About This Guide

This hypertext guide contains over 1000 pages of information and over 100 separate graphics. It consolidates most of the available Windows NT marketing materials as well as strategic whitepapers on Microsofts Open Services Architecture, Object Linking and Embedding and other important computing technologies. It took two individuals approximately five months to develop this guide. This included the development of content as well as the creation and production of the interactive media.

This guide was created using Microsoft products including Microsoft Word for Windows 6.0, the Microsoft Windows Help Compiler, Microsoft Access, Microsoft Project and the Microsoft Hot Spot Editor. To expedite many of the tedious and repetitive processes, we employed several of the Microsoft Office Automation components. One specific example was creation of the Solution Provider Guide, which has about 300 entries. The Mail Merge automation between Microsoft Access and Microsoft Word 6.0 made this process both flexible(since as the database changes it is reflected in the document) and intelligent - we were able to use the Microsoft Word Macros to generate the helpfile format.

Helpfiles require no run-time license and are easy to create. Their interactive nature facilitates quick information retrieval and the ability to browse and scan topics at a pace compatible with ones level of time and interest. Like most Microsoft products, the help compiler allows you to start external applications and access Dynamic Link Libraries (DLLs) through a macro language. Creating a help file does not require previous programming experience and thus provides powerful functions to a broad base of individuals.

Internally, Microsoft uses Helpfiles to provide quick, informative information on tools and processes. For instance, in the search for editors and technical writers, for this project we consulted a helpfile developed by Microsofts Corporate Communications Group. This tool provides detailed information on contracting external resources and generally simplifies what can be a tedious process.

Any Questions or comments on this guide, the content or its construction may be directed over the Internet to:

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Managing The Windows NT System

Because administration is critical to the deployment of any system solution, one of the primary design goals for the Microsoft® Windows NT™ operating system was to ensure that it was extensively yet easily managed in an enterprise environment. As a result, Windows NT provides one of the most comprehensive set of management facilities ever offered in an operating system. Graphical tools help administrators centrally configure both systems and users quickly and easily. Every management tool provided with Windows NT is fully remoteable, optimizing the effectiveness of administrators and help desk personnel, and making their talents available across the enterprise.

The Graphical, Remote Administration Tools

Windows NT provides a wide variety of services which can be accessed using any of a number of intuitive graphical tools. Every management tool--from the Registry Editor to the Performance Monitor--can be accessed directly by applications and all are fully remoteable across the enterprise.

Windows NT Setup

User Manager

User Profile Editor

Performance Monitor

Event Viewer

Control Panel

Server Manager and Services

The Registry Editor

File Manager

Print Manager

Remote Administration

A commonly used feature of UNIX is the capability to login remotely. You can connect to any machine and perform administrative tasks remotely. Likewise, you can use any of the Windows NT and Windows NT Advanced Server administration tools remotely but without logging in to the remote machine. Here are some examples of things that you can do without leaving your desk:

Monitor a remote desktops performance	**Performance Monitor**
Monitor a remote print job and adjust priorities	**Print Manager**
Create local accounts on a remote machine	**User Manager for Domains**
View System events on a remote machine	**Event Log**
Redirect system alerts from other systems to your own desktop	Server Manager
Inspect the connections to any Windows NT system	**Network Watcher***
Edit the Registry on a remote machine	**Registry Editor**
Build directories and set access privileges on a remote machine	**File Manager**
Send network messages to popup on users' screens	**Server Manager**
Check the free hard disk space on a remote machine	**Performance Monitor**

Event Viewer

The **Event Viewer**, as its name implies, is used to record and view Windows NT events. An event is any significant occurrence, in the system or in an application, that warrants notification of the user. For critical events, Windows NT can notify users with an alert on the screen. For those events that do not require immediate attention, Windows NT can add information to an event log file. Event logs can be viewed in real-time, or can be saved for later analysis. The Event Viewer is the single facility for logging events by system and Windows-based applications.

The Event Viewer has three defined logs: System, Security, and Application. The System Log records all events relating to the base operating system, device drivers, and services. For example, if a driver or system component fails to load on booting, this generates an event in the log. The Security Log records events relating to system security, such as failed logons. The Application Log records events generated by applications, such as "log file too large."

The Event Viewer has five defined event types: Error, Warning, Information, Success Audit, and Fail Audit (the last two are used for the security log). The Event Viewer supports various combinations of log "retention wrapping." You set the log size and choose what you want it to do when the log is full. You can tell it to overwrite as needed, overwrite events older than a specified number of days, or not to overwrite events at all, so you can clear the log manually.

The Event Viewer supports comprehensive filtering. You can filter by event types, date and time of events, source, category, user, computer, or event ID. Event logs can be saved in archive log format to be later reopened in the Event Viewer, or saved as text format or comma-delimited text for later analysis (on a spreadsheet, for example). As with many of the administrative tools, the Event Viewer is fully remoteable and can be used to view events on remote Windows NT machines and down-level servers.

The Registry Editor

The **Registry Editor** is a tool for viewing and manipulating the configuration registry. The registry is a database that contains secure configuration information. It is structured as a disjointed set of multi-way trees. Each node in the tree is named, and each tree is rooted at a pre-defined, known node called a pre-defined key handle. The registry works very much like a hierarchical file system where each node is called a "key." Each key can contain zero or more data items, called "value entries", that are associated with the key. Keys are analogous to directories, and the value entries are analogous to files.

The registry looks very much like the File Manager, and as with File Manager, security can be applied to registry keys to prevent users from modifying registry entries. The registry is used mainly for troubleshooting and problem resolution. Sections of the registry can be saved to disk and transported to another computer for analysis, and configuration information can be viewed remotely.

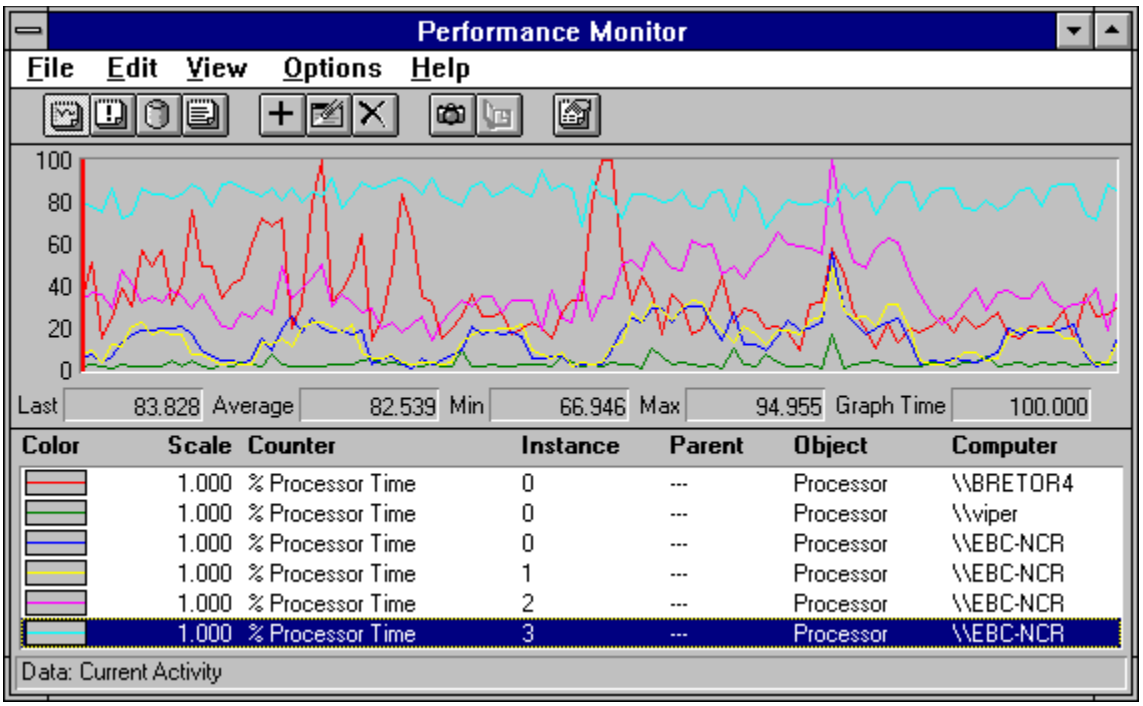
Server Manager and Services

All Windows NT machines can act as servers or workstations. On a Windows NT workstation, the server component is controlled with Server Manager, Services, and File Manager.

Server Manager makes it possible for you to monitor who is connected to your machine, check who is using its shared resources, and set directory replication and administrative alerts. Through Server Manager, you have complete control over the users who are connected to your machine and over the resources they are using. If there are several users connected to a particular resource, you can either disconnect each user individually, or simply close the resource. A Windows NT server can use Server Manager to remotely control another Windows NT server, or a down-level LAN Manager server.

Windows NT networking is built from discrete components known as services. These services are the components that bind together to provide the full-featured networking environment. Services have certain properties--they can be started, stopped, paused, and made to continue. You can also set up a service to replicate a set of files and directories from one machine to multiple machines on the network. For the benefit of the administrator, these services can be controlled individually, using the **Services** tool.

Performance Monitor



Click on the diagram to find out more about Performance Monitor.

Performance Monitor Description

Performance Monitor is a graphical tool which can be used to measure the performance of any Windows NT computer accessible over the network. You can monitor several aspects of your computer's performance, including CPU utilization, disk reads and writes/second, number of processes, and number of threads. Performance Monitor provides real-time charting, alerting, and reporting capabilities, and a logging facility. Logs can be saved for further analysis. Performance Monitor is particularly useful for cost management and planning purposes.

Performance Monitor can also be used by many applications to measure vital information. For example, both SQL Server for Windows NT and SNA Server use Performance Monitor to measure statistics such as transactions per second and workstation response time.

Performance Monitor Data Area

Performance Monitor is fully remoteable and can be used to measure activity on several computers simultaneously. The real-time charts can be changed dynamically to provide more or less information on the screen. Performance Monitor can be set to provide an alert when a given threshold is reached, or to execute a program when a counter goes over or under a certain user-defined value. You can also present the information as a table, for example, to present a list of alerts for a given machine.

In this example, three different computers with six CPUs are being monitored.

Performance Monitor Statistics Area

This bar shows a numerical summary of one particular object that is being measured. In this case the fourth processor (CPU3) in a machine called EBC-NCR.

Performance Monitor Object List

The object list gives you information about each object that you are monitoring. This line shows that you are monitoring the processor time on a single CPU machine called BRETOR4 and that its plot color is red.

Performance Monitor Object List

This section of the object list shows that you are monitoring processor time on a four processor machine called EBC-NCR. Each processor has a different color on the chart so that you can observe the load balancing of the remote machine.

Performance Monitor Toolbar

The toolbar is a convenient way to control Performance Monitor. You can change views, add or delete traces and insert bookmarks for future reference.

Control Panel

The **Control Panel** contains many useful tools for controlling different components of Windows NT.

Server Manager is for monitoring who is connected to your machine and seeing which shared resources are in use. This tool is also used for setup, directory replication, and administrative alerts. **Services** controls Windows NT Networking services individually. Services can be started, stopped, paused, and continued. For example, you can stop the messenger service if you don't want to receive messages from other users. With **Devices**, you can stop, start, and set the startup value for system drivers.

The Windows NT Boot Loader feature allows you to have more than one operating system installed on your computer. With **System**, you can tell Boot Loader which operating system to use as the default. That is, if you have multiple operating systems on your computer and you reboot, Boot Loader will automatically boot the default if you don't intervene. Boot Loader has a delay timer that counts down before it boots the default operating system--you set this timer with System. System is also the place where you set user environment variables, which are added to the system environment variables. Environment variables are available in each command shell. Windows NT supports multiple paging files, and you can gain a substantial improvement in performance by using this capability. You set the size and location of your paging file(s) from System.

The networking architecture within Windows NT lets you support multiple simultaneous network cards and multiple simultaneous protocols in a single machine. You can have one card and multiple protocol stacks, or one protocol stack and multiple cards. **Network** is the tool you use to install and configure your network cards, and to install and configure network protocol stacks. This is also the tool you would use to join a work group or a domain. The process of associating a protocol stack with a network card is called "binding." In order to support multiple network cards and protocol stacks, Network supports the configuration of multiple bindings.

Windows NT Setup

Windows NT system maintenance is handled through Windows NT Setup. System maintenance is a privileged operation, and requires high-level access rights for uninhibited access to the system. The Windows NT setup program is similar to the Windows 3.x setup program, with some additional options. You can still change your display, mouse, and keyboard settings, and add or delete components such as readme files and games groups. The new options allow you to add new SCSI disk and tape devices, add drivers to the system, and delete user profiles.

Windows NT File Manager

The Windows NT **File Manager** has more features than the Windows 3.1 File Manager, and is similar to the one contained in Windows for Workgroups. As with Windows 3.1, the Windows NT File Manager can be used for file copying, moving, renaming, and deleting. In addition, it allows users to browse, connect, and disconnect from different types of networks. That is, you can browse Advanced Server, LAN Manager and Novell® networks simultaneously with a single tool.

Working with different file types

The Windows NT File Manager shows the name of the file system (FAT, HPFS, CDFS, NTFS) for the current working directory. On **NTFS** (NT File System) partitions, you can view the long filename and the MS-DOS filename at the same time. File Manager can be used to share part or all of your disk with other users on the network. A share is created by selecting the directory to share and giving it a "share name." Shares can be protected from unauthorized access by setting permissions on the share name. You can share information on **FAT** (File Allocation Table), **HPFS** (High-Performance File System), or NTFS partitions, but note that permissions on FAT and HPFS apply only to the share name for remote network access--if a user is sitting at the source, he or she has unrestricted access to all files on FAT and HPFS partitions.

Windows NT Print Manager

As with Windows 3.1, **Print Manager** is used to install printers and modify print properties on a Windows NT network. In addition, Print Manager allows you to browse all of the printers that are physically connected to your network and, even more conveniently, browse them from the Print Setup dialog box of Windows-based applications. Apart from the new user interface, the biggest change is in the way printing is handled in an all-Windows NT environment (that is, an environment with a Windows NT print server and a Windows NT client). In this situation, the client is not required to install a printer driver for the printer device to which the client is printing--the device needs only to be installed on the print server. For example, you can print to a PostScript® printer connected to a print server, without having a PostScript driver installed on your machine.

Print Manager Remote Functions

Print Manager is fully remoteable and can be used to remotely administer print servers, printers, and print jobs on other network workstations or servers. Any Windows NT machine can be a print server. Traditionally, many LAN (Local Area Network) operating systems have used the term "queue" to represent the logical device that you print to. Windows NT uses the term "logical printer" for the logical printing device. Logical printers and physical printers can be arranged in a number of flexible combinations: one-one--one logical printer for every physical printer, one-many--one logical printer for many physical printers, and many-one--many logical printers to one physical printer. You can also define times when the printer is available. For example, a certain printer can be configured to be available only between the hours of 9:00 pm and 12:00 pm. The print spooler will accept jobs at all times, but will only print between 9:00 pm to 12:00 pm. Logical printers can have different priority levels. For example, you can set up a situation in which the print jobs of one group of users takes precedence over those of everyone else. Windows NT supports printing from parallel, serial, or network-attached printers.

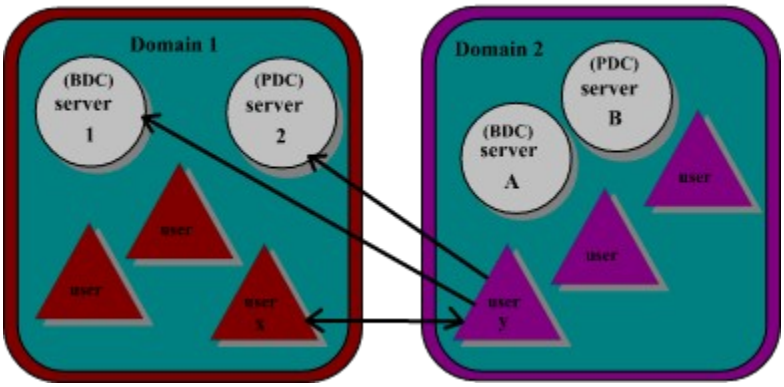
Account Management and Domains

Windows NT servers support managing accounts by **domains**, a set of servers together in a logical group. Within each domain, one server is the Primary Domain Controller (PDC), which holds the master user account database. All other servers within the domain are Backup Domain Controllers (BDCs) and maintain a copy of the PDC user account database. All servers within the domain function as logon servers; but new user accounts for the domain must be added to the PDC.

The domain model is effective because an enterprise can include hundreds of servers and thousands of users, and yet require only a single account in the entire domain. This is achieved by creating **trust relationships** between domains. Suppose an organization has two domains that trust each other, so that domain 1 trusts domain 2, and domain 2 trusts domain 1. Users in either domain could have access to resources in the other domain. However, trust relationships do not have to be bi-directional--domain 2 might trust domain 1 but conversely, domain 1 might not trust domain 2. It is left to the administrator to set up these trust relationships.

Once the trust relationship is established, you can, for example, take the domain2\ userY account and give it permissions to use objects within domain 1. This is exactly how the accounts are represented within the permissions editor, meaning that if an account belongs in another domain, you see the account name preceded by the domain name to which the account belongs.

Unidirectional Trusted Domain Relationship



User Manager

To access a Windows NT machine, you must log onto that machine with a valid user account. All user and group accounts are managed by a tool called **User Manager**, which can be used to add or delete user and group account information, set user account security policy (account and user rights), and modify user account properties.

Configuring Users

There are two ways to add new accounts to the user account database: create one from scratch; or copy (clone) an existing account. When you create a new account through User Manager, you can set the user account properties, including group membership, user profile, logon hours, account expiration date, and valid logon workstations. After setting the properties, you can set the security policy for the account (maximum/minimum password age, minimum password length, and password uniqueness). For example, you might want to specify that users must change their passwords after one month, and set password uniqueness to 4.

Configuring User Rights

A system administrator can use the User Manager to grant users' rights or privileges. User rights are granted for operations for which normal discretionary access control does not provide a mechanism--for example, setting the system time. It is undesirable to let anybody or everybody change the system time, so Windows NT requires that the user be granted the privilege to perform that action. Other rights include the ability to remotely shut down a Windows NT workstation or server, and the ability to log on locally to a machine.

Auditing User Actions

If you want to audit user actions, you would do so from this interface. Auditing can be enabled for such things as successful or failed logon/logoff, file and object access, and use of user rights. Note: for very secure environments, you can halt the system when the event log is full, which is exactly what you want to do when you can't expand the event log any further. When using the User Manager for domains, you can establish trust relationships with other domains. Trust relationships are links between domains that allow one to set up pass-through authentication, in which a user has one account for the entire enterprise. This is possible in part because, like other administration tools for Windows NT, the User Manager is fully remoteable and configurable for any Windows NT workstation or server.

User Profile Editor

The **User Profile Editor** is a tool that allows you to set up and maintain environment profiles for users on a per-user basis. Environment profiles include personal groups and the program items in those groups—screen colors, window size, and more. A user profile can be assigned to one user or a group of users. When a user logs on, the user profile is loaded and the Windows NT environment specified in that profile is loaded. There are two types of profiles, mandatory and personal. Mandatory profiles allow users to change their environments for the current session, but it does not save the changes when the user logs off. Personal profiles allow users to make changes and have their changes saved for their next logon session. The User Profile Editor can be used to create default user profiles for new user accounts and to change the default profile of the system.

Creating and Maintaining User Configurations

The User Profile Editor allows the system administrator to centrally manage user accounts. The desktop's profile and access to application and network resources can be stored and carried with users as they move throughout the enterprise. For instance, it could be useful to establish standard desktops by department, with access to specific applications and files. Using the Profile Editor, the administrator can establish pools of standard desktops and assign them to users. In turn, these profiles can be configured to keep the user from making any changes to the desktop. This prevents unnecessary configuration maintenance and significantly reduces help desk calls.

The User Manager is also an excellent tool for maintaining account information for users who move from one machine to another. These users can access Windows NT in a uniform manner with the same desktop and access to resources.

Finally, the User Manager is an excellent way to manage a scarce number of workstations. In environments with several shifts of users, more than one user can share a single PC. The User Manager gives an administrator the ability to establish multiple desktops on the same PC--this means that user A and user B can use the same machine at different times, with desktop and security tailored to their specific needs. When user A logs off and user B logs on, the security and access to resources can be completely different.

Auditing

The Windows NT auditing system provides useful system, network, and user information, which administrators can use to make intelligent decisions concerning the enterprise computing environment. Audit entries can be written to the security event log whenever certain actions are performed or files are accessed. The audit entry displays the action performed, the user who performed it, and the date and time of the action. Both successful and failed attempts at actions can be audited, so the audit trail shows both those users who actually performed the actions on the network and those who tried to perform actions unsuccessfully.

This table lists the categories of events you can audit and the events covered by each category. For each of the categories listed, you can choose whether to audit only successful actions in that category, failed attempts to perform actions, both, or neither.

Category	Event
Logon and Logoff	Logon/Logoff attempts, and the creating and breaking of network connections to servers
File and Object Access	Accesses of a file or directory set for auditing
Use of User Rights	Successful use of user rights, and failed attempts to use rights not assigned to user
Security Policy Changes	Granting or revoking of user rights to users and groups and the establishing and breaking of trust relationships with other domains
Restart, Shutdown and System	Shutdowns and restarts of the computer. The filling up of the audit log and the discarding of audit entries.
Process Tracking	Starts and stops of processes on the computer
User and Group Management	Creation, deletion and modification of user and group accounts

Frequently Asked Questions

Q: To what extent does Windows NT integrate with IBM NetView?

Q: Windows NT Advanced Server has several group administration tools that do not appear in Windows NT. How do I administrate my network from my Windows NT desktop?

Q: Can I use RAS (Remote Access Services) to configure users on a remote

Advanced Server?

Q: Windows NT Advanced Server uses Mandatory and User Profiles. What is the difference between the two, and why would I choose to use profiles?

Q: Can I limit where and when a user can log on to a Windows NT Advanced Server Domain?

A: Through the use of SNA Server, Windows NT provides comprehensive integration with NetView. SNA Server for Windows NT is designed to maximize administrative flexibility by notifying NetView of communications problems through automatic data-link alerts. Alerts can be sent to NetView from either a third party emulator or from the Windows NT Event Log. SNA Server also provides support for NetView RUNCMDs, which allows administrators to issue Windows NT commands from the NetView Console. Any command, application or Windows NT management utility can be managed from the NetView Console.

A: The Windows NT Resource Guide includes several tools to address this specific problem.

User Manager for Remote Computers is a graphical configuration management tool, similar to the version found on Advanced Server, which provides the ability to manage Advanced Server domains remotely.

Server Manager for Remote Computers is for remote administration of replication, services, shared and open resources, etc.

NetWatcher shows which users are connected to shared resources.

Command Scheduler provides the ability to easily schedule commands and programs to run at a specific time and date.

Remote is used to start and control command line programs remotely.

A: Absolutely. Because RAS users are actually participating members of the network, provided a remote user has proper security, he or she can use any of the administration tools to manage the network including User Manager for Remote Computers.

A: Profiles are an excellent way to centralize user configurations. Each Windows NT computer records certain configuration information on a per-user basis. This information includes the saved desktop, personal program groups, network connections, shared printers, etc. When a user logs on to the domain, the appropriate profile is loaded so that the Windows NT desktop reflects that of its user. The advantage of this system is that the user can log in from any Windows NT machine and maintain the same desktop.

Mandatory profiles are for organizations that require a higher degree of security or control over the user desktop. They differ from User profiles in that the desktop remains the same from one logon session to the next. Once the administrator creates a mandatory profile, it can be distributed to a number of users. The mandatory profile describes the desktop, its content, file permissions and any of a range of options set by the administrator. Conversely, the User Profile, while subject to permissions set by the administrator, can change from one logon session to the next. For example, a user may have the freedom to completely change his or her desktop, but not to delete files or shut down the system.

A: Yes, within the User Manager for Domains, the administrator can choose to limit both the computer and specific times the user may log on. If the user exceeds the specific time set forth by the administrator they will be given a warning and then logged off automatically.

Evaluating Windows NT as an Application Server

Although the database is considered a fundamental building block in most organizations, the underlying hardware on which databases run is changing. Many medium to large businesses that have been using minicomputers or mainframes for database solutions, are turning to **client-server computing** and the increased processing power of servers for their database requirements. Accordingly, user-base expansion in client-server Database Management Systems (DBMS) is expected to increase by 40% per year over the next 24 months. (Source: Datamation projects: June, 1993)

The Microsoft® Windows NT™ operating system runs RDBMS cost-effectively and reliably, while providing maximum power and increased manageability to your client-server computing environment. In addition, Windows NT is scalable. It runs on hardware ranging from a single Intel 486 50MHz chip, to a 100MHz Digital Alpha chip, to a 16-processor Sequent or NCR server. This flexibility helps you adapt quickly to changing market conditions.

More on Client-Server Computing

Windows NT Provides Maximum Capacity

Windows NT is the Most Cost-Effective Client-Server Platform

The Scalability of Windows NT will Protect Your Investment

Windows NT is Reliable

Windows NT is the Most Manageable Client-Server Platform

Windows NT Provides Maximum Scalability

Whether you are considering a workgroup project, or, like **AT&T**, you wish to run a large-scale application with millions of records, Windows NT can handle your data. Using the 64-bit Windows NT File System (NTFS), your organization can access up to 16 TB of disk space and 4 GB of memory.

Hardware Support for Windows NT

Windows NT is the Most Cost-Effective Client-Server Platform

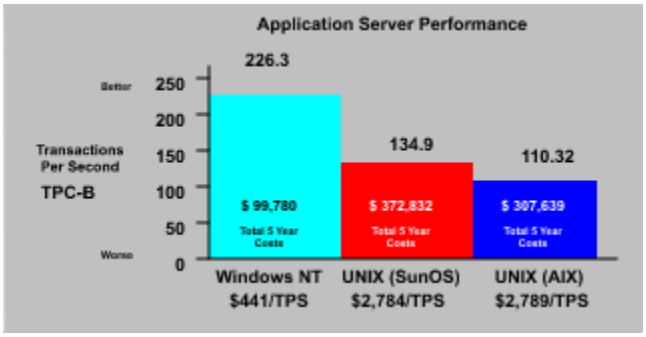
Windows NT has both the speed and the power you need at competitive prices. It delivers the power of mini and mainframe systems, on hardware that is significantly less expensive, and easier to manage. This was the conclusion of **The National League for Health Care** and **Chevron Canada**, both of whom evaluated a number of platforms including UNIX, OS/2 and Windows NT.

In audited benchmark testing, we compared Windows NT to similar platforms, running Sun Microsystem Solaris with the Sybase RDBMS, as well as Oracle running on IBM AIX. **See Graph** From the beginning, the significant cost advantage of Windows NT Advanced Server and SQL Server was clear. As the graph shows, the transactions per second scale as the underlying hardware is increased. **Benchmark Details**

Related Topics:

Windows NT Delivers Value

The Windows NT Cost Advantage


Application Server Performance
226.3
134.9
110.32
Better
Worse
250
200
150
100
50
0
Transactions Per Second
TPC-B
$ 99,780
Total 5 Year Costs
$ 372,832
Total 5 Year Costs
$ 387,639
Total 5 Year Costs
Windows NT
$441/TPS
UNIX (SunOS)
$2,784/TPS
UNIX (AIX)
$2,789/TPS

Benchmark Details

The TPC-B is a standard benchmark created and maintained by the Transaction Processing Performance Council. Using this benchmark, you can compare the performance and cost of different systems. System speed is measured in transactions per second, while system cost is the total five-year cost of ownership. Dividing the system cost by the speed yields the price/performance measure ($/TPS).

The following TPC-B benchmarks represent audited results of the five-year costs to run Microsoft SQL Server for Windows NT on two different Compaq ProLiant systems: a dual Pentium™ processor system, and a single-CPU 486 system.

System	Transactions per Second (TPS)	Total System Cost	$/TPS
Windows NT on a Compaq ProLiant, 486/50*	93.84	$52,828	**$563**
Windows NT on a Compaq ProLiant, dual Pentium*	226.32	$99,780	**$441**
UNIX (SunOS) on a SPARC™ server 690MP c/s**	134.90	$372,832	**$2,764**
UNIX (AIX) on a RS/6000/970***	110.32	$307,639	**$2,789**

*** Microsoft SQL Server, ** SYBASE® SQL Server, *** INFORMIX® OnLine**

Windows NT Delivers Value

When you purchase an application server product what is included in the purchase price? Are you able to link all of your MS-DOS, Windows, Macintosh and remote dial-in clients? Are there built-in fault-tolerance and back-up features or must you purchase those separately? Finally, does the cost of the shrink-wrapped package include the ability to grow or change with your business needs?

Windows NT offers you these features:

- **Unlimited Client Support**: At $2,995, Windows NT Advanced Server includes unlimited client licensing, with no additional software components to acquire or license fees incurred.
- **Built-in Advanced Fault Tolerance**: With Windows NT you get every major fault tolerance technology right out of the box.
- **Integration with Macintosh Clients**: Windows NT Advanced Server allows Macintosh users to connect with no interruption or changes to their environment. **More on Macintosh Support**
- **Excellent Connectivity and Interoperability**: Windows NT is protocol independent, and includes TCP/IP, NETBEUI, AppleTalk, DLC, and IPX in the purchase price.

The Windows NT Cost Advantage

Solution	Advanced Server and SQL Server	OS/2 and DB2/2	NetWare 4.01 and Sybase	Solaris and Sybase
LAN Operating System Cost	$2,995.00	$2,544.00	$12,495.00	$5,995.00
Software Cost Of Adding Additional Hardware Processor To Server	$0.00	Not Supported	Not Supported	$3,750.00
DBMS Server (Unlimited license)	$14,995.00	$2,495.00	$17,995.00	$52,100.00
Per Client Cost (if applicable)	$0.00	$150.00	$200.00	$218.00
Total Client Cost	$0.00	$37,500.00	$50,000.00	$54,500.00
Total Cost for 250 Users	$17,990.00	$42,539.00	$80,490.00	$112,595.00

Pricing on Microsoft products comes from Latest Microsoft Pricing sheet;
Pricing on IBM comes from Computerland;
Pricing on NetWare comes from "The LocalNetter Newsletter" June, 1993;
Pricing on Sun comes from DataPro Report on SunSoft Inc. Solaris, 1993

The Scalability of Windows NT will Protect Your Investment

Windows NT has the ability to deliver maximum power at significantly lower costs than other operating systems. An example is its compatibility with symmetric multiprocessing (SMP) machines. The idea behind SMP is that two or more equivalent processors on one machine will deliver better price/performance than a single processor machine with twice the rated processing power.

