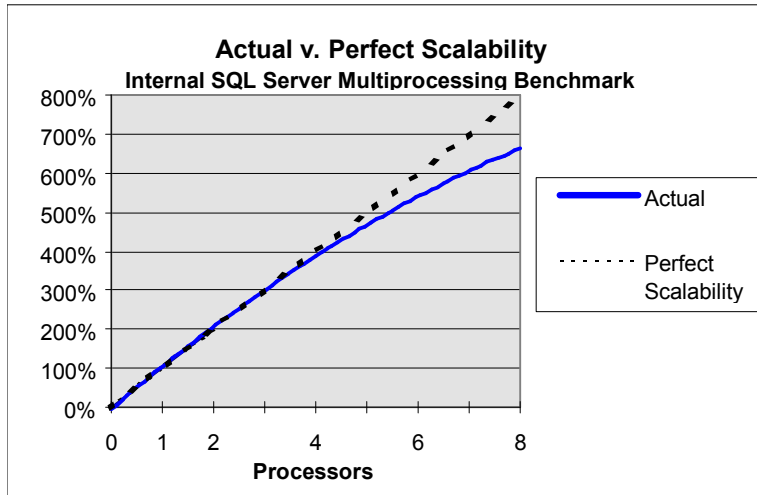
Windows NT Server's Symmetric Multiprocessing Architecture

Microsoft invested considerable time and effort in Windows NT Server's SMP technology. Windows NT Server's ability to run on machines with up to 32 processors is one of the operating system's most important features. It is fundamental to the design of the kernel. The technology necessary to achieve genuine, load balancing symmetric multiprocessing is intrinsic to all components of Windows NT Server. It is not something that could have been "added on" later. This is important to note when evaluating multiprocessing operating systems. When SMP is not integrated into the basic design of an operating system, its implementation is inherently limited. In addition, Microsoft collaborated with many vendors that supply multi-processor hardware to provide full optimization of Windows NT Server and its associated applications.

Operating System Architecture

The critical distinction of Windows NT Server's architecture is that access to key system resources is dynamically and equally parceled out. A small number of worker tasks or threads service the queue of incoming user requests with

dynamic load balancing across CPUs and high performance access to protected virtual memory space and network I/O. The result is that well designed applications enjoy excellent scalability on Windows NT Server. Microsoft SQL Server's unique Symmetric Server Architecture was engineered to take optimum advantage of the native multiprocessing capabilities for Windows NT Server. The graph below demonstrates the scalability of Microsoft SQL Server 4.21a in a 50 user test on an NCR® 3550 Pentium server. Notice the scalability of SQL Server in a high-volume OLTP environment with up to 8 Pentium processors.



The Network Client Administrator

The Network Client Administrator enables you to install the the rams and tools contained on the Windows NT Server CD quickly. The Network Client Administrator is automatically installed in Program Manager's Network Administration group during the Windows NT Server installation.

The Windows NT Server compact disc (CD) contains the following types of client installation files:

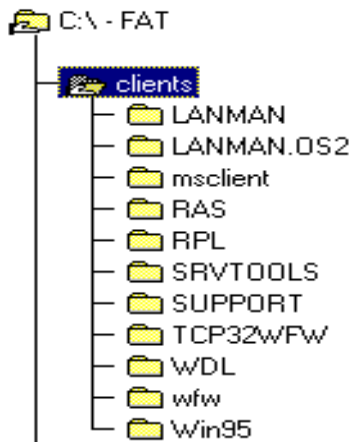
- Microsoft Windows for Workgroups 3.11.
- Microsoft Network Client for MS-DOS 3.0.
- Microsoft LAN Manager for MS-DOS 2.2c.
- Microsoft LAN Manager for MS OS/2 2.2c.
- Client-based network administration tools.
- Microsoft RAS for MS-DOS 1.1a.
- Microsoft TCP/IP-32 for Windows for Workgroups 3.11.
- Microsoft Windows 95.

The Network Client Administrator enables you to quickly install the programs and tools contained on the Windows NT Server CD. The Network Client Administrator is automatically installed in Program Manager's Network Administration group during the Windows NT Server installation.

With the Network Client Administrator, you have the following options:

- The installation files on the Windows NT Server CD can be put on a shared directory.
- The Network Client Administrator can create the following directory structure on a network server, and then copy the installation files located on the Windows NT Server CD to the network server.

The installation files on the Windows NT Server CD can be put on a shared directory.



Application and File Server Optimization

Windows NT allows you to adjust the relationship between memory allocated to network connections and memory allocated to applications running on your computer.

The following optimization options are available to set the desired system performance for either file sharing or distributed applications execution.

- Maximize Throughput for File Sharing. This option allocates maximum memory for file sharing applications. The setting is best for computers running Windows NT Servers on a large network.
- Maximize Throughput for Network Applications. This is used to optimize server memory for distributed applications that handle their own memory caching, such as Microsoft SQL Server.

These options can be found in the Control Panel. Using the Network icon, in the Installed Network Software list, choose Server and select Configure. You will see a dialog displaying a list of optimization options, including the two listed above.

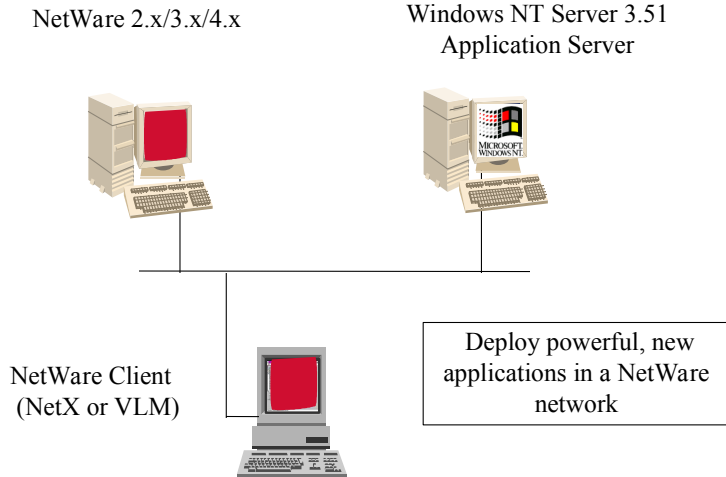
Services for NetWare in Windows NT Server

Microsoft's networking strategy is to allow any desktop computer to access any server. Users get their client of choice in a mixed server environment and can take advantage of a new generation of network applications that run on Windows NT Server.

The NetWare Connectivity service outlined below is available from Microsoft for Windows NT Workstation or Windows NT Server. There are also a variety of products available from third parties that provide NetWare connectivity and interoperability for Windows NT Server.

IPX Compatible Transport Stack

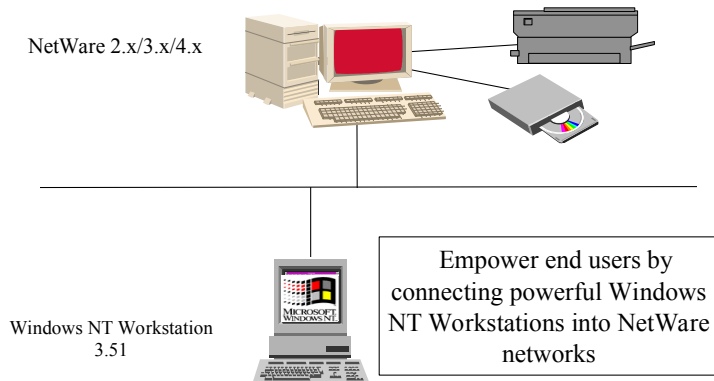
The IPX-Compatible Transport Stack makes it easy to integrate Windows NT Server into a NetWare network. Using the IPX-Compatible Transport Stack customers can deploy and access powerful Windows NT Server-based business applications, without changing their NetWare client software.



Client Service for NetWare

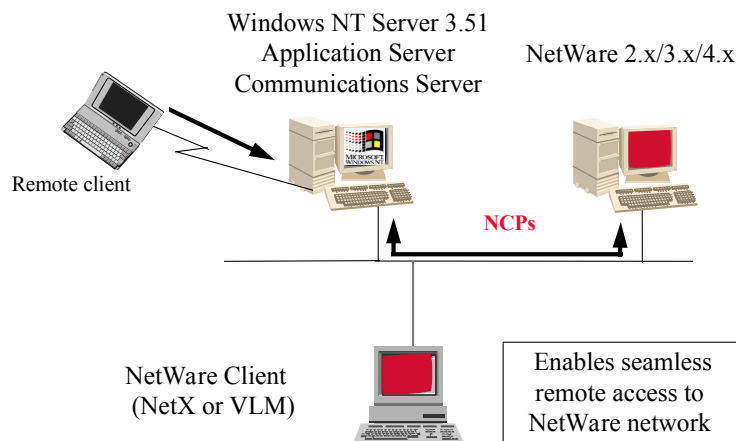
The Client Service for NetWare provides NetWare client capabilities for the Windows NT Workstation. It allows the Windows NT Workstation to connect to file and print services provided by the NetWare servers. Windows NT Workstations can store and print information on NetWare servers, and they can have access to many of the most commonly used NetWare-aware applications, such as NetWare SAA and Lotus Notes. Users who have supervisor rights will also be able to run the administrative utilities, such as Syscon and PConsole, commonly used in managing NetWare servers.

The Client Service for NetWare smoothly integrates into both the Windows NT Server and NetWare environments. It can be configured so that a single logon can provide access to the Windows NT Workstation, NetWare file and print servers, and Windows NT-based application servers.



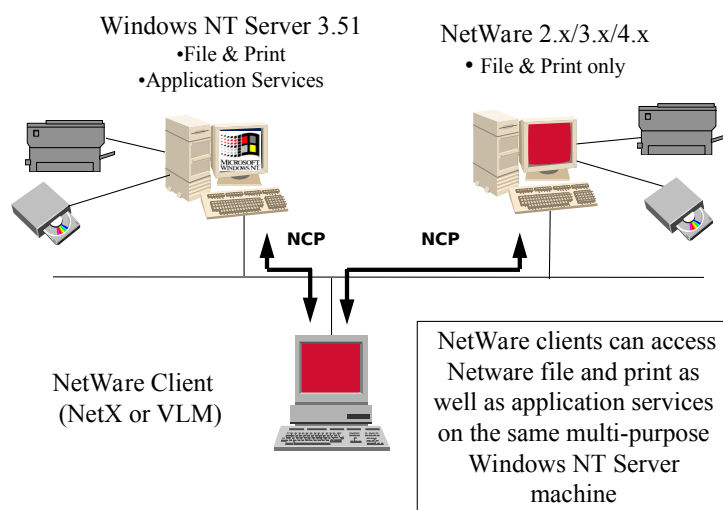
Gateway Service for NetWare

The Gateway Service for NetWare is a Windows NT Server utility that allows Windows NT Server to act as a gateway to a NetWare network. With the Gateway Service for NetWare, customers can deploy Windows NT Server as a communications server and enable their remote users to have access to the NetWare LAN. The Gateway Service for NetWare also allows NetWare customers to deploy the protocol of their choice on the desktop, while still retaining access to the NetWare LAN. Customers can hence choose to gradually deploy TCP/IP as their strategic protocol while eliminating the cost associated with a rip-and-replace approach.