Because Windows NT is able to schedule system and application threads over multiple processors, applications such as RDBMS run very well with it. With an SMP system, you can significantly increase the performance of your servers for much less than the cost of adding machines. An SMP system reduces administration, because there are fewer servers to manage. With Windows NT, you can purchase as much processing power as you need now, while ensuring a smooth migration path for the future. Companies such as **Chevron Canada**, Nordstrom, 3M, and NASA are already developing solutions using this strategy.

Related Topics:

SMP is More Viable Under Windows NT Than Under Other Systems

Windows NT Does Not Force Your Organization To Take Unnecessary Risks

SMP is More Viable Under Windows NT Than Under Other Systems

SMP support is not unique to Windows NT. In fact, several versions of UNIX currently support SMP. The difference in the way SMP extensions are implemented with the two systems depends on whether the hardware and applications need to be modified in order to take advantage of multiprocessors. **More Technical Information on SMP**

With Windows NT Advanced Server, any multithreaded application can be distributed over multiple processors. Applications written to Solaris 2 or HP UX, however, must be written specifically to those systems, and are not portable across UNIX versions. Additionally, the threading itself is less reliable and robust under Solaris than Windows NT. UNIX graphic systems, such as X Windows and Motif, do not support multiple threads, nor are they **thread-safe**.

Another limitation with UNIX in terms of SMP is cost. In most cases, there are no hardware substitutes for machines that run systems such as Solaris 2 or HP UX, which means that you must accept the market limitations of having only a single hardware provider. Windows NT, however, supports hardware from many competitors. **See graph** Similarly, because Windows NT supports a broad range of multithreaded applications and can run on a wider array of hardware, software vendors are more likely to apply resources to Windows NT because their potential market is much larger.

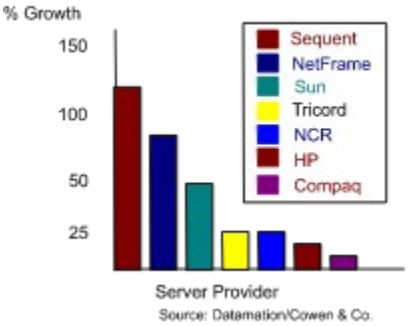
How Windows NT Architecture Supports SMP

Supported Windows NT SMP Systems

thread safe

a method that the system employs to ensure system integrity when code segments are used by multiple threads of execution

Percentage Growth in Current v. Future User by Supplier



This graph shows the projected growth for specialized network servers in existing NetWare environments. Currently, Windows NT comes pre-installed on all of these SMP servers except Sun and HP.

Windows NT Does Not Force Your Organization to Take Unnecessary Risks

Because of its portable design, Windows NT Advanced Server is able to run not only on Intel processor machines, but also on those supporting RISC, such as the MIPS R4000 and R4400, the Intergraph Clipper, and the new Digital Alpha chip. This is important because with new technologies from Digital, Intel, IBM and MIPS, it is not clear which chip architecture will deliver the best price performance. **See Table**

Whether your choice is Intel, Alpha, MIPS, or another chip architecture, however, Windows NT will provide consistent functionality and access to applications. Unlike UNIX and OS/2, hardware decisions with Windows NT do not limit access to applications, leaving you free to choose the best hardware and software for your organization.

What is the Most Cost-Effective Chip Architecture?

Chip	DEC Alpha 21064A-225	Integrated Device Technology R 4600	IBM Power PC 603	Intel Pentium P54C
Clock Speed	225 MHz	100 MHz	66 MHz	100 MHz
SPECfp92	205	60	70	85
System Due	Q4 '94	Q2 '92	Q4 '94	Q2 '94
Price	$877	$240	$300*	$900*

Source: PC Week * Estimates: Actual Price not yet set

Windows NT is Reliable

Application Servers must be reliable--there is no compromise when vital company information is at stake. When the **National Fuel Gas Supply Corporation** became concerned about the long term reliability of its OS/2 system, Windows NT provided a solution. Windows NT is designed to preserve data integrity, and includes these critical operating system components:

- **Complete hardware isolation**
- **Memory isolation**: at no time do 32-bit applications share memory with themselves or the operating system
- **Full government-standard C2-level security**
- **Built-in support** for **disk mirroring**, duplexing, **disk striping with parity**, and UPS support

More on Windows NT System Reliability

How SQL Server Uses Windows NT Thread Security

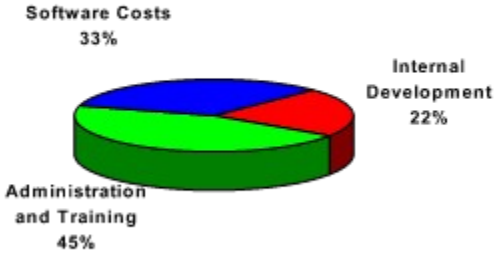
Windows NT is the Most Manageable Client-Server Platform

Recently, a Gartner Group study revealed the disproportionate costs of administration and training in delivering a solution to users. **See Graph** Windows NT is designed to facilitate system administration, providing one of the most comprehensive set of management facilities ever offered in an operating system. Graphical tools help administrators to centrally configure systems and users quickly and easily, and every management tool provided with Windows NT is fully remoteable across the enterprise, thus maximizing the talents and costs of administrators and help desk personnel.

What Makes Windows NT the Most Manageable Platform?

Why Applications Are More Easily Managed Under Windows NT

Cost of Delivering an Internally Developed Solution



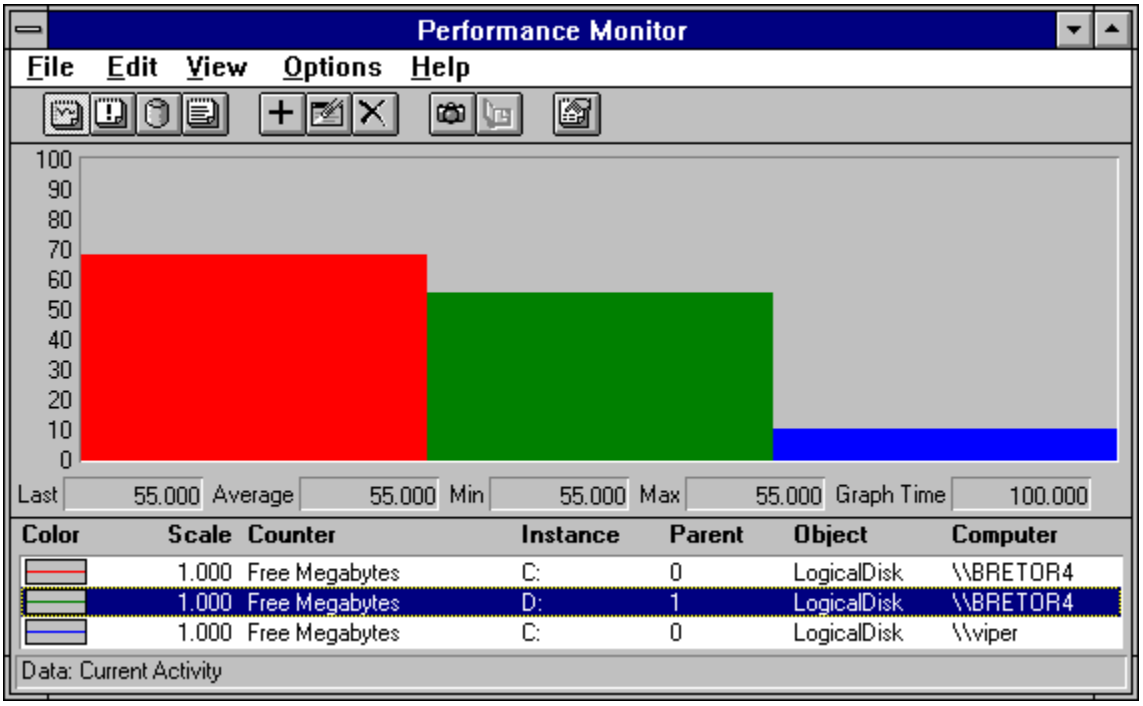
Source: Gartner Group

What Makes Windows NT the Most Manageable Platform?

Windows NT is easily managed from anywhere in the enterprise. It includes comprehensive graphical utilities to make this an intuitive process. The **Performance Monitor** is an excellent example. You can use this graphical tool to observe and record any significant measurable event or condition that exists within the Windows NT system. Because any management tool within the Windows NT system can examine both local and remote systems simultaneously, it is possible to track system performance of an entire enterprise. The resulting information logs are useful for capacity planning and hardware forecasting. Additionally, because management is inherent in the Win32 programming interface, any application can use these existing tools--there is no need to rewrite the same functions into the application itself.

More Information on Managing Windows NT Systems

Windows NT Performance Monitor



Why Applications Are More Easily Managed Under Windows NT

While it is imperative that the operating system provide comprehensive management facilities, it is equally important for the actual applications, such as RDBMS, to have intuitive and powerful tools. Because management is integrated into the Windows 32 programming interface, any application can use these tools. For instance, SQL Server for Windows NT uses both the Performance Monitor and Event Viewer to communicate valuable information to administrators. **More On SQL Server** The benefit of providing management functions in the Win32 programming interface is two-fold.

1. Administrators do not need to learn many different tools for each application, virtually eliminating the need to reconcile differences or limitations from one application to another.
2. Applications vendors will be less likely to re-invent management tools when efficient tools already exist.

In either case, the consumer is the ultimate beneficiary.

Windows NT provides a wide variety of services which can be accessed using any of a number of intuitive graphical tools. Every management tool, from the Registry Editor to the Performance Monitor, can be accessed directly by applications and all are fully remoteable across the enterprise.

More on Windows NT Management Tools

Windows NT Architecture

Complete architecture description

Inside the Windows NT Architecture

The Microsoft® Windows NT™ operating system uses sophisticated techniques, such as a microkernel architecture, structured exception handling, an internationalization model, and memory-mapped files.

The internationalization model provides an efficient way for developers to create multilingual applications. Structured exception handling is generally accepted to be one of the most effective and intuitive methods of dealing with error conditions.

For Additional Information:

Windows NT Concepts

Windows NT Structure

Internationalization

Structured Exception Handling

Windows NT Structure

Windows NT has two modes of execution: the **user mode** (the Windows NT **protected subsystems**) and the **kernel mode** (the **Windows NT Executive**). The user mode servers give the Windows NT Executive its user and programming interfaces and provide execution environments for various types of applications.

With minor exceptions, Windows NT does not appear to be a unique new operating system from a user's point of view. It looks like the Windows™ operating system and runs Windows-based programs. Underneath its user interface, however, it is radically different.

For Additional Information:

Logon Session

Native Services

Introduction to Windows NT Concepts

An operating system model is a broad framework that unifies the many features and services the system provides, and the tasks it performs. Windows NT uses a client-server model to provide multiple operating system environments (initially, Windows, MS-DOS®, OS/2®, and POSIX), and it uses an object model to uniformly manage operating system resources and dispense them to users. A third model, symmetric multiprocessing (SMP), allows Windows NT to achieve maximum performance from multiprocessor computers.

For Additional Information:

The Client-Server Model

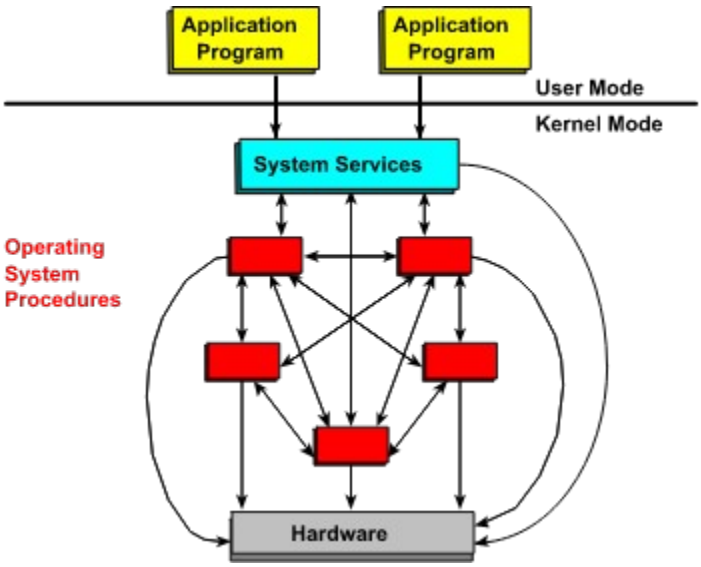
Windows NT Approach

Object Model

Symmetric Multiprocessing

Monolithic Operating System

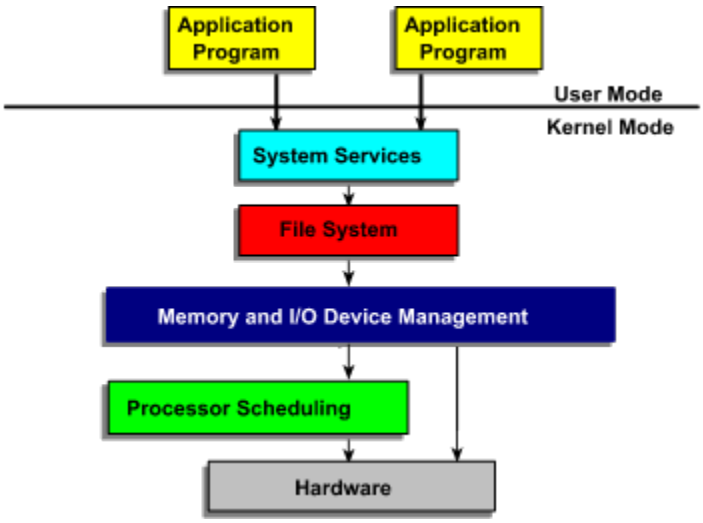
One structure, particularly common in smaller operating systems such as MS-DOS, organizes the operating system as a set of procedures and allows any procedure to call any other. This monolithic structure does not enforce data hiding in the operating system, and it embeds assumptions about how the system fits together throughout the operating system code. Extending such a system can be difficult, because modifying a procedure can introduce bugs in seemingly unrelated parts of the system.



In all but the simplest monolithic operating systems, applications are separated from the operating system itself. That is, the operating system code runs in a privileged processor mode (referred to here as kernel mode), with access to system data and to the hardware; applications run in a non-privileged processor mode (called user mode), with a limited set of interfaces available and with limited access to system data. When a user-mode program calls a system service, the processor traps the call and then switches the calling thread to kernel mode. When the system service completes, the operating system switches the thread back to user mode and allows the caller to continue.

Layered Operating System

A layered operating system is divided into modules that are layered on top of each other. Each module provides a set of functions that other modules can call. Code in any particular layer calls code only in lower layers. On some systems, such as VAX® or VMS®, hardware even enforces the layering (using multiple, hierarchical processor modes).



One advantage of a layered operating system structure is that each layer of code is only given access to the lower level interfaces (and data structures) that it requires, thus reducing the amount of code that has unlimited power. This structure also allows the operating system to be debugged starting at the lowest layer, adding one layer at a time until the whole system works correctly. Layering makes it easier to enhance the operating system; one entire layer can be replaced without affecting other parts of the system.

Client-Server Operating System

A client-server operating system is made up of several processes, each of which implements a single set of services. Each process can supply or demand services from other processes by making requests through the Executive.

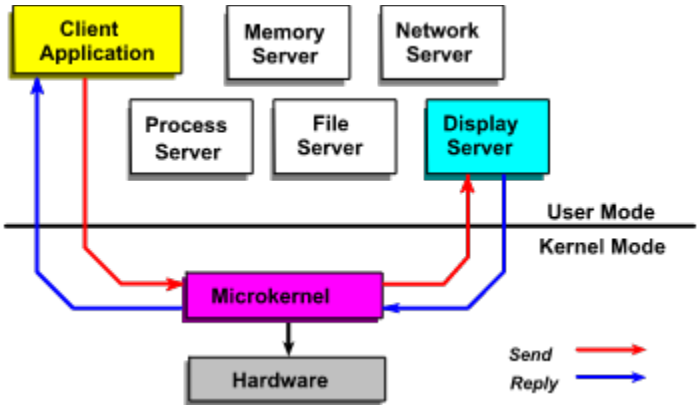
For Additional Information:

View Graphic

An Example of Client-Server Architecture Model

The Monolithic Model

The Layered Model


Client Application
Memory Server
Network Server
Process Server
File Server
Display Server
User Mode
Kernel Mode
Microkernel
Hardware
Send
Reply

An Example of the Client-Server Architectural Model

Each **server** runs in user mode, executing a loop that checks whether a client has requested one of its services. The **client,** which can be either another operating system component or an application program, requests a service by sending a message to the server. An operating system **kernel** (or microkernel) running in **kernel mode** delivers the message to the server; the server performs the operation; and the kernel returns the results to the client in another message.

The client-server approach results in an operating system whose components are small and self-contained. Because each server runs in a separate **user mode** process, a single server can fail (and perhaps be restarted) without crashing or corrupting the rest of the operating system. Furthermore, different servers can run on different processors in a multiprocessor computer or even on different computers, making the operating system suitable for distributed computing environments.

This theoretical model is an idealized depiction of a client-server system in which the kernel acts as a message-passing facility. In reality, client-server systems fall within a spectrum, some doing very little work in kernel mode and others doing more. **Example**

View Graphic

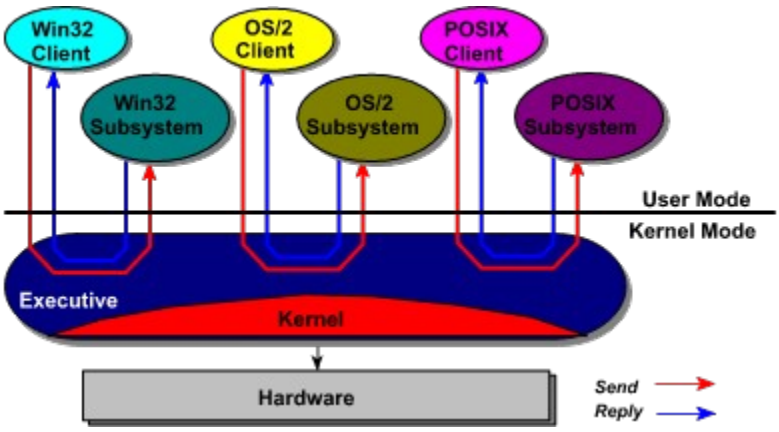
Example

The Mach operating system, a contemporary example of the client-server architecture, implements a minimal kernel offering thread scheduling, message passing, virtual memory, and device drivers. Everything else, including various application programming interfaces (APIs), file systems, and networking, runs in user mode.

Windows NT Approach

Windows NT uses concepts from both the layered model and the client-server model. The kernel-mode part of Windows NT is called the Windows NT Executive, which is a series of components that implements all of these functions:

- **Virtual memory management**
- **Object (resource) management**
- **I/O** and file systems (including network drivers)
- Interprocess communication
- Portions of the security system



Generally, these components interact with one another in a modular, rather than a layered, fashion. Each component calls the others through a set of carefully specified internal routines.

The layered operating system model is used in the Windows NT Executive I/O system and in the lowest parts of the Windows NT Executive: the **kernel** and the **hardware abstraction layer (HAL).** All other parts of the Windows NT Executive are layered on these two components. The Windows NT kernel performs low-level operating system functions such as:

- **Thread scheduling**
- **Interrupt and exception dispatching**
- **Multiprocessor synchronization**

It also provides a set of routines and basic objects that the rest of the Executive uses to implement higher-level constructs. The HAL manipulates hardware directly.

Windows NT uses the client-server model primarily to provide APIs and the facilities associated with an operating system environment. Although the Win32 protected subsystem (server) provides the user interface and is fundamental to the system's operation, the other servers "plug into" the Executive and can be loaded at will, with several in operation at a time. The servers communicate with application processes through a message-passing facility provided in the Windows NT Executive.

Object Model

It is difficult to identify a single "main program" that drives an operating system. Therefore, instead of attempting to design from the top down, object-oriented methods focus initially on the data that the software must manipulate to do its job. For an operating system, this means system resources like files, processes and blocks of memory.

The primary goal of designing a system around data is to create software that is easy to maintain. Because around 70 percent of software cost is attributable to maintenance, dramatic savings can be made if this goal is achieved.

One way in which object-oriented software helps maintenance is by hiding the physical representation of data within **objects.** Although not strictly an object-oriented system, Windows NT uses objects to represent system resources. Any system resource that can be shared by more than one process, including files, shared memory, and physical devices, is implemented as an object and manipulated by using object services. This lessens the impact of potential changes in the system over time. **Example**

In addition to limiting the effects of change, building an operating system based on objects has some distinct advantages:

- **Uniformity**
- **Security**
- **Resource Sharing**

Example

If a hardware change forces a change in the operating system, the only elements that must change are the object that represents the hardware resource, and the services that operate on the object; code that merely uses the object remains the same. Likewise, when the system needs to support new resources, a new object is created and added to the system without disturbing the existing code.

Uniformity

When the operating system accesses and manipulates its resources uniformly, it creates, deletes, and refers to an event object in the same way it does a process object: by using object handles. Additionally, because each resource is an object, the system tracks resource usage by monitoring the creation and use of objects.

Security

Security is simplified because all objects are protected in the same way. When someone tries to access an object, the security system intervenes and validates the operation, regardless of whether the object is a process, a section of shared memory, or a communication port.

Resource Sharing

Objects provide a convenient and uniform paradigm for sharing resources between two or more processes.

- Object handles are used to manipulate all types of objects.
- Two processes share an object when they each open a handle to it.
- The operating system can track how many handles are open to an object to determine whether the object is still in use.
- The operating system can then delete the object when it is no longer in use.

Symmetric Multiprocessing

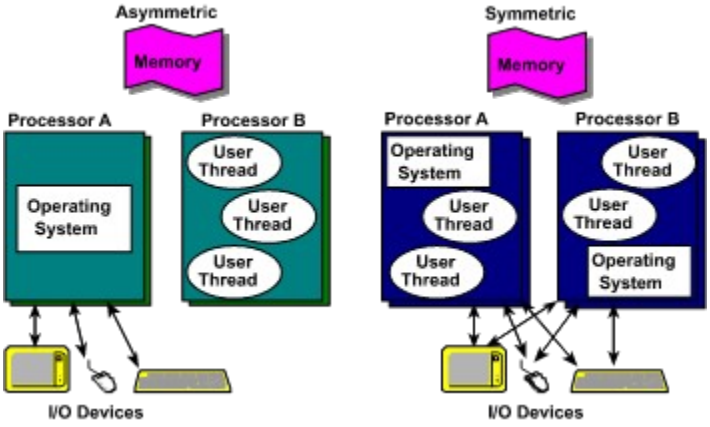
Multitasking is a way of running multiple tasks on a single processor. However, when a computer has more than one processor, the multitasking model must be upgraded to a **multiprocessing** model. A computer that has two processors can execute two threads simultaneously. In theory, the threads would finish executing twice as quickly as on a single processor.

There are two types of multiprocessing systems:

1. **Asymmetric Multiprocessing (ASMP)**
2. **Symmetric Multiprocessing (SMP)**

Comparison of Symmetric and Asymmetric Multiprocessing.

Comparison of Symmetric and Asymmetric Multiprocessing



Asymmetric Multiprocessing (ASMP)

ASMP operating systems typically select the same processor to execute operating system code while other processors run only user jobs. Because operating system code runs on a single processor, ASMP operating systems are relatively easy to create by extending existing single-processor operating systems. ASMP operating systems are especially well suited to running on asymmetric hardware, such as a processor with an attached coprocessor or two processors that don't share all available memory. However, it is difficult to make ASMP operating systems portable. Hardware from different vendors (and even different versions of hardware from the same vendor) tends to vary in its type and degree of asymmetry. Either the hardware vendors must target their hardware for specific operating systems or the operating system must be substantially rewritten for each hardware platform.

Symmetric Multiprocessing (SMP)

Symmetric Multiprocessing (SMP)

SMP systems, including Windows NT, allow the operating system to run on any free processor or on all processors simultaneously, sharing memory among them. This approach better exploits the power of multiple processors, because the operating system itself can use a significant percentage of a computer's processing time, depending on the applications it is running. Executing the operating system on only one processor can tax that processor, leave others idle, and decrease the system's throughput. As the number of processors on the system increases, operating system activities are more likely to become a bottleneck. In addition to balancing the system load, SMP systems reduce downtime because operating system code can execute on other processors if one processor fails. Finally, because symmetric hardware is implemented similarly from vendor to vendor, it is possible to create a portable SMP operating system.

Unlike ASMP systems, SMP systems are usually designed and written from the ground up because they must adhere to strict coding guidelines to ensure correct operation. Resource contention and other performance issues are more complicated in multiprocessing systems than in ordinary operating systems and must be accounted for in the system's design.

Windows NT incorporates several features that are crucial to its success as a multiprocessing operating system:

Preemptive Multitasking

Multithreading

Interprocess Communications

Asymmetric Multiprocessing (ASMP)

Preemptive Multitasking

This is the ability to run operating system code on any available processor and on multiple processors at one time. With the exception of its kernel component, which handles thread scheduling and interrupts, all operating system code can be preempted (forced to give up a processor) when a higher-priority thread needs attention.

Multithreading

Using multiple threads of execution within a single process is called multithreading. Threads allow one process to execute different parts of its program on different processors simultaneously. Server processes can use multiple threads to process requests from more than one client simultaneously.

Interprocess Communications

Convenient mechanisms for sharing objects between processes and flexible interprocess communication capabilities, including shared memory and an optimized message-passing facility

Protected Subsystems

Windows NT servers are called protected subsystems because each one is a separate process whose memory is protected from other processes by the Windows NT Executive. Because the subsystems do not share memory, they communicate by passing messages.

As the term "server" implies, each protected subsystem provides an **API** that programs can call. When an application (or another server) calls an API routine, a message is sent to the server that implements the API routine via the Windows NT Executive **local procedure call (LPC) facility**, a locally optimized message-passing mechanism. The server replies by sending a message back to the caller.

Windows NT has two types of protected subsystems:

Environment Subsystems

Integral Subsystems

Environment Subsystems

An **environment subsystem** is a user-mode server that provides an **API**, which is specific to an operating system. When an application calls an API routine, the call is delivered through the **local procedure call (LPC) facility** to the environment subsystem, which executes the API routine and returns the result to the application process by sending another LPC.

The most important environment subsystem is the Win32 subsystem, which makes the **Microsoft 32-bit Windows API** available to application programs. The Win32 environment subsystem also provides the Windows NT graphical user interface and controls all user input and application output. Windows NT also supplies:

- A POSIX environment subsystem
- An OS/2 environment subsystem
- A 16-bit Windows subsystem
- An MS-DOS subsystem

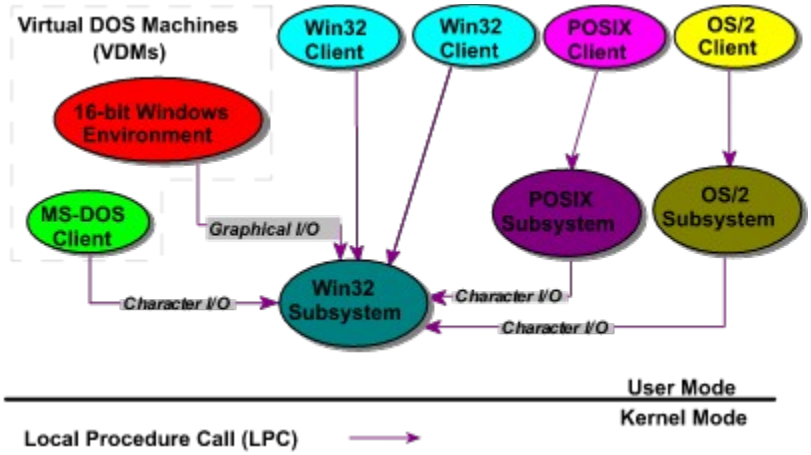
These subsystems provide APIs but use the Win32 subsystem to receive user input and display output.

More on Environment Subsystems

Environment Subsystems and Client Applications

More on Environment Subsystems

The environment subsystem provides the Windows NT user interface. It controls the video display, the keyboard, the mouse, and other input devices. In addition, it provides the **Win32 API.**



The Win32 subsystem does not control the execution of non-Win32 applications. When the user runs an application that the Win32 subsystem does not recognize, the subsystem determines what type of application it is and then either calls another subsystem to run the application, or calls code to initialize an MS-DOS environment in which to run the application. **Example**

Example

The Win32 subsystem supplies 32-bit Windows API routines, and the OS/2 subsystem supplies OS/2 API routines. Applications cannot mix API routines from different subsystems because each environment subsystem operates differently. A file handle created by the Win32 subsystem does not translate to the POSIX subsystem, for example. Furthermore, such hybrid applications would not run on MS-DOS, Windows, POSIX, or OS/2 operating systems.

Environment Subsystems and Client Applications

MS-DOS and 16-bit Windows run inside an environment subsystem called a **Virtual DOS Machine (VDM)**. VDMs are unlike other environment subsystems in that many of them can be running at one time.

Because the Win32 subsystem handles all video output, the other environment subsystems must direct the output of their applications to the Win32 subsystem for display. The VDM running 16-bit applications for Windows translates the applications' output calls into Win32 calls and sends them in a message to the Win32 subsystem for display. The OS/2 and POSIX subsystems, as well as any VDMs running MS-DOS-based applications, direct their applications' character-mode output to the Win32 subsystem, which displays the output in character-mode windows, called **consoles**.

An environment subsystem can support many client applications. Each subsystem keeps track of its clients and maintains any global information that all the client applications share. Although several subsystems and VDMs might be running, Win32 is the only environment subsystem that makes itself visible. To the user, it appears that Windows NT runs all the applications.