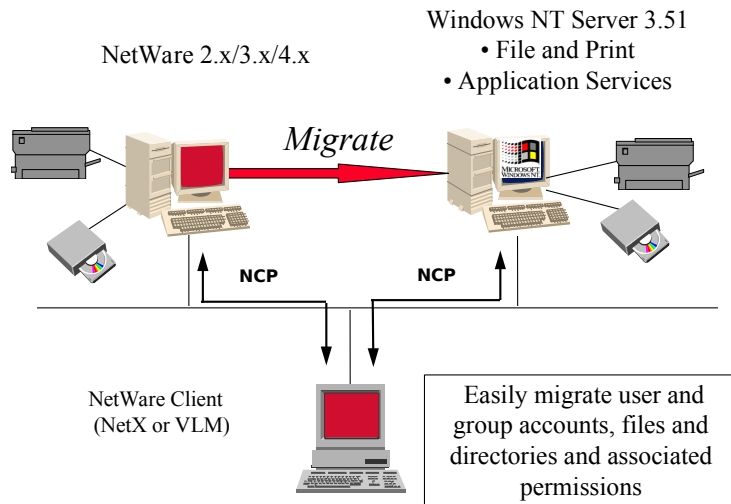
File and Print Services for NetWare

File and Print Services for NetWare is a Windows NT Server utility that makes Windows NT Server look like a NetWare 3.12 compatible file and print server. With File and Print Services for NetWare, customers can deploy basic NetWare file and print services plus powerful, advanced business applications on the same Windows NT Server-based machine, without changing their client software. NetWare customers can therefore integrate Windows NT Servers without incurring the expensive operation of reconfiguring the desktop and the network.



Migration Tool for NetWare

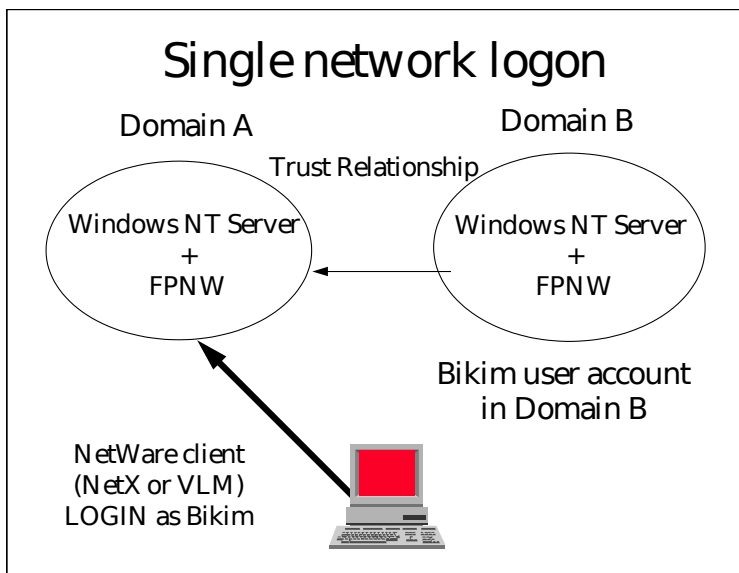
The Migration Tool for NetWare is a Windows NT Server utility that automatically migrates NetWare user and group accounts, login scripts, files and directories, and security and permissions to Windows NT Server. By automatically migrating these components, administrators can save the time, effort and cost of recreating them manually while upgrading to Windows NT Server.



Deploying Windows NT Server Directory Services for NetWare Clients

By using Windows NT Server Directory Services, end users can have a single network logon to the various resources within the enterprise. The Windows NT Server Directory Service allows replication of the directory so that end users can always login to the network, even when a server may not be running. Windows NT Server Directory Services also enables centralized management of the enterprise from one console.

- Set up two Windows NT Server-based machines running File and Print Services for NetWare in Domain A. Note: there is no need to manually synchronize the passwords of the File and Print Services on the two different Windows NT Server-based machines. The Windows NT directory replication will automatically enable password synchronization.
- Set up two Windows NT Server-based machines running File and Print Services for NetWare in two different domains, Domain A and Domain B. Establish a uni-directional trust relationship from Domain B to Domain A. Establish an end-user account in Domain B but not in Domain A. A NetWare client can now login to the Windows NT Server-based machine in Domain A. Also, establish that the NetWare client can login to Domain B.



Testing Network Interoperability

Installing and testing the Client Service for NetWare is covered in the Windows NT Workstation reviewers guide. Configuring the Gateway Services for NetWare is covered in the Installation Guide for Windows NT Server. We recommend that you test the file gateway capabilities as well as the print gateway.

In order to test interoperability of Windows NT Server with Novell NetWare, we recommend that you try each of the scenarios diagrammed above.

In particular we recommend that you:

- Set up Windows NT Server as an application server with Microsoft SQL Server, using the NWLink protocol.
- Install the Client Services for NetWare on a Windows NT Workstation and test its functionality as a NetWare client.
- Install the IPX/SPX transport protocol on both a workstation and the server and test its functionality in a routed environment.
- Set up the Gateway Services for NetWare on Windows NT Server and test its effectiveness.

- ✓ *Install Microsoft SQL Server with the NWLink protocol on a Windows NT Server in a NetWare environment. Ensure that the NetWare clients can access SQL Server.*
- ✓ *Install File and Print Services for NetWare and access the SQL Server database on Windows NT Server using a Windows for Workgroup desktop machine running NetWare client software (NetX or VLM).*
- ✓ *Install Client Service for NetWare on a Windows NT Workstation and test its functionality as a NetWare client. Test some of the NetWare management utilities such as Syscon, PConsole, etc. Also test performance features such as Large Internet Packet (LIP) and Packet Burst (PBURST).*
- ✓ *Use IPX/SPX as the native transport protocol for Windows NT Server. Check its functionality with routers that are set up to route IPX/SPX traffic.*
- ✓ *Set up Gateway Service for NetWare and share NetWare resources to workstations running either TCP/IP or NetBEUI.*
- ✓ *Test the functionality of the Migration Tool for NetWare by converting a NetWare 3.11 server to Windows NT Server.*

Services for Macintosh

Microsoft Windows NT Server Services for Macintosh® is a thoroughly integrated component of Microsoft Windows NT Server, making it possible for PC and Apple® Macintosh clients to share files and printers.

When you install Windows NT Server, you can choose to set up Services for Macintosh and other components, such as Microsoft Windows NT Server Remote Access Service, or you can set up these components later. Once Services for Macintosh is set up, a computer running Windows NT Server can also function as an AppleTalk® router. Routing capability is supported for AppleTalk Phase 2.

With Services for Macintosh, Macintoshes need only the Macintosh operating system software to function as clients; no additional software is required. You can, however, set up the optional user authentication module, which is software that provides a secure logon to the Windows NT Server.

Services for Macintosh Features in This Version

Version 1.0 of LAN Manager Services for Macintosh made it possible for a LAN Manager server to share files and printers with Macintosh clients. This meant that both PC and Macintosh clients could share resources on the same network. This version of Services for Macintosh does that and more. Version 3.5 uses the capabilities of Windows NT Server, which include built-in networking services for multiple-domain networks of MS-DOS® – based, Windows – based, and OS/2 clients. Version 3.5 includes these features:

- Increased performance because of better resource use.
- Secured logon, which provides added protection from network "sniffers." (Sniffers can detect cleartext passwords.)
- Easy-to-use graphical administration tools that are fully integrated into the Windows NT Server File Manager, Print Manager, and Server Manager.
- Printing to non-PostScript® printers.
- Increased number of clients that can be simultaneously connected to the server.
- Compatibility with all the computers that can run Windows NT Server, including 80386, 80486, MIPS®, Pentium™, Alpha AXP™, and multiprocessor systems.
- Support of AppleTalk Phase 2, which is available for routers and networking protocols. (AppleTalk Phase 1 is not supported in this version of Services for Macintosh.)

Moreover, a conversion utility is included to make it easier to upgrade from version 1.0 to version 3.5 of Services for Macintosh (version 3.1 requires no modifications). Information about installing services for Macintosh on a Windows

NT Server can be found in Chapter 7 of the Windows NT Server Installation Guide. For more information about Services for Macintosh see *Services for Macintosh* in the on-line documentation for Windows NT Server, version 3.51.

When you install Services for Macintosh, an NTFS partition is necessary to store Macintosh files. If there is not an NTFS partition, Services for Macintosh may still be installed, but only print services will be available.

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NTFS
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Services

for Macintosh may still be, but only print services will be available. TCP/IP Improvements

New TCP/IP Stack

Microsoft has been committed to TCP/IP for a number of years. In 1991, we shipped our first TCP/IP stack for Microsoft LAN Manager 2.1. In 1992, we shipped some enhancements to this stack in LAN Manager 2.2 that improved TCP/IP's functionality in routed environments. In 1993, we shipped TCP/IP for Windows for Workgroups 3.1 and for Windows NT and Windows NT Advanced Server. Microsoft also shipped basic connectivity utilities including: ftp, tftp, telnet, r* commands, arp, route, and finger.

Microsoft was one of the leaders in establishing a public sockets interface for Windows. Windows Sockets is an open specification that defines a Windows programming interface to network protocols. It is also part of the Microsoft Windows Open Services Architecture (WOSA). It enables any compliant TCP/IP stack to host any Windows Sockets compatible application. It offers a familiar interface to UNIX network programmers plus Windows-based extensions, and it has quickly become a standard method for developers writing Windows applications to do remote procedure calls, particularly to TCP/IP, but also over IPX and NetBEUI.

Also in 1993, Microsoft established its own Internet FTP server, running on an unmodified Windows NT Server 3.5. Currently, an average of 25,000 users connect to this server every week, downloading a total of 75,000 files per week.

Dynamic Host Configuration Protocol (DHCP)

Assigning and maintaining IP address information is a tremendous burden for network administrators in today's dynamic workplace. Contributing to this burden is the problem that many users do not have the knowledge necessary to configure their own computers for internetworking and must therefore rely on their administrators.

The Dynamic Host Configuration Protocol (DHCP) was established to relieve this administrative burden. DHCP provides safe, reliable, and simple TCP/IP network configuration; ensures that address conflicts do not occur; and helps conserve the use of IP addresses through centralized management of address allocation. DHCP offers dynamic configuration of IP addresses for computers, plus the ability to associate duration leases with assigned addresses. DHCP also provides for Internet configuration of certain diskless workstations.

As an example of how maintenance tasks are made easy with DHCP, suppose a DHCP client computer is removed from a subnet automatically releases its IP address. A new address for the new subnet is automatically assigned when that computer reconnects on another subnet. Neither the user nor the network administrator needs to intervene to supply new configuration information.

DHCP is based on an Internet Engineering Task Force (IETF) standard. The IETF designed the DHCP protocol to alleviate the network administrator's configuration burden when deploying TCP/IP in internetworks. DHCP centralizes TCP/IP network configuration, manages the allocation of IP addresses, and automates much of the configuration process. DHCP was designed as an extension of the useful bootstrap protocol (BOOTP) already used to configure systems across internetworks.

Windows Internet Name Service (WINS)

Configuring a machine with TCP/IP requires the computer name and an IP address, which are unique identifiers for the computer on the network. Computers use IP addresses to identify each other, but users usually find it easier to work with computer names. A mechanism must be available on a TCP/IP network to resolve names to IP addresses. A Windows for Workgroups or Windows NT-based computer can use one or more of the following methods to ensure accurate name resolution in TCP/IP internetworks:

■ **Windows Internet Name Service (WINS)**

Windows for Workgroups and Windows NT-based computers can use the Windows Internet Name Service if one or more servers are available. WINS provides a distributed database for registering and querying dynamic computer name-to-IP address mappings in a routed network environment. It is the first choice for name resolution because it reduces the use of local broadcasts for name resolution and it is dynamically updated. For example, when dynamic addressing through DHCP results in a new IP address for a particular computer, the changes are automatically updated to WINS. Neither the user nor the administrator needs to manually update the database.

■ **Broadcast name resolution**

Windows for Workgroups and Windows NT-based computers can use broadcast name resolution, as defined by the b-node protocol in RFCs 1001 and 1002.

■ **DNS name resolution**

The Domain Name System (DNS) provides a way to look up name mappings when connecting a computer to foreign hosts using Windows Sockets applications such as FTP. DNS is a distributed database designed to relieve the traffic problems that arose with the exploding growth of the Internet in the early 1980s.

■ **An LMHOSTS file to specify computer name and IP address mappings**

The HOSTS and LMHOSTS files on a local computer contain lists of known IP addresses mapped with corresponding computer names. This method of name resolution was the predecessor to WINS. It is still used in Windows NT for small-scale networks or remote subnets where WINS is not available. The drawback to this method is that it is not dynamic and must be manually maintained by an administrator.

We recommend that you test WINS in conjunction with DHCP. If a Windows NT Server is also DHCP-enabled, then the computer will automatically be configured with WINS server information. More information about installing and configuring WINS is contained in chapter 5 of the TCP/IP manual.

Installing the TCP/IP Stack

If you did not install TCP/IP during the initial installation, go to the Control Panel and select Networks. From the Network Settings dialog box, click on the Add Software button, then select TCP/IP Protocol and related components. In addition to the protocol and basic connectivity utilities, you may also choose to install the SNMP service (which allows your computer to be administered remotely from an SNMP network management console), TCP/IP network printing support and the FTP server service.

Note: if you choose the SNMP service, you will be presented with the SNMP Service configuration dialog; the easiest choice is to click OK. You may, however, add community names in this dialog.

Note: if you choose the FTP Server service, you will be asked to configure the maximum number of users, specify the home directory, and decide whether to allow anonymous connections. Again, you can click OK to accept the defaults.

You will be prompted for your IP address and subnet mask. If you are installing a DHCP server, you will need to specify an IP address and subnet mask. If you are installing a client or a server that will not function as a DHCP server, check the box enabling DHCP. The IP address and subnet mask will be assigned dynamically.

Installing a DHCP Server

Installing a DHCP Server is covered in the release notes (p. 49), which supersede Chapter 4 of the TCP/IP manual. After installing it and rebooting, you will also have to start the DHCP service. You can do this either in the Control Panel through the services icon or in the Server Manager by choosing services from the computer menu.

Enabling DHCP at a Client

Enabling DHCP at a client is covered in Chapter 2 of the TCP/IP manual. Make sure that the Enable Automatic DHCP configuration option is checked either during installation of TCP/IP or during configuration of TCP/IP at the client.

Installing a WINS Server

Installing a WINS Server is covered in the release notes, which supersede Chapter 5 of the TCP/IP manual. Generally, you will have installed it at the same time that you installed DHCP. Configuration of a WINS server is described beginning on page 113-114 of the TCP/IP manual.

Testing DHCP, WINS, and the New TCP/IP Stack

- Begin by installing a DHCP Server as outlined above. If a Windows NT Server is DHCP-enabled, then the computer will automatically be configured with WINS server information.
- Next, enable DHCP at a client. If the client logs onto the network and is able to access files on the server, then DHCP worked, dynamically assigning the IP address. To find out information about the IP address assigned, enter the command "IPCONFIG" at the command line. You can also view information about the client lease using the DHCP manager tool. From the Scope menu, choose Active Leases.
- To test WINS, browse a network of TCP/IP-configured servers. Note that you can browse them by name, rather than by IP address. To view the WINS database, use the WINS manager tool. From the Mappings menu, choose the Show Database command.

Other Network Connectivity

In addition to the improvements made in the TCP/IP connectivity and the release of the Microsoft Compatible Workstation Service, a number of advanced connectivity products have been released for Windows NT from third-party vendors.

Banyan Vines

A redirector that allows a Windows NT Workstation-based computer to function as a client on a Banyan® VINES® network is available from Banyan. Banyan can be reached at (800) 2BA-NYAN. The redirector is available via the Banyan VINES BBS at (508) 836-1834.

DEC® Pathworks

Digital Equipment has released Pathworks™ for Windows NT.

NFS - Network File System

Intergraph has announced the release of its NFS connectivity services for both client and server functionality. This version of the NFS product is licensed and co-developed with SunSoft. There are other NFS products that are available from vendors such as NetManage and Intergraph. NetManage can be reached at (408) 973-7171. Intergraph can be reached at 205-730-6112. The contact at Intergraph is John Allen.

Other UNIX Connectivity

Beyond TCP/IP and NFS connectivity, another common UNIX networking standard is X-Windows. At this time, at least five vendors—DEC, AGE Logic, Hummingbird, Intergraph, and VisionWare—have released their X-server products.

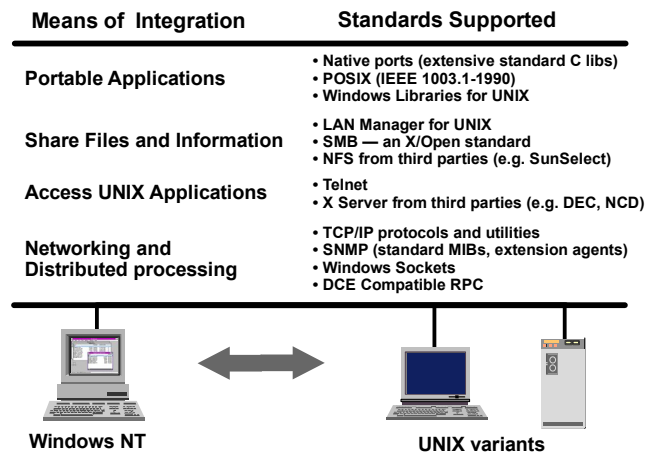
- To test these connectivity products, you will need to contact the vendors directly.

UNIX Interoperability

Integration with UNIX is important to a number of customers. Microsoft is committed to support for widely available, industry-standard communication capabilities in its operating systems. Many important, standards-based interoperability capabilities, such as support for TCP/IP, are built into Windows NT. Independent software vendors (ISVs) are also providing a rich selection of third-party interoperability tools.

Windows NT Server fits well into environments that contain UNIX-based systems through:

- Common, standard networking protocols (including TCP/IP).
- Character and graphical terminal support.
- Standards-based distributed processing support.
- Standards-based file systems and data sharing.
- Easy application portability.



Common, Standard Networking Protocols

At the most basic level, Windows NT Server includes communication protocol support, network utilities, and APIs that allow Windows NT Server to communicate with most UNIX variants:

- **TCP/IP** - Windows NT Server has TCP/IP support built in, so Windows NT Server can communicate “right out of the box” with most UNIX variants. The core TCP/IP protocols provided include the user datagram protocol (UDP), address resolution protocol (ARP), and Internet control message protocol (ICMP).
- **TCP/IP utilities** - More than a dozen basic network utilities are included with Windows NT products, including utilities that provide terminal access to, or file transfer capabilities to and from, most UNIX-based systems. The basic TCP/IP connectivity applications include finger, ftp, rcp, rexec, rsh, telnet, and tftp. TCP/IP diagnostic utilities provided include arp, hostname, ipconfig, nbstat, netstat, ping, and route.
- **SNMP support** - Windows NT Server provides several facilities for integrating Windows NT-based systems into networks that employ Simple Network Management Protocol (SNMP), a common TCP/IP-based network management facility. This component allows a Windows NT Server to be administered remotely using management tools such as SUN® Net Manager or HP® OpenView.

Character and Graphical Terminal Support

Although designed to support sophisticated client-server computing, Windows NT Workstation can also host a variety of terminal emulation capabilities for easy integration with UNIX-based hosts.

- Telnet and third-party terminal emulators—Basic character-oriented terminal access via *telnet* is included with Windows NT and integrated with the Windows Terminal applet. There are also a variety of terminal emulators with more advanced features available from third parties.
- X servers available—X servers are available from a variety of third parties to allow users of Windows NT Workstation to access and run existing X-based applications on their UNIX-variant hosts.

Standards-based Distributed Processing Support

- Windows NT Server includes powerful application programming interfaces (API's) to support computing in a distributed environment.
- DCE-interoperable RPC—Remote Procedure Calls (RPCs) are a critical component needed to build distributed applications. The RPC built into Windows NT Server is interoperable with the Open Software Foundation's Distributed Computing Environment (DCE) RPC. Using this RPC, customers can build distributed applications that include not just other Windows NT-based systems, but *any* system that supports DCE compatible RPCs — including systems from DEC, HP, and other vendors.
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- Windows Sockets—Windows Sockets is an API compatible with Berkeley-style sockets, a popular distributed computing mechanism among UNIX variants. Windows Sockets enables customers to build applications that interoperate with any other system that supports this industry-standard API.

- Windows Open Services Architecture (WOSA)—Microsoft is leading the industry(which industry?) in the development of the Windows Open Services Architecture (WOSA), a set of open APIs for integrating Windows platforms with a broad range of back-end services from multiple vendors running on multiple back-end systems.

Standards-based File Systems and Data Sharing

- LAN Manager for UNIX (LMU)—LMU is an implementation of Microsoft Windows networking for servers that run UNIX variants. LMU allows Microsoft network clients to access data stored on UNIX hosts (including data on remotely mountable UNIX file systems such as NFS, RFS, and AFS). LMU is based on Server Message Blocks (SMBs), a set of protocols developed by Microsoft that are now an X/Open standard.
- Network File System (NFS)—Sun's NFS is a popular tool for sharing files among different UNIX operating systems, and is available for Windows NT Server from several third parties (including SunSelect).
- File Transfer Protocol (FTP)—Microsoft has also developed client and server versions of FTP for Windows NT Server. FTP is a popular TCP/IP-based utility that allows users to copy files among diverse systems (including UNIX and non-UNIX systems).

Easy Application Portability

- Native application ports—Thousands of 32-bit applications are being developed for Windows NT, including large numbers of applications first developed for UNIX variants, VMS, or MVS. (Approximately 25 percent of the applications being developed for Windows NT are ports from these other platforms.) Many UNIX ISVs are porting their high-end technical and business applications to Windows NT.
- POSIX—The IEEE 1003.1-1990 standard (usually referred to as POSIX.1) specifies a set of API's that describe an interface between applications and an operating system. Windows NT Server includes a protected subsystem that provides full support for POSIX.1.
- Windows Libraries for UNIX—Microsoft has licensed Windows source code, test suites, trademark, and logo to Locus Computer Corporation, MainSoft Corporation, and Insignia Solutions. These companies will bring products to market that allow Windows-based applications to run on all major implementations of the UNIX operating system, including Solaris SunOS, UNIXWare, SCO UNIX, AIX, and HP-UX. These agreements make the Windows API a universal standard for both the Intel® x86 and RISC-based UNIX platforms and help ensure that customers can take advantage of evolving 32-bit Windows technology in both their operating systems and application development.

SNA Networks

Microsoft provides connectivity to the IBM mainframe and IBM AS/400® through the Microsoft SNA Server. SNA Server is a communication gateway that allows a desktop computer to access both the local area network (LAN) and an IBM host without requiring dual network cards or dual protocol stacks. The result is cost savings in RAM requirements and hardware.

SNA Server provides IBM host access that is easy to set up, use, and maintain. It offers a complete solution for transparent access to IBM hosts for LAN-based desktops while providing administrators with flexibility and the ability to expand easily. It also takes advantage of the benefits of Windows NT Server; it is completely integrated with Windows NT Server's security (designed to be C-2 secure), which ensures only authorized users have access to the host., And it takes advantage of Windows NT Server's portability and scalability.