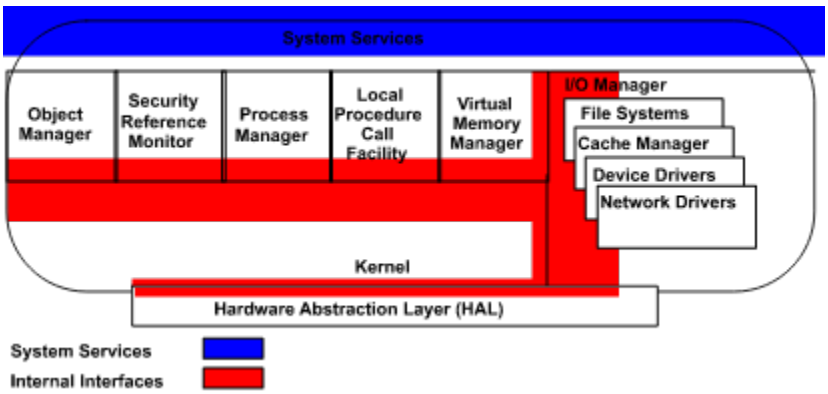
Integral Subsystems

Integral subsystems are servers that perform important operating system functions. An example of an integral subsystem is the **security subsystem.**

Several components of the Windows NT networking software are also implemented as integral subsystems. Two such components are the **workstation service** and the **server service**. Both of these **services** are user-mode processes that implement an API to access and manage the LAN Manager network **redirector** and server, respectively. The **server** sits on the remote machine and receives remote requests from the **redirector**. Both the LAN Manager redirector and the LAN Manager server are implemented as file system drivers.

Windows NT Executive

The Windows NT Executive is the **kernel mode** part of Windows NT and is a complete operating system without a user interface. The **Executive** is a series of **components**, each performing two functions: system services and internal routines.



Although the Executive provides API-like system services, it is fundamentally different from the environment subsystems. It does not run continually in a process of its own, but instead runs in the context of an existing process by taking over an executing thread when important system events occur. **Example**

Executive components maintain independence from one another, each creating and manipulating the system data structures it requires. Because the interfaces between components are carefully controlled, it is possible to completely remove a component from the operating system and replace it. As long as the new version implements all the system services and internal interfaces correctly, the operating system runs as before. Maintaining the operating system is also an easier task because the Executive components interact in predictable ways.

The Executive Manages the Following Components:

Kernel

Security Reference Monitor

Process Manager

Local Procedure Call (LPC) facility

Virtual Memory (VM) Manager

Object Manager

I/O System

Hardware Abstraction Layer (HAL)

Example

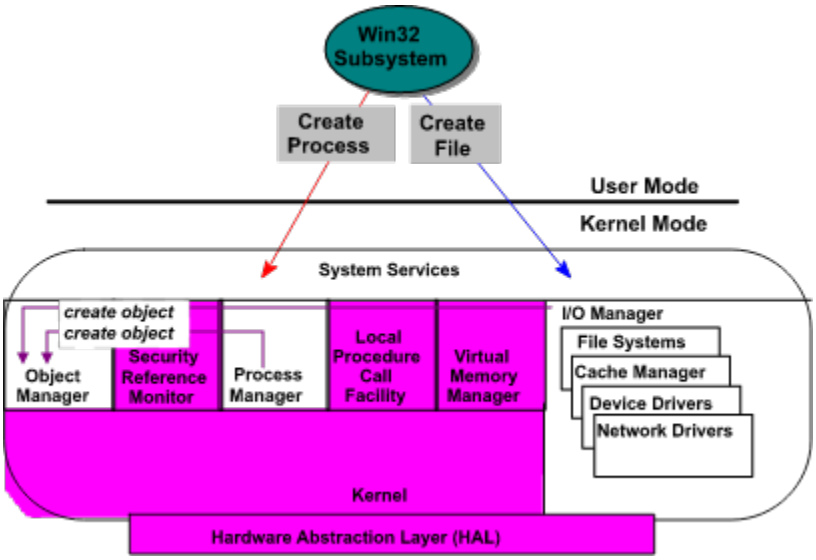
When a thread calls a system service and is trapped by the processor or when an external device interrupts the processor, the Windows NT kernel gains control of the thread that was running. The kernel calls the appropriate system code to handle the event, executes it, and then returns control to the code that was executing before the interruption.

Object Manager

The Object Manager creates, manages, and deletes Windows NT Executive **objects.** Many Windows NT native services are **object services,** meaning that they perform some action on an object in the Windows NT Executive. A **thread** opens a **handle** to an object and then uses that handle when calling services to operate on the object.

Shareable resources, including processes, threads, files, and shared memory, are implemented as objects in the Windows NT Executive. This allows the operating system to take advantage of the similarities among resources and to use common code wherever possible to manage them. The Windows NT object system is a focal point for several resource management tasks, such as resource naming, placing limits (called quotas) on the amount of resources each process can use, sharing resources between two processes, and securing resources against unauthorized access.

Environment subsystems frequently call object services to create, open a handle to, manipulate, or delete objects. **Example** Much of the Windows NT resource management takes place when some process creates an object or opens a handle to an object.



Objects are allocated from operating system memory. To keep any one process from using too much system memory, processes are given quotas that limit how much memory they can use.

As well as managing and sharing resources, the Windows NT object system is a focal point for resource security. When a process opens a handle to a Windows NT object, the Windows NT **security subsystem** is activated. Each object has attached to it a small database, called an **access control list (ACL),** containing information regarding which processes can access the object and what they can do to it. When a process opens a handle to an object, it specifies the operations it wants to perform. **Example**

Because a process must open a handle to an object before it can do anything to it and

because opening a handle invokes the security system, no process can bypass Windows NT security.

Example

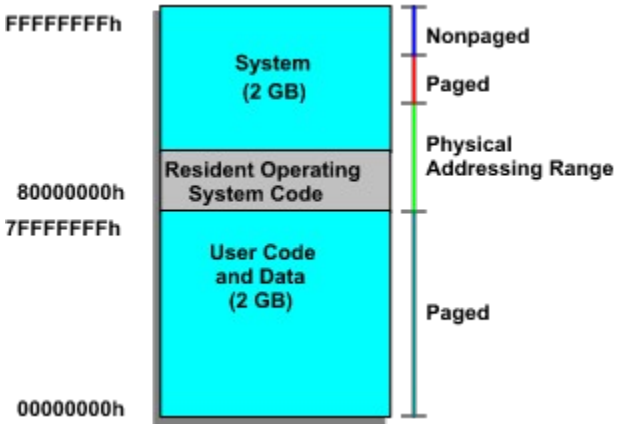
If the user starts a Win32-based application, the Win32 subsystem calls the Windows NT Process Manager to create a process and open a handle to it. The Process Manager, in turn, calls the Object Manager to create a process object and a thread object. Similarly, if the user saves data from the application, the Win32 subsystem calls the Windows NT I/O Manager to create a file object that represents the file in which the spreadsheet is stored and to open a handle to the object. The I/O Manager calls the Object Manager to do the job.

Example

A process opens a file for read access. The security system checks whether the process is allowed read access to the file object, and if so, the Object Manager returns an object handle containing read access. The caller can then use the handle to read from that particular file.

Virtual Memory (VM) Manager

Windows NT implements virtual memory (VM), a memory management scheme that provides a large, private address space for each process and protects it from other processes. When more memory is needed than there is available RAM, the VM manager transfers selected RAM contents to disk and reloads the contents when they are used again.This is called **paging**.



In Windows NT, application programs run in an operating system environment that behaves like Windows, MS-DOS, POSIX, or OS/2. The challenge is to allow all the different types of applications to run without being rewritten and without bumping into each other in memory.

Each of the Windows NT environment subsystems provides a view of memory that corresponds to what its applications expect. Underneath the environment subsystems, the Windows NT Executive has its own memory structure, which the environment subsystems access by calling Windows NT native services.

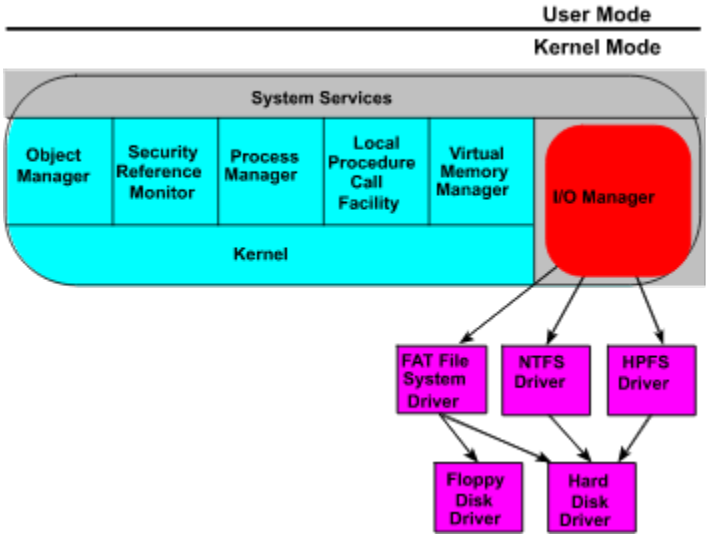
The Windows NT memory architecture is a virtual memory system based on 32-bit addresses in a flat (linear) address space. A process's **virtual address space** is the set of addresses available for the process's threads to use. At runtime, the VM manager, with assistance from hardware, translates, or maps, the virtual addresses into physical addresses, where the data is actually stored. By controlling the mapping, the operating system can ensure that individual processes don't bump into one another or overwrite the operating system.

The Windows NT operating system resides in high virtual memory and the user's code and data reside in low virtual memory. A user-mode thread cannot read or write to system memory directly.

A portion of the system memory, called **nonpaged pool**, is never paged to disk and is used to store some Windows NT objects and other important data structures. Another portion of system memory, called **paged pool**, is paged to disk. All of user memory can be paged.

I/O System and I/O Manager

A group of components that process input and output between a variety of devices. The I/O system includes the I/O Manager, and File Systems.



More on the I/O Manager and File Systems

More on the I/O Manager and File Systems

As with memory, environment subsystems provide whatever I/O facilities their applications expect. They implement those individual facilities by calling native Windows NT I/O services.

The native I/O system uses an **asynchronous I/O** model, but it provides system services that allow environment subsystems to use either synchronous or asynchronous I/O.

Windows NT supports multiple file systems, including the file allocation table (FAT), the **high performance file system (HPFS)**, and a new file system called the **Windows NT file system (NTFS)**. NTFS extends the capabilities present in both the FAT file system and the HPFS to add:

- **File System Recovery**, that allows for quick restoration of disk-based data after a system failure.
- **The Ability to Handle Large Storage Media**: approximately 17 billion gigabytes in size.
- **Security Features**, including execute-only files.
- **Unicode Filenames**, which allow documents to be transferred from one computer to another internationally, without disrupting filenames and pathnames.
- **Support for the POSIX Operating System Environment**, including hard links, case-sensitive names, and information about when a file was last opened.
- **Features for Future Extensibility**, such as transaction-based operations to support fault tolerant applications, user-controlled version numbers for files, multiple data streams per file, flexible options for file naming and file attributes, and support for popular file servers.
- **Network Redirector and Network Server** are file system drivers that send and receive remote I/O requests to a machine on the network.
- **Executive Device Drivers** are low-level drivers that directly manipulate hardware to write output to or retrieve input from a physical device or network.
- **Cache Manager** improves the performance of file-based I/O by storing the most recently read disk information in system memory. The cache manager uses the VM manager's paging facility to automatically write modifications to the disk in the background.

Hardware Abstraction Layer (HAL)

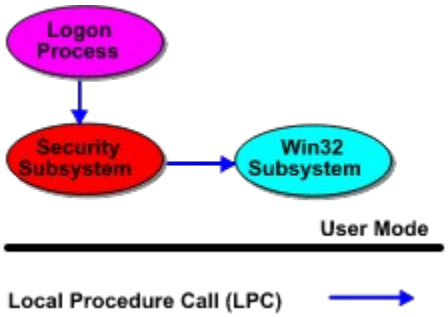
The HAL isolates the Windows NT Executive from the hardware platform on which Windows NT is running.

Rather than access hardware directly, Windows NT Executive components maintain maximum portability by calling the HAL routines when they need platform-dependent information.

Platform-dependent code (code that relies on a particular manufacturer's hardware implementation) is located in the HAL and is provided by individual computer manufacturers. Device drivers avoid processor-dependent and platform-dependent code by calling kernel routines and HAL routines.

Logon Session

Windows NT is a secure operating system that requires each user to establish an account and to logon to that account before they can use the system. Each user account has a security profile, which is a collection of security-related information stored in a system database. The **security subsystem** uses this information to verify that users are who they claim to be.



A security system process, called a **logon process**, waits for user input. Several logon processes can be active, each one monitoring a separate class of logon devices like a keyboard/mouse combination or a network connection. A **thread** in the process detects when a user attempts to access the system and prompts the user for an account name and a password.

The logon process then passes the user's information to the security subsystem, which checks the information against a security database. If the logon is authentic, the subsystem creates an object that uniquely identifies this user in all subsequent transactions. The object, called an **access token**, is the key to security in Windows NT: It determines which system resources the user's threads can access.

After the user's identity is established, the security subsystem creates a **process**, attaches the user's access token to it, and then passes the process to the Win32 subsystem, which runs the Win32 Program Manager in the process's address space. With that, the user has established a logon session. Windows NT supports both local and remote logons, and a server machine running Windows NT is likely to have numerous logon sessions active at the same time.

As soon as an interactive user successfully logs onto Windows NT, the Win32 subsystem takes control of the screen. Windows NT looks like, and is compatible with, Windows 3.1. With Windows NT, users can transparently run Win32-based programs and 16-bit Windows-based programs, as well as programs for MS-DOS, OS/2, and POSIX.

Native Services

Environment subsystems implement their API routines by calling Windows NT native services (the system services provided by individual components of the Windows NT Executive). The **virtual memory (VM) manager** supplies memory allocation and deallocation services, for example, while the Process Manager provides services to create and terminate processes and threads. When a subsystem calls a Windows NT native service, hardware detects the call and transfers control to the Windows NT Executive. The service then runs in **kernel mode**.

Because the native services are used by different environment subsystems, they must be: general, flexible and without side effects that might conflict with the environment subsystems. One way in which the native services are flexible is in their ability to act on any process the caller specifies. The caller supplies a handle to a process, and the service operates on that process. **Example**

Protected subsystems, DLLs, and components of the Windows NT Executive are the primary users of Windows NT native services.

Example

The subsystem can call a native service to create a thread or allocate memory for one of its client processes, because most normal processes cannot perform such operations on other processes. Environment subsystems have powerful access tokens that grant them control over their clients.

Internationalization

The goal for developers was to create a truly multilingual operating system, one that provides a solid foundation for developing and using international applications.

International support is streamlined in Windows NT, providing modular facilities for applications as well as for important system components such as the Win32 subsystem. The user interface to internationalization facilities will continue to evolve in future releases.

For Additional Information:

Windows NT Support for Locales

Windows NT Support for Unicode

Windows NT Support for Locales

A **locale** consists of a language, a country, and a **code set.** When installing Windows NT, you will select a language to use, after which you will be assigned a default locale. The default locale gives you culturally correct defaults for keyboard layout, sorting order, currency, and date and time formatting, any of which you can override.

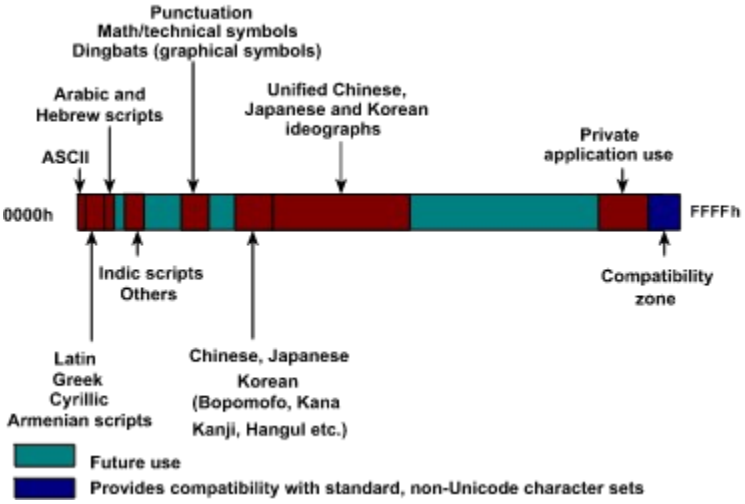
In multilingual countries such as Canada, Switzerland, and Belgium, users require the ability to switch among two or more languages on a regular basis. Moreover, some companies have divisions in which several different languages are routinely spoken. Ideally, each user should be able to switch among locales at any time or to send data among locales without losing information. To accomplish this, applications (and in this case, Windows NT) must be separated into two pieces: code, which can be used in all locales, and data, which must be translated for different locales.

In Windows NT, the data category consists of resources such as menus and messages. These resources are separated from the main body of the code and can be attached to or detached from Windows NT. When the user switches locales, the resource set changes to represent the new locale. Because the set of resources is much smaller than Windows NT itself, many different resource sets can be loaded at installation time--the user can switch between locales easily without loading new files from floppy disks. Moreover, a single Windows NT package can be shipped to all countries with localization support already built in. The only remaining task is to translate the resource files and the documentation.

To facilitate localization, the Windows NT Win32 subsystem provides a **national language support (NLS)** API that gives applications (and Windows NT) access to: culturally correct string comparisons, collation tables for sorting the characters of different languages, date, time, and currency formatting routines and routines for determining the locale that is in effect and the other locales present on the system. In addition, the NLS API provides routines to convert between the international code set used by Windows NT and other commonly used code sets. Both the Win32 subsystem and the C runtime library provide their own API routines based on NLS. Using these facilities allows applications to support localization with the minimum possible effort.

Windows NT Support for Unicode

The lowest layer of localization support is in the representation of individual characters, the code sets. The United States has traditionally employed the ASCII (American Standard Code for Information Interchange) standard for representing data. For European and other countries, however, ASCII is not adequate because it lacks common symbols and punctuation.



The International Standards Organization (ISO) established a standard **code set** called Latin1 (ISO standard 8859-1), which defines codes for all the European characters omitted by ASCII. Windows 3.1 uses a slight modification of Latin1 called the Windows ANSI code set. Windows ANSI is a **single-byte coding scheme**. The maximum number of characters that can be expressed using 8 bits is 256 (2 to the 8th power). The same **script** is often used for several languages. For example, the Cyrillic script is used for both the Russian and Ukrainian languages.

Windows ANSI and other single-byte coding schemes can encode enough characters to express the letters of Western scripts. However, Eastern scripts such as Japanese and Chinese, which need thousands of separate characters, cannot be encoded using a single byte. These scripts are typically stored using a double-byte coding scheme, or a multibyte coding scheme, in which some characters are represented by an 8-bit sequence and others are represented by a 16-bit, 24-bit, or 32-bit sequence. The latter scheme requires complicated parsing algorithms to determine the storage width of a particular character. Furthermore, a proliferation of different code sets means that a particular code might yield entirely different characters on two different computers, depending on the code set each computer uses.

To solve the problem of multiple coding schemes and to accommodate a more comprehensive set of scripts, Windows NT employs the new Unicode standard for data representation. Unicode, a 16-bit character-coding scheme, can represent 65,536 (216) characters. This is enough to include all languages in computer commerce today, as well as several archaic or arcane languages with limited applications (such as Sanskrit and, eventually, Egyptian hieroglyphics). Unicode also includes

representations for punctuation marks, mathematical symbols, and a set of graphical characters called dingbats, with plenty of room remaining for future expansion.

Unicode separates the "essence" of a character from the font and formatting information used to display it. Each code corresponds to one (and only one) character; font information is applied to Unicode characters to display them in various styles and shapes.

Although the Win32 subsystem provides both ANSI and Unicode string API routines, Unicode is the Windows NT native code set. All character strings in the system, including object names, pathnames, filenames, and directory names, are represented with 16-bit Unicode characters. Even the Win32 subsystem converts any ANSI characters it receives to Unicode strings before manipulating them; it converts them back to ANSI, if necessary, upon exit from the system.

Using Unicode removes all limitations on the set of characters that Windows NT can represent. Because Unicode establishes a unique code for every character of every script, Windows NT can ensure that the round-trip character translation, into and out of the system, is always accurate.

Structured Exception Handling

The second special architecture supported and used by Windows NT is called **structured exception handling**. Exceptions are synchronous errors or atypical events that cause the execution of code outside the normal flow of control. Unlike interrupts, which are generated from an external source, exceptions occur when a program executes a particular code sequence. Exceptions can also be reproduced.

Exception handlers and termination handlers can be used separately or in combination to achieve robust behavior in any application. Windows NT uses both to ensure robust behavior at all levels of the system.

For Additional Information:

Exception Handler

Termination Handler

Exception Handler

Structured exception handling is the way Windows NT processes hardware and software exceptions. With this technique, any block of code can determine which exceptions to guard against and register a special code sequence (the exception handler) to be executed if the exceptions occur.

Each block of code can have a separate exception handler, and exception handlers can even be nested within one another. When an exception occurs, the exception filter can test the type of exception and conditionally tell the operating system to execute the exception handler, continue the program, terminate the program, or look for an exception handler in an enclosing block of code.

Operating system exceptions aren't the only exceptions to which applications might want to respond. Applications can generate an exception using the Win32 API routine RaiseException(), causing control to transfer to a registered exception handler. The operating system supports this operation by registering exception handlers and searching for them in the proper order when exceptions are raised. If no exception handler takes care of the problem, the operating system terminates the program that caused the error. The Windows NT exception-handling facility is not language specific; a single mechanism is used across all languages, each language defining how the underlying exception-handling mechanism is exposed.

Termination Handler

A termination handler ensures that a particular block of code always executes, even if a guarded block of code terminates in an unexpected way. Termination handlers often contain code that frees allocated resources so that if a procedure terminates unexpectedly, the resources it allocated are released back to the system. **Example**

Example

A thread gains access to the **critical section**, allocates a buffer, and then modifies the buffer. If something goes wrong (an unhandled exception, perhaps) and causes the routine to terminate while the thread is in the critical section, any other thread waiting for the resource will be perpetually blocked. Furthermore, the buffer that the thread allocated will be lost, with the operating system unable to recover it. These errors are sometimes called memory leaks because If too many occur, available memory gradually "drains away". The termination handler ensures that the thread releases the critical section object and frees the buffer.

Windows NT: History and Development

Development of the Microsoft® Windows NT™ operating system began in 1988. This section examines the creation of Windows NT itself, the strategic move away from OS/2® Presentation Manager®, and how Dave Cutler and his development team built a modern 32-bit operating system based on a number of proven technologies, including VMS® and the Mach Kernel.

Designing an Operating System for the 1990s

As hardware technology advances, new computers with faster processors, more memory, and multiple processors are being introduced in swift succession, prompting operating system developers to extend their systems to take advantage of new hardware features. Innovative processor technology has rapidly emerged in both the **CISC** and **RISC** arenas.

In 1988, Microsoft recognized that it needed to produce an operating system that would exploit the ongoing advances of hardware technology. It needed to produce an operating system for the 1990s--one that was portable and moved easily between hardware platforms. Although Microsoft and IBM created the OS/2 operating system in the 1980s, Microsoft understood that the system had many shortcomings. For example, OS/2 is not portable. It was written in assembly language to run on single-processor, Intel® 80286 computers. Instead of overhauling the OS/2 system software, Microsoft decided to build a new, portable operating system from the ground up.

CISC

The Intel 80386 and 80486 chips, along with many other popular processors, are known as Complex Instruction Set Computer (CISC) chips. Their chief characteristic is a large number of machine instructions, each of which is elaborate and powerful. In the last few years, Intel has made major advances in the speed and power of its processors, and other manufacturers have developed multiprocessor machines based on the Intel CISC technology.

RISC

In the mid-1980s, the hardware industry created another type of processor architecture called Reduced Instruction Set Computer (RISC) chips. RISC chips differ from CISC chips primarily in the small number of simple machine instructions they provide. Because of the simplicity of their instruction sets, the RISC processors run at increased clock speeds and achieve very fast execution times.

The Creation of Windows NT

In the fall of 1988, Microsoft hired **David N. Cutler** to lead a new software development effort to create Microsoft's operating system for the 1990s. Cutler, a well-known architect of minicomputer systems, assembled a team of engineers to design the Microsoft's New Technology (NT) operating system. Early in 1989, Bill Gates and key Microsoft strategists met to review the operating system specifications that Cutler's group had defined. Their plans identified these primary market requirements for the new operating system:

Portability

Multiprocessing and Scalability

Distributed Computing

POSIX Compliance

Government-Certifiable Security

Dave Cutler

Prior to his work at Microsoft, Dave Cutler was a senior corporate consultant at Digital Equipment Corporation and had spent 17 years there developing a number of operating systems and compilers, including the VAX®/VMS® operating system, the MicroVAX I workstation and operating system, the RSX-11M operating system running on DEC's PDP-11 machine, and the VAX PL/1 and VAX C language compilers.

Portability

Hardware advances occur quickly and often unpredictably. For example, RISC processors represent a great departure from traditional CISC technology. Writing Windows NT in a portable language would allow it to move freely from one processor architecture to another.

Multiprocessing and Scalability

Applications should be able to take advantage of the broad range of computers available today. For example, computers with more than one processor appear on the market regularly, but few existing operating systems can fully employ them. Making Windows NT a scalable, multiprocessing operating system would make it possible for a user to run the same application on single-processor and multiprocessor computers. At the high end, the user could run several applications simultaneously at full speed, and compute-intensive applications could deliver improved performance by dividing their work among several processors.

Distributed Computing

The increasing availability of personal computers has irrevocably altered the nature of computing. Where once a single, large mainframe computer served an entire company, smaller and cheaper microcomputers have proliferated and are now standard issue for rank-and-file employees. Enhanced networking capabilities now make it possible for the smaller computers to communicate with one another, often sharing hardware resources such as disk space or processing power (in the form of file servers, print servers, or compute servers). To accommodate this change, developers of the Windows NT operating system would build networking capabilities directly into the operating system and would provide the means for applications to distribute their work across multiple computers.

POSIX Compliance

In the mid-to-late 1980s, U.S. government agencies began specifying POSIX as a procurement standard for government computing contracts. POSIX, an acronym rather loosely defined as "a portable operating system interface based on UNIX," refers to a collection of international standards for UNIX-style operating system interfaces. The POSIX standard (IEEE Standard 1003.1-1988) encourages vendors implementing UNIX-style interfaces to make them compatible, so that programmers can move their applications easily from one system to another. To meet the government's POSIX procurement requirements, Windows NT would be designed to provide an optional POSIX application execution environment.

Government-Certifiable Security

In addition to POSIX compliance, the U.S. government also specifies computer security guidelines for government applications. Achieving a government-approved security rating makes an operating system competitive in that arena. Of course, many of these required capabilities are advantageous features for any multi-user system. The security guidelines specify required capabilities such as protecting one user's resources from another's and establishing resource quotas to prevent one user from garnering all the system resources, such as memory.

The initial target for Windows NT security is the Class C2 level, defined by the U.S. Department of Defense as providing "discretionary (need-to-know) protection and, through the inclusion of audit capabilities, for accountability of subjects and the actions they initiate." This means that the owner of a system resource has the right to decide who can access it, and that the operating system can detect when data is accessed and by whom.

See Also:

U.S. Government Security Levels

U.S. Government Security Levels

These classifications extend from level D (least stringent) to level A (most stringent), with levels B and C each containing several sublevels. Although Windows NT would initially be written to support the C2 security level, enhancements in future releases could meet the more stringent requirements of higher security levels.

The Move from Presentation Manager to Win32®

Originally, the plan for the creation of Windows NT called for an OS/2-style user interface and the OS/2 application programming interface (API). However, midway through the development of the system, Microsoft Windows version 3.0 finally achieved the critical mass from both users and developers lacking in OS/2. Recognizing this marketplace mandate and the complexities involved in enhancing and supporting two incompatible operating systems, Microsoft decided to alter its course and direct its energy toward a single, coherent operating system strategy.

This strategy was to produce a family of Windows™-based operating systems that supported computers from the smallest notebooks to the largest multiprocessor workstations. Windows NT, as the next-generation Windows operating system is named, takes its place at the high end of the Windows family. It has a Windows graphical user interface and is Microsoft's first Windows-based operating system to supply the **Win32 API**, a 32-bit programming interface for new application development. The Win32 API makes advanced operating system capabilities available to applications through features such as:

- **Multithreaded processes**
- **Synchronization**
- **Security**
- **I/O**
- **Object management**

Integrating Windows NT with Banyan Vines

The Microsoft® Windows NT™ operating system integrates seamlessly as either a client or server into a Banyan Vines network. Banyan's networking software provides access to information from any desktop to any network resource in a global enterprise. With Windows NT, it integrates hosts, terminals and workstations into a single, manageable network over which information can be transparently exchanged across the globe.

A Windows NT-based client, can take advantage of Banyan's enterprise network services including the Global Directory (StreetTalk III), Intelligent Messaging and Security.

As an applications server, Windows NT can run client-server applications such as Microsoft SQL Server. Because Windows NT was designed to use the VINES Internet Protocol, a Banyan client workstation can access server applications running on Windows NT workstations on the same network.

In general, a Banyan client running Windows NT is integrated into a Banyan network in the same way as a Windows 3.1 client. Specifically, a Banyan client running Windows NT can take advantage of Common Login, giving you the ability to use a single username/password to automatically log on to the Banyan network through your Windows NT login. A single Banyan/Windows NT workstation provides complete access to multinetwork vendor print and file resources.

For More Information:

Banyan Systems Bulletin Board Service:	**(508) 836-1834**
CompuServe	**Go Banyan**

Baxter Healthcare Corporation

Intending to provide the best distribution in the business, Baxter Healthcare Corporation teamed up with a Microsoft Solution Provider to develop an innovative Warehouse Management System built around the Microsoft® Windows NT™ operating system. The system is expected to help Baxter respond better to its customers' changing needs, which should improve the company's competitiveness.

Baxter Healthcare Corporation Case Details

Baxter Healthcare Corporation provides hospitals with 120,000 different products--from sheets to heart valves. The company estimates that it supplies 70 percent of what a typical U.S. hospital buys.

As part of Baxter International, the world's largest health care supplier, Baxter's strategy is to provide the "undisputed best service" to hospitals by satisfying their needs better than anyone else. One critical need all hospitals share is cost control, especially in light of the national move for health care reform. Don Schoen, Baxter's manager of Distribution Operating Systems, says improved distribution is one way Baxter can help its customers control costs. "By making our distribution more efficient, we can keep costs low," he says.