SNA Server can work with any of the LAN protocols supported by Windows NT Server: IPX/SPX, TCP/IP, or NetBEUI. SNA Server also provides a number of advanced fault tolerance capabilities, most notably hot back-up and load balancing, which ensure maximum uptime for your PC users.

DLC Support

The Data Link Control (DLC) protocol isn't used as a general networking protocol in the same sense that TCP/IP, IPX/SPX, and NetBEUI are used. It is used primarily to support connection to IBM mainframes using 3270 emulators, and secondarily to provide connectivity to local-area printers that are connected directly to the network.

More information about installing and configuring DLC can be found in Chapter 3, page 69 of the Windows NT Server Installation Guide.

Improved Dial-in Support (Remote Access Service)

Remote Access Service (RAS) is a combination of two components: a server running on Windows NT Server and a client running on MS-DOS, Windows for Workgroups, or Windows NT Workstation.

Workstations connected to the network via RAS appear as if they are directly attached to the network. They can participate fully in the network, sharing files and printers, accessing databases such as SQL Server, connecting to SNA hosts via SNA Server, and communicating with colleagues via e-mail.

The transparency of network access provided by RAS makes it a useful tool for telecommuters, system administrators, and mobile workers. RAS also greatly facilitates branch office automation.

More sessions—RAS can now support up to 256 sessions, up from 64 in Windows NT Advanced Server 3.1.

PPP and SLIP—The Point to Point Protocol (PPP) is a set of industry-standard framing, authentication, and network configuration protocols that enable remote access solutions to interoperate in a multi-vendor network.

PPP support in this version of Windows NT Workstation and Windows 95 ensures that Windows-based workstations will be able to dial up to remote networks through any industry-standard PPP remote access server. It also enables Windows NT Server to receive calls from and provide network access to other vendors' remote access workstation software.

RAS allows remote users to work as if they are connected directly to the network. The RAS connection is transparent to Microsoft clients and network applications. A Windows NT RAS configuration will include the following components:

- Remote access clients – Windows NT, Windows for Workgroups, MS-DOS (with Microsoft network client software installed), and LAN Manager RAS clients can all connect to a Windows NT RAS server. Clients can also be any PPP client.
- Remote access protocols – Windows NT version 3.5 RAS servers support the PPP protocol, enabling any PPP client to use TCP/IP, IPX, or NetBEUI. Windows NT version 3.5 clients can also access the large installed base of SLIP remote access servers. The Microsoft RAS protocol allows any Microsoft RAS client to dial in.
- WAN options – Clients can dial in using standard telephone lines and a modem or modem pool. Faster links are possible using ISDN. You can also connect RAS clients to RAS servers using X.25 or an RS-232C null modem.
- Security options – Windows NT logon and domain security, support for security hosts, data encryption, and callback provide secure network access for remote clients.
- RAS servers – Windows NT Server RAS permits up to 256 remote clients to dial in. Windows NT Workstation permits one remote client to dial in. The RAS server can be configured to provide access to an entire network or restrict access to the RAS server only.
- LAN protocols – IP protocol support permits accessing a TCP/IP network, such as the global Internet. IPX protocol support enables remote clients to access NetWare servers and printers. You can also use NetBIOS applications over IPX, TCP/IP, or NetBEUI. Windows Sockets applications over TCP/IP or IPX, named pipes, Remote Procedure Call (RPC), and the LAN Manager API are supported.

RAS Compression

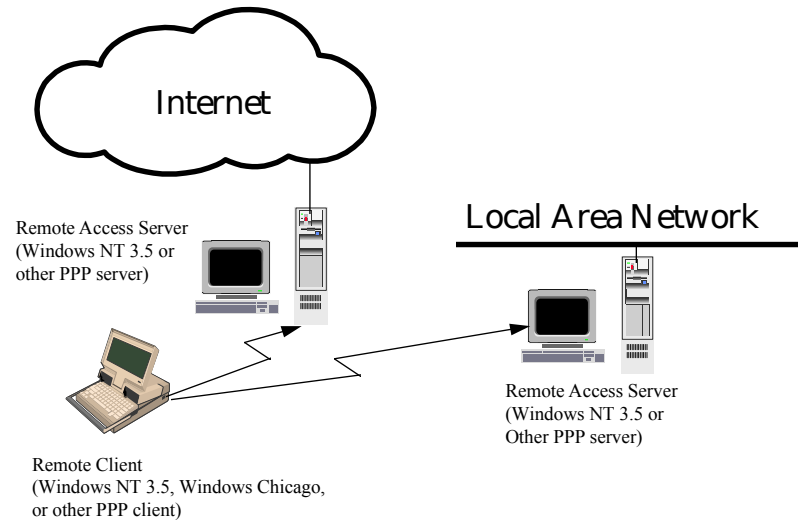
With Windows NT Server, version 3.51, support for RAS software compression between Windows for Workgroups and Windows NT has been added. With this support, you won't have to turn on modem compression to benefit from a faster throughput. Tests show that software compression results in better throughput than modem compression. Software compression also lowers the interrupt rate and diminishes the risk of overruns.

Note that the formulas used for calculating compression statistics in the Port Status dialog box are different for Windows for Workgroups 3.11 and Windows NT 3.51.

Remote Access Service in this version of Windows NT Server supports any combination of NetBEUI, TCP/IP, and IPX protocols to access remote networks. IPX support makes Windows NT Server an ideal remote access server for NetWare networks.

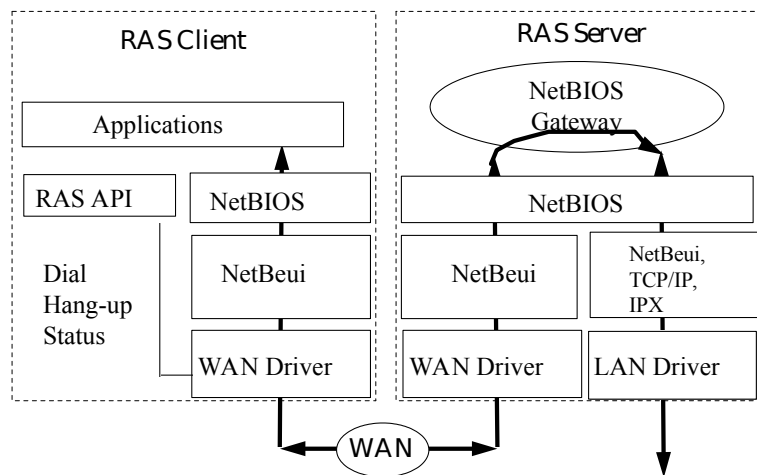
In addition to making RAS a great enterprise solution, TCP/IP support in this version of Windows NT Workstation and the upcoming release of Windows 95 make them “Internet-ready” operating systems. Users can connect to the Internet provider via RAS and access the vast resources of the Internet using any Internet browsing tool.

SLIP is similar in concept to PPP, except that it is an older standard that only addresses TCP/IP connections over serial lines. It does not provide automatic negotiation of network configuration without user intervention. It also does not support encrypted authentication. SLIP is not recommended because of its limitations, but it is available on this version of Windows NT Server for customers who already have SLIP servers installed. A SLIP server is not provided with this version of Windows NT Server.

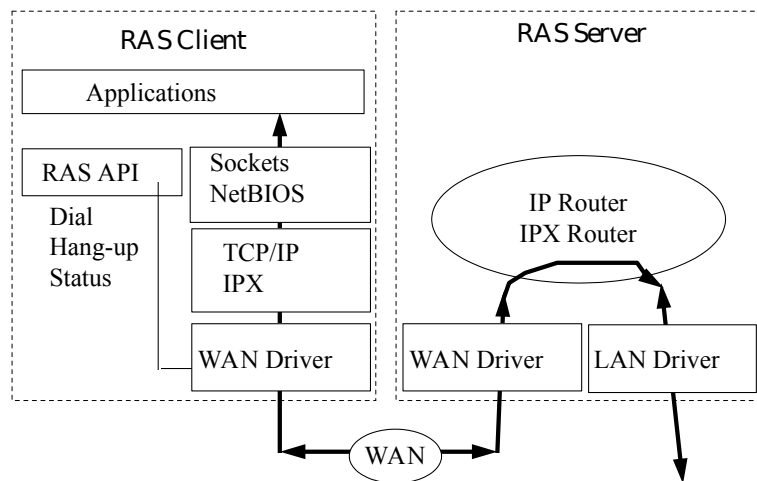


Automatic modem detection—Modem detection during setup makes installation of Remote Access Services a snap.

IP and IPX Router capability—The Windows NT 3.1 RAS server only provided a NetBIOS gateway. As shown in the diagram below, use of the NetBIOS gateway meant that remote workstations had to run the NetBEUI protocol, although they could access resources on servers that used NetBEUI, TCP/IP, or IPX as their primary protocol. In order to allow multiple protocol support, the administrator had to install TCP/IP with RFC 1001/1002 NetBIOS support or IPX with NetBIOS support on the server, in addition to NetBEUI support. The RAS NetBIOS gateway then took care of mapping data from NetBEUI on the WAN to TCP/IP, IPX, or NetBEUI on the LAN.



This version of Windows NT Server enhances the RAS architecture by adding IP and IPX router capability. This version of Windows NT Workstation and Windows 95 remote workstations can now run TCP/IP and IPX locally and run Windows Sockets applications or NetBIOS applications over their local TCP/IP and IPX protocols.



This feature significantly enhances RAS's multi-protocol support and makes it an ideal solution for NetWare and UNIX networks.

- To test RAS, begin by installing the RAS Server service. This is described in Chapter 6, page 94 of the Installation Guide. After installing Remote Access software on a server, grant Remote Access permissions to users before they try to connect through Remote Access client software. This is described on pages 94-97 of the same manual. The last step is to install and configure the client software, which is included with Windows NT Workstation and Windows for Workgroups.
- After installing the client software, test the connection by copying files and running network aware programs like email or front ends to SQL Server.

Directory Services Review

One of the benefits of a distributed system is the administrator's ability to add, remove, or relocate system components (i.e. servers and printers) easily without disrupting the services provided by other system components. Similarly, end users within an organization are regularly added, removed, and relocated. These users must continuously maintain appropriate access to system resources regardless of any changes in their location or status. Users also need to have seamless access to all of the resources available to them, no matter where within the distributed system those resources are located. Seamless access means a user can enter one username and password combination upon logon and, after being validated by the system, access files, applications, messaging, and communication services without logging on again.

In order to track and manage the many different resources and users of a distributed system, most of today's network operating systems employ *directory services*. Effective directory services provide the following capabilities:

- **Single point of administration.** By using directory services, the network operating system can be managed from an individual network location chosen by the administrator. That location may be anywhere in the network yet still provides a central view of the network. Centrality means the administrator can perform any network-wide management function from any single network location.
- **Single network logon for file and print services.** Users provide a single username and password combination and are authenticated on the network. They then have access to all the file servers and printers they have rights to access without entering additional username and password combinations.
- **Single network logon for network applications.** Similar to file and print services, each user's username and password combination grants them access to all the application, messaging, communications, and other services offered to them by the network. No additional user logons are required.

- **Replication.** A directory service guarantees that users and administrators have location-independent access to network resources and services. This is accomplished by replicating user and resource information efficiently throughout the network. As a result, services such as user authentication are performed in multiple network locations and user information is consistent in all these locations.

As the foundation for powerful, distributed systems, Windows NT Server provides directory services that simplify the management and use of a Windows NT Server-based network. These directory services are based upon the configuration and use of Windows NT Server *domains*. Domains are logical groupings of multiple Windows NT Server-based computers that allow them to be managed and used as a single unit. They are the building blocks of Windows NT Server's Directory Services. Using domains, administrators create one user account for each user. That account is stored in the Windows NT Server user account database and includes user information, group memberships, and security policy information. Users then log on to the domain, not the individual servers in the domain.

Once logged on, those users can access all the resources they have rights to access including files, directories, servers, and printers. Windows NT Server Directory Services allow the administrator to maintain one user account for each user regardless of the number of servers in the distributed system. Similarly, users log on only once to gain access to all the different files, printers, and other network resources they need to use.

Domain Configuration and Replication

Windows NT Server domains are the building blocks of Windows NT Server-based networks and the basis of Windows NT Server Directory Services. Domain configuration is a straightforward, intuitive process. An individual server is configured to be the *primary domain controller (PDC)*. The PDC contains the domain's user account database and all changes to the user account database occur on the PDC. Other servers in the domain can be configured as *backup domain controllers (BDCs)* or, simply, *servers*. BDCs contain copies of the user account database and are available to authenticate users when they log on to the domain. BDCs also provide authentication fault tolerance. If the PDC is down for any reason, BDCs are available to authenticate users and guarantee their access to network resources.

When changes are made to the user account database on the PDC, those changes are replicated to each of the BDCs. The replication process is designed to limit network bandwidth consumption. When the user account database is updated, the changes are sent to a fixed number of BDCs at a time. This fixed number is configurable by the administrator and ensures that all transmissions do not take place serially. Also, the replication process requires only 2 kilobytes to set up the transmission session and a maximum of only 1 kilobyte per user, so minimal network bandwidth is used. For update and backup purposes, all servers and client machines in the Windows NT Server-based network can be synchronized to a single system clock.

Again, BDCs share the user authentication processing load with the PDC. Frequently, a BDC is physically closer to an individual user's point of logon than the PDC. Therefore, the BDC's ability to authenticate the user reduces both authentication time and network traffic. This is particularly useful in large networks with a single, master user domain. In addition, BDCs provide added system fault tolerance. If the PDC goes down, users can still be authenticated by the BDCs. Further, any BDC can be promoted to PDC so that changes to the directory can still be made and propagated throughout the network.

Configuring a domain member server as simply a server, not a PDC or BDC, is very useful when building a distributed system. As a member of the domain, the server can take advantage of the single user account database and the security policies it contains. Access rights to that server can be granted to users with accounts in the user account database instead of creating new user accounts on that server. However, since the server is not a PDC or BDC, it has no responsibility for authenticating users. Therefore, all of its processing power can be dedicated to a particular service such as file & print, messaging, or a database application.

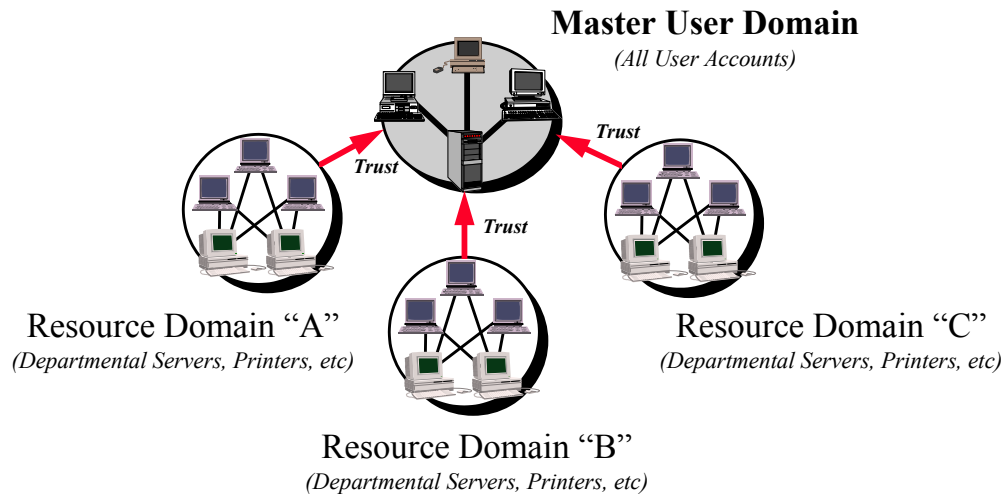
Synchronizing with the Primary Domain Controller may be necessary when making changes to the account database and immediate implementation testing is desired. Any Backup Domain Controller can validate logons and supply account information, but if the changes made to the account database on the PDC have not been copied to the validating BDC by the time the test is run, the test will fail.

Syst your implation. ny BDC can validat your Domain Scaling and Multiple Domains

Windows NT Server Directory Services scale extremely well. The user account database in an individual domain can maintain tens of thousands of individual user accounts. Microsoft has successfully managed user account databases with over 80,000 accounts. Additionally, many large Windows NT Server customers create multiple domains within their organizations and establish *trust relationships* between them. A trust relationship allows the users in one domain

(Domain A) to access the resources in another domain (Domain B). In this situation, Domain B is said to “trust” Domain A.

Trust relationships are very useful because they allow administrators to set up one “master” domain that contains all the user accounts in their organization and multiple “resource” domains that contain individual group and departmental resources such as printers and servers. As a result, resources can be managed locally by the groups that own them and central MIS can maintain one global account for each user in the organization. Since a single domain can maintain thousands of physical resources (servers, printers, etc.) and tens of thousands of user accounts, large organizations typically create a minimum number of individual domains. This helps keep Windows NT Server-based networks easy to manage. Since user accounts tend to be maintained in one master domain, trust relationships are established only between the master domain and the resource domains. The diagram below represents a typical master domain model and the required trust relationships.



In very large organizations, user management responsibilities are sometimes distributed. To accommodate distributed management, a Windows NT Server-based network can be configured with “multiple-master” domains. In this case, a number of master user domains, such as one for the United States and one for Europe, are created. Individual resource domains are then configured to trust the appropriate master user domains. This multiple-master domain model allows administrators in the US to maintain user accounts for US-based employees while allowing administrators in Europe to maintain the user accounts for employees based in Europe. This sort of configuration is easy to administer because it offers the flexibility to manage user accounts locally while keeping the number of individual domains and trust relationships to a minimum.

To administer computers and domains, make extensive use of the Server Manager located in the Administrative Tools group in Program Manager. Do not confuse Server Manager with the Server application in Control Panel which can only manage properties for the local computer. Server Manager can manage properties of both local and remote computers.

Administrative Tools group in the Program Manager. Do not confuse Server Manager with the Server application in the Control Panel. Why are Domains Useful?

There are a number of instances in which domains are useful. One example is when a user moves from one group within an organization to another. The Windows NT Server directory supports the creation of user account *groups*. Groups are collections of users that share a predefined set of resource access rights. For example, everyone in the Marketing group can access the Marketing’s servers and printers. Access rights to these servers and printers are assigned to individual users simply by making them members of the marketing group. Resource owners, such as the administrator of a server or creator of a file, do not have to assign individual access rights to each individual user. He or she simply assigns resource access rights to the group account and then everyone in the group can access that resource. Groups are useful because individual users can be moved easily between groups. For example, if an employee moves from Marketing to Finance, that employee’s user account can simply be deleted from the Marketing group and added to the Finance group. This simple procedure will remove that employee’s rights to access Marketing

resources and grant him or her rights to access Finance resources. Therefore, the Windows NT directory makes it easy for the distributed system to handle changes in an organization.

Traveling users also benefit greatly from the Windows NT directory service. Suppose an employee based in Los Angeles travels to his or her company office in New York. Upon arrival in New York, the user goes to a local workstation and logs on to the network using the same user name and password he or she uses in Los Angeles. Since there is a single directory for the entire network, the traveling user is granted all the network access rights and privileges in New York that he or she would have in Los Angeles. This means that no matter where an employee travels, Windows NT directory services guarantee them access to the information, applications, and peripherals they need.

The single Windows NT directory also makes it easy to add and remove users from the network. For example, if an employee resigns or is terminated, the Windows NT network administrator simply highlights that user's single user account and deletes it. That simple action completely removes the user from the directory. As a result, that user cannot log on to the network or access any network resources. Similarly, a user account can be temporarily disabled and then reinstated without requiring a complete recreation of that user's account.

To test Windows NT Server's Directory Service, begin by installing the Domain Planning Guide from the Windows NT Resource Kit. The utility includes a Domain Planning Wizard which allows reviewers and administrators to experiment with different directory models depending upon the organizational and geographic constraints on their network. The output of the Wizard is a detailed, step-by-step guide showing how to configure the different domains in the network, including how to configure the primary domain controllers and where to setup user accounts.

Account Lockout

Account lockout is the ability to lock a user's account after a specified number of unsuccessful logon attempts. This feature enables you to make Windows NT Server more secure from intruders who try to log on by guessing the passwords of valid user accounts. The administrator can lock the account for a specified period of time or until he or she resets the account.

The screenshot shows the 'Account Policy' dialog box for the domain 'JONN_DOM2'. It is divided into several sections:

- Password Restrictions:**
 - Maximum Password Age:** Radio buttons for 'Password Never Expires' and 'Expires In 42 Days' (selected).
 - Minimum Password Age:** Radio buttons for 'Allow Changes Immediately' (selected) and 'Allow Changes In [] Days'.
 - Minimum Password Length:** Radio buttons for 'Permit Blank Password' (selected) and 'At Least [] Characters'.
 - Password Uniqueness:** Radio buttons for 'Do Not Keep Password History' (selected) and 'Remember [] Passwords'.
- Account Lockout:**
 - Radio buttons for 'No account lockout' and 'Account lockout' (selected).
 - Lockout after:** 5 bad logon attempts.
 - Reset count after:** 25 minutes.
 - Lockout Duration:** Radio buttons for 'Forever (until admin unlocks)' and 'Duration 25 minutes' (selected).
- Other options:**
 - Forcibly disconnect remote users from server when logon hours expire.
 - Users must log on in order to change password.

Buttons for 'OK', 'Cancel', and 'Help' are located on the right side of the dialog.

To enable this feature, in Program Manager start the *User Manager for Domains* tool in the Administrative Tools group. From the Policy menu, choose Account. In the Account Policy dialog box, enable account lockout by choosing the Account lockout radio button. You can set the maximum number of bad logon attempts as well as the lockout duration.

- This feature can be found in the User Manager tool in the Administrative Tools group.*
- To test this feature, simply attempt to logon to your machine and exceed the maximum number of bad logon attempts. Then enter the correct user id/password combination.*

Windows NT Server Tools

Windows NT Server tools should be installed on a Windows 3.11 or Windows for Workgroups 3.11 machine from the appropriate sub-directory using the setup program. The setup program will install four programs: User Manager, Server Manager, Event Viewer, and Printer Manager. All of these tools function identically as their Windows NT Workstation counterparts but allow administration to take place from a 16-bit Windows machine, giving the administrator more flexibility. Note that the tools prompt you to re-enter your password; this extra security prevents someone from walking up to the unattended workstation of an administrator and administering the network.

- To test this feature, install these tools and perform some administrative tasks like adding a user, starting and stopping a service, viewing event logs, and managing printers.*

Member Server

In addition to primary and backup directory controllers, with this release you can create another kind of server—a member server. These servers can participate in directory security, although they don't have to. A server that participates in a directory gets the benefits of the directory's single logon, but it doesn't have to spend resources authorizing logon attempts or receiving replicated copies of the directory's user database. Instead, it can perform time-critical tasks or devote all its resources to running an application.