As part of a bold move to enhance its distribution processes, Baxter developed a plan to improve its warehouse facilities, operating concepts, and system tools. Next, the company looked for the computing solution that would make the system it envisioned a reality.

Business Objectives Dictate High-Performance Solution

Baxter had several goals for the new generation of system tools that would support its 60 nonautomated distribution centers across the country. These goals included improving the centers' abilities to respond flexibly to customer requirements for enhanced distribution services; managing and controlling inventory; effectively utilizing space; improving material handling efficiency; and facilitating the monitoring and management of quality throughout the distribution process. **Excellent goals**--but how could Baxter achieve them without sacrificing its existing investment in its growing enterprise-wide LAN-based computing system?

Microsoft Solution Provider Contributes Specialized Skills

That's the question Schoen brought to MIDAK International, a Microsoft Solution Provider. The Tucson, Arizona-based systems developer specializes in Windows-based **client-server** computing. MIDAK's vice president of Development, Armand Sperduti, says his company had been doing its own strategic evaluations. "Our goal as developers is to do everything under a common architecture," says Sperduti. "We need the integrity of a server-based operating system we can work with into the future. After much testing and research, we decided Windows NT is that operating system." MIDAK had been using OS/2®.

Baxter was also pursuing the Windows NT operating system, so the two companies enjoyed an immediate rapport. Baxter and MIDAK agreed the Windows NT architecture offered them a number of appealing features, including remote supportability of the servers; integration between SQL Server for Windows NT, Windows NT Advanced Server, and Windows NT Remote Access Service (RAS) support; multiple **domain** administration; and compatibility with Baxter's existing LANs.

"If the system went down for a day, we'd be out of business. Obviously, we're placing a lot of trust in the stability of Windows NT."

"Being the best in distribution commits you to effective integration with the rest of your business. This system gives us this kind of integration."
Don Schoen, Manager of Distribution Operating Systems, Baxter Healthcare Corporation

A Multifaceted System

MIDAK and Baxter split the project into two phases. The first phase was an inbound system that would track products as they arrive at each regional warehouse and are moved into storage locations. The second phase involved streamlining the process of shipping products to customers.

In the first phase, product information from Baxter's IBM® 3090 mainframe is downloaded to the warehouse's LAN running Microsoft LAN Manager, Windows NT, and SQL Server for Windows NT. MIDAK is providing a radio-frequency terminal interface to the database, so Baxter warehouse personnel can receive and enter information from anywhere in the warehouse--a wireless computer network.

Each time a remote radio-frequency terminal is turned on inside the warehouse, MIDAK's RF multiplexer software receives a code and becomes that client's server--in effect, all remote units each have their own "server," thanks to the **multithreading** and **multitasking** capabilities of the Windows NT operating system. Warehouse workers use these remote units to scan product bar codes and send the information to the SQL Server for Windows NT database.

Confidence in Windows NT

Since Baxter was making a substantial investment--the distribution system would ultimately be installed in 60 warehouses nationwide--the company wanted to be certain of a good return on that investment. MIDAK's confidence in Windows NT helped convince Schoen's group at Baxter that the operating system would offer years of pay-back, and would provide a long-term strategic platform. The company has been extremely satisfied with the performance and stability of Windows NT during the initial stages of the project.

Benefits Expected to Exceed Objectives

Baxter is confident that its distribution system will meet its objectives--and then some. "We believe the system will allow us to provide improved service, reduced turnaround times, and lower costs," says Schoen.

Beyond these core benefits, Baxter expects the system to allow the company to improve its response to special requests while fulfilling a number of warehouse administrative functions.

Developing a Company's Future Around Windows NT

With the first phase of the distribution system set to go into a pilot location, Baxter has started work on the second phase. It will focus on optimizing product storage and shipping.

And Schoen says the company is already planning to apply Windows NT and SQL Server for Windows NT technology in other areas.

Schoen says Baxter is committed to leading the health care industry in its distribution capabilities. "It's clear to me that our Windows NT-based Warehouse Management System is a key element in accomplishing what weve set out to do--provide the best distribution services in the business," says Schoen.

Baxter Healthcare Corporation Solution Summary

Industry
Health care

Business Solution
Warehouse Management System

Architecture
Wireless computer network using radio frequency input devices to report product information to Microsoft SQL Server for Windows NT and Windows NT

Products Used
Microsoft SQL Server for Windows NT
Microsoft Visual Basic(TM)
Microsoft Visual C++(TM)
Microsoft Windows NT
Microsoft Windows NT Advanced Server

Development Resources
MIDAK International, a Microsoft Solution Provider specializing in Windows-based client-server computing

Development Time
Design process, three months; first phase of development, approximately five months

Benefits
Improved customer service, reduced delivery times, and lower distribution costs

Reference Books For Windows NT

Microsoft Press provides a range of books on programming and technical topics that assist technical professionals through the planning, design, and implementation phases of the development project life cycle. Microsoft Press books provide systems integrators and solution developers with useful information that sharpens programming skills and helps reduce development and debugging time. For support professionals, Microsoft Press provides comprehensive reference and how to information.

Microsoft Press publishes over 100 titles that contain thorough, reliable, and timely information on Microsoft applications, operating systems, and languages. These books provide a direct connection to the best and most reliable technical information sources: Microsoft development teams, programming experts, and some of the most capable writers in the industry. Many Microsoft Press books include disks with online reference information, utilities, and source code.

Inside Windows NT

By: Helen Custer
Foreword by: David Cutler
Price: $24.95 ($32.95 Can.)
Length: 416 pages
ISBN: 1-55615-481-X

An accessible, inside look at the design, philosophy, and architecture of the revolutionary next-generation operating system that will bring into mainstream computing once-exotic concepts: microkernel architecture, object-based security, built-in networking, and client-server subsystems. Written by a member of the Windows NT development team, this book reads like a wide-ranging, in-depth discussion with the Windows NT developers.

Windows NT Answer Book

By: Jim Groves
Price: $16.95 ($21.95 Can.)
Length: 224 pages
ISBN: 1-55615-562-X

A fact-filled guide that provides complete, straightforward answers to the most commonly asked questions about Microsoft Windows NT. The question-and-answer format provides accessible coverage of all relevant topics for making the decision to move to Windows NT, installing Windows NT, and implementing Windows NT. Topics include:

- Hardware requirements
- File format systems
- Compatibility with other operating systems

What happens to existing files and applications when Windows NT is installed

The differences between Windows NT, Windows 3.1, UNIX, and OS/2

How to use Windows NT security features

How to plan a Windows NT network

How to share resources How to revoke a user's privilege

Microsoft Windows NT Step by Step

By: Catapult, Inc.
Price: 29.95 ($39.95 Can.)
Length: 300 pages with one 3.5" disk
ISBN: 1-55615-573-5

Self-paced training developed by professional trainers, for those who don't have the time for instructor-led training. With disk-based tutorials, follow-along lessons, and practice exercises, this book-and-disk package is a complete self-training course for beginners and a guide to learning specific skills for intermediate users. Lessons include starting NT, working at the desktop, running applications, managing files, using built-in accessories, securing your system, and sharing information within a group. Available September 1993.

Running Windows NT

By: Craig Stinson
Price: $27.95 ($37.95 Can.)
Length: 600 pages
ISBN: 1-55615-572-7

Comprehensive reference to the features and compatibilities of Windows NT, from installation to customization. Running Windows NT is truly a "look under the hood" for the new Windows NT user with helpful tutorials, great examples, advanced information, and insightful tips on running Windows NT. Useful workgroup solutions are also featured throughout the book, including using Mail to send electronic documents, sharing documents, using NT on a network, and using NT security features to protect data. Available September 1993.

Advanced Windows NT

The Developer's Guide to the Win32 Application Programming Interface
By: Jeffrey M. Richter
Price: $39.95 ($53.95 Can.)
Length: 660 pages with one 3.5" disk
ISBN: 1-55615-567-0

Advanced Windows NT is the reference for Windows programmers who want to make the jump to Windows NT programming. It concentrates on the core areas of Windows NT programming, insightfully analyzes what's new and different about Windows NT,

and provides programs that put those insights into action. Each chapter tackles a specific Windows NT programming topic and how programmers can exploit the feature or mechanism in their programs. Most chapters include a full sample program in C that demonstrates the pertinent programming techniques. This book will transform any experienced Windows programmer into a ready-to-roll Windows NT programmer. Available October 1993.

Microsoft Windows NT Resource Kit

By: Microsoft Corporation
Price: $109.95 ($148.95 Can.)
ISBN: 1-55615-602-2

The Microsoft Windows NT Resource Kit is the one-stop solution resource packed with the technical information and tools you need to support installation of Windows NT in your office. The kit includes the Resource Guide, Messages, and Optimizing Windows NT.

Three-volume set boxed with eight 3.5" disks and one CD-ROM

Available October 1993. Each volume is also available separately.

Microsoft Windows NT Resource Kit Vol. 1: Windows NT Resource Guide

By: Microsoft Corporation
Price: $49.95 ($67.95 Can.)
Length: 950 pages with four 3.5" disks
ISBN: 1-55615-598-0

This complete technical guide to Windows NT includes information about installing, configuring, customizing, and troubleshooting Windows NT. It also includes information on applications compatibility and migration from Windows 3.1, MS-DOS, OS/2, and LAN Manager using the built-in accessories; networking; and using database services with Windows NT. The four disks include a number of tools, utilities, and value-added software, including tools to manage users and groups of servers, a computer profile setup to easily set up large groups of workstations, an adapter card Help file, and an online registry database. Available October 1993.

Microsoft Windows NT Resource Kit Vol. 2: Windows NT Messages

By: Microsoft Corporation
Price: $39.95 ($53.95 Can.)
Length: 600 pages with three 3.5" disks
ISBN: 1-55615-600-6

An alphabetical reference and online database that provides in-depth, accessible discussions about Windows NT and Windows NT Advanced Server messages. The messages have been loaded into a Microsoft Access database with a simple user interface. This enables the user to search the database, add personal notes under a message, back up the database, and print a selected group of messages. Included with the book are three disks containing a run-time version of Microsoft Access and the

Messages database. Available October 1993.

Microsoft Windows NT Resource Kit Vol. 3: Optimizing Windows NT
By: Microsoft Corporation
Price: $34.95 ($46.95 Can.)
Length: 350 pages with one 3.5" disk
ISBN: 1-55615-619-7

The complete guide to Windows NT bottleneck detection and capacity planning for the desktop and network. Also includes information on designing and tuning your Windows NT applications for high performance. Included with the book is one 3.5" disk full of software accessories and utilities for troubleshooting, fine-tuning, and optimizing PC performance. Available October 1993.

Chevron Canada

Chevron Canada designed a streamlined **client-server**-based pricing system to keep the company competitive in the oil industry. Today, a pricing process that used to take days to complete can be wrapped up in less than an hour. And the improvement in communication between departments and sites was another key benefit.

Solution Summary

Case Details

For More Information

Chevron Canada Solution Summary

Industry
Oil refining and marketing

Business Solution
Pricing

Architecture
Client-server

Products Used
Microsoft Access®
Microsoft Windows NT Advanced Server
DCA®/Microsoft Communications Server
Microsoft LAN Manager
Microsoft MS-DOS®
Microsoft SQL Server
Microsoft SQL Server for Windows NT
Microsoft Visual Basic
Microsoft Windows
Microsoft Windows NT
SNA Servers
Sybase® APT Programming Language

Development Resources
Ten-person development team; two years

Development Cost
$2 million Canadian for development costs, $600,000 of which was spent on pricing system

Benefits
Chevron Canada reduced the time necessary to make global pricing changes from 10 days to 55 minutes. Marketing is more aware and accountable for the profitability of each account.

Chevron Canada Case Details

Since the 1960s, Chevron Canada had relied on their parent company's mainframe in San Francisco to help determine prices for the Canadian market. The British Columbia-based oil refining and marketing company calculated pricing for each transaction manually, factoring in customer history, the competitive situation, and the crude oil rate established by the Canadian government. After a profit analysis was completed on paper, order-entry people wrote the suggested number on an unpriced invoice. Then it was keyed in by the Finance Department and batched to San Francisco that night for processing. Though the process was slow and the resulting prices inconsistent, in a regulated marketplace there was little incentive to change.

Deregulation came in 1985. Suddenly, Chevron Canada faced a new set of competitive pressures. Under the regulated system, rates had been both artificially low and comfortably stable, changing only once every quarter. Now, as prices shot up six dollars a barrel or more, conservation efforts intensified; Chevron and its competitors had to scramble for a share of the smaller pie. What's more, their customers rapidly became more sophisticated as world pricing took effect. Chevron was fighting for its place in a global market.

It was this intense competition that caused Chevron to streamline its pricing system to be more cost-effective. Because it lacked flexibility, the remote mainframe could not handle the overheated information climate of the post-1985 oil business: prices that changed by the hour; a diverse customer base that included farming, forestry, mining, trucking, airlines, and marine industries, each with a unique set of needs; and a service area that stretched from Alberta to the Yukon, requiring flexible, localized decision making.

Chevron Canada developed a two-tiered response to the crisis. The short-term fix was to hire more clerks to handle pricing exceptions and retroactive price adjustments. Then, in early 1989 the company launched a long-term program that they hoped would dramatically reduce the need for exceptions and adjustments: they formed a task force to select and implement a new computer system designed to take Chevron Canada into the '90s and beyond.

A Client-Server System That Rethinks Conventional Ways of Working

The task force knew that finding ways to streamline the existing pricing process was critical to the success of any new information system. There was a benefit in starting with such an outdated system: since the company hadn't invested in the existing system in 20 years, the task force now had the luxury of starting virtually from scratch and building the ideal solution.

As the task force began its research, a distinct personality trait began to emerge: the group was not afraid to challenge conventional wisdom. They began to look for a system that would not only solve their immediate needs, but would also give them a competitive advantage in the future.

The task force itself consisted of end users, such as marketing and finance representatives, who would actually be using the new system, as well as technical staff who would be supporting it. Therefore, the task force focused on issues like usability, interface intuitiveness, reporting simplicity, and decision-support capabilities, while still considering critical issues like raw power, reliability, and compatibility.

The solution they chose is a client-server system running three Microsoft® SQL Servers on a Microsoft network. An IBM® 295 "super server" handles all transaction processing, including the pricing module. A second super server is dedicated to decision support, covering the reporting and query side of the sales system. It maintains a database that acts as a snapshot of all historical transactions that took place up to the previous day. The design of this overall solution makes up-to-the-minute information from either super server easily accessible by all 200 users--regardless of their department or location--from any Windows™ client desktop.

When the system first went live in 1992, it ran OS/2® on both clients and servers, with the plan to evolve toward Microsoft's future system strategy. As the technology community began to focus more on the Microsoft Windows operating system, it was easy for Chevron Canada to migrate to Windows, with no interruption in service. Today, the system configuration shows OS/2 and SQL Server running on the database servers, Microsoft LAN Manager on multiple departmental file servers, and Microsoft Windows on most of the clients. In order to implement the next step in its planned migration, Chevron will move to the Windows NT operating system platform on the server side this year.

When the project first started, Chevron received advice from consultants that it would take at least 50 person years to complete the work. But from the time they started writing code, it took a ten-person development team two years (approximately 20 person years) to put the pricing and order-entry components of the system into place, along with the Customer Master, the kernel of the system that contains all account information. Chevron's internal IS people worked with two Calgary, Alberta, consulting firms to develop the system. The primary development tools were Sybase® APT and the Microsoft Visual Basic™ programming system. Development costs were $2 million Canadian ($1.55 million U.S.) of which the pricing component required approximately $600,000 Canadian ($465,000 U.S.).

Faster Pricing, Greater Accuracy

"Marketing can look at the current status of a customer's pricing online, so they are more aware and accountable for an account's profit history. They are empowered with the information they need to make decisions."

Bill Soper, Manager of Information Services

"Designing this new system was critical for us to remain the market leader in our industry," says Bill Soper, Chevron Canada's manager of Information Services.

Today, pricing for 300 products at 70 supply points is all handled online by seven

people in the marketing department at Chevron's Vancouver-area headquarters. The profitability analysis that used to be done on paper and batched to the mainframe is now done on-site.

There, the marketing group can access a customer's pricing status instantly, online. This crucial information could only be found in paper reports under the old system. Prices can now be changed globally or selectively, by supply point. And because new prices are now input by the people responsible for the account, there are fewer delays and fewer errors in transposition. What's more, the shift in responsibility from finance to marketing puts information and accountability in the hands of people who affect the company's profitability most directly.

The numbers showed that the new system gave Chevron a competitive advantage. Moving to a client-server system resulted in an estimated 65 percent overall reduction in paper handling for Chevron Canada.

Shortening the billing cycle puts money in the bank for any company. Chevron Canada's billing cycle used to be 14 days long. The task force forecasts that they will reduce it to 12 days by the end of summer '93. Their goal is to tighten it even more, estimating that a one-third reduction would save $170,000 per month in carrying charges.

The numbers in the pricing area are equally impressive. When the system depended on handwritten information, a global price change on some products took 10 days to complete. Today, under the client-server system, those same changes take just 55 minutes.

Similarly, tax changes that took 15 days under the old system are now done in just two days.

Fewer transposition errors and faster pricing updates mean fewer retroactive price adjustments. While customer demand will always require some adjustments, they are handled with maximum efficiency today: where it once took half an hour *apiece* to do 90 price adjustments, the staff now completes 90 in half an hour.

The Future Looks Like Windows NT™

To ensure that Chevron's information system would keep working for them well into the future, the task force had to build in flexibility. They designed a system that could take advantage of technological advances as they happen, including a planned migration to Windows NT.

As a beta test site for Windows NT, Chevron Canada experienced many of the advances Windows NT offers. For instance, creating a database took 25 minutes under Windows NT, versus 45 minutes in OS/2--a productivity increase of 180 percent. A 250-MB sales database took one hour to load in OS/2, but only 13 minutes with Windows NT--a 462 percent productivity gain.

Another demonstrated advantage of the Windows NT platform is its ability to double the number of users served (compared to OS/2's capacity) with no deterioration in performance. Moreover, the **multitasking** capability built into Windows NT speeds up information processing and enhances efficiency. For example, Windows NT allows an end user to run more than one productivity application at the same time--in this case Microsoft Word for Windows and Microsoft Excel. That user can achieve better application integration performance particularly cutting and pasting and "hot linking" information between the applications--than when running the same two programs under OS/2.

For the database administrator, SQL Server for Windows NT brings a new level of manageability to Chevron's servers. For example, Chevron uses the **built-in administration tools** in Windows NT to monitor SQL Server connections and to centrally manage security for all servers.

Chevron Canada's migration from OS/2 to Microsoft Windows on the client side has already demonstrated the system's ability to adapt to changing technology. The move to Windows NT is the next logical step in a planned evolution, as business needs are redefined and the industry continues to offer new options. Chevron will be implementing scaled-down versions of its head-office LAN at other sites in the future. Some sites will have single Windows NT machines that will run SQL Server and business applications simultaneously. Other sites will have a combination of Windows NT and servers based on the Windows NT platform that will communicate with the central enterprise servers and keep all databases in sync.

In 1989, Chevron Canada had the vision to redesign their pricing system in order to remain at the forefront of their industry. Today, because of the task force's hard work and the open-minded response of their peers, the company is a leader in the shift to a technology that helps people work together more intelligently. What's more, it remains the leading retailer of gasoline in British Columbia.

An Overview of Client-Server Computing

A range of emerging business needs has placed new demands on computing systems in recent years. Businesses want to improve enterprise-wide access, management, and distribution of information to maintain their competitive advantage. In an effort to improve price/performance ratios, they are using smaller, less-expensive, networked personal computers to take over tasks traditionally performed by larger, more costly minicomputers and mainframes.

At the same time, new technologies such as the Intel® Pentium™, MIPS R4x00, and DEC® Alpha AXP microprocessors have made more powerful computing models possible. Advances in communication devices, such as fiber optics, eliminate potential network bottlenecks. Graphical user interfaces (GUIs), like Microsoft Windows™, make computers more accessible and easier to use, minimizing training and support costs.

Client-server computing offers a key to solving the enterprise-wide computing needs of corporate, government and other organizational computer users. It offers flexible integration of disparate systems, and it provides organizations with an effective solution for a smooth upgrade path to the future.

The Benefits of Client-Server Computing

Requirements for Client-Server Computing

The Benefits of Client-Server Computing

Businesses are moving to client-server systems for **increased productivity**, **lower operating costs**, the **enabling of new applications**, **efficient management**, and **enhanced network performance**. A Forrester Research survey lists the leading business-critical, client-server applications as: customer service, inventory, human resources, sales and marketing, and order entry.

Sixty-nine percent of corporate computing respondents in a 1992 Dataquest survey said that they already have PC-based servers in place for client-server computing. Two-thirds of corporate computing professionals said they have implemented or intend to implement client-server computing within the next two years.

(Source: May 1993 survey by the Business Research Group (BRG) Business Research Group, User Implementations of Client-Server Computing).

Increased Productivity

You gain immediate access to up-to-date corporate data when you need it, without compromising security. In addition, you can use familiar tools, such as spreadsheets and database systems, to access data. A consistent graphical user interface reduces training and learning time. By integrating client-server applications with personal productivity applications, you can quickly build customized solutions to meet changing needs. Client-server systems are quicker to deploy than mainframe/minicomputer systems.

Lower Operating Costs

According to BRG, cost is the greatest motivator for businesses moving to client-server computing.

- Client-server systems are less expensive to deploy than traditional mainframes and minicomputers. They reduce hardware, system, and software maintenance costs.
- User-friendly graphical interfaces implemented with client-server systems reduce training costs.
- Existing systems can be incorporated into a client-server system. For example, older PCs can add processing power to the network; expensive servers and peripheral devices (printers, for example) can be shared across a large base of clients, and collections of PCs can do the work of minicomputers and mainframes.

Power, Scalability and Portability: the Enabling of New Applications

- Client-server systems are scalable and flexible. New processors, servers, and clients can be added as needs increase. Benchmark studies show the per-transaction cost of PC platforms to be less than one-tenth that of mainframes.
  Source: Datamation
- A rich set of tools and APIs are available, facilitating client-server system development.
- Client-server systems are very efficient. Back-end services (for example, database services) can be shared by several front-end applications at once (for example, a spreadsheet and a custom ordering tool).
- Client-server systems help companies consolidate their information systems. 55% of those surveyed by BRG considered this to be a primary benefit.

Efficient Management

- Administrators can centrally control user access to critical, corporate information and resources on servers.
- Administrators can change desktop and server configurations, maintain security, update user permissions or troubleshoot problems from any workstation on the network.

Enhanced Network Performance

Client-server architecture eliminates the need to move large blocks of information over the network to the PC for processing. The server controls data and processes requests, transferring only requested data to the desktop machine. The desktop machine then presents the requested data in an understandable fashion to the user. This process reduces network traffic and results in a network that can support more users. It is especially important for new remote and wireless technologies that connect users with limited bandwidth network channels.

Requirements for Client-Server Computing

Client-server computing requires an operating system that is powerful, reliable, and open.

You require a system that can grow as your needs change and new options develop. A **powerful operating system** reduces the burden on users, administrators and developers, while offering the ability to run any type of application--from simple, stand-alone applications to sophisticated, integrated applications.

You require a reliable system to maintain your competitive advantage. Downtime of business-critical applications can mean lost orders and customers, delayed communications and decision making, or manufacturing problems. A **reliable operating system** reduces downtime and its costs, ensures that work gets done, and always delivers the powerful solutions it promises.

You want the flexibility to evolve and adopt new technology while maintaining consistency with your existing systems. An **open operating system** gives you the freedom to choose from a range of new options while protecting your investment in legacy systems.

Attributes of Power

- Multiple applications can run simultaneously in an integrated fashion.
- Both simple and complex operations are quickly handled using powerful features that are readily accessible.
- Process-oriented (as opposed to task-oriented) applications are directly integrated and customized.
- Applications can run on a range of computing platforms, including pen-based and notebook computers, desktop PCs, x86 and RISC-based workstations, servers and multiprocessing systems, as well as future platforms.
- The system has complete scalability.
- The system accesses and integrates with enterprise computing resources.
- The system thrives in heterogeneous, multi-vendor environments that include a range of systems, standards and protocols.

Aspects of Reliability

- Monitoring tools minimize failure through early detection and correction of potential problems.
- Fault tolerance features protect power supplies, disks, and applications. In the event of failure, much of the system continues to operate (for example, through application and system isolation), and full recovery happens quickly.
- Integrated data backup features are extensible and hardware independent. Data is protected against loss and corruption.
- The system offers high security against theft and tampering.
- Security features prevent inadvertent and malicious interference with the system, while providing seamless access to authorized information.
- Implementation of security is flexible and changes to user or system requirements are simple to do.
- Management functions are centralized.
- Administrators can monitor system performance and availability, and correct problems from anywhere on the network.
- The underlying technology is backed by sufficient testing and design expertise, and has strong industry support from hardware and applications developers.

Characteristics of Openness

- Works with a broad range of rich applications.
- Offers a wide selection of powerful, cost-effective development tools.
- Interoperates with legacy systems.
- Supports industry-standard protocols, networks, and network management systems to connect and access information and services already deployed on other systems.
- Is hardware independent.
- Gives users the flexibility to implement solutions on their hardware platform of choice, and the ability to increase the power of that platform as their needs increase.
- Provides a large number of vendors, solution providers and integrators from which to choose.
- Integrates personal productivity applications with business-critical applications on the same platform.
- Gives users the ability to update systems, peripherals, applications, and tools without learning new skills or incurring further training and support costs.
- Offers cost-effective upgrades.

AT&T Inbound Services

To provide a more cost-effective and easier-to-use platform for its telecommunications management software, AT&T moved to the Microsoft® Windows NT™ operating system to give its business customers greater power and flexibility in managing their vital 800 numbers.

Solution Summary

Case Details

For More Information

AT&T Solution Summary

Industry
Telecommunications

Business Solution
Inbound call-management software

Architecture
Custom Windows-based applications running on Windows NT linked over a wide area network to host machines

Products Used
Microsoft Visual Basic
Microsoft Windows NT
Microsoft Windows NT Advanced Server
Borland C++

Benefits

- Eliminated extensive, specialized customer training requirements for operating systems and applications.
- Lowered hardware entry price point for mission-critical solutions by at least 80 percent, to roughly $3000.

AT&T Case Details

"Some of our customers have in excess of half-a-million phone calls a day, which vary in length from six seconds to hours. The way AT&T sees it, every single call is vital to that customer's business. We don't just complete the call--the Inbound mission is to provide for the successful completion of our customers' transactions."

Joe Aiuto, product manager for AT&T Inbound Services

Businesses today depend on "800" numbers (and now "900" numbers) more than ever before as a core part of their operations. For example, every time a credit card purchase is made at a local store, the clerk slides the card through an automated reader that dials the credit card vendor via an 800 number. Computers answer the line and process the transaction without human intervention. And there's the nationwide retailer with hundreds of customer service representatives taking catalog orders over phones at seven sites across the country. Or the 900 number that the buyer of a new computer might call to get technical assistance.

In all these cases it is imperative that the calls reach their destination and that the callers aren't left waiting. Too long a wait or a misdirected call can result in a lost sale or an angry customer. Moreover, companies today are looking at their phone calls as a source of strategic business information--from how well a regional advertisement worked to the immediate spotting of high-demand products in order to adjust manufacturing and inventory volumes.

AT&T® Inbound Services provides these 800- and 900-number services to over 1 million businesses, ranging from small shops such as a local auto parts dealer to every Fortune 500 company.

"Some of our customers have in excess of half-a-million phone calls a day, which vary in length from six seconds to hours. The way AT&T sees it, every single call is vital to that customer's business. We don't just complete the call, the Inbound mission is to provide for the successful completion of our customers' transactions," explains Joe Aiuto, product manager for AT&T Inbound Services.

For the last several years, AT&T has offered a high-end family of products that telecommunications managers in each business can use to monitor call activity, route calls to their different sites, and identify key trends and warning signs. Called the ACCUMASTER® Services Family of Network Management Software, these telecommunication management systems are UNIX®-based, requiring workstation hardware and customized training.

Growth Required New Platform

As demand for AT&T's 800-number services grew to include a wide range of businesses and customers, the need became evident for an additional systems platform. "As more customers needed access to these network management tools, it

was necessary to develop them on a platform that supported a common interface that was already widely accepted in the marketplace, one that a business user is typically working with in his or her daily environment," says Aiuto.

To address this need, AT&T had begun to offer its telecommunications network management software on Windows™ 3.1 running with MS-DOS®, calling these applications the ACCUMASTER Services Personal Computer Software. While this solution provided a standard graphical environment, many of AT&T's larger customer sites needed additional system power. Aiuto sought an alternative that would give users a standard interface and that had the power and sophistication for large mission-critical situations.

Windows NT Provides Strong Application Platform

AT&T Inbound Development is targeting Windows NT as the optimum platform for many of its 800-number customers and their network management software applications.

One of the key ACCUMASTER applications originally developed for UNIX is Routing Manager, which is what telecommunications managers use to direct calls to various locations in real time.

Grant Smith, development team leader for AT&T, is creating a version of this application for Windows NT, as well as creating entirely new telecommunication applications that will take advantage of the 32-bit, **multitasking**, and networking strengths of Windows NT. Currently, the AT&T programming staff are using Borland® C++ and the Microsoft Visual Basic™ programming system for the bulk of the development, while evaluating Microsoft Visual C++™ development system, WATCOM C/386 for Windows NT, and the 32-bit version of Borland C++.

Moving to Windows NT will not require a change in the basic way AT&T delivers the information to telecommunications managers. The raw data on the phone calls will still be downloaded from AT&T host systems that manage the initial calls, to the customer's local computer network over high-speed transmission lines. This link is a two-way street. Not only do telecommunications managers receive the data in real time, they are also able to give "orders" to the hosts, such as redirecting calls to another customer service site.

Aiuto expects that each of his ACCUMASTER Services Personal Computer Software customers that use Windows NT on the desktop will have at least one local network running Windows NT Advanced Server. This network takes advantage of the domain name services and **TCP/IP** protocols of Windows NT for the wide-area-network link to the AT&T hosts. "That would be our point of presence with the customer," notes Development Team Leader Smith.