- To test this feature, when you install Windows NT Server, choose "server" rather than primary domain controller or backup domain controller. This is particularly useful if you are running Microsoft SQL Server.*

Dump Facility with Automatic Reboot

The Dump Facility with Automatic Reboot feature allows you to specify how Windows NT Server behaves when a fatal system error occurs. By default, this version of Windows NT Server writes an event to the system log, alerts administrators, dumps system memory to a file that you can use for debugging, and then automatically reboots the server. If you want to change how Windows NT Server reacts to a fatal error, use the System option in Control Panel. This procedure is described on page 48 of the Installation Guide.

- To activate this feature, in the Control Panel, choose the System option. In the System dialog box, choose the Recovery button. In the Recovery dialog box, choose the appropriate options. The most reliable way to simulate a crash is to have a debugger hooked to a machine and to type `cntrl-C` in the debugger and enter `.crash` (a debugger command just like `.reboot`).*

Remoteboot Service

Remoteboot Service allows Windows 3.x and MS-DOS clients to boot their operating systems using software on the server's hard disk instead of the client's local hard disk. Instructions for setting up the remoteboot service begin on page 112 of the Installation Guide.

- To test this feature, install the remoteboot service following the instructions beginning on page 112 of the Installation Guide. Make sure that after you install the remoteboot service on the server, that you start the remoteboot service using the Services icon in the Control Panel. Use the remoteboot manager to create at least one profile, and make sure that at least one workstation can RPL using the remoteboot facility.*

Long Filenames under the FAT File System

File and directory names on the File Allocation Table (FAT) file system are no longer restricted to the 8.3 naming convention. Instead, file and directory naming rules are similar to those of NTFS: names can be up to 255 characters,

and case is preserved. This capability is supported both within File Manager and at the command prompt. If you refer to file names with embedded spaces at the command prompt, enclose them in quotation marks.

Note: Many 16-bit Windows-based programs do not support long file names. In that case, Windows NT Server presents these programs with a short version of the long file name. For example, “This is a long file name.txt” becomes “Thisis~1.txt” to an application that expects 8.3 filenames.

- | |
|--|
| <p><input checked="" type="checkbox"/> <i>To test this feature, at the Windows NT Server command prompt, issue the following commands: (The current partition should be a FAT partition)</i></p> <ul style="list-style-type: none">• <i>Mkdir “This is a long directory name”.</i>• <i>Chdir “This is a long directory name”.</i>• <i>Notepad “This is a long file name”.</i>• <i>Insert some text, then save the file.</i>• <i>Move to a Windows for Workgroups-based machine and look at the directory and file you just created in 16-bit file manager.</i> |
|--|

This release of Windows NT Server includes drivers for a number of Hewlett-Packard® pen and raster plotters. The complete list can be found in the release notes.

TCP/IP Printing

TCP/IP printing allows computers on a Windows network to access printers connected to UNIX computers or TCP/IP printers connected directly to the network. To take advantage of the printing capabilities of Microsoft TCP/IP, only the single Windows NT Server that defines a TCP/IP printer needs to have TCP/IP installed. All other computers can print to these printers over any protocol they share with the Windows NT TCP/IP printing server.

Any Windows NT Server with TCP/IP printing installed can print directly to these printers and can function as a gateway for other network users. For complete information about setting up a TCP/IP printer, see chapter 9 of the TCP/IP manual.

Documentation

The documentation set for this version of Windows NT Workstation and Windows NT Server has expanded. To help make setup even easier for the user, we consolidated all the Setup and Troubleshooting information for both the operating system and networking components into a single Installation Guide. The TCP/IP book has also been reorganized, and a large portion has been rewritten to incorporate all of the new functionality.

Documentation On-line

This release of Windows NT Server also features full documentation in on-line. The documentation is a help file icon launched from the Program Manager and it includes all the printed books that are part of the documentation package, featuring tables-of-contents, indexes, hypertext links, glossaries, and searches. All the information you need to operate Windows NT Server is at your fingertips.

Hardware Compatibility List

Windows NT Server has been tested with, and is compatible with, more hardware than any other advanced operating system. A complete list of compatible hardware is available on the Installation CD. As of May 1995, our most recent published Hardware Compatibility List for Windows NT included the following categories:

x86 uniprocessor systems	3,437
x86 MP systems	115
MIPS® uniprocessor systems	24
MIPS MP systems	9
ALPHA uniprocessor systems	17
ALPHA MP systems	5
PowerPC uniprocessor systems	14
Total Systems	3,621

Processor Upgrade Products	4
PCMCIA supported HW:	
Systems	31
Add-in Adapters	1
Network Adapters	11
Modems	19
Hard Drives	5
SCSI Adapters	1
SCSI Host Adapters	112
SCSI CD-ROMS	52
Non-SCSI CD-ROMS	47
SCSI Tape Drives	103
SCSI Removable Media	23
SCSI Scanners	3
Disk Controllers	9
SCSI Hard Drives	40
IDE Hard Drives	17
PCMCIA Hard Drives	4
Storage Cabinets	11
Raid Systems	9
Video Capture	2
X86 Video Display	113
Alpha Video Display	27
Network Adapters	176
UPS	71
Multi Media Adapters	19
Modems	329
Hardware Security Hosts	3
ISDN Adapters	3
Multi-port Serial Adapters	39
X.25 Adapters	4
Third Party Remote Access Servers	4
Keyboards	2
Pointing Devices	32
Printers	952
Total Devices	2,268

Microsoft® Windows NT™ Server version 3.51 Estimated Retail Pricing (US)

May, 1995

Part Number	Product Description	Estimated Retail Price
2271275v351	Windows NT Server 3.51 10-Client Network Value Pak Contains Server and 10 Client Access Licenses. Client software and on-line documentation also included. CD-ROM media only.	\$999.00
227-075v351	Windows NT Server 3.51 Operating System, O-Clients Server, client software, on-line system documentation and single administrator license included. <i>Client Access Licenses must be purchased separately.</i> 3.5" media must be ordered separately. CD-ROM media only.	699.00
2272075v351	One Client Access License for Windows NT Server 3.51 License for a single client to access any Windows NT Server in a network. Acquired separately from Windows NT Server.	39.95
2272275v351	20-Pak Client Access License for Windows NT Server 3.51 License for 20 clients to access any Windows NT Server in a network.	569.00
2274074v351	Windows NT Server 3.51 Operating System MLP License to make one copy of Windows NT Server. <i>Client Access Licenses must be purchased separately.</i> No media included.	599.00
Upgrades and Special Offers		
227-075-270	Windows NT Server 3.51 Step-Up For Windows NT Server 3.5 customers that want to upgrade to Windows NT Server 3.51. Software checks system for Windows NT Server 3.5. Server, client software, on-line system documentation, updated documentation and single administrator license included. Customers are not required to purchase new Client Access Licenses for the step-up. If additional Client Access Licenses are desired then customers are only eligible for standard licenses.	69.95
2271275-351	Windows NT Server 3.51 Operating System Upgrade 10-Client Network Value Pak Available only for customers upgrading from LAN Manager, Novell NetWare, LAN Server, PATHWORKS, Banyan VINES, Windows NT 3.1 and Windows NT Advanced Server 3.1 to Windows NT Server 3.51. Contains Server and 10 Client Access Licenses. Client software and on-line documentation also included. CD-ROM media only. P VrAccess Licenses. Client software and on-line documentation also included. CD-ROM media only.	83
2271075-351	Windows NT Server 3.51 Operating System Upgrade, O-Clients Available only for customers upgrading from LAN Manager, Novell NetWare, LAN Server, PATHWORKS, Banyan VINES, Windows NT 3.1 and Windows NT Advanced Server 3.1 to Windows NT Server 3.51. Server, client software, on-line system documentation and single administrator license included. <i>Client Access Licenses must be purchased separately.</i> CD-ROM media only.	699.00
2272075-351	Windows NT Server 3.51 Upgrade Client Access License One Client Access License to access any Windows NT Server in a network. Acquired separately from Windows NT Server Upgrade. Available only for customers upgrading from LManager, Novell NetWare, LAN Server, PATHWORKS, Banyan VINES, Windows NT 3.1 and Windows NT Advanced Server 3.1 to Windows NT Server 3.51. Customers upgrading from omers are limited to purchasing a quantity of upgrade Client Access Licenses equal to or less than the number of existing Client Access Licenses. For Windows NT 3.1, customers are deemed to have 20 users that are eligible to be upgraded. For Windows Advanced Server 3.1, customers are deemed to have 250 users	24

Part Number	Product Description	Estimated Retail Price
	Licenses must be purchased at the standard price.	

Part Number	Product Description	Estimated Retail Price
2272275-351	Windows NT Server 3.51 Upgrade Client Access Licenses, 20-Pak License for 20 clients to access any Windows NT Server in a network. Acquired separately from Windows NT Server Upgrade. Available only for customers upgrading from LAN Manager, Novell NetWare, LAN Server, PATHWORKS, Banyan VINES, Windows NT 3.1 and Windows NT Advanced Server 3.1 to Windows NT Server 3.51. <i>Customers upgrading from Windows NT Server 3.5 to Windows NT Server 3.51 are not eligible for these upgrade Client Access Licenses.</i> Customers are limited to purchasing a quantity of upgrade Client Access Licenses equal to or less than the number of existing Client Access Licenses. For Windows NT 3.1, customers are deemed to have 20 users that are eligible to be upgraded. For Windows NT Advanced Server 3.1, customers are deemed to have 250 users that are eligible to be upgraded. Additional Client Access Licenses must be purchased at the standard price. See Microsoft channel policy for further details on eligibility.	289.00
2274274-351	Windows NT Server 3.51 Operating System Upgrade MLP License to make one copy of the Windows NT Server upgrade. No media included.	599.00
227-575v351	Windows NT Server 3.51 Operating System (NFR) Server, client software, and on-line documentation for evaluation purposes. Not for Retail Sale. Includes 10 Client Access Licenses. CD-ROM media only.	Call Distributor
227-375v351	Windows NT Server 3.51 Academic Edition, 0-Clients Server, client software and on-line system documentation. Single administrator license included. <i>Client Access Licenses must</i>	419.00
2272375V351	Client Access License for Windows NT Server 3.51 Academic Edition Academic license for a single client to access any Windows NT Server in a network. Acquired separately from Windows NT Server Academic Edition.	19.95
2272475V351	20-Pak Client Access License for Windows NT Server 3.51 Academic Edition Academic license for 20 clients to access any Windows NT Server	209.00
2274374V351	Windows NT Server 3.51 Academic Edition MLP License to make one copy of Windows NT Server. <i>Client Access Licenses must be purchased separately.</i> CD-ROM media only.	209.00
227-074-455	Windows NT Server 3.51 Documentation Kit Printed documentation for Windows NT Server, including concepts and planning video.	69.95

Microsoft Support Services

Microsoft Corporation is committed to providing the level of service and support that companies need to successfully implement mission-critical business systems using Microsoft BackOffice products. Microsoft provides complete 24x7 product support on Microsoft products, while Microsoft Solution Providers and Authorized Support Centers (ASCs) offer additional on-site, multivendor systems integration within their areas of expertise.