Customers Benefit in Several Ways

"Under Windows NT, we look forward to being able to say that our same applications now have a mission- critical capability by virtue of the fact that Windows NT offers us a C2 level of security--multitasking, multithreaded security--that will not take that machine out of service, which is a requirement. Its a measurement of quality within AT&T."

Grant Smith, Development Team Leader, AT&T

According to Aiuto, by expanding the ACCUMASTER Services software to Windows NT, AT&T customers will be able to take advantage of a large base of existing technology while benefiting significantly in the areas of reduced training, reliable networking and security, and a lower entry price for mission-critical network management solutions.

"The applications that we are developing around the Microsoft Windows and Windows NT operating systems don't require extensive customized training for users," explains Tom Hicks, development manager on the project. "Once they install the software, our customers can be up and running right away because it's a graphical user interface they're used to working on."

While security is a traditional weak point with PCs, says Smith, Windows NT offers surprising strength. "Security is a key issue with AT&T and with our customers because we value and respect the privacy of their information. We wanted to be able to talk to UNIX workstations. We wanted to be able to talk to other PCs. So what we needed was the capability of securing an application, securing an executable file. And Windows NT allows me to do that."

Smith points out that the real benefit comes from a network perspective. "In a networking environment, I feel Windows NT provides enhanced security," he explains. "Both from an administrative standpoint and a user's standpoint, because of the way that Windows NT was developed with a **client-server model** in mind. Under Windows NT, we look forward to being able to say that our same applications now have a mission-critical capability by virtue of the fact that Windows NT offers us a C2 level of security--multitasking, **multithreaded** security--that will not take that machine out of service, which is a requirement. It's a measurement of quality within AT&T."

Cost is also a key customer benefit in expanding to Windows NT. At the time AT&T Inbound Services made the decision to develop solutions for its customers on Windows NT, "We were looking for a lower entry price point for delivering mission-critical, high-performance solutions, and sufficient power and scalability for growing with our customer needs," explains Aiuto.

"Windows NT provides the capability for us to deliver robust applications on systems costing roughly $3000, and the cross-platform capability enhances its value. Customers needing more power can take our Windows NT-based applications with them onto hardware platforms such as MIPS® and Pentium™ chips, DEC® Alpha's, and SPARC™ systems." The new entry-level price point, according to Aiuto, is at least one-fifth the hardware price of traditional high-end systems.

Of course, the standard environment of Windows provides benefits to the customer as well. Development Manager Hicks cites an example of a hypothetical telecommunications manager whose New Jersey customer service office was closed by a gas leak. From a standard desktop PC, the manager could use AT&T's Windows-based Routing Manager software to divert calls to the Florida office. Then, without having to change operating environments or move to a different system, that manager could simply bring up another window and send an e-mail message to the Florida office, notifying them of the change.

Future Services Will Demand New Applications

"As new AT&T inbound services and advanced features are developed, we will develop new applications and new tools to allow our customers to be able to manage those services. We will utilize Windows NT to develop applications that will be deployed on systems running Windows, Windows™ for Workgroups, and--especially--on Windows NT," says Aiuto. "Those applications will involve distributed computing, networking, and client-server technology."

One of those planned applications is called the Online Call Detail Manager (OCDM), which will run under Microsoft SQL Server for Windows NT. According to Aiuto, OCDM is a master database that will store detailed information on every call placed to a company's 800 number--where it came from, the duration, who answered it, and so on. The company can analyze this data from many different views for marketing planning, staffing decisions, and more.

When each phone call can mean dollars lost or profit earned, the OCDM database and all the ACCUMASTER Services software for Windows NT can add up to a significant competitive advantage for AT&T customers.

Freightliner Corporation

Freightliner's Microsoft® Windows NT™-based information system, ServicePro, integrates several independent systems and applications to help the company maintain a leadership position in an increasingly competitive industry. ServicePro helps technicians repair trucks faster and more efficiently, while reducing customer downtime and repair costs.

Freightliner Corporation Solution Summary

Industry
Truck manufacturer

Business Solution
Truck dealership and fleet service and repair system

Architecture
Server based on the Windows NT platform, providing a single graphical client interface that integrates mainframe, minicomputers, and other Windows-based applications

Products Used
Microsoft SNA Server
Microsoft SQL Server for Windows NT
Microsoft Visual Basic
Microsoft Visual C++
Microsoft Windows 3.1
Microsoft Windows NT

Development Time
Twelve months from initial design to system launch

Benefits
- Faster, more accurate truck repairs
- More profitable service operations
- Lower vehicle operating costs through better record-keeping

For More Information

For Microsoft Consulting Services in the United States, call **(800) 922-9446**.For more information about Microsoft products and Solution Providers, in the 50 United States call Microsoft Inside Sales at **(800) 227-4679**. In Canada, call the Microsoft Canada Customer Support Centre at **(800) 563-9048**. If you require Text Telephone (TT/TDD) services for people who are deaf or hard of hearing, call **(800) 892-5234** in the United States and **(416) 568-9641** in Canada. Outside the 50 United States and Canada, please contact your local Microsoft subsidiary.

Freightliner Corporation Case Details

Freightliner Corporation, a wholly owned subsidiary of Daimler-Benz, is North America's leading manufacturer of heavy-duty trucks, and is determined to stay ahead of the pack. With more than 23 percent of the market in 1992, the company ranked first in retail sales. But to gain equal footing in the critical aftermarket service business, Freightliner needed to give its dealers a better way to manage the enormous quantities of information they use every day.

To run their businesses, the 250 Freightliner dealers throughout North America previously contended with an assortment of disparate computer systems. For accounting, invoicing, tracking inventory, and recording repair orders, they used several kinds of stand-alone minicomputers from a variety of service bureaus running systems based on RISC, AS/400®, and UNIX®. For specifying and ordering truck parts, they used a Windows™- and LAN-based electronic parts catalog called PartsPro. And to obtain truck warranty information, they accessed the Freightliner mainframe using 3270 terminals or PCs.

This conglomeration of systems, not to mention the shelves of manuals and microfiche in every dealership, "was a Tower of Babel," according to Freightliners Director of Technical Service Systems, Doug Vakoc. "Every kind of information was on a different system, each with its own format, interface, sign-on procedure, and so on. This made it very difficult for people to find information and to stay up-to-date. Ultimately, the confusion cost us money--in lost service opportunities and the erosion of customer confidence when there were delays or mistakes."

Poor Information Access Hampers Service Efforts

Because the computer systems were based on various platforms, and because some of Freightliner's business areas were not automated, dealers and fleet technicians faced the following issues--all of which are common in the trucking industry:

- *Training.* With so many different systems in use, training the technicians and dealer personnel on warranty, parts, and diagnostic services was costly and potentially confusing to employees.
- *Information access.* Service information, stored on paper or microfiche, often had to be located before repairs could be done. Finding the right information was time-consuming, and the information itself was sometimes out-of-date.
- *Diagnostics.* Technicians found the information available to properly diagnose and repair problems limited, and sometimes too simplistic for some service procedures.
- *Maintenance.* Without an easy way to access service updates, recall campaigns, and maintenance schedules for each truck, dealers missed opportunities to "piggyback" this work with repair service.
- *Warranties.* Unlike automobiles, truck service warranties can be custom-configured for each vehicle from a wide variety of options. Dealers had difficulty figuring out

whether specific repairs were covered by warranty.

These problems were compounded by the increasing sophistication of today's trucks which, designed to meet environmental regulations and competitive pressures, have grown more complex to diagnose and repair. Moreover, today's truck fleet operators have very little tolerance for downtime. In an industry that has seen more than 60 percent of truck carriers go out of business since it was deregulated in 1980, lowering the cost of fleet operation is a competitive necessity.

Integrated System Brings Information to Users

"Our customers expect a reliable place to have truck repair and maintenance done, with consistent, high-quality service. We built ServicePro to raise the overall performance of our dealers."

Doug Vakoc, Director of Technical Service Systems, Freightliner Corporation

With a corporate goal to be the industry's leading provider of support services as well as premium vehicles, Freightliner set about addressing these challenges. The company's sophisticated solution, called ServicePro, is an integrated information system that will be installed on servers running the Microsoft Windows NT operating system at all Freightliner dealerships. Designed and developed with the assistance of Microsoft Consulting Services (MCS), ServicePro incorporates state-of-the-art technology with point-and-click simplicity. It allows dealer service writers to perform their daily work--diagnosing truck problems, looking up warranty and service information, generating repair orders, and selling parts and service--at the push of a button.

ServicePro achieves this simplicity through a **client-server** architecture that allows client applications running with Microsoft Windows™ for Workgroups or Windows 3.1 to access any information--whether it is located on the server based on the Windows NT platform, the Freightliner mainframe, or the dealer's minicomputer-based business system.

ServicePro's graphical front end, prototyped with the Microsoft Visual Basic™ programming system and developed with the Microsoft Visual C++™ development system, provides menu access to Windows 3.1-based client applications developed by third parties. These applications supply parts information, service literature, and diagnostic assistance. Because they are based on the Windows operating system, the applications--several of which were purchased specifically for integration into the ServicePro system--were able to be used without modification both on the Windows-based PC clients and on the server based on the Windows NT platform.

The centerpiece of the ServicePro system is each dealer's server, which provides communication, data management, and file server capabilities. Through SNA Server, the server communicates with Freightliner's Amdahl mainframe, where information on warranty coverage, components, and service campaigns is stored. In addition, a custom-designed application on the server communicates directly with the business applications running on dealers' minicomputers, giving users access to customer

information each dealer stores there. In ServicePro's distributed database architecture, each dealer's server runs Microsoft SQL Server for Windows NT. The SQL Server database stores all information necessary to create a repair order. This information can be customized to reflect the dealer's individual shop repair procedures.

Freightliner's decision to implement ServicePro on the Windows NT operating system was based on several key technical features of the operating system. These include its **scalability** and portability; high performance for disk caching; support for **symmetric multiprocessing** machines; support for applications that require more than 16 MB of memory; support for hard-**disk striping**, database management services, and connectivity services; and the ability to run existing 16-bit applications for Windows seamlessly on the server's 32-bit operating system.

Consultants Share Knowledge in Partnership

For several reasons, Freightliner management decided early that ServicePro would be a Windows-based system. One of the key applications in the ServicePro system ran under Windows. Moreover, other Windows-based applications were available from specialized software vendors---there was no reason to coauthor or cofund the development of new applications. "We chose the Windows operating system because we knew the software we needed was available," says Vakoc.

Freightliner also knew from the outset that it would need outside resources to help develop ServicePro. Not having in-house expertise to write Windows-based applications to integrate the new system, Freightliner evaluated several consulting firms. Microsoft Consulting Services was selected on the basis of the following criteria:

- *Knowledge of programming for Windows.* "Since we had already decided that ServicePro would be Windows-based, our consultants' familiarity with programming and applications for Windows was a must," says Vakoc. "We also wanted a strong, real, client-server environment. We thought Microsoft was in the best position to get us up to speed on Windows NT early."
- *Skills transfer.* Freightliner chose MCS for its ability to convey knowledge about Windows NT and client-server technology, putting Freightliner in a stronger position to manage ServicePro on its own and, down the road, to design other client-server systems and applications for Windows NT. "We also wanted a partner who generates ideas," explains Vakoc. "In our experience, we've worked with other consultants who were mostly executing our ideas, but MCS shared the creative work with us. This was a very sophisticated project--especially in the communications area--and we knew that, with complex projects, there are always setbacks. It's easy to get discouraged. Because we clicked with the MCS people, it kept our motivation high."
- *Partnership.* "Our priority was to choose who we viewed to be the best long-term partner," says Vakoc, "who can help us develop our ideas into long-range strategies and implement them most quickly."

ServicePro Increases Efficiency and Profitability

ServicePro makes daily operations dramatically easier and more efficient for Freightliner dealers. For example, instead of wading through piles of microfiche or service binders, dealers can call up service bulletins and work instructions, including illustrations, to view on-screen or to print. CasePoint, the Windows-based artificial intelligence application integrated into ServicePro, guides service writers through diagnostic questions that help isolate the cause of a problem before the technician begins work. The service writer can then instantly determine if the needed part is in stock and whether the repair is covered by warranty. At the same time, the system alerts the user to other work that may be performed along with the repair--whether it be routine maintenance or an outstanding service campaign.

ServicePro will help dealers work more cost-effectively by reducing faulty repairs, and it will help them receive faster reimbursement for warranty work through better record-keeping. Moreover, ServicePro's guided procedures will make it easier for dealers to train technicians and advisers; eventually, ServicePro will include special training modules, as well. As ServicePro improves the overall quality of customer service, Freightliner expects to see higher customer loyalty after warranties expire. In turn, this will create more parts and service business for the dealer network.

"Through ServicePro, we can help our customers use their trucks more profitably, while helping our dealers achieve higher profitability too," says Vakoc. "We estimate that ServicePro will help our dealers substantially increase their nonwarranty service business."

For customers, ServicePro will contribute to faster, more accurate truck repairs, less downtime, and lower repair costs. Scheduled maintenance and service campaigns also will be done in a more efficient way, saving time and money.

Companywide, ServicePro will reduce warranty costs by helping dealers avoid unnecessary repairs. In addition, ServicePro will capture reliable repair histories that enhance the value of vehicles for future owners.

Doing It Right, Today and Tomorrow

In future versions of ServicePro, Freightliner sees an important role for pen-based tablets and wireless LANs that will allow technicians to take diagnostic programs right to the truck. The company hopes to introduce a pen-based ServicePro system in 1994.

For now, as it introduces ServicePro at dealerships across the country, Freightliner expects to see tangible benefits right away. By providing instant access to information, ServicePro helps dealers and fleet technicians do repairs more efficiently. Says Vakoc: "It's mind-boggling what benefits ServicePro can deliver to our dealers and customers."

Reuters

With the Reuter Terminal service moving to the Microsoft® Windows NT™ platform, securities brokers and dealers around the world gain the critical advantage of faster desktop performance while analyzing global real-time news and market data.

Solution Summary

Case Details

For More Information

Reuters Solution Summary

Industry
News and financial information

Business Solution
World news and financial market information service

Architecture
PC workstations and servers delivering real-time information from mainframes over worldwide network

Products Used
Microsoft Excel
Microsoft Windows NT
Microsoft Windows NT Advanced Server
Borland Brief
Intersolv PVCS
Primia Software Codewright

Benefits
- Increased workstation performance for math-intensive computations
- Substantially reduced hardware costs for workstations

Reuters Case Details

To maintain its position as the world's leading electronic information publisher, Reuters is committed to taking advantage of the latest technology to deliver news and financial market information in real-time to a worldwide network of over 200,000 terminals. With securities brokers and foreign exchange dealers depending on up-to-the-second information to make financial transactions, Reuters is constantly looking for ways to give its customers a performance edge. Since 1990 the company has offered its core product--the Reuter Terminal--as a Windows™-based PC workstation running Microsoft Excel for financial calculations. Reuter services are also offered for dumb terminals and UNIX® workstations.

"The process of establishing price and risk is called financial engineering. It has a tremendous amount of math in it and the math has to be done very quickly," explains Buford Smith, president of Reuters Information Technology. "Often a dealer has a client on the telephone and needs to quote a price to him and has to figure out what the price should be. The underlying financial instrument may be changing value as often as several times a second, so you have to have quite a bit of system capability."

According to Smith, the Windows PC platform is very popular with Reuters customers, with the installed base of Windows-based Reuter Terminals growing at a rate of thousands per year.

While the ease of use of a PC graphical environment was a decided advantage for traders and brokers around the world, there were still areas to improve. Smith notes that many of their customers needed greater performance than a PC running the Windows operating system under MS-DOS® could provide: "Basically we had to limit some of the math you could do in order not to overrun the broadcast network," notes Smith.

Windows NT-based Solution Impacts Both Workstations and Servers

To provide greater performance while maintaining the graphical ease of use of Windows, Reuters adopted the Microsoft Windows NT operating system as a new standard for the Reuter Terminal. "We definitely see a demand for being able to do more computations on the desktop and up until now, in order to satisfy that, basically we would have had to supply a much more expensive workstation," explains Smith.

Reuters is applying Windows NT and Windows NT Advanced Server in two areas--on the client workstations that deliver and customize the data on the desktops of the traders, and as the primary back-end server operating system that makes the bridge between the terminals and Reuters's constant data downloads from their three worldwide data centers in Tokyo, London, and New York.

The mainframes at these data centers receive constantly updated information throughout the day from about 150 stock and commodities exchanges as well as over

3000 firms around the world that contribute prices on other tradable financial instruments such as foreign currencies. This information is transmitted over satellite and cable to 25,000-plus customer sites in over 110 countries. At customer sites with computer networks, this information is received and stored on a PC server running Reuters proprietary database software. Until recently, some of the servers associated with Reuter Terminals ran under UNIX. According to Smith, Reuters is converting its server database software and all of its PC network servers to run under Windows NT Advanced Server.

The development staff at Reuters is using several tools to create the Windows NT-based versions of its terminal and server software. These include Borland® Brief, Primia Codewright, Intersolv™ PVCS, and the tools in the Windows NT Software Development Kit (SDK).

Workstation Performance, PC Price

"The bottom line is that Windows NT will enable us to significantly increase the mathematical capabilities of our terminals, and will broaden the appeal of our services."

Buford Smith, President, Reuters Information Technology, Inc.

What are the benefits of this move to Windows NT? "For us, performance is the primary reason for making the transition to Windows NT," says Smith. Specifically, he identifies the 32-bit capability of Windows NT and its support for **RISC** workstations and **multiple processors.** "We can envision having Reuter Terminals with a tremendous improvement in mathematical capability for people doing financial engineering work."

Cost savings will play a role as well. Smith explains that Windows NT allows Reuters to offer high-end networked workstations at a lower cost than traditional workstations.

The move to Windows NT and Windows NT Advanced Server on the back-end server also provides a benefit to the many Reuters customers who do not have a network. "One of the things the Windows NT-based platform will give us is a much more simplified approach to bringing the server and the workstation applications together on a single piece of hardware," notes Smith. "We can't do that right now and a lot of our clients have a single key station. So instead of having to supply them with a UNIX server and a Windows-based PC we'll be able to supply them one Windows NT-based set of hardware that actually runs the server application and the workstation application both. That will be a significant cost reduction for us. And ultimately for the customer."

Reuters is committed to supplying the tools that best fit their customers' needs. "We still have lots of UNIX customers and will continue to expand upon and improve our UNIX offerings, but for the customers who want to use PCs and stay in the Windows graphical environment, this will be a tremendous benefit."

Additional Services Look to Windows NT in the Future

Smith points out that Windows NT gives Reuters and its customers tremendous flexibility in the future to choose from a wide range of computing platforms. The version of Reuter Terminal software for Windows NT has already been run successfully on two different hardware platforms--Intel®-based PCs and MIPS® workstations--and will be tested on additional platforms in the near future.

Beyond the Reuter Terminal services, Smith notes that Reuters is looking at moving some of its other online information services to the Windows NT platform as well. The goal is to provide a single, easy-to-use screen that gives traders all the information tools they need to successfully complete crucial financial transactions.

With Windows NT-based workstations on their desktops, these traders will be able to get up-to-the-second market information while communicating online with financial institutions, simultaneously and reliably.

Windows NT Design Goals

Microsoft® Windows NT™ operating system software design required some serious thinking. For the system to fulfill its market requirements, it was crucial that complex features such as symmetric multiprocessing and security be incorporated from the beginning.

Before they began writing the several hundred thousand lines of code that Windows NT would eventually comprise, the system's designers carefully constructed a set of software design goals to facilitate making the thousands of ancillary decisions that determine the internal structure of a large software project. When two proposed design options conflict, the design goals help establish which is best. The following are the Windows NT design goals:

Extensibility

Portability

Reliability and Robustness

Compatibility

Performance

Extensibility

The code must be written to comfortably grow and change as market requirements change.

Operating systems invariably change over time, those changes usually presenting themselves incrementally in the form of new features. Examples include support for a new hardware device, such as a CD-ROM reader; the ability to communicate over a new type of network; or support for up-and-coming software technologies, such as graphical user interfaces or object-oriented programming environments.

System Integrity
Ensuring the integrity of the Windows NT code as the operating system changes over time was a primary design goal. For the Mach operating system developed at Carnegie-Mellon University, Dr. Richard Rashid and his colleagues took a unique approach to this problem by creating an operating system base that provides primitive operating system capabilities. Application programs called servers provide additional operating system capabilities, including full-featured APIs. The base portion of the system remains stable, while the servers are enhanced or new ones are created as requirements change.

User and Kernel Modes
Windows NT borrows from this design and consists of a privileged **executive**and a set of nonprivileged servers called **protected subsystems**. The term **privileged** refers to a processor's modes of operation. Most processors have a privileged mode (or perhaps several), in which all machine instructions are allowed and system memory is accessible, and a nonprivileged mode, in which certain instructions are disallowed and system memory is inaccessible. In Windows NT terminology, the privileged processor mode is called **kernel mode** and the nonprivileged processor mode is called **user mode**.

Usually an operating system executes only in kernel mode, and application programs execute only in user mode except when they call operating system services (This type of server refers to a process on a local computer and should not be confused with separate computers on a network that provide file services or network services). The Windows NT design is unique, however, because its protected subsystems execute in user mode like applications do. This structure allows protected subsystems to be modified or added without affecting the integrity of the executive.

Other System Components
In addition to protected subsystems, Windows NT includes numerous other features to ensure its extensibility:

Modular Structure

Use of Objects to Represent System Resources

Loadable Drivers

Remote Procedure Call Facility

A Modular Structure

The executive comprises a discrete set of individual components that interact with one another only through functional interfaces. New components can be added to the executive in a modular way, accomplishing their work by calling the interfaces supplied by existing components.

Use of Objects to Represent System Resources

Objects, abstract data types that are manipulated only by a special set of object services, allow system resources to be managed uniformly. Adding new objects does not undermine existing objects or require existing code to change.

Loadable Drivers

The Windows NT I/O system supports drivers that can be added to the system as it runs. New file systems, devices, and networks can be supported by writing a device driver, file system driver, or transport driver and loading it into the system.

Remote Procedure Call (RPC) Facility

This allows an application to call remote services without regard to their locations on the network. New services can be added to any machine on the network and can be immediately available to applications on other machines on the network.

Portability

As dictated by market goals, the code must move easily from one processor to another.

The second design goal, code portability, is closely related to extensibility. Extensibility allows an operating system to be easily enhanced, whereas portability enables the entire operating system to move to a machine based on a different processor or configuration, with as little recoding as possible. Although operating systems are often described as either "portable" or "nonportable," portability is not a binary state, but a matter of degree. The crucial question is not whether software will port (most will, eventually), but how difficult it is to port.

Writing an operating system that is easy to port is similar to writing any portable code--you must follow certain guidelines. First, as much of the code as possible must be written in a language that is available on all machines to which you want to port. Usually this means that you must write your code in a high-level language, preferably one that has been standardized. Assembly language code is inherently nonportable, unless you plan to port only to machines with upwardly compatible machine instructions (such as moving from the Intel 80386 to the Intel 80486, for example).

Second, you should consider to which physical environments you want to port your software. Different hardware imposes different constraints on an operating system. For example, an operating system built on 32-bit addresses could not be ported (except with enormous difficulty) to a machine with 16-bit addresses.

Third, it's important to minimize, or eliminate wherever possible, the amount of code that interacts directly with the hardware. Hardware dependencies can take many forms. Some obvious dependencies include directly manipulating registers and other hardware structures or assuming a particular hardware configuration or capacity.

Fourth, whenever hardware-dependent code cannot be avoided, it should be isolated to a few easy-to-locate modules. Hardware-dependent code should not be spread throughout the operating system. These last two guidelines work hand in hand. For example, you can hide a hardware-dependent structure within a software-defined, abstract data type. Other modules of the system manipulate the data type rather than the hardware by using a set of generic routines. When the operating system is ported, only the data type and the generic routines that manipulate it must be changed.

Some of its features include **Portable C** and **Processor Isolation**.

Portable C

Windows NT is written primarily in the C language, with extensions for the Windows NT structured exception handling architecture. The developers selected C because it is standardized and because C compilers and software development tools are widely available. In addition to C, small portions of the system were written in C++, including the graphics component of the Windows environment and portions of the networking user interface. Assembly language is used only for parts of the system that must communicate directly with the hardware (the trap handler, for example) and for components that require optimum speed (such as multiple precision integer arithmetic). However, nonportable code is carefully isolated within the components that use it.

Processor Isolation

Certain low-level portions of the operating system must access processor-dependent data structures and registers. However, the code that does so is contained in small modules that can be replaced by analogous modules for other processors.

Windows NT encapsulates platform-dependent code inside a dynamic-link library known as the Hardware Abstraction Layer (HAL). Platform dependencies are those that vary between two vendors' workstations built around the same processor--for example, the MIPS R4000. The HAL abstracts hardware, such as caches and I/O interrupt controllers, with a layer of low-level software so that higher-level code need not change when moving from one platform to another.

Windows NT was written for ease of porting to machines that use 32-bit linear addresses and provide virtual memory capabilities. It can move to other machines as well, but at a greater cost.

Reliability and Robustness

The system should protect itself from both internal malfunction and external tampering. It should behave predictably at all times, and applications should not be able to harm the operating system or its functioning.

Reliability was a third design goal for the Windows NT code. Reliability refers to two different but related ideas. First, an operating system should be robust, responding predictably to error conditions, even those caused by hardware failures. Second, the operating system should actively protect itself and its users from accidental or deliberate damage by user programs.

Structured Exception Handling

Modular Design

NTFS

Security

Virtual Memory

Structured Exception Handling

This method for capturing error conditions and responding to them uniformly is the primary defense against errors in software or hardware. Either the operating system or the processor issues an exception whenever an abnormal event occurs; exception handling code, which exists throughout the system, is then automatically invoked in response to the condition, ensuring that no undetected error wreaks havoc on user programs or on the system itself.

Modular Design

This function divides the executive into a series of orderly packages, the individual system components interacting with one another through carefully specified programming interfaces. A component such as the memory manager, for example, could be removed in one piece and replaced by a new memory manager that implements the same interfaces.

NTFS

A new file system designed for Windows NT, NTFS can recover from all types of disk errors, including errors that occur in critical disk sectors. It uses redundant storage and a transaction-based scheme for storing data to ensure recoverability.

Security

Windows NT comprises a U.S. government-certifiable security architecture, which provides a variety of security mechanisms, such as user logon, resource quotas, and object protection.

Virtual Memory

This function furnishes every program with a large set of addresses that it can use. When a program accesses these virtual addresses, the memory manager maps, or translates them into actual memory locations. Because it controls the placement of every program in memory, the operating system prevents one user from reading or modifying memory occupied by another user, unless the two users explicitly share memory.

Compatibility

Although Windows NT should extend existing technology, its user interface and APIs should be compatible with existing Microsoft systems.

Software compatibility, the fourth design goal for Windows NT code, is a complicated subject. In general, compatibility refers to an operating system's ability to execute programs written for other operating systems or for earlier versions of the same system.

Binary and Source Compatibility

Application Support

Binary and Source Compatibility

Binary compatibility is achieved when you can take an executable program and run it successfully on a different operating system. Source-level compatibility requires you to recompile your program before you can run it on the new system. Whether a new operating system is binary compatible or source-code compatible with an existing system depends on several things. Foremost among them is the architecture of the new system's processor. If the processor uses the same instruction set (with extensions, perhaps) and the same size memory addresses as the old, then binary compatibility can be achieved.

Binary compatibility is not as easy, however, between processors based on different architectures. Each processor architecture ordinarily carries with it a unique machine language. This means that with cross-architecture, binary compatibility can be achieved only if an emulation program is provided to convert one set of machine instructions to another. Without an emulator, all applications moving from the old architecture to the new must be recompiled and relinked (and likely debugged).

Application Support

Through use of protected subsystems, Windows NT provides execution environments for applications other than its primary programming interface--the Win32 API. When running on Intel processors, the Windows NT protected subsystems supply binary compatibility with existing Microsoft applications, including MS-DOS, 16-bit Windows, OS/2, and LAN Manager. On the MIPS RISC processors, binary-level compatibility is achieved for MS-DOS, 16-bit Windows, and LAN Manager-based applications (using an emulator). Windows NT also provides source-level compatibility with POSIX applications that adhere to the POSIX operating system interfaces defined in IEEE Standard 1003.1.

In addition to compatibility with programming interfaces, Windows NT supports existing file systems, including the MS-DOS file system (FAT), the OS/2 high performance file system (HPFS), the CD-ROM file system (CDFS), and the new, recoverable NT File System (NTFS).

Performance

Within the constraints of the other design goals, the system should be as fast and responsive as possible on each hardware platform.

The final Windows NT design goal was to achieve great performance. Compute-intensive applications such as graphics packages, simulation packages, and financial analysis packages require rapid processing in order to give the user good response times. Fast hardware is not enough to achieve good performance, however. The operating system must also be fast and efficient. The following process helped achieve this performance goal:

Performance Testing

Local Procedure Call

Environment Subsystems

Networking

Performance Testing

Each component of Windows NT was designed with an eye toward performance. Performance testing and modeling were done for the parts of the system that are critical to performance. System calls, page faults, and other crucial execution paths were carefully optimized to ensure the fastest possible processing speeds.

Local Procedure Call

The protected subsystems (servers) that perform operating system functions must frequently communicate with one another and with client applications. To guarantee that this communication does not hinder the servers' performance, a high-speed message-passing mechanism called the local procedure call (LPC) facility was included as an integral part of the operating system.

Environment Subsystems

Each protected subsystem that provides an operating system environment was carefully designed to maximize the speed of frequently-used system services.

Networking

Crucial components of the Windows NT networking software were built into the privileged portion of the operating system to achieve the best possible performance. Although they are built-in, these components can also be loaded and unloaded from the system dynamically.

Windows NT Road Test

When reviewing the Microsoft® Windows NT™ operating system or any other advanced operating system, it is important to consider how you will use it. Your tests should focus on the functionality and performance required to support business solutions. There is no universal test suite that accurately grades operating systems--your choice should depend entirely on your requirements and how each candidate addresses them.