The chart below defines Microsoft's three service offerings appropriate for Windows NT deployment. Customers needing the assistance of a dedicated technical account manager and Premier Support Team will prefer Premier or Premier Global service offerings. Both Premier and Premier Global provide proactive account services such as an annual customer support plan; monthly status reports detailing service requests, escalation procedures and overall support issues for the previous month, and a Supportability Review Report with detailed analysis of the customer's computing infrastructure and specific recommendations by Microsoft. The Premier Global account, new in 1995, also

offers large multinational corporations the advantage of unlimited enterprise support worldwide under one contract. Priority Comprehensive is appropriate for small to large corporations with internal expertise to handle the bulk of their support needs. All three programs offer 24x7 mission-critical product support through an 800 number.

Technical Support At-A-Glance: 24x7 , fee-based support available via 800 number. Mission-critical support includes: immediate, server-down support; technical and management issue escalation; remote diagnostics (Automatic Recovery Facility and Remote Kernel Debug); problem replication labs; hotfix and service pack releases; detailed bug lists and fix lists, and on-line services.

Microsoft Support Programs

PLAN	PRICE/PROGRAM COMPONENTS	FEATURES
Premier Global	<ul style="list-style-type: none"> • \$225,000 Base Price • 10 contacts located anywhere in the world, unlimited support incidents • Additional contacts: \$10,000/year • Designated Premier Global Support Team • Single contract for global services • Globally coordinated proactive account services/support planning and review • Unlimited access to support services for named contacts • 24x7, 800 toll free access where available worldwide • TechNet subscription and full access to on-line support • Access to Microsoft Knowledgebase via Tech Net, MSDN, Microsoft OnLine, CompuServe, Internet, America Online, Prodigy and GENie • Regional Support Centers provide 24x7 mission critical support worldwide 	<ul style="list-style-type: none"> • Mission Critical, Server Down Support • Remote Diagnostics • Problem replication labs • Defined response times for varying severity levels • Standard escalation path for all technical issues • Quick Fix Engineering Policy evaluates and addresses product problems between regular product release cycles (Hotfixes and Service Packs to customers) • Product resource kit available for Windows NT Server via TechNet, Internet, CompuServe® and GENie • Documented Buglist and Fixlists • Proactive notification of new technical articles of interest as uniquely defined by the customer.
Premier	<ul style="list-style-type: none"> • \$25,000 year flat fee includes 150 support incidents/year • Additional 10 pack of incidents, \$1,500 • Designated Premier Support Team • Proactive account services/support planning and review • 24x7, 800 toll free access • TechNet subscription and full access to on-line support • Access to Microsoft Knowledgebase via Tech Net, MSDN, Microsoft OnLine, CompuServe, Internet, America Online, Prodigy and GENie 	<ul style="list-style-type: none"> • Same as Premier Global
Priority Comprehensive	<ul style="list-style-type: none"> • \$3,995/year including 35 incidents/year • \$1,500/10-pack of incidents • \$150/incident • Priority access to support queues • 24x7 access, 800 toll-free access <p>(annual contract only) Access to Microsoft Knowledgebase via MSDN, Microsoft OnLine, CompuServe, Internet, America On-line, Prodigy and GENie</p>	<ul style="list-style-type: none"> • Same as Premier Global

Microsoft Authorized Support Centers

Microsoft's ASCs are specially trained and certified on Microsoft products and are selected for their ability to provide a broad range of mission-critical support options. Customers can choose to work with the ASC as a single point-of-contact or they can combine ASC services, Microsoft services, other Microsoft partners and/or in-house staffing. ASCs are provided with high-level backup support from Microsoft, along with complete product information, extensive training, diagnostic tools, and service offerings. Microsoft teams with the following ASCs: AT&T Global Information Solutions, Corporate Software, Digital Equipment Corporation, Hewlett Packard, HFSI, Inacom Corp., Softmart Inc., Spectrum Integrated Services, Unisys Corporation, and Vanstar.

Authorized Technical Education Centers

In the U.S. dial 1-800-SOL-PROV for a list of the three ATEC's nearest you. For International locations, contact your local Microsoft subsidiary.

Server Product Comparison

The following pages provide a detailed comparative listing of features between the Windows NT Server and NetWare operating systems. This comparison is based on information published by Novell on the current implementations of their products. The key to the individual line item is:

- ✓ Functionality of the feature is included within the product (unless otherwise noted)

When appropriate, additional information is provided in the table or in footnotes.

Summary of Key Features:

Architecture:			
Pre-emptive multitasking	✓		
Processors – Intel	✓	✓	✓
Processors – RISC	MIPS, DEC Alpha, PowerPC		
Symmetric multiprocessing	✓ 32 Processors		
Virtual memory	✓		
Microkernel architecture	✓		
Memory protection for apps and subsystems	✓		(for debugging only)
Transports:	NetBEUI, IPX TCP/IP (native)		IPX, TCP/IP (tunneling)
File System:			
Efficient subblock allocation	✓ 512 bytes	✓ 16K	✓ 16K
File compression	✓		✓
High performance Asynchronous I/O	✓		
Performance optimizations:			
Dynamic cache	✓ 1GB per process		(static cache)
Security:			
Designed to meet C2 Security	✓		
Single logon compatibility for client-server applications	✓		✓
Centralized security event auditing	✓		
Network Management:			
GUI utilities	✓		✓

Remote administration, performance and event monitoring	✓		
DHCP support for TCP/IP	✓		
WINS support for TCP/IP	✓		
Performance monitoring:			
Graphical remote performance monitoring	✓		
Fault tolerance:			
File System Recovery Log	✓		

Detailed Feature Comparison:

Architecture:			
Multi-user operating system	✓	✓	✓
Pre-emptive multitasking	✓		
Processors – Intel	✓	✓	✓
Processors – RISC	MIPS, DEC Alpha, PowerPC		
Symmetric multiprocessing	✓ up to 32 Processors		
Asymmetric multiprocessing		✓	
Clustering			
Minimum memory RAM	16 MB	4 MB	6 MB
Maximum memory RAM	4 GB	4 GB	4 GB
Paged virtual memory	✓		
Dynamic memory cache	✓		
Maximum number of user connections	unlimited	250	1000
32-bit operating system	✓	✓	✓
Dynamic loading of services	✓	✓	✓
Memory protection of applications	✓		
Audit alerts	✓	✓ Audit Y, Alerts N	✓
Structured exception handling	✓		
Microkernel based architecture	✓		
Protected subsystems	✓		
Hardware abstraction layer	✓		
Unicode support	✓		
Installable File systems	✓	✓	✓
NIC support - Client:			
16-bit Ethernet support	✓	✓	✓
32-bit Ethernet support	✓	✓	✓
16-bit Token Ring support	✓	✓	✓
32-bit Token Ring support	✓	✓	✓
NDIS support	✓		✓
ODI support	✓	✓	✓
Third party driver support	✓	✓	✓

NIC support - Server:			
16-bit Ethernet support	✓	✓	✓
32-bit Ethernet support	✓	✓	✓
16-bit Token Ring support	✓	✓	✓
32-bit Token Ring support	✓	✓	✓
NDIS support	✓		
ODI support	✓ Novell requestor only	✓	✓
Third party driver support	✓	✓	✓
Multiple network adapters	✓	✓	✓
Other hardware support:			
CD-ROM	✓	✓	✓
SCSI adapters	✓	✓	✓
Plotters	✓	✓	✓
Scanners	✓		
Transports:			
IPX	✓	✓	✓
IPX Dial-in	✓	✓	✓
Packet Burst	✓	✓	✓
LIP	✓	✓	✓
AppleTalk	✓	✓ (extra cost)	✓ (extra cost)
NetBEUI	✓		
TCP/IP (tunneling)		✓	✓
TCP/IP (native)	✓		
OSI	✓ (in SDK)		
DECNet	✓ (DEC)		
DLC	✓	✓	✓
Internal routing	✓RAS only	✓	✓
IPCs:			
Named Pipes (client side)	✓	✓	✓
Named Pipes (server side)	✓		
Sockets	✓	✓	✓
Transport Library Interface	✓		
DCE compatible RPC	✓		
LU 6.2, LU1, LU0, LU2, LU3	✓ (SNA Server)	✓ (NetWare SAA)	✓ (NetWare SAA)
HLLAPI	✓ (3rd party)	✓ (3rd party)	✓ (3rd party)
Local Procedure Call (LPC)	✓		
Semaphores	✓		✓
Mutexes	✓		✓
Timers	✓		
Asynchronous Procedure Calls	✓		

File System:			
Maximum number of file locks	unlimited	100K	100K
Maximum number of file opens	unlimited	100K	100K
Maximum file size	17 billion GB	4 GB	4 GB
Efficient subblock allocation	✓ 512 bytes	✓	✓ 16K
File compression	✓		✓
Transaction-based file system	✓		✓
Support for DOS files	✓	✓	✓
Support for Mac files	✓	✓	✓
Support for OS/2 files	✓	✓	✓
Support for NFS	✓ 3rd party	✓ extra cost	✓ extra cost
Volumes/files span drives	✓	✓	✓
Total disk storage	408 million TB	32 TB	32 TB
Maximum volumes/server	25	64	64
Maximum physical drives/server	limit of hardware	1024	1024
Maximum partition size	17,000 TB	drive size	drive size
Maximum volume size	17,000 TB	32 TB	32 TB
Disk quotas	✓ 3rd party	✓	✓
High performance asynchronous I/O	✓		
Memory mapped File I/O	✓		
Maximum length of file name	255	255	255
Long file names made visible to MS-DOS programs	✓	✓ only on HPFS	✓ only on HPFS
Performance optimizations:			
Dynamic cache	✓ 1GB per process		(static cache)
Elevator seeking	✓	✓	✓
Read-ahead caching	✓	✓	✓
Background writes	✓	✓	✓
Overlapped seeks	✓	✓	✓
Split seeks	✓	✓	✓
Directory hashing	✓	✓	✓
Directory caching	✓	✓	✓
File caching	✓	✓	✓
Virtual Memory	✓		
Returnable memory	✓	✓	✓
Data scattering		✓	✓
Security:			
Designed to meet C2 security	✓ Redbook ✓ Orangebook		✓ Redbook Orangebook N/A
Designed to meet B2 security	✓ 3rd party		
Single login to network	✓		✓
Single, secure logon	✓	✓	✓
Single logon for compatible client/server apps			
Minimum password length restriction	✓	✓	✓
Passwords encrypted	✓	✓	✓
Packet signing (secure authentication)	✓	✓	✓
Password aging	✓	✓	✓
Password history	✓	✓	✓
Min. time until password can be changed	✓	✓	✓

Account lockout	✓	✓	✓
Restrict login to specific workstation	✓	✓	✓
Replaceable client login	✓		✓
Limit concurrent connections for single user		✓	✓
Restrict login by time and day	✓	✓	✓
Set account expiration date	✓	✓	✓
Disconnect when access time expires	✓	✓	✓
Re-key password verify	✓	✓	✓
Configurable administrative rights	✓	✓	✓
Centralized security event auditing	✓		
Security event alerts	✓		
File system auditing	✓	✓	✓
Directory and File rights:			
Read	✓	✓	✓
Write	✓	✓	✓
Execute	✓	✓	✓
Delete	✓	✓	✓
Change permissions (Grant)	✓	✓	✓
Take ownership	✓	✓	✓
List Directory	✓	✓	✓
Create files in Directory	✓	✓	✓
User rights:			
Access workstation from network	✓		
Logon locally	✓		
Back up files and directories	✓	✓	✓
Restore files and directories	✓	✓	✓
Change the system time	✓		
Shut down system locally	✓	✓rconsole	✓rconsole
Force system shutdown remotely	✓	✓rconsole	✓rconsole
Load and unload device drivers	✓	✓rconsole	✓rconsole
Manage audit and security logs	✓		
Take ownership of files or other objects	✓	✓yes, with supervisor rights	✓yes, with supervisor rights
Security auditing:			
Audit user security transactions	✓	✓	✓
Audit user file transactions	✓	✓	✓
Audit administrator transactions	✓	✓	✓
Audit file-creation statistics	✓	✓	✓
Audit volume statistics	✓	✓	✓
Filter audit logs	✓	✓	✓
Audit security policy changes	✓		
Audit restart or shutdown of system	✓		✓
Non-dedicated server	✓		with OS/2 add-in product