Power, Scalability and Portability

An advanced operating system must provide:

Power

Scalability

Portability

Tests for:

Power

Scalability

Portability

Power

An operating system is critical in realizing performance advantages from powerful hardware. For example, many CPUs, including the Intel® x86 family, offer the ability to run several tasks concurrently by switching between them. However, most users of x86-based computers never gain access to this feature because they are using DOS which is not a multi-tasking operating system. An advanced operating system provides features like multi-tasking so that you can get the maximum performance from your hardware.

Scalability

One responsibility of the operating system is to provide resources like processing, memory, and mass storage for applications. Scalability is the capability of an operating system to automatically accommodate additional resources as they are added to the system. For example, if you use a single processor machine, you can get better performance by adding processors. However, you can only gain the performance advantage you need if the operating system you choose can automatically find the new processors and schedule tasks to run on them.

Portability

In an ideal world, you would choose the best hardware for your needs. Unfortunately, in reality, your options are often limited because your existing operating system can only run on certain hardware. Modern, advanced operating systems overcome this limitation by being portable so that they can run on several different types of machine. An advanced operating system gives you the widest possible choice of hardware.

Power

True 32-bit

Windows NT delivers power as a result of its 32-bit design. For compute-intensive applications, performance improves because computations are 32-bit instead of 16-bit. Consider the simple case of multiplying two 32-bit integers together--you will see the advantage. On a 32-bit operating system this operation takes one instruction. On a 16-bit operating system, seven instructions are needed: four multiplications and three additions.

Test the performance of compute-intensive 32-bit applications such as modeling or recalculation of a large spreadsheet.

High Performance Graphics

The 32-bit design also accounts for the superior graphics power of Windows NT. Graphics are very demanding computationally. A 32-bit graphics subsystem combined with 32-bit graphics device drivers enable very fast rendering of graphics images.

Test graphics-intensive applications and compare performance to other platforms that support these applications. We recommend using the 256-color video drivers for maximum performance with these advanced applications.

Multitasking

When comparing multitasking capabilities, you should confirm that the operating system design really delivers the benefits of running multiple processes. Points to watch for are:

Preemptive Multitasking

Can one process interrupt another one? If not, it is possible for the system to be "hogged" by a single process that refuses to give up the processor. Preemptive multi-tasking allows the operating system to remove, or preempt, any process so that all processes get a chance to run.

Multithreading

Even within a process, there may be tasks that can run independently. This is multithreading. For example, your word processor could assign a long printout to one thread while continuing interactive operation with another thread. You can then continue working while the print compiles in the background.

Note: It is important to note that because Windows NT provides a high level of compatibility for 16-bit, Windows-based applications, they cannot preemptively multitask. Instead, these applications multitask cooperatively so that features like DDE and OLE are available.

When you test Windows NT, run the Performance Monitor and notice that applications share CPU time according to their needs. Physical memory pages are also allocated based on the need of the application. Parameters such as working set size are

important to review as well, since they are good indicators of how individual applications are using the system.

Asynchronous I/O

Generally, the CPU in your computer is much faster than the peripheral devices such as memory, hard disk or CDR. Asynchronous I/O allows the processor to request access to peripherals and then get on with something else while the peripheral fulfills the request. This technique makes very efficient use of modern, high performance CPUs.

You should test disk-intensive applications including databases (both single-users and multi-user). Also try large reads and writes to verify the I/O performance.

Scalability

You should test the **scalability** of an operating system with respect to various hardware parameters that can bottleneck system performance. Using Windows NT, for example, load the system until Performance Monitor indicates that the CPU resource is fully extended. This bottleneck can be eliminated by adding an additional CPU, or moving the application to a more powerful microprocessor, perhaps one based on a different architecture.

These same kinds of tests can also be run to create and then overcome memory or disk bottlenecks. Simply adding more memory or a faster disk drive can increase performance quickly and efficiently.

Windows NT can support:

Memory: 4GB (2GB per application)

Mass Storage: 2^64 bytes

Processors: 32

Portability

Both operating system portability and application portability are needed to provide a flexible hardware choice. You should compare:

CISC Architectures Supported
For Windows NT this means Intel 80386, 80486 and Pentium support, including multiprocessor machines. Over 800 manufacturers of Intel based PCs have been certified to be compatible with Windows NT.

RISC Architectures Supported
Most users of RISC machines use the hardware vendors operating system. Windows NT is available on Digital® Alpha architecture, MIPS® R3000 and R4000 family and Intergraph® Clipper. These new architectures are providing the ultimate desktop performance at PC market prices.

Application portability
If you want to use applications on different architectures, the operating system must provide application level portability. You should check for:

Binary Compatibility - applications run in binary form, unmodified.

Source Level Compatibility - applications can be re-compiled without modification of the source code.

API level Compatibility - applications can be re-compiled providing the source code does not make use of special vendor extensions. This is the most common level of compatibility between UNIX-based systems and in practice, it is very unlikely that an application designed for Solaris 2 will simply re-compile under HP-UX.

Note: Windows NT provides binary-compatible support for 16-bit Windows- and MS-DOS®-based applications across all implementations. 32-bit Windows-based applications are binary-compatible for a particular CPU architecture and 100% source-compatible between CPU architectures.

Application Integration

The operating system not only exposes system resources to the user, it also provides a backplane for applications to run and communicate. Application integration allows you to combine information and functionality from multiple applications. For example, you may want to write a document with graphics, a sales forecast and a personnel list. The operating system provides links between your document processor, graphics package, spreadsheet and database so that each can contribute to the final document.

Linking applications together makes it easy to build custom solutions with off-the-shelf software. Often a business solution can be enhanced by integrating the features of standard personal productivity applications. The result is a powerful solution that makes end users more effective.

Tests for Application Integration: Common User Interface, Cut and Paste, Linked Data, Linked Objects.

Common User Interface

The Windows user interface is the most widely used GUI available. Windows NT is the only platform that provides this user interface for 32-bit applications.

Cut and Paste

Most operating systems provide a buffer known as the Clipboard that applications can use to exchange data. A less common capability is to enable applications to exchange data over the network using a network-transparent clipboard.

Linked Data

An extension of cut and paste is the ability to form a permanent link between the source and destination of the data. For example, if you write a report that contains data from a sales spreadsheet, you can create a link so that the report is automatically updated whenever the spreadsheet changes. Very useful for monthly sales reports!

In Windows NT, this is known as Dynamic Data Exchange (DDE). The system also includes NetDDE which allows you to create the same links over a network. When testing DDE or an equivalent with Windows applications, be sure to create links between both 16-bit and 32-bit applications. You should also try nesting DDE links.

Linked Objects

Object linking extends inter-application links so that applications can share functionality. For example, if you want a project proposal to include a diagram, you can insert a graphical object from your favorite drawing program and edit the graphic without leaving the original proposal. You see a single editing window whose functionality (menus, toolbar, ruler etc.) changes according to whether you select the text or the diagram.

Windows NT provides object linking through a technology called Object Linking and Embedding (OLE). You should look for the same things as in DDE: OLE between 16-bit and 32-bit applications and nested OLE.

Networking

Countless business users are recognizing the benefits of networking: better use of resources, better communication and better distribution of information. Networking is therefore a requirement of any advanced operating system. But how the operating system implements networking is critical to its success. You should be able to access resources over the network transparently and independently of your protocol choice. Your applications should be able to interoperate over the network. Your system administration tools should keep the cost of supporting a network to a minimum.

When testing network capabilities, focus on your own particular needs. Decide whether you are mainly interested in performance, security, reliability, ease of administration or network functionality. Then compare the features that specifically address your objective.

Standard features for networking:

Windows NT includes support to access remote resources.

Windows NT includes tools for managing distributed resources.

Windows NT includes functionality necessary to create distributed applications based on the client-server model including distributed IPCs.

Windows NT is extensible, enabling third parties to create additional connectivity options.

Windows NT Advanced Server enables a single network logon to the enterprise with domains.

Windows NT Advanced Server allows remote clients to access Windows NT-based resources over Remote Access Service (RAS). RAS supports connectivity options including telephone line via standard modems, ISDN connections and X.25 networks.

Windows NT Advanced Server includes Services for Macintosh® enabling Macintosh systems to be fully interoperate with PCs and be full clients to Windows NT Advanced Servers.

Networking tests: File Sharing, Network Access, Application Server

File Sharing

Connect multiple MS-DOS-, Windows- and Windows NT-based clients to the server system. Measure maximum data transfer rate for reads and writes of reasonable length.

You will find that Windows NT, as a file server, performs especially well for large data access and for in-cache access. With disk striping without parity, you will notice a significant performance advantage compared to the same test run on disks of the same type that are not striped.

Network Access

Be sure to set-up multiple domains to test single network logon.

As you consider an advanced operating system's capabilities as a server, it is important to look well beyond its capabilities as a file and print server, and focus instead on its capabilities as an application server. Applications based on the client-server architecture provide the highest level of power and reliability when they can take advantage of the following features:

- **Pre-emptive multitasking with multi-threading for increased responsiveness.**
- **Protected virtual memory for increased software fault tolerance and extra capacity.**
- **Integrated, open networking for easy access to distributed resources independent of the type of server on which they run.**

Application Server

A good example of a server application is Microsoft SQL Server for Windows NT. Tests against SQL Server should include multiple MS-DOS-, Windows-, Windows for Workgroups- or Windows NT-based clients. Because Sybase markets SQL Server as a NetWare NLM and as a UNIX application, it is easy to compare the performance of Windows NT Advanced Server as an application server to these other platforms.

Load each of the three platforms to capacity using realistic queries from multiple clients. Avoid averaging results of extremely large or small queries. These results will reflect the unique implementations of a single component of one operating system, but will not be a good estimate of how the system will perform.

Verify the **scalability** of the system. When any one of the system's resources is loaded to capacity, use performance monitoring tools to isolate the bottleneck and correct it by adding additional resources. Scalable resources include: virtual memory, disk space and processors. The operating system and server application should automatically take advantage of the new resources as they are provided.

To demonstrate the importance of **preemptive multitasking**, set up several workstations with normal queries against the SQL Server database and a single client making an extremely long query. You will find that with Windows NT Advanced Server, the short queries will still make progress, even though the longer query is still in the system.

Finally, it is important to test Windows NT Advanced Server in NetWare environments. Install NWLink IPX/SPX support in Windows NT network set-up. Install the ODBC drivers for SPX in SQL Server set-up. Using ODBC on an MS-DOS- or Windows-based client with Novell client software (NetX) installed, you can use front-end applications such as FoxPro or Microsoft Access® to connect to Windows NT Advanced Server.

Security

System security is needed to provide a common way to protect resources from tampering and accidental damage. This is particularly important for resources like enterprise databases that your business relies on. Also, an effective security system must to be easy to use to be successful. You should look for powerful features like C2 compliance, but be careful to find a system that is easy enough to administer so that it will actually get used. Some points to check:

1. Does the system enforce full security with authentication required?

2. Can users be managed as groups?

3. Do users have to maintain multiple user accounts to gain enterprise access?

4. Does the system support security auditing?

5. Can the system control what operations various users can and cannot perform?

6. Do security capabilities extend to applications?

Security Features in Windows NT

Security Features in Windows NT

Windows NT provides user-level security, with authentication required, designed to comply with US Government security standards.

Windows NT supports local user groups, and Windows NT Advanced Server supports global user groups.

Windows NT Advanced Server enables a single network logon to the enterprise per user.

Windows NT supports full security auditing.

All operations on a Windows NT-based system require a privilege.

The Windows NT security model includes APIs to extend security to applications.

Fault Tolerance

The two most common causes of system crashes are bugs in applications and power failures. Another, less common cause is hard disk failure. In each case, an advanced operating system can protect you from data and productivity loss. Techniques like structured exception handling, hardware isolation, UPS support, disk mirroring, duplexing and striping all help to make a system fault tolerant.

In comparing the **fault tolerance** of advanced operating systems, consider:

1. The level of protection between applications.

2. The level of protection of the system from applications.

3. Support for uninterruptable power supplies (UPS).

4. Ease of recoverability of hard disks after system failure.

5. Protection of information from failure of the hard disk.

Windows NT Provides Fault Tolerance

Windows NT Provides Fault Tolerance

Windows NT provides a completely protected 2GB virtual address space per application. This means that applications cannot interfere with each other or the system. If an application crashes, other applications can continue to run.

Windows NT runs all system-wide operations in a protected micro-kernel that runs in a separate address space.

Windows NT includes full support for UPS systems.

Windows NT's NTFS file system is transaction-based and does not require the hard disk to be scanned after system failure. Windows NT also includes an integrated tape backup system.

Windows NT Advanced Server supports hard disk fault tolerance options including disk mirroring and striping with parity (RAID5) without special hardware.

Test these things:

Install a **UPS** on the system and then simulate a power failure.

Shut off the system while it is running and notice how quickly **NTFS** partitions recover when the system is rebooted. Compare this to systems that require CHKDSK or a similar utility.

Set up a disk mirror and/or stripe set and then power off one of the drives (Windows NT Advanced Server only).

Back up a hard disk to tape using the Windows NT tape backup facility. Delete a file or directory and then try to recover the deleted file from tape.

Management Facilities

System management is a major part of the cost of running a network. When evaluating business platforms it is important to compare the facilities available to manage both server systems and desktop systems. Management includes:

system installation
control of users
application installation
system performance monitoring
network resource management
configuration control
hardware support

A powerful set of management facilities should be "remotable" so that systems can be managed remotely, from a central administration station.

Management Features in Windows NT

Things to try

Management Features in Windows NT

Windows NT installation is graphical.

Windows NT includes a remotable Performance Monitor that is extensible to applications.

Windows NT includes comprehensive, graphical administrative tools including User Manager, Disk Administrator, Performance Monitor, Backup Utility and Event Viewer.

Windows NT Advanced Server includes tools for centralized management of server resources including share points and server applications.

Testing Management Features in Windows NT

Start by actually installing the system. You'll find that Windows NT requires only a few simple steps for installation using the express set-up option off a CD-ROM drive.

Try changing the video driver for Windows NT.

Try adding a new user account on Windows NT with the User Manager.

Create a new disk partition using the Disk Administrator.

Create a new group of users.

Use the Performance Monitor to study CPU utilization for the system and for individual processes.

Assign permissions to files and directories over the network.

Use the Disk Administrator to view and manage disk partitions.

Use the File Manager (or the Server Manager on Windows NT Advanced Server) to share resources on the network.

Use the Server Manager on Windows NT Advanced Server to start and stop services running on the system.

Use the Event View to examine the system, security or application logs.

Interoperability

Integration with existing information systems is a key success factor for any business solution platform. Ultimately, existing solutions may be migrated to the new platform, but in the short term, the new solutions must interoperate with existing ones.

Some key factors for practical interoperability are:

Hardware compatibility - with the current machines, options and peripherals.

Protocol compatibility.

Communications - to exchange files for example.

Remote access - terminal access to remote legacy systems is useful.

Messaging services.

Resource re-direction to legacy systems.

Interoperability in Windows NT

Interoperability in Windows NT

Windows NT is based on an open networking design

Windows NT includes standard networking transports including TCP/IP, IPX/SPX and Data Link Control (DLC) in the package

Windows NT enables client-server interoperability with UNIX over TCP/IP, Sockets and OSF/DCE-compatible remote procedure calls (RPCs). Windows NT is a full Telenet® client and also includes support for FTP client and server.

Windows NT is a full client to Novell® NetWare® servers with Novell's NetWare Client for Windows NT.

Windows NT Advanced Servers can be application servers in existing NetWare environments without additional networking software on the NetWare client.

With Microsoft SNA Server for Windows NT, Windows NT-based systems become full clients to IBM® hosts over SNA.

Application Availability

In many cases, your choice of operating system is driven by the applications that you need to run. You should satisfy yourself that all the applications you need are available for your choice of operating system. Furthermore, you need to be confident that you will get good application support from your software vendors in the future.

Thousands of software vendors are committed to supplying applications written for the Win32 API. Furthermore, Windows NT supports all 16-bit Windows- and MS-DOS-based applications as well as 16-bit character mode OS/2 applications and POSIX applications. This guarantees the widest range of application support you can get.

32 bit Applications for Windows NT Available Today

Evaluating Windows NT as a File and Print Server

Microsoft® Windows NT™ is an advanced, modern operating system capable of many different functions. One service that it provides is file and print sharing. However, because Windows NT is a high performance, client-server operating system with built in networking, it offers many compelling advantages over the leading file and print system, Novell® NetWare® 3.11. As you evaluate file and print sharing products, think about what is necessary to:

Get The Most Value From Your File And Print Server

Reduce Your Administration Costs

Maximize Your Enterprise Resources

Get the Most Value From Your File and Print Server

Getting the most value from a file and print server requires:

- **Leveraging your existing investment in hardware, software and skills**
- **Reducing administration costs**
- **Protecting your investment in mission critical data and information**

Key issues:

Choose a System that Delivers Value

What You Can Get For $20,000

Are You Saving Money As Your Network Grows?

Don't Let Your Operating System Limit Your Choice of Hardware

Why Not Use Your Server As A Workstation?

Simplifying Access To Your Mainframe

Choose a System that Delivers Value

When you acquire a file or print server product, what is included in the purchase price? Are you able to link all of your MS-DOS®-based, Windows™-based, Macintosh® and remote dial-in clients? Are there built-in fault tolerance and back-up features or must you purchase those separately? Finally, does the cost of the shrink-wrapped package include the ability to grow or change with your business needs? For example, what if the demands on your server increase significantly? Does your file and print server provide the flexibility to support multiple processors, thus paying only for the additional processor and not another system? Windows NT Advanced Server provides all of these components in the purchase price, and will be able to grow and expand with your changing business needs.

Windows NT Standard Features:

Unlimited Client Support

Excellent Connectivity And Interoperability

Built-In Advanced Fault Tolerance

Windows NT Makes Your Remote Users More Productive

Integrate Macintosh Clients

Unlimited Client Support

The $2,995 purchase price of Windows NT Advanced Server includes unlimited client licensing.

This means that any client running MS-DOS, Windows, Macintosh, or OS/2 can utilize the unique features of Windows NT. There are no additional software components to obtain, or license fees incurred.

Built-In Advanced Fault Tolerance

With Windows NT you get every major fault tolerance technology right out of the box.

When you use your file server for mission critical information, you need a server you can *trust*. There are many **fault tolerance** features available today that give you peace of mind, but how much do they cost?

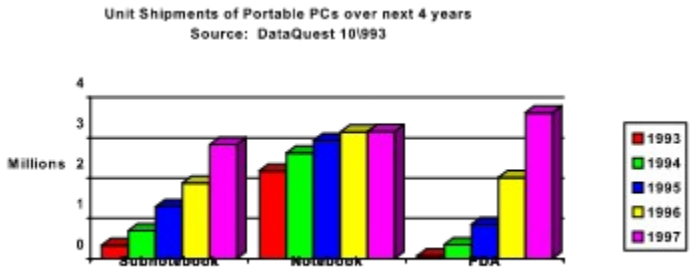
Standard Fault Tolerant Features:

	Windows NT Advanced Server	Netware 4.x
Disk Mirroring and Duplexing	**Included**	**Included**
Disk Striping (RAID5)	**Included**	**Unavailable**
UPS Support	**Included**	**Included**
Journalling File System	**Included**	**Included**
Backup Profiler and Scheduler	**Included**	**Included**

More Details on Windows NT Fault Tolerance

Windows NT Makes Your Remote Users More Productive

Does your network operating system connect all of your users, both local and remote? The graph below shows how demand for smaller, more mobile computers will increase over the next four years. As your users spend more time computing outside the office, it will be essential to provide them the same network access remotely that they get with a direct connection.



Because Windows NT Advanced Server is **protocol** independent, remote users are treated exactly as if they were locally connected. Thus, daily tasks such as E-Mail, mainframe emulation, and server application use can all be accomplished remotely under Advanced Server. All security and administration issues are retained without additional overhead. Additionally, because of the power and reliability of Windows NT, you need not dedicate a separate machine for dial-in services, as is the case with other systems.

More Information About Remote Access Service (RAS)

Integrate Macintosh Clients

Windows NT Advanced Server allows Macintosh® users to connect with no interruption or changes to their environment.

Behind PCs, Apple's Macintosh is the most widely used desktop computer. The flexibility of sharing printers, physical disks and a common security and fault tolerant model greatly leverages hardware, software and human resources. It also preserves the respective environments, allowing users to focus on productivity, not interoperability.

More Information About Macintosh Support

Excellent Connectivity And Interoperability

Windows NT is **protocol independent.** This is important because most larger businesses must support a variety of network protocols for a number of specific purposes. Recognizing that fact, Microsoft includes, in the purchase price, support for:

- **TCP/IP**
- **NETBEUI**
- **DLC**
- **IPX**

This means that if your environment currently supports TCP/IP, a Windows NT Advanced Server could be installed and run natively in that environment with no additional cost. This is an important and unique distinction of Advanced Server because it separates the network operating system decision from the protocol issues.

What You Can Get for $20,000

For $20,000, this is what you could acquire with either Microsoft Advanced Server or Novell NetWare.

Suppose you are responsible for making the purchasing decision for a network infrastructure in your department. You must provide a powerful and reliable file and print services to all your users including both Macintosh and remote users, and you must also allow users in other departments or areas of your company to share information.

$20,000 with Microsoft Advanced Server and Novell NetWare

Component	**Windows NT Advanced Server**	**Novell NetWare Version 4.x**
Hardware	**Dual Pentium™**/66 + 64Mb RAM or **R4400**/75 RISC + 64Mb RAM or **Alpha AXP™**/150	**Single Processor 486** 66MHz with 16Mbytes RAM
Number of Users	Unlimited	100
Macintosh Clients	Unlimited clients - included	5 clients - included 1,000 clients - $1,195
Remote Access	64 connections - included	16 connections - $2,395
Protocols Included	TCP/IP, IPX, NETBEUI, AsynchBEUI, DLC, AppleTalk®	IPX only
Processors Supported	Up to 16 Processors	Single processor only

There are two very important factors to consider with this chart:

1. Only Advanced Server gives you the **flexibility** to utilize these advanced hardware platforms, such as the Digital Alpha AXP, MIPS® or symmetric multiprocessing machines that are either Intel- or RISC-based, letting you predicate your hardware decision on the specific needs of your organization and not on the network operating system.
2. Only Advanced Server provides **seamless access of network resources** to all users regardless of whether they are PC or Macintosh users or whether they are locally or remotely connected. Additionally, Advanced Server provides an unlimited license to all potential clients, unlike the NetWare solution, which incurs additional costs for adding users.

Are You Saving Money As Your Network Grows?

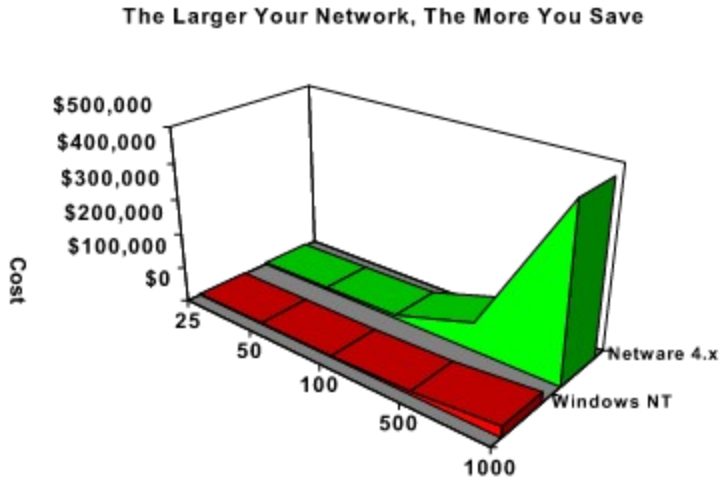
One of the largest hidden costs with network operating systems is the licensing of clients. Some vendors of networking products charge a per client cost while others provide licensing on a 10, 50, 100, or 1000 user basis. When Microsoft created the unlimited license cost structure for the Windows NT Advanced Server, we based the decision on customer suggestions. The biggest complaints about per client cost structure were:

- It imposes restrictions.
- It forces network managers to (sometimes arbitrarily) limit information availability to users.

The following chart compares client licensing charges of Microsoft Advanced Server and Novell NetWare **(Note: These are suggested retail prices from 10/1/93. Actual prices may vary)**.

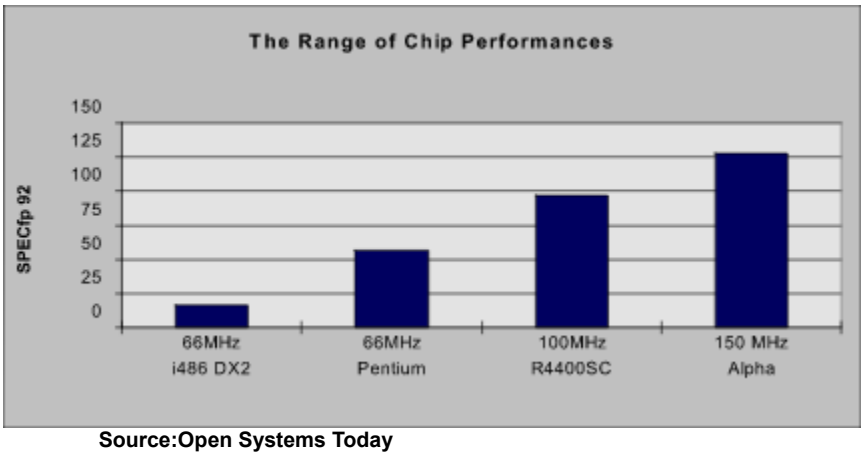
Servers	Clients	Windows NT Advanced Server	Novell NetWare Version 4.01	Novell NetWare Version 3.1x
1	25	$2,995.00	$4,695.00	$3,495.00 (20 users)
1	50	$2,995.00	$6,295.00	$4,995.00
1	100	$2,995.00	$8,795.00	$6,995.00
1	500	$2,995.00	$26,395.00	Not supported
3	500	$8,985.00	$79,185.00	Not supported
3	1000	$8,985.00	$143,985.00	Not supported
10	1000	$29,950.00	$479,950.00	Not supported

Graphical Representation


The Larger Your Network, The More You Save
$500,000
$400,000
$300,000
$200,000
$100,000
$0
Cost
25
50
100
500
1000
Netware 4.x
Windows NT

Don't Let Your Operating System Limit Your Choice of Hardware

One of the biggest challenges in any Information Technology (IT) group is getting the most use out of hardware resources. As new technology becomes available, the dangers are that existing systems may become obsolete, or that the lack of return on investment may not justify the purchase of the latest technology.



Source:Open Systems Today

Unlike other operating systems, however, Windows NT Advanced Server protects your investment by minimizing these dangers. For example, compare the hardware choices available with Windows NT Advanced Server against those available with NetWare, specifically in terms of:

- **Symmetric Multiprocessing**
- **Portability**

Symmetric Multiprocessing

Symmetric Multiprocessing allows purchasers to significantly increase processing power by purchasing only additional processors, not entire systems. It thereby doubles the processing power at roughly one third the price. However, no benefit accrues unless the operating system software natively supports SMP. Since Windows NT Advanced Server does support SMP, the cost savings is clearly applicable. Novell NetWare, however, does not support SMP, and therefore cannot take advantage of this cost savings.

Portability

Through its portable design, Windows NT Advanced Server is able to run not only on Intel processor machines, but also those supporting RISC, such as the MIPS R4000® and R4400, the Intergraph Clipper™ and the new Digital Alpha AXP chip. This is important for two reasons. First, with new technologies from Digital, Intel, IBM and MIPS, it is not clear which chip architecture will deliver the best price performance. Portable operating systems such as Windows NT help minimize the risk since it will run on any of these systems.

Second, because customers have strategic relationships with their hardware vendors, it is advantageous to separate the hardware from the operating system and applications decision. Unlike NetWare, which only supports a single processor type, Windows NT Advanced Server does not force or limit the customer to choose according to the requirements of a specific type of processor. Windows NT Advanced Server is both sold and supported by a variety of chip manufacturers, providing a broad range of choices for customers.

Save Money by Using Your Server as a Workstation

Why purchase an additional PC when Windows NT can run popular applications for MS-DOS and Windows, and support hundreds of users simultaneously?

Unlike NetWare, Windows NT Advanced Server need not be dedicated solely to file and print sharing. In small and mid-size work environments, the ability to use the file and print server as a workstation means empowering another user. NetWare cannot do this because it does not run desktop applications: it neither provides protection, nor does it employ the type of desktop security necessary to allow a server to function simultaneously as a workstation.

Windows NT, however, delivers on these requirements:

- **It runs MS-DOS-based, Windows-based 16bit, Windows-based 32-bit, POSIX, and OS/2 character-based applications.**
- **It supports integration functions such as OLE and WOSA.**
- **It uses the same Windows interface used by over 30 million users.**

Additionally, Windows NT is secure. Windows NT Advanced Server enables the administrator to configure a personality or customized configuration on a per user basis, which has the effect of limiting or restricting access to various components of the operating system. It also ensures that companies who wish to get the most out of the file and print servers can without the traditional fear that it would compromise system integrity.

Simplifying Access To Your Mainframe

There are several important criteria to consider when implementing a communications server into networking environment:

1. **The gateway must be stable and reliable.**
2. **Administration must be intuitive and easy to manage.**
3. **The gateway must have support from industry leading client providers.**
4. **The gateway should be cost effective.**

SNA Server for Windows NT and Windows NT Advanced Server meets each of these criteria and provides administrators with a reliable and easy to manage integration platform for LAN users and their mainframe.

SNA Server for Windows NT simplifies mainframe access:

SNA Server is Stable and Reliable

SNA Server Is Easy To Install and Manage

SNA Server Is Supported By Third Parties

SNA Server is Stable and Reliable

A fully 32-bit server application, SNA server runs fully protected on Windows NT and Windows NT Advanced Server. Unlike Novell's NetWare for SAA which usually runs on a separate server, SNA Server can utilize the same hardware as your file and print server. Like Windows NT itself, it is both scalable and portable, and thus it can take advantage of multiprocessing or RISC servers. And, unlike NetWare 3.1x, all applications are protected from the operating system. This, combined with the flexibility to run on more powerful hardware allows departments to consolidate servers, which in turn reduces administration overhead.

SNA Server is Easy to Install and Manage

One administrator can easily configure several SNA Servers, add users, and establish security without ever leaving his or her desk.

Windows NT Advanced Server accommodates the needs of both administrators and end users for flexibility and ease of use:

- **It is easy to install.**
- **It can support simultaneous sessions from multiple mainframes.**
- **It allows remote users to run mainframe sessions and applications (including client-server APPC applications) just as they would locally on the network. Example**
- **It provides excellent integration with IBM's NetView®.**

Because it is tightly integrated with Windows NT Advanced Server, SNA Server uses the same graphical administration tools and the same security model, and it can be remotely monitored, configured and managed. Additionally, SNA Server inherits the same users' rights that have been established under Windows NT Advanced Server, significantly reducing repetitive administrative tasks that would be necessary using Novell's NetWare for SAA and NetWare.

Under Windows NT Advanced Server, an administrator establishes a single logon and security profile for each user. That security and user profile is automatically mapped to additional servers, including SNA Server. Under NetWare 2.x and 3.x, the administrator must configure security and profile administration for each server. Additionally, since NetWare for SAA must run on a separate server, additional and redundant configuration is necessary. This type of additional administrative overhead directly translates into expensive and unnecessary costs which most organizations can hardly justify.

Aside from supporting such functions as RTM, administrators can map any number of user-defined system alerts to notify NetView. Similarly, the completely bi-directional NetView support allows an MIS administrator to manage a Windows NT Advanced Server from the NetView console. This level of integration ensures that investment in mainframe applications and information can be shared, and even enhanced, with Windows NT Advanced Server

SNA Server Is Supported By Third Parties

SNA Server enjoys broad support from third parties. Aside from supporting the WOSA services for SNA, SNA Server supports most third party 3270 and 5250 emulation products for Windows, MS-DOS, OS/2 and the Macintosh. This helps ensure that investments made in those products will be preserved, while adding significant value in the form of lower administration costs, better performance and enhanced reliability.

Details on SNA Integration

Reduce Your Administration Costs

Less than 15 percent of the five-year total cost of a personal computer ownership is represented by capitalized hardware and software.

The remaining 85 percent is dominated by such personnel costs as support, training and so on. Clearly, making system administration easier reduces these personnel costs. (Statistic provided by Gartner Group)

Compared with Windows NT, NetWare 2.x and 3.x simply don't provide the features you need to set up an enterprise network. There is no way to link servers and provide the single network login that you need for centralized administration and practical user access. There is also no provision for WAN capability through inter-domain relationships.

To cut administration costs, consider the following suggestions:

Centralize Your Enterprise Management

Secure Your Information

Administer Your System From Anywhere

Control the Distribution of Your Software

Centralize Your Enterprise Management

One big drawback with many local area networks is that each new server you add needs its own security system.

As the administrator, you have to duplicate effort for each new server. As a user, you have to login separately to each server that you need to access. To solve this problem, Windows NT allows servers to work together and provide a common, enterprise-wide security system. Windows NT allows you to set up wide area networks, so you can get access to resources anywhere in the world with a single network login.

Implementation of this management feature is easy. By replicating a database of users on each server, you can establish a "domain" of multiple servers with a single entry point. Domains can then be assigned trust relationships, which allow either unilateral or bilateral access between two or more domains. Once you log in to one of the servers, you are automatically recognized by all the others. This makes both security administration and enterprise access much more convenient.

Secure Your Information

Windows NT is designed to meet government-certifiable, C2 level security as standard feature.

As information spreads across your network, so does the potential for security breaches. A good security system needs to be unobtrusive for legitimate users, impenetrable by hackers and easy enough to set up so that it will actually be used. This security is administered using a simple, graphical interface.

NetWare does not include C2 level security as a standard feature, and because of the lack of server-to-server integration in NetWare 2.x and 3.x, administering security in multi-server networks is complicated .

More Information on Security

Administer Your System From Anywhere

With Windows NT, you can administer any server from any Windows NT-based workstation.

For example, you might want to monitor a remote server's event log and check the file activity that has been occurring. With Event Viewer, you can check any Windows NT host on the network without leaving your seat. This includes tracking such things as: logins, logouts, file or object accesses, system shutdowns and user rights. The same is true for the Performance Monitor. It can be used not only for checking system functions like processor activity, hard disk accesses and I/O, but also to monitor server applications like SQL Server.

A third feature of Windows NT that helps you administer large networks centrally is its support for the simple network management protocol (SNMP). This standard protocol allows you to setup "agents" that report network activity to your central management station through management information bases (MIBs). Windows NT provides several network administration tools for SNMP that you can use immediately.

Control the Distribution of Your Software

A major problem facing companies with large networks is controlling software distribution across the clients.

Microsoft has demonstrated a product that revolutionizes this aspect of network administration. Code-named Hermes, it can remotely audit, install and upgrade software across any network. This technology is supported by **several independent vendors** who plan to ship enhanced software distribution and auditing packages.

Vendors Supporting Hermes

Attachmate Corporation
Automated Designs Systems, Inc.
Brightwork Development, Inc.
Compaq Computer Corp.
Computer Associates International Inc.
Corporate Software
Digital Equipment Corporation
800-Software
HDC
Hewlett-Packard Company
Infonet
Legent
Microcom
NCR Corporation
Netlabs
NetWork Managers
Olivetti
Siemens Nixdorf Information Systems
Softmart
Software Spectrum
Synoptics
Tally Systems
VisiSoft

Maximize Your Enterprise Resources

One of the reasons you installed a network in the first place was to get better use from your resources by sharing them between users. But are you really maximizing your resources?

Check these points against NetWare and the others and you will see how Windows NT delivers the best enterprise resource-sharing:

Don't Let Your Operating System Limit Your Connectivity

Get Everyone Connected

Keep In Touch From Outside The Office

Don't Let Your Operating System Limit Your Connectivity

In many cases, your choice of network protocol has been determined by your choice of network operating system. Consequently, you have implicitly standardized on a particular protocol that restricts your future choices for network software and hardware. Many customers, however, are now rejecting the inherent link between network products and the underlying protocol in favor of protocol independent systems, like Windows NT Advanced Server. The benefit of protocol independence to you is simple: you get freedom of choice. By avoiding protocol "lock in", you can choose whatever network products emerge in the next few years according to your needs, not your system's requirements.

Protocols supported by Windows NT Advanced Server:

- **NetBEUI**
- **AsynchBEUI**
- **TCP/IP**
- **IPX/SPX**
- **DLC**
- **AppleTalk**

Protocols supported by NetWare:

- **IPX/SPX**
- **TCP/IP (using tunneled IPX)**

Get *Everyone* Connected

Most networks are heterogeneous. Even if 99% of your clients are PCs running MS-DOS and Windows, you may still need heterogeneous support just to add a few UNIX® workstations or Macintoshes.

Windows NT Advanced Server has standard features to connect to Macintoshes and UNIX networks. Compared with NetWare:

Interoperability with...	Windows NT Advanced Server	NetWare
Macintosh	AppleTalk, long filenames, transparent file and print access from Chooser. Unlimited clients.	AppleTalk NLM, 5 users, transparent file and print.
UNIX	TCP/IP protocol and utilities are standard. DCE compatible RPC allows distributed applications.	No standard support. NFS and FTP/print are available at extra cost. TCP/IP is tunneled into IPX so IP routing is not possible.

Keep in Touch from Outside the Office

Portable computers have had a huge impact on work styles. This new trend also has implications for networking, since remote access capability is now an important feature that lets you use the network even when you are away from the office. Windows NT includes remote access capabilities as a standard feature. Both desktop and server versions can be accessed by modem. Windows NT Advanced Server supports up to 64 serial connections.

NetWare by comparison does not allow you to login to a server remotely. Instead, another machine must be dedicated as a communications server. Remote users then connect to the communications server with dumb terminal software. You cannot download files, your connection is slow, and running Windows is impractical.

Microsoft® FORTRAN PowerStation 32 for Windows NT™ - Fact Sheet

Main Features

Increased Power

- 32-bit executables for the Microsoft® Windows NT™ operating system yield mainframe-class performance
- Advanced Intel® i486™ and Pentium™ optimizations
- 32-bit graphics support

Increased Capacity

- 32-bit compiler for Windows NT avoids capacity limitations
- 4 gigabytes of addressable memory
- 80387 math coprocessor support and emulation

Downsizing and Porting

- Large suite of VAX®, IBM® and Microsoft's own extensions allows easy porting of mainframe and minicomputer code
- Key subset of FORTRAN 90
- Mixed-language programming with the Microsoft Visual C++™ development system and MASM
- Assembly language listings allow finer hand-tuned optimization

Visual Workbench

- Windows™-hosted Visual Workbench
- Toolbar allows quick interaction with Editor functions
- Icons for commonly used operations
- Multiple document interface allows easier and more consistent management of multiple windows
- Access to the clipboard in the Microsoft Windows™ operating system provides convenient cut and paste from other Windows-based applications
- Full access to the printing functionality of Windows from within Visual Workbench

Editor Features

- Syntax coloring for easier maintenance of new and existing code
- Bookmark facility for editing large files efficiently and returning to positions set in a previous editing session
- Customizable colors and fonts for easier viewing
- Multiple levels of "undo"
- Parenthesis balancing makes typing complicated expressions easier
- Saving and restoring work spaces makes maintenance easier

Project Maintenance Capabilities

- Automated "make" file generation
- Flexible graphical selection of options for compile and link stages
- Ability to create both libraries and executable files
- Alternate project environments supported from within Visual Workbench
- Ability to add tools and commands to the Tools menu
- Conditional compile, full project and build facilities using icons

Code Browser

- Seamless integration of Browser with Editor
- Graphical call-tree display makes code structure easy to visualize
- Ability to identify all locations in the code where a variable or subroutine is defined or referenced

Debugger

- Integrated debugging, including single-stepping, step-in and step-over functions and step-to line
- Toolbar allows easy access to Debugger functionality
- Set and release breakpoints with a simple Mouse click
- Ability to expand and view multidimensional array values in Local and Watch windows
- Assembly instructions along with the Register window simplify low-level debugging

Product Assistance and Support

- Context-sensitive Windows online Help allows instant help on language and features
- Sophisticated "hot links" allow easy browsing through Help
- Numerous examples for syntax usage online that can be copied and pasted
- List of commonly asked questions available online
- CompuServe® support with dedicated FORTRAN forum allows other serious programmers to assist with problems
- 90-day telephone support at no charge for setup assistance
- Continuing support for previous versions of MS®-FORTRAN

Graphics Library Support

- 32-bit graphics libraries
- VGA, Super VGA and VESA support

System Requirements

- Microsoft Windows NT version 3.1
- IBM 100-percent-compatible PC using a 80386/25 or higher processor
- 16MB of memory
- One 3.5-inch high-density disk drive with 12MB of available disk space
- Microsoft Mouse or compatible pointing device (optional)
- 80387 or higher math coprocessor (optional)

National Fuel Gas Supply Corporation

With deregulation of the natural gas industry creating a new, more competitive business environment, National Fuel Gas Supply Corporation decided to upgrade its OS/2®-based mission-critical computerized control system to one that would allow better, faster access to information. The new system is based on the Microsoft® Windows NT™ and Windows™ for Workgroups operating systems.

National Fuel Gas Supply Corporation Solution Summary

Industry
Natural gas utility

Business Solution
Supervisory Control and Data Acquisition (SCADA) system

Architecture
Custom application for Windows NT™ ported from OS/2 running on a Microsoft LAN Manager network and a satellite-based wide area network

Products Used
Microsoft Access®
Microsoft Excel for Windows™
Microsoft LAN Manager
Microsoft SQL Server
Microsoft Visual Basic®
Microsoft Windows NT™
Microsoft Windows™ for Workgroups
Microsoft Word for Windows
Novell® NetWare®

Development Resources
In-house
PanData
8 Main Street,
Flemington, NJ 08822

Development Time
Two years

Benefit
Provides faster access to mission-critical data, positioning the company to do business in the highly competitive deregulated environment.

For More Information

To learn more about Microsoft products, call the Microsoft Sales Information Center at **(800) 426-9400**. In Canada, call the Microsoft Canada Customer Support Centre at **(800) 563-9048**. If you require text telephone services (TT/TDD), call **(800) 892-5234** in the U.S.A. or **(905) 568-9641** in Canada. Outside the 50 United States and Canada, please contact your local Microsoft subsidiary. For more information about PanData, call **(908) 782-5003**.

National Fuel Gas Supply Corporation Case Details

The National Fuel Gas Supply Corporation can sum up the reason it changed its computer system in a single word: deregulation.

Part of the 90-year-old National Fuel Gas Company, National Fuel Gas Supply Corporation purchases, gathers, transports, or stores natural gas in markets throughout the United States. More than 700,000 customers in western New York and western Pennsylvania depend on National Fuel Gas for their natural gas.

For much of its existence, the company's operations--like those of all other natural gas companies in the country--were closely regulated by the federal government. That changed in 1985 when the natural gas industry began to evolve toward a more competitive environment. The evolution was completed in 1992 when the Federal Energy Regulatory Commission issued Order 636, a restructuring mandate that requires all interstate pipeline companies such as National Fuel Gas to "unbundle" and separately market the components of their traditional merchant function. These components include transportation, storage, and sales of natural gas.

The company uses computers to control the movement of gas throughout a network of pipelines, compression facilities, and storage sites from its headquarters in Buffalo, New York. Recently, National Fuel Gas made the transition from a minicomputer-based control system to one running the OS/2 operating system on PCs.

But the added competitive requirements created by Order 636 put pressure on National Fuel Gas to have a system that would provide the increased power, speed, reliability, and **scalability** it would need to respond effectively in a changing environment. Management grew increasingly concerned about the ability of the OS/2 system to withstand the demands that would be placed on it.

Developing a Response to Deregulation

National Fuel Gas Supply Corporation's first minicomputers were a big improvement over the manual systems they replaced. But they had limited control and data handling capabilities, and the company soon grew to the point where the computer could no longer effectively handle the amount of data required to run the system.

The OS/2-based system was a further improvement. It replaced three minicomputers with a PC-based system that provides real-time measurement of gas flows and manages remote control valves and compressors. And the corporation recently installed a series of Supervisory Control and Data Acquisition (SCADA) systems running under OS/2. The software, called ScadaNet™, was developed by PanData, a company that has been providing vertical control software to the natural gas industry for more than 20 years.

In National Fuel Gas's system, a main control center in Buffalo centrally manages gas flow from five interstate pipelines, 31 underground gas storages, remotely starts and

shuts down compressor stations, and monitors and controls the distribution systems. All of this is accomplished through the communication by remote field points with the central dispatching center through a network of satellites and fiber optic links.

But deregulation meant more people would need access to data on gas capacity--and they would need it quickly. That's because each gas company owns a certain amount of capacity in a pipeline. If the company doesn't need the capacity, it can be packaged and sold to customers who do need it.

Walt DeForest, National Fuel Gas senior vice president, says as the company was analyzing how to use its computer systems to respond to deregulation, it learned from PanData that the developer would be porting ScadaNet to the Microsoft Windows NT operating system and would no longer provide enhancements to the OS/2 version.

National Fuel Gas became convinced to move to Windows NT as well because the operating system would enhance the company's ability to respond to increased competition and best prepare National Fuel for a deregulated future.

Why Windows NT

"There were a lot of reasons to move to Windows NT, but they came down to power, ease of use, reliability, and security."

Walt DeForest, Senior Vice President, National Fuel Gas Supply Corporation

Given the mission-critical nature of its control system, National Fuel Gas Supply Corporation required an operating system platform that was absolutely reliable and secure--a computer system failure in the middle of winter could have severe consequences for National Fuel. "There were a lot of reasons to move to Windows NT," says DeForest. "But they came down to power, ease of use, reliability, and security." Another factor in the decision was the company's existing investment in Windows™-based computing.

Just as important, says DeForest, is compatibility with the future. "Windows NT is our best chance to be part of what's going to happen over the next decade," he says.

PanData agrees. "We consider Windows NT to be the future," says Mike Alfano, PanData president. "We're putting all of our development dollars into Windows NT--in fact, we're licensing the rights to our OS/2 code."

Alfano adds that his company was pleased with the support it received from Microsoft as it developed its application for Windows NT. "We can get answers to specific technical questions in a meaningful time frame. The beta program has enabled us to begin development more than a year before Windows NT began to ship."

Meeting the Needs of an Evolving Company

"We like the fact that Windows NT is geared to be used on different hardware platforms. Parallel processing, multiple networks--it's all taken into account."

Walt DeForest, Senior Vice President, National Fuel Gas Supply Corporation

The new demands on National Fuel Gas Supply Corporation to gather, analyze, and distribute information about its pipeline capacity mean more people need real time access to the SCADA data. Windows NT enables the company to provide that data in a number of ways.

"We like the fact that Windows NT is geared to be used on different hardware platforms," says DeForest. "Parallel processing, multiple networks--it's all taken into account. We can run office applications on our Novell® NetWare® LAN and ScadaNet at the same time. That means we can get a variety of information to more people at once."

ScadaNet information from field operations, such as statistics on the movement of natural gas and storage operations, is stored in a SQL Server for Windows NT database, providing improved access to the information. National Fuel Gas personnel can integrate data from the ScadaNet system into Microsoft Excel worksheets for analysis and planning. The company also uses Microsoft Word for Windows to consolidate ScadaNet information in management reports. Both applications run under Windows for Workgroups on PCs across the company's LAN.

DeForest says the Windows NT operating system will help National Fuel work with information in another way, too. The pipeline companies that supply National Fuel with natural gas also post product information on electronic bulletin boards. This information may include when gas supplies or transport capacity is available, on which pipelines, and at what cost. Most of these bulletin boards have a Windows-based interface, making them extremely easy to use--especially for people who are unfamiliar with bulletin board systems. National Fuel's Windows NT-based system will enable the company to transfer data from a bulletin board to a spreadsheet, analyze it, and repackage excess capacity as a product that can then be sold to others. For example, if the highest prices are for one-day blocks during peak usage periods, the available capacity can be sold at market clearing prices.

More Information, Delivered More Quickly

DeForest says critical information can now be delivered quickly in a format that makes decision-making easier and faster. That puts National Fuel Supply in a much better position to react quickly and flexibly to market changes, such as variances in the supply and prices of natural gas.

Since Windows NT also allows low-end and high-end systems to share the same software, National Fuel can have the same software running a station with a single compressor or the complete pipeline. That cuts training costs and reduces hardware requirements.

PanData's Alfano says that scalability allows his company to easily size its core SCADA system to accommodate the needs of its various customers in gas, electric,

water, and waste water treatment utilities, and manufacturing and train control industries. And, he says, Windows NT offers access to a richer application base than OS/2. "Windows™-based productivity applications are available at a lower cost and provide greater functionality than those now available for OS/2 or UNIX®," he says.

This was critical to making SCADA data available throughout the organization. Otherwise, every time a user wanted to incorporate operating statistics into a worksheet, he or she would have to move from a UNIX machine to one running the Windows operating system, or leave OS/2 and reboot with the Windows operating system. Both of these options were considered to be too disruptive to the company's workflow.

The Need for Greater Security

Before deregulation was fully imposed, security wasn't a big concern at National Fuel Gas because the SCADA system was closed. As a result, only 15 people had access to the system. These people had the ability to control the flow of gas by opening and closing valves remotely.

With deregulation, as many as 100 people throughout the company will need gas supply information so they can analyze and respond to market conditions. That creates a need for much greater security. As DeForest put it, "Once we open the system up to the rest of the company to pull data out, we have to make sure that if someone connects to the SCADA part of the system, they can't open or close any valves."

According to PanData's Alfano, the version of ScadaNet for Windows NT adds security by using Microsoft SQL Server as a gateway to SCADA information. "SCADA sends data to the SQL Server database," he says. "That way, non-operational people can still access SCADA data without actually getting onto the SCADA system. They just log on to SQL Server and the data is right there."

DeForest was impressed with the ability of Windows NT to provide high-end security down to the file level. This feature was vital to the company's goal of delivering pipeline information to as many people as possible.

Looking Ahead--Greater Integration, More Effectiveness

"Ultimately, data from any database will be accessible through the same interface."

Walt DeForest, Senior Vice President, National Fuel Gas Supply Corporation

National Fuel Supply Corporation envisions combining all individual SCADA systems at the various company sites as well as internal departments into one large, integrated system based on Windows NT. "Data from any database will be accessible through the same interface," explains DeForest. "Different computer operators will be able to take their machines and gather all the information they need to put together."

DeForest says this kind of integration is vital because he wants to avoid people rekeying information they don't have in their PC.

As the full effects of deregulation hit the natural gas industry, National Fuel Gas Supply Corporation is confident it has positioned itself to react in the most effective way possible to dynamic market conditions.

Close

A

access control entry (ACE)
access control list (ACL)
access right
access token
ACE
ACL
address space
alert
alertable thread
alerter service
alerting a thread
APC
APC object
APC queue
API
APPC
application programming interface (API)
ASMP
associated IRPs
associativity
asymmetric multiprocessing (ASMP)
asynchronous
asynchronous I/O
asynchronous procedure call (APC)
attribute caching
auditing
authentication
authentication package
automatic working set trimming

B

backing store
batching

C

cache manager
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D

deferred procedure call (DPC)
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I

impersonation
installable file system (IFS)
instruction execution unit
integral subsystem
Interactive logon
interrupt
interrupt dispatcher
interrupt dispatch table (IDT)
interrupt object
interrupt request level (IRQL)
interrupt service routine (ISR)
invalid page
I/O completion
I/O Manager
I/O request packet (IRP)
IOSB
I/O status block (IOSB)
IRP
IRP stack location
IRQL
ISR
ISV

K

kernel
kernel mode
kernel object
kernel process object
kernel thread object
key object

L

layered operating system
lazy evaluation algorithms
link
locale
local procedure call (LPC) facility
local replacement policy
logon process
LPC

M

mandatory access control
map

N

O

object
object attribute
object class
object directory object
object domain
object handle
object manager
object model
object retention
object service
object table
object type
ODINSUP
OOP
Open Systems Interconnection (OSI) reference model
operating system
OSI

P

page
paged pool
page fault
page frame
page frame database
pager
page table
page table entry (PTE)
paging
paging file
parent process
placement policy
POSIX
port
power notify object
power status object
PPTE
preempt
preemptive multitasking
primary domain
privileged processor mode
process
process context
process manager
processor affinity

Q

R

S

single-byte coding scheme
SMB
SMP
SNMP
spin lock
STREAMS
structured exception handling
stub procedure
symbolic link object
symmetric multiprocessing (SMP)
synchronization
synchronization objects
synchronous
synchronous I/O

T

TCP/IP transport
TDI
termination handler
thread
thread context
thread dispatching
thread object
thread of execution
thread scheduling
thunking
tightly coupled system
time quantum
TLB
token object
topology
translation lookaside buffer (TLB)
transport driver interface (TDI)
trap
trap frame
trap handler
trusted domain relationship
trust relationship
type object

U

UNC
Unicode
uniform naming convention (UNC) names
uninterruptible power supply (UPS)

access control entry (ACE)

An entry in an **access control list**. It contains a security ID (SID) and a set of access rights. A process with a matching SID is either allowed the listed access rights, denied them, or allowed them with **auditing**.

access control list (ACL)

The part of a **security descriptor** that enumerates the protections applied to an object. The owner of an object has **discretionary access control** of the object and can change the object's ACL to allow or disallow others access to the object. Access control lists are made up of **access control entries** (ACEs).

access right

A permission granted to a process to manipulate a particular object in a particular way (for example, by calling a service). Different object types support different access rights, which are stored in an object's access control list (ACL). See also **access control entry** and **access control list**.

access token

An object that uniquely identifies a user who has logged on. An access token is attached to all the user's processes and contains the user's **security ID** (SID), the names of any groups to which the user belongs, any privileges the user owns, the default owner of any objects the user's processes create, and the default **access control list** (ACL) to be applied to any objects the user's processes create.

ACE
Access Control Entry

ACL
Access Control List

address space
See **virtual address space**.

alert

An **asynchronous** notification that one thread sends to another. The alert interrupts the recipient thread at well-defined points in its execution and causes it to execute an **asynchronous procedure call** (APC). See also **alertable thread**.

alertable thread

A thread that has declared itself ready to execute an **asynchronous procedure call** (APC). A thread becomes alertable either by waiting on an object handle and specifying that its wait is alertable or by testing whether it has a pending APC. See also **alert**.

alerter service
A network **service** that sends system messages to a user.

alerting a thread
See **alert**.

APC
Asynchronous Procedure Call

APC object

The kernel's representation of an **asynchronous procedure call** (APC). It is a control object, containing the address of an APC and a pointer to the thread object that will execute it. See also **APC queue**.

APC queue

A list of **asynchronous procedure call** (APC) objects to be executed by a particular thread. The presence of an **APC object** in a thread's APC queue causes a software interrupt to occur at APC interrupt request level (IRQL) the next time the thread executes (if other enabling conditions are present).

API
Application Programming Interface

APPC

Advanced Program to Program Communications - A set of protocols designed by IBM that enable application programs to interact directly with each other on a peer-to-peer basis (not necessarily required to go through a host), even when programs are on separate and/or remote processors.

application programming interface (API)
A set of routines that an application program uses to request and carry out lower-level services performed by an operating system.

ASMP
asymmetric multiprocessing

associated IRPs

A set of **I/O request packets** (IRPs) created to process a single I/O request. Each associated IRP causes some part of the request to be fulfilled. When all the associated IRPs are processed, the I/O request completes.

associativity

Refers to the number of data entries available on a per-line basis in the cache. This means that a 128K 2-way set associative cache has 256K worth of available data entries. A direct-mapped cache is name commonly given to a 1-way set associative cache--a cache in which there is one data entry per cache line.

asymmetric multiprocessing (ASMP)

A multiprocessing operating system that always selects the same processor to execute operating system code while other processors run only user jobs. See also **multiprocessing** and **symmetric multiprocessing**.

asynchronous
Occurring at any time without regard to the main flow of a program (for example, a device interrupt). Compare **synchronous**.

asynchronous I/O

A model for I/O in which an application issues an I/O request and then continues executing while the device transfers the data. The application synchronizes with the completion of the data transfer by waiting on a file handle or an event handle. Compare **synchronous I/O**.

asynchronous procedure call (APC)

A function that executes asynchronously in the context of a particular thread. The kernel issues a software interrupt when the thread executes (if other enabling conditions are present) and directs the thread to execute the APC. See also **APC object** and **APC queue**.

attribute caching

A technique used in the Win32 subsystem to achieve performance gains when a Win32 application calls drawing functions. The client-side dynamic-link library (DLL) remembers when an application changes some attribute of the screen display and sends the data to the Win32 server only when the application draws something on the screen. See also **batching**.

auditing

The ability to detect and record important security-related events, particularly any attempt to create, access, or delete objects. The Windows NT security system uses security IDs (SIDs) to record which process performed the action. See also **security ID**.

authentication
Validation of a user's logon information. Performed by an **authentication package** in conjunction with the Windows NT security subsystem.

authentication package
A software module that can be plugged into the Windows NT security system to authenticate user logons for various input devices. See also **authentication**.

automatic working set trimming

A technique used by the Windows NT virtual memory (VM) manager to increase the amount of free memory available in the system. It decreases each process's working-set size when free memory runs low. See also **working set**.

backing store
A storage medium, such as a disk, that serves as backup "memory" for **paging** when physical memory becomes full.

batching

A technique used in the Win32 subsystem to achieve performance gains when a Win32 application calls drawing functions. The client-side dynamic-link library (DLL) stores drawing application programming interface (API) calls in a queue, sending them in a single message to the server when the queue gets full or when the user enters input. See also **attribute caching**.

cache manager

A component in the I/O system that provides file-caching services to file systems and the Windows NT **redirector**. It uses the paging mechanisms of the virtual memory (VM) manager to bring pages into memory from disk and to write cached pages back to disk.

callback

A request message that a server sends to a client in response to a request from the client. A server sends a callback to a client to get more information about a client request. See also **local procedure call**.

CDFS
CD-ROM File System

child process

A process created by another process that is called a **parent process**. The child process inherits some or all of the parent process's resources.

CISC
Complex Instruction Set Computer

client

A process whose threads call services provided by either a local or a remote server process. In Windows NT, communication between a client and a server occurs through the **local procedure call** (LPC) or **remote procedure call** (RPC) facilities. See also **client-server model**.

client-server model

A model for structuring applications or operating systems. The system is divided into processes (servers), each of which provides a set of specialized services to other processes (clients). Client processes request service by sending messages to server processes, and servers return results through another message. Systems built on a strict client-server model are appropriate for distributed computing environments in which servers can run on different computers.

clone upgrade

Implemented by installing Windows NT Advanced Server on a separate computer and transferring (cloning) the LAN Manager server data and services from an existing server to the new Windows NT Advanced Server

code set

The binary codes used to represent the characters of a particular language. (Windows ANSI is one such code set.)

committed memory

Virtual memory (VM) for which space in the paging file has been set aside. The process that commits the memory is charged paging file quota at that time. See also **reserved memory**.

complex instruction set computer (CISC)

A processor that employs powerful, often elaborate, machine instructions. Because of the instructions' complexity, each can take several clock cycles to complete. Compare **reduced instruction set computer**.

component

A reusable piece of software that can be "plugged into" other components from other vendors with relatively little effort. For example, a component might be a spelling checker, sold by one vendor, that can be plugged into several different word processing applications from multiple vendors.

component software

Software that is based on the notion of a component which is a reusable piece of software that can be "plugged into" other components from other vendors with relatively little effort. For example, a component might be a spelling checker, sold by one vendor, that can be plugged into several different word processing applications from multiple vendors.

concurrent application

An application that can execute in two or more locations. In Windows NT, a concurrent application is one that has created more than one thread of execution, either within a single process or in separate processes. See also **process** and **thread**.

configuration manager

A set of software components that simplifies storage and retrieval of system configuration information. It includes the **configuration registry**, the graphical Registry Editor, and hardware recognizer firmware/software.

configuration registry

A database repository for information about a computer's configuration--for example, the computer hardware, the software installed on the system, and environment settings and other information entered by the person or persons using the system. See also **key object**.

connecting an interrupt object

Associating an interrupt service routine (ISR) with a particular **interrupt request level (IRQL)**. A device driver calls the system to connect an interrupt object, which "turns on" interrupt handling for the device. See also **disconnecting an interrupt object**, **interrupt object**, and **interrupt service routine**.

console
A text-based window managed by the Win32 subsystem. Environment subsystems direct the output of character-mode applications to consoles.

context
See **thread context**.

context switching

Saving the context of an executing thread, loading another thread's context, and transferring control to the new thread. Context switching is performed by the kernel's dispatcher. See also **dispatcher** and **thread context**.

control object

A **kernel object** that provides a portable method for controlling various system tasks. The set of control objects includes the asynchronous procedure call (APC) object, the deferred procedure call (DPC) object, the kernel process object, and several objects used by the I/O system.

copy-on-write

Page-based (as opposed to object-based) memory protection that allows two processes to share a page until one of them writes to it. At that time, the process whose thread modified the page is given a private copy of the page in its virtual address space.