Printing:			
Remote printer port on Workstation	✓	✓	✓
Peer print services	✓		
Assign priorities to print queue	✓	✓	✓
Multiple queues to a single printer	✓	✓	✓
Multiple queues on multiple printers	✓	✓	✓
Multiple printers on one queue	✓	✓	✓
Postscript supported	✓	✓	✓
Maximum shared printers per server	unlimited	16	255
Cross platform printing (OS/2)	✓	✓	✓
Cross platform printing (UNIX)	✓	✓extra cost	✓extra cost
Cross platform printing (NetWare)	✓	✓	✓
Cross platform printing (SNA)	✓	✓	✓
Remote queue management	✓	✓	✓
Support for multiple forms	✓	✓	✓
Network attached printer support	✓	✓	✓
User notification of job completion	✓	✓	✓
Operator notification of print problem	✓	✓	✓
Printer alerts:			
Out of paper	✓	✓	✓
Print request deleted	✓	✓	✓
Print request completed	✓	✓	✓
Printer off-line	✓	✓	✓
Paper jam	✓	✓	✓
Needs specific form	✓	✓	✓
Configure error reporting to specific users	✓	✓	✓
Network Management:			
Command line utilities	✓	✓	✓
GUI utilities	✓		✓
Remote administration, performance, and event monitoring	✓	✓	✓
Asynch remote administration	✓	✓	✓
Remote installation	✓	✓	✓
Remote upgrade	✓	✓	✓
Remote corrective service	✓	✓	✓
Remote session security	✓	✓	✓
Remote modem callback	✓	✓extra cost	✓extra cost
DHCP support for TCP/IP	✓		
WINS support for TCP/IP	✓		
Performance monitoring:			
View total percent CPU use	✓	✓	✓
View total privileged CPU use	✓		
View total user CPU use	✓		
View logical disk use	✓	✓	✓

View physical disk use	✓	✓	✓
View cache utilization	✓	✓	✓
View packets/bytes sent	✓	✓	✓
View page/faults per second	✓	✓	✓
View number of active processes	✓	✓	✓
View number of active threads	✓		
View processor time by process	✓		
View processor time by thread	✓		
Log performance statistics	✓		
Delegating admin responsibility:			
Account operators	✓	✓	✓
Backup operators	✓	✓	✓
Directory administrator	✓	✓	✓
Enterprise administrator	✓	✓	✓
Print operator	✓	✓	✓
Replication operator	✓		
Server operator	✓	✓	✓
Alert messages:			
Volume is getting full	✓	✓	✓
Volume is full	✓	✓	✓
Error log is full	✓	✓	✓
Connection slots depleted	✓	✓	✓
Memory for resource allocation depleted	low virtual memory alert	✓	✓
Disk utilization above threshold	✓	✓	✓
Fault tolerance:			
File system recovery log	✓		
Redundant directory structures	✓	✓	✓
Directory verification during power-up	✓	✓	✓
Read-after-write verification	✓	✓	✓
Hot fix	✓	✓	✓
Salvage/undelete	✓ (FAT only)	✓	✓
UPS support	✓	✓	✓
Disk duplexing	✓	✓	✓
Disk mirroring	✓	✓	✓
Software RAID 5	✓		
Server mirroring	✓3rd party	✓	
Dynamic volume sets	✓		
Backup:			
Backup/restore of server disk w/security	✓	✓	✓
On-line backup of account files	✓	✓	
Backup utility included	✓		
Workstation backup (Windows for Workgroups, Windows NT Workstation)	✓	✓ TSR	✓ TSR
Automatic file replication service	✓		
Server Job Scheduling	✓		

Current Publications on Windows NT

As of February, 1995, there are at least 60 books in print on Windows NT.

TITLE	AUTHOR	ISBN
Advanced Windows NT	Richter, Jeffrey	1-55615-567-0
Application Programming for Windows NT	Murray, William H., III	0-07-881933-4
Borland C Plus Plus X.0 Programming for Windows & Windows NT	Yao, Paul	0-679-75146-7
C Plus Plus Windows NT Programming	Andrews, Mark	1-55828-300-5
Customizing & Optimizing Windows NT	Pappas, Chris H.; Murray, William H.	0-201-62624-1
Customizing & Optimizing Windows NT	Pappas, Chris H.; Murray, William H.	0-201-62624-1
Distributing Applications across DCE & Windows NT	Rosenberry, Ward; Teague, Jim	1-56592-047-3
Help Windows NT 3.1	Ezzell, Ben	1-56276-151-X
Inside AutoCAD, Release 13.0 for Windows & NT	New Riders Publishing	1-56205-319-1
Inside the Windows NT File System	Custer, Helen	1-55615-660-X
Inside Windows NT	Stoddard	1-56205-124-5
Learn Windows NT In a Day	Columbus, Louis	1-55622-365
Mastering Windows NT	Simpson, Alan	0-7821-1352-4
Mastering Windows NT 3.5 Server	Minasi, Mark	0-13-097817-5
Mastering Windows NT Programming	Myers, Brian; Hamer, Eric	0-7821-1264-1
Mastering Windows NT Special Edition	Simpson, Alan	0-7821-1128-9
Microsoft ODBC 2.0 Programmer's Reference & SDK Guide: For Microsoft Windows & Windows NT	Microsoft	1-55615-658-8
Microsoft Windows NT Resource Kit: The Information & Tools You Need to Become a Windows NT Expert, Version 3.5 for Workstation & Advanced Server Editions	Microsoft	1-55615-657-X
Microsoft Foundation Class Primer: Programming Windows & Windows NT with MFC	Conger, Jim	1-878739-31-X
Microsoft LAN Manager for Windows NT	Microsoft	1-55615-543-3
Microsoft Windows NT 3.5: Guidelines for Security, Audit & Control	Microsoft	1-55615-814-9
Microsoft Windows NT Messages Reference		1-55615-600-6
Microsoft Windows NT Resource Guide		1-55615-598-0
Microsoft Windows NT Resource Kit		1-55615-602-2
Microsoft Windows NT Step by Step	Catapult, Inc.	1-55615-573-5
Microsoft Windows NT TCP-IP Guide		1-55615-601-4
Microsoft Windows NT Workstation Step by Step	Catapult, Inc.	1-55615-695-2
Migrating to Windows NT: The Insider's Integration Guide	Kennedy, Randall C.	1-56686-103-9
Moving into Windows NT Programming	Leavens, Alex	0-672-30295-0
Multitask Windows NT	Powell, Joel	1-878739-57-3
Network Remote Procedure Calls: Windows NT, Windows, DOS	Eddon, Guy	0-13-100223-6
Networking NT: Using Windows NT in the Corporate LAN Environment	Monro, Christopher	0-442-01829-0
Networking Windows NT	Ruley, John D.	0-471-31072-7
Networking with Windows NT	Columbus, Louis	1-55622-421-4
Optimizing Windows NT	Blake, Russ	1-55615-619-7
Optimizing Windows NT	Microsoft	1-55615-655-3
Optimizing Windows NT	Blake, Russ	1-55615-619-7
OS - 2 2.X vs. Windows NT	Computer Technology Research Corp.	1-56607-021-X
PC Magazine Windows NT Networking	Derfler, Frank	1-56276-114-5

TITLE	AUTHOR	ISBN
Practical Guide to Windows NT	Spencer, Kenneth L.; Schoeniger, Eric-	1-878956-39-6
Programming Windows NT with C & C	Andrews, Mark	1-55828-300-5
Running Windows NT	Stinson, Craig	1-55615-572-7
SAS Companion for the Microsoft Windows NT Environment, Version 6		1-55544-527-6
Seven Keys to Learning Windows NT	Houlette, Forrest	1-56205-156-3
Show-Stopper: The Breakneck Race to Create Windows NT & the Next Generation at Microsoft	Zachary, G. Pascal	0-02-935671-7
Teach Yourself . . . Windows NT	Rao, Hy	1-55828-269-6
Ultimate Windows NT	New Riders Development	1-56205-135-0
Using Windows NT: Special Edition	Que Development Group, Columbus, Eidoson, Woehner, Peterson	1-56529-101-8
Using Windows NT: The Essentials for Professionals	Brain, Marshall, Campbell, Kelly	0-13-091977-2
Van Wolverton's Guide to Windows NT: Easy Directions for Immediate Results	Van Wolverton	0-685-66618-2
Voodoo Windows NT: Tips & Tricks with an Attitude	Feldman, Len	1-56604-069-8
Win32 System Services: The Heart of Windows NT	Brain, Marshall	0-13-097825-6
Windows NT Administration: Single Systems to Heterogeneous Networks	Brain, Marshall	0-13-176694-5
Windows NT	Schwartz, Karl	1-56243-114-5
Windows NT 3.1 Graphics Programming	Ezzell, Ben	1-56276-113-7
Windows NT 3.1 Programming	Ezzell, Ben	1-56276-112-9
Windows NT Administration: Single Systems to Heterogeneous Networks	Brain, Marshall	0-13-176694-5
Windows NT Advanced Server: LAN Manager for NT	Spencer, Kenneth	0-13-107046-0
Windows NT Answer Book	Groves, James A.	1-55615-562-X
Windows NT Basics	Technical East	0-13-176579-5
Windows NT Client-Server Developer's Guide	Clark, Jeffrey	0-672-30302-7
Windows NT Companion	Borland, Russell	1-55615-554-9
Windows NT Developers Treasure Chest	McCord, James	0-672-30294-2
Windows NT in a Day	Knox, Weber	0-929704-25-8
Windows NT Inside & Out	Sheldon, Thomas	0-07-881826-5
Windows NT Instant Reference	Powell, James E.	0-7821-1219-6
Windows NT Messages	Microsoft	1-55615-654-5
Windows NT Network Programming: How to Survive in a Thirty-Two Bit Networking World	Davis, Ralph	0-201-62278-5
Windows NT Network Resource Guide	Microsoft	1-55615-656-1
Windows NT Power Tools	Leblond Group	0-553-37206-8
Windows NT Power Tools	Leblond Group	0-679-79142-6
Windows NT Programming: An Introduction Using C Plus Plus	Brain, Marshall, Campbell, Kelly	0-13-097833-7
Windows NT Resource Guide	Microsoft	1-55615-653-7
Windows NT SECRETS	Livingston, Brian	1-878058-71-1
Windows NT Server (LAN Manager for NT)	Spencer, Kenneth	0-13-107046-0
Windows NT Unleashed	Cowart, Mark	0-672-30380-9
Windows NT: A Developer's Guide	Goodman, Kevin	1-55851-306-X
Windows NT: A Practical Guide	Tennick, Arthur	0-7506-0852-8
Windows NT: Making the Move	Forney, Jim	0-8306-4391-5
Windows NT: Microsoft's New Operating System Strategy	Varhol, Peter D.	1-56607-007-4
Windows NT: Programming Handbook	Schildt, Herbert	0-07-881873-7
Windows NT: The Complete Reference	Wyatt, Sr., Allen L.,	0-07-881832-X
Windows NT: The Next Generation	Feldman, Leonard	0-672-30298-5

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