CPI-C

Common Programming Interface for Communications - A peer-to-peer protocol for communications in an SAA environment see also **APPC**.

critical section

A block of code that accesses a nonshareable resource. To ensure correct code, only one thread can execute in a critical section at a time. See also **mutual exclusion**.

deferred procedure call (DPC)

A function that executes asynchronously, interrupting the execution of the thread that is currently running. DPCs perform system tasks that have been deferred until the processor's **interrupt request level (IRQL)** drops below dispatch IRQL. See also **DPC object** and **DPC queue**.

demand paging

A **fetch policy** for paging that postpones loading pages into physical memory until a **page fault** occurs.

desired access rights

The set of access rights a thread requests when opening a handle to an object. See also **granted access rights**.

device object

A system object that represents a physical, logical, or virtual device and describes its characteristics. A device object is associated with a **driver object**.

disconnecting an interrupt object

Dissociating an interrupt service routine (ISR) from a particular **interrupt request level (IRQL)**. A device driver calls the system to disconnect an interrupt object, which "turns off" interrupt handling for the device. See also **connecting an interrupt object**, **interrupt object**, and **interrupt service routine**.

discretionary access control

The protection the owner of an object applies to the object by assigning various access rights to various users or groups of users. Discretionary protections can be limited by **mandatory access controls** applied to the object.

disk mirroring

The procedure of duplicating a disk partition on two or more disks, preferably on disks attached to separate disk controllers so that data remains accessible if either a disk or a disk controller fails. See also **fault tolerance**.

disk striping

The procedure of combining a set of same-size disk partitions that reside on separate disks into a single volume, forming a virtual "stripe" across the disks. This technique enables multiple I/O operations in the same volume to proceed concurrently. See also **disk striping with parity**.

disk striping with parity

The procedure of maintaining parity information across a disk stripe so that if one disk partition fails, the data on that disk can be recreated by performing an exclusive-OR operation across the remaining partitions in the disk stripe. See also **disk striping** and **fault tolerance**.

dispatcher

A kernel module that keeps track of threads that are ready to execute, selects the order in which they will run, and initiates **context switching** from one thread to another.

dispatcher database

A set of global data structures that the kernel uses to keep track of which threads are ready to execute and which processors are executing which threads. The database includes the **dispatcher ready queue**. See also **dispatcher**.

dispatcher object

A kernel object that supports **synchronization**. The kernel's dispatcher implements the signaled and nonsignaled synchronization semantics. See also **kernel object**, **signaled state**, and **nonsignaled state**.

dispatcher ready queue

The data structure in the **dispatcher database** that tracks threads that are ready to execute. It is a series of queues, one queue for each scheduling priority. See also **dispatcher**.

distributed object computing

This new computing method allows an application to be split into a number of components that can run on different machines and transparently connect to another application's components on other machines. As a result, the entire network appears to be one large computer with enormous processing power and capacity. For example, a database system could be built as a set of components: a query engine, a report engine, a forms builder, and a transaction manager. Each of these components could run on a machine suited to the amount of processing power, I/O bandwidth, and disk capacity required for it. Since inter-component communication is handled by the operating system, building such an application does not take significantly more effort than building a monolithic application, but the benefits of the component approach are numerous.

domain controller

A server in a **network domain** that accepts user logons and initiates their authentication. See also **authentication**.

DPC
Deferred Procedure Call

DPC object

A kernel object used to asynchronously execute a system function. It is a control object that contains the address of a **deferred procedure call** (DPC) to execute. The kernel places DPC objects in a global **DPC queue** to await execution.

DPC queue

A kernel-managed data structure that contains **deferred procedure calls** (DPCs) waiting to execute. The presence of a **DPC object** in the DPC queue causes the kernel to issue a software interrupt at dispatch/DPC **interrupt request level (IRQL)**. The processor that takes the interrupt transfers control to the kernel, which executes all the DPCs in the queue.

driver object

A system object that represents an individual driver on the system and tells the I/O manager the address of the driver's entry points. A driver object can be associated with multiple **device objects** (each one representing a device the driver operates).

Dynamic Data Exchange (DDE)

The ability to form a permanent link between the source and destination of the data. For example, if you write a report that contains data from a sales spreadsheet, you can create a link so that the report is automatically updated whenever the spreadsheet changes.

Dynamic-link Library (DLL)

An application programming interface (API) routine that user-mode applications access through ordinary procedure calls. The code for the API routine is not included in the user's executable image. Instead, the operating system automatically modifies the executable image to point to DLL procedures at runtime.

embed

To insert an object in a document by either creating a new object by using the Insert Object command or inserting an existing object by using copying and pasting operations. The object appears in its original format and can subsequently be edited by using the application that created it--or, in the case of sound, video, or macros, can subsequently be played or run.

environment subsystem

A **protected subsystem** (server) that provides an application programming interface (API) and environment--such as Win32, MS-DOS, POSIX, or OS/2--on Windows NT. The subsystem captures API calls and implements them by calling native Windows NT services. See also **integral subsystem** and **protected subsystem**.

exception

A synchronous error condition or atypical event that causes the execution of code outside the normal flow of control. Exceptions can be either hardware-detected errors, such as division by zero, or software-detected errors, such as a guard page violation. Unlike interrupts, which are generated from an external source, exceptions occur when a program executes a particular code sequence. Exceptions can also be reproduced.See also **exception handler**, **structured exception handling**, **interrupt** and **trap handler**.

exception dispatcher

A kernel module that fields **exceptions**, transferring control to caller-supplied **exception handlers** or, if none are present, executing system default exception handlers.

exception handler

Code that responds to exceptions. The two types are frame-based exception handlers (including termination handlers) and system default exception handlers. See also **exception**, **structured exception handling**, and **termination handler**.

executive
See **NT executive**.

executive object

A Windows NT object made visible to user mode by a component of the Windows NT executive. The executive exports object services, which are used to manipulate executive objects.

FAT
File Allocation Table

FAT file system
The file system traditionally used on MS-DOS systems.

fault tolerance

A computer and operating system's ability to respond gracefully to catastrophic events such as power outage or hardware failure. Usually, fault tolerance implies the ability either to continue the system's operation without loss of data or to shut the system down and restart it, recovering all processing that was in progress when the fault occurred.

fetch policy

The algorithm a **virtual memory (VM)** system uses to determine when the pager should bring a page from disk into memory. Windows NT uses a modified **demand paging** algorithm.

file handle
A handle to a **file object**.

file-mapping object
The Win32 subsystem's version of a Windows NT section object that is backed by a **mapped file**.

file object
An **executive object** that represents an open file, a directory, a volume, or a device.

file systems
Windows NT drivers that accept file-oriented I/O requests and translate them into I/O requests bound for a particular device.

frame-based exception handler

An exception handler that is associated with a particular procedure or part of a procedure. The kernel invokes a frame-based exception handler when an exception occurs within that block of code. A frame-based exception handler can either resolve the exception, resignal the exception to a higher layer of code, or ignore the exception and resume the program's execution. See also **exception**, **structured exception handling**, and **termination handler**.

global group

A global group is a number of user accounts from one domain who are grouped together under one group name on a Windows NT Advanced Server. A global group can contain only user accounts from a single domain. Local groups on a workstation or server can contain global groups. Hence, Windows NT workstation users don't have to manage their own groups and users.

granted access rights

The set of access rights the security system gives a thread that opens a handle to an object. The granted access rights are a nonproper subset of the requester's desired access. The object manager stores granted access rights in the object handle it returns. See also **desired access rights**.

GUI
Graphical User Interface

HAL
Hardware Abstraction Layer

handle
See **object handle**.

hardware abstraction layer (HAL)
A layer of code that protects the kernel and the rest of the Windows NT executive from platform-specific hardware differences

Hermes

A Microsoft tool that can remotely audit, install and upgrade software across any network.

high performance file system (HPFS)

A file system designed for OS/2, version 1.2, which was created to address the limitations of the file allocation table (FAT) file system used by MS-DOS. It added features such as longer filenames, the ability to associate attributes with a file, faster searching for files, and other optimizations.

HPFS
High Performance File System

idle thread

A system thread that executes when no other thread is ready to execute. The idle thread executes deferred procedure calls (DPCs) and initiates **context switching** when another thread becomes ready to execute. One idle thread exists for each processor in a multiprocessor system.

IDT
Interrupt Dispatch Table.

IFS
Installable File System.

impersonation
The ability of a thread in one process to take on the security identity of a thread in another process and perform operations on the thread's behalf. Used by environment subsystems and network services when accessing remote resources for client applications.

installable file system (IFS)

A file system that can be loaded into the operating system dynamically. Windows NT can support multiple installable file systems at one time, including the file allocation table (FAT) file system, the Windows NT file system (NTFS), the high performance file system (HPFS), and the CD-ROM file system (CDFS). The operating system automatically determines the format of a storage medium and reads and writes files in the correct format.

instruction execution unit

A processor-dependent block of code in a **virtual DOS machine** (VDM). It acts as a **trap handler** on Intel processors and as an Intel instruction emulator on the MIPS processors.

integral subsystem

A protected subsystem (server) that performs an essential operating system task. This group includes network servers and the security subsystem. See also **environment subsystem** and **protected subsystem**.

interactive logon
A logon at the attached keyboard and screen

interrupt

An **asynchronous** operating system condition that disrupts normal execution and transfers control to an interrupt handler. Interrupts are usually initiated by I/O devices requiring service from the processor. See also **exception** and **trap handler**.

interrupt dispatcher

A submodule of the kernel's **trap handler**. It determines the source of an **interrupt** and transfers control to a routine that handles the interrupt.

interrupt dispatch table (IDT)
A per-processor data structure that the kernel uses to locate an interrupt-handling routine when an interrupt occurs. See also **interrupt dispatcher**.

interrupt object

A kernel object that allows a device driver to associate ("**connect**") an **interrupt service routine** (ISR) with an **interrupt request level** (IRQL). It is a control object, containing the address of the ISR, the IRQL at which the device interrupts, and the entry in the kernel's **interrupt dispatch table** (IDT) with which the ISR should be associated.

interrupt request level (IRQL)

A ranking of interrupts by priority. A processor has an interrupt request level (IRQL) setting that threads can raise or lower. Interrupts that occur at or below the processor's IRQL setting are blocked, or masked, whereas interrupts that occur above the processor's IRQL setting are not masked. See also **masking interrupts**.

interrupt service routine (ISR)

A device driver routine that the kernel's interrupt handler calls when a device issues an interrupt. The routine stops the device from generating interrupts, saves device status information, and then queues a device driver **deferred procedure call** (DPC) to complete interrupt servicing.

invalid page

A virtual page that causes a **page fault** if an address from it is referenced. The page is either loaded from disk and made valid or recovered from the standby or modified page list and made valid; otherwise, the reference was an access violation. See also **valid page**.

I/O completion

The final step in the I/O system's processing of an I/O request. Typical operations include deleting internal data structures associated with the request, returning data to the caller, recording the final status of the operation in an I/O status block, setting a **file object** and/or event to the **signaled state**, and perhaps queuing an asynchronous procedure call (APC). See also **asynchronous procedure call**.

I/O Manager

The Windows NT executive component that unifies the various pieces of the I/O system. It defines an orderly framework within which I/O requests are accepted and delivered to file systems and device drivers. It also provides code that is common to more than one driver.

I/O request packet (IRP)

A data structure used to represent an I/O request and to control its processing. The I/O manager creates the IRP and then passes it to one or more drivers in succession. When the drivers are finished performing the operation, the I/O manager completes the I/O and deletes the IRP. See also **I/O completion**.

IOSB
I/O Status Block

I/O status block (IOSB)
A data structure that a caller supplies as a parameter to an I/O service. The I/O manager records the final status of the operation in the I/O status block when processing is complete.

IRP
I/O Request Packet.

IRP stack location

A data area in an **I/O request packet** that contains information a particular driver needs to perform its part of an I/O request. Each driver that works on the request has a separate stack location in the IRP.

IRQL
Interrupt Request Level.

ISR
Interrupt Service Routine.

ISV
Independent Software Vendors

kernel
See **NT kernel**.

kernel mode

The privileged processor mode in which Windows NT system code runs. A thread running in kernel mode has access to system memory and to hardware. Compare **user mode**.

kernel object

A runtime instance of a kernel-defined abstract data type. The kernel defines special semantics for the behavior of kernel objects and implements kernel routines that the Windows NT executive can call to manipulate kernel objects. Kernel objects fall into one of two categories: **control objects** and **dispatcher objects**. Both types of kernel objects are used as a basis for Windows NT **executive objects**.

kernel process object

The kernel's representation of a process. It is a **control object** that contains the information necessary to load the process's address space and to keep track of process resources and default attributes.

kernel thread object

The kernel's representation of a thread. It is a **dispatcher object** that contains the elemental information necessary to dispatch the thread for execution.

key object
An **executive object** that represents system configuration information stored in the **configuration registry**.

layered operating system

A structuring approach that divides the operating system into modules and **layers** them one on top of the other. Each module provides a set of functions that other modules can call. Code in any particular layer calls code only in lower layers. On some systems, such as VAX/VMS or the old Multics operating system, hardware even enforces the layering (using multiple, hierarchical processor modes).

lazy evaluation algorithms

A general category of algorithms that avoid performing an expensive operation until it is required. If the operation is never required, no processing time is wasted. The Windows NT virtual memory (VM) manager uses lazy evaluation algorithms to improve memory performance. Demand paging, copy-on-write page protection, and reserving and committing memory separately are examples. See also **committed memory**, **copy-on-write**, **demand paging**, and **reserved memory**.

link

To insert a copy of information from a source document into a destination, or container, document while maintaining a connection between the two documents. When the information changes in the source document, the changes are reflected in the destination, or container, document.

locale

The national and/or cultural environment in which a system or a program is running. The locale determines the language used for messages and menus, the sorting order of strings, the keyboard layout, and date and time formatting conventions.

local procedure call (LPC) facility

Passes messages between a client process and a server process on the same computer. LPC is a flexible, optimized version of **remote procedure call (RPC)**, an industry-standard communication facility for client and server processes across a network.

local replacement policy

A page replacement algorithm that allocates a fixed number of page frames to each process. When a process exceeds its allotment, the virtual memory (VM) manager begins transferring pages in the process's **working set** to disk to free space for additional page faults the process generates. See also **replacement policy**.

logon process

A Windows NT process whose threads detect a user's attempt to log onto the operating system. It verifies the user's logon information with the security system before granting the user access to the system.

LPC
Local Procedure Call

MIBs
Management Information Bases

mandatory access control

Protection assigned to an object by a system administrator. Mandatory access controls typically label objects with a level, such as "Secret" or "Top Secret." Users wanting to access the objects must be cleared at the appropriate level. Mandatory access control supersedes any **discretionary access controls** that an owner applies to an object.

map
To translate a virtual address into a physical address.

mapped file

A file that is loaded into a section object in memory. By mapping views of the section into its address space, a process can access the file as a large array stored in **virtual memory (VM)**. The virtual memory (VM) manager automatically pages to and from the file, loading pages from disk when they are used and writing pages to disk when they are modified. See also **map** and **paging file**.

mapped file I/O

File I/O performed by reading and writing to **virtual memory (VM)** that is backed by a file. See also **mapped file**.

marshal

To order and package procedure parameters in a particular format for sending across the network. See also **remote procedure call**.

masking interrupts

Raising a processor's **interrupt request level (IRQL)** to block interrupts at and below the new IRQL.

master/slave system
See **asymmetric multiprocessing**.

master domain

A Windows NT Advanced Server domain controller designated as a principle domain that contains the user accounts database. All other domains on the network have trust relationships with the master domain. You can also have multiple master domains.

messenger service
A network **service** that receives messages from other systems and displays them.

method

A function associated with an **object type** that the object manager calls automatically at well-defined points during an object's lifetime.

MIDL
Microsoft Interface Definition Language

MIDL compiler

A compiler that takes files written in Microsoft interface definition language and produces stub routines for use in **remote procedure call** applications. See also **stub procedure**.

model

A tentative description of a system or theory that accounts for all its known properties; a broad framework that unifies the many features and services the system provides, and the tasks it performs.

modified page writer
A thread in the virtual memory (VM) manager that asynchronously writes modified virtual pages to disk, thus increasing the number of available page frames.

monolithic applications

Applications that come pre-packaged with a wide range of features, most of which can't be removed or replaced with alternatives. Compare **component software**.

MPR
Multiple Provider Router

multiple provider router (MPR)
A dynamic-link library (DLL) that determines which network (and thus which file system) to access when an application uses the Win32 WNet application programming interface (API) for browsing remote file systems.

multiple UNC provider (MUP)

A driver that determines which network (and thus which file system) to access when an application uses the Win32 I/O application programming interface (API) to open remote files.

multiprocessing

An operating system's simultaneous execution of two or more threads on different processors. Only multiprocessing operating systems can exploit the extra processors in a multiprocessor computer. As a general rule, multiprocessing operating systems also perform **multitasking**.

multiprogramming
See **multitasking**.

multitasking

A processor's execution of more than one thread by **context switching** from one to the other, providing the illusion that all threads are executing simultaneously. See also **preemptive multitasking**.

multithreading

The capability of an application to execute in two or more locations using multiple threads. The term is sometimes used inter- changeably with **multitasking** in reference to an operating system that supports threads.

MUP
Multiple Uniform naming convention (UNC) Provider

mutual exclusion

Allowing only one thread at a time to access a resource. Mutual exclusion is necessary when a system resource does not lend itself to shared access or when sharing might produce unpredictable results. See also **critical section**.

named pipe
An interprocess communication mechanism that allows one process to send data to another local or remote process.

name retention

The procedure by which the object manager keeps an object's name in its namespace. When the last handle to the object is closed, the object manager deletes the object's name from its namespace, preventing subsequent open operations on that object. See also **object retention**.

national language support (NLS)
An application programming interface (API) that gives applications access to locale-specific information. See also **locale**.

native services

System services that the Windows NT executive makes available to user mode for use by environment subsystems, dynamic-link libraries (DLLs), and other system applications.

NDIS
Network Driver Interface Specification.

NetBEUI transport

NetBIOS (Network Basic Input/Output System) Extended User Interface. Windows NT's primary local area network transport **protocol**. See also **NetBIOS interface**.

NetBIOS interface

A programming interface that allows I/O requests to be sent to and received from a remote computer. It hides networking hardware from applications.

network domain

A set of workstations and servers that share a security accounts manager **(SAM) database** and can be administered as a group. A user with an account in a particular **network domain** can log onto and access his or her account from any system in the domain.

network driver interface specification (NDIS)

A Windows NT interface for network card drivers. It provides transport independence for network card vendors because all transport drivers call the NDIS interface to access network cards. Network drivers written to the NDIS interface (NDIS drivers) will be portable to the MS-DOS virtual device driver environment.

network redirector

Networking software that accepts I/O requests for remote files, named pipes, or mailslots and sends ("redirects") them to a **network server** on another machine. Redirectors are implemented as file system drivers in Windows NT.

network server

Network software that responds to I/O or compute requests from a client machine. Windows NT network servers can be implemented either as server processes or as drivers. See also **protected subsystem**.

NLS
National Language Support.

nonpaged pool
The portion of system memory that cannot be paged to disk. Compare **paged pool**.

nonprivileged processor mode
See **user mode**.

nonsignaled state

An attribute of every object whose object type supports **synchronization**. A thread waiting on an object that is in the nonsignaled state continues to wait until the kernel sets the object to the **signaled state**.

NOS

The Banyan VINES Networking Operating System (NOS) line. VINES NOS is a fully featured, pre-configured enterprise-wide network operating system designed for large-scale, complex networks that support numerous users at many sites.

VINES NOS provides Banyan's basic suite of network services--Directory, Network and System Management, Security, and Messaging. These distributed services interoperate across any size environment to create a single, integrated system. As a result, users never have to worry about where resources are located and administrators never have to update multiple services or servers when users and resources are relocated, added or removed from the network. It's all done automatically by these cooperative network services.

NT

New Technology

Windows NT executive

The portion of the Windows NT operating system that runs in **kernel mode**. It provides process structure, interprocess communication, memory management, object management, thread scheduling, interrupt processing, I/O capabilities, networking, and object security. Application programming interfaces (APIs) and other features are provided in user-mode **protected subsystems**.

NT file system (NTFS)

An advanced file system designed for use specifically with the Windows NT operating system. It supports file system recovery, extremely large storage media, and various features for the POSIX subsystem. It also supports object-oriented applications by treating all files as objects with user-defined and system-defined attributes.

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NT kernel

The component of the Windows NT executive that manages the processor. It performs thread scheduling and dispatching, interrupt and exception handling, multiprocessor **synchronization**, and provides primitive objects that the Windows NT executive uses to create user-mode objects.

object

A single runtime instance of a Windows NT-defined **object type**. The physical format of the object's data structure is hidden behind a type definition. It contains data that can be manipulated only by using a set of services provided for objects of its type. It embodies a set of formal properties (called **attributes**) and is manipulated by a set of services.

object attribute

A field of data in an object that defines or records the object's state and that can be manipulated by calling an object service.

object class
See **object type**.

object directory object

An object that stores the names of other objects, much as a file directory stores filenames. It provides the means to support a hierarchical naming structure for Windows NT objects.

object domain
A self-contained set of objects that is accessible through the Windows NT object manager's object name hierarchy but is managed by a secondary object manager (such as the Windows NT I/O system).

object handle

An index into a process-specific object table. It is used to refer to an opened object and incorporates a set of access rights granted to the process that owns the handle. It also contains an inheritance designation that determines whether the handle is inherited by child processes. Programs use handles to refer to objects when calling object services. See also **object table**.

object manager

The component of the Windows NT executive that creates, deletes, and names operating system resources, which are stored as objects.

object model

A model for structuring programs around the data they manipulate. The format of data structures is hidden inside **objects**, and programs must use specially defined services to manipulate object data. The primary goal of the object model is to maximize the reusability of code.

object retention

The procedure by which the object manager keeps an object in memory. When the last reference to an object is removed, the object manager deletes a temporary object from memory. See also **name retention**.

object service

A user-mode-visible system service for manipulating an object. In Windows NT, an object service generally reads or changes an object's attributes and is used primarily by protected subsystems.

object table

A process-specific data structure that contains handles to all the objects the process's threads have opened. See also **object handle**.

object type
An abstract data type, a set of services that operate on instances of the data type, and a set of **object attributes**. An object type is defined by using a **type object**.

ODINSUP

A conversion program that allows NDIS protocols to run one card using ODI drivers.

OOP
Object-Oriented Programming

Open Systems Interconnection (OSI) reference model

A software model defined by the International Standards Organization that standardizes levels of service and types of interaction for networked computers. The OSI reference model defines seven layers of computer communication and what each layer is responsible for.

operating system

A computer program that provides an environment in which other computer programs can run, allowing them to easily take advantage of the processor and of I/O devices such as disks.

OSI
Open Systems Interconnection

page
Blocks of contiguous virtual addresses that the virtual memory (VM) manager copies from memory to disk and back during its **paging** operation. See also **page frame**.

paged pool
The portion of system memory that can be paged to disk. Compare **nonpaged pool**.

page fault
A processor trap that occurs when an executing thread refers to a virtual address that resides on an **invalid page**. See also **paging**.

page frame

A block of contiguous physical addresses used to store the contents of a virtual page. Page frame size (and often page size) are dictated by the processor. On most systems, the page size and page frame size are the same. See also **page** and **paging**.

page frame database
A data structure that the virtual memory (VM) manager uses to record the status of all physical **page frames**.

pager
A component of the virtual memory (VM) manager that performs the **paging** operation.

page table

A process-specific table that the virtual memory (VM) manager uses to map virtual addresses to physical memory addresses or to disk locations. A **page table** is made up of page table entries (PTEs). See also **page table entry** and **paging**.

page table entry (PTE)
An entry in a process's page table. It contains the information necessary for the **virtual memory (VM)** system to locate a page when a thread uses an invalid address. The size and format of PTEs are processor dependent. See also **invalid page** and **page table**.

paging

A **virtual memory (VM)** operation in which memory management software transfers pages from memory to disk when physical memory becomes full. When a thread accesses a page that is not in memory, a page fault occurs and the memory manager uses page tables to locate the required page on disk and load it into memory. See also **invalid page**, **page fault**, and **page table**.

paging file
A system file containing the contents of virtual pages that have been paged out of memory. See also **backing store** and **mapped file**.

parent process

A process that has created another process, called a **child process**. The child process inherits some or all of the parent process's resources.

placement policy

The algorithm a **virtual memory (VM)** system uses to decide where in physical memory to put data it is paging in from disk. The Windows NT virtual memory (VM) manager uses a series of first in, first out (FIFO) page lists to keep track of free pages and to retrieve a free page when loading information from the disk after a **page fault** occurs.

port

A communication channel through which a client process communicates with a **protected subsystem**. Ports are implemented as Windows NT objects. See also **local procedure call**.

POSIX

Loosely defined as "a portable operating system interface based on UNIX," POSIX refers to a collection of international standards for UNIX-style operating system interfaces. The POSIX standard (IEEE Standard 1003.1-1988) encourages vendors implementing UNIX-style interfaces to make them compatible so that programmers can move their applications easily from one system to another.

power notify object

A kernel object that allows device drivers to register a power recovery routine with the kernel. It is a control object that contains a pointer to a device driver routine, which the kernel calls when the power returns after a power failure.

power status object

A kernel object that allows device drivers to determine whether the power has failed. It is a control object containing a Boolean variable that a device driver can test before proceeding with an uninterruptible operation. If the power has already failed, the driver does not start the operation.

PPTE
Prototype Page Table Entry

preempt

To interrupt the execution of a thread when a higher-priority thread becomes ready to execute and to context-switch to the higher- priority thread. See **preemptive multitasking**.

preemptive multitasking

A form of **multitasking** in which the operating system periodically interrupts the execution of a thread and executes other waiting threads. Preemption prevents a thread from monopolizing the processor and allows another thread to run. See also **time quantum**.

primary domain
The network domain with which a particular user account is associated. See also **network domain**.

privileged processor mode
See **kernel mode**.

process

A logical division of labor in an operating system. In Windows NT, it comprises a virtual address space, an executable program, one or more **threads** of execution, some portion of the user's resource quotas, and the system resources that the operating system has allocated to the process's threads. It is implemented as an object.

process context
See **thread context**.

process manager

Creates and terminates processes and threads. It also suspends and resumes the execution of threads and stores and retrieves information about Windows NT processes and threads.

processor affinity
The set of processors on which a **thread** can run.

process tree
A hierarchy of parent and child processes maintained by the POSIX and OS/2 subsystems.

protected subsystem

A server process that performs operating system functions. Each Windows NT protected subsystem operates in user mode with a private address space. See also **environment subsystem** and **integral subsystem**.

protocol

A set of rules and conventions by which two computers pass messages across a network medium. Networking software generally implements multiple levels of protocols layered one on top of another.

protocol stack

The collection and sequence of network **protocols** used to transmit a network request from one machine to another.

prototype page table entry (PPTE)
A data structure that looks similar to a normal **page table entry** (PTE) but points to a **page frame** shared by more than one process. See also **section object**.

provider
A generic name for software that establishes Windows NT as a client of a remote **network server**.

provider interface

A programming interface that allows network vendors to make their remote file systems available for browsing by applications using Windows' WNet application programming interface (API). See also **multiple provider router**.

PTE
Page Table Entry

quick LPC

A form of local procedure call (LPC) used by portions of the Win32 subsystem and its clients. Quick LPC increases the speed of passing a message by bypassing port objects, storing messages in shared memory, and using a built-in **synchronization** mechanism. See also **local procedure call** and **port**.

quota

A resource limit imposed on user accounts. The object manager charges a process some portion of the user's quota each time one of the process's threads creates or opens a handle to an object. When the quota is depleted, the user's processes can no longer create objects or open object handles until the processes release some resources.

raise an exception

To deliberately transfer control to an **exception handler** when an exception occurs. Software raises an **exception** when errors or unexpected conditions occur.

RAID - Redundant Array of Inexpensive Disks

A number of different partitions on different disks are combined to make one large logical drive. The partitions are used and arranged to allow multiple single points of failure in the array. This is known as "disk striping with parity" and is supported by Windows NT Advanced Server.

RAS - Remote Access Service

Remote Access Service for the Microsoft® Windows NT™ operating system enables users to participate fully as a network client from remote locations. With RAS, several functions can be performed transparently on remote workstations.

redirector

Networking software that accepts I/O requests for remote files, named pipes, or mailslots and sends ("redirects") them to a **network server** on another machine. Redirectors are implemented as file system drivers in Windows NT.

reduced instruction set computer (RISC)

A processor that employs a small number of simple instructions that are used in conjunction to perform more powerful operations. Because of the instructions' simplicity and their use of large numbers of registers, each generally takes only one clock cycle to execute, and the processor can run at higher clock speeds than can most complex instruction set computers (CISCs). Compare **complex instruction set computer**.

remote procedure call (RPC)

A message-passing facility that allows a distributed application to call services available on various machines in a network without regard to their locations. Remote network operations are handled automatically. RPC provides a procedural view, rather than a transport- centered view, of networked operations. Compare **local procedure call**.

replacement policy

The algorithm used by a **virtual memory (VM)** system to decide which virtual page must be removed from memory to make room for data being paged in from disk. Windows NT adopts a least-recently-used local replacement policy. See also **local replacement policy**.

reserved memory
A set of **virtual memory (VM)** addresses that a **thread** has allocated. See also **committed memory**.

robustness
The ability of a program to function well or to continue functioning well in unexpected situations.

RPC
Remote Procedure Call

RPC transport provider interface

A DLL that acts as an interface between the **remote procedure call** facility and network transport software. It allows RPCs to be sent over various transports.

SAM database

A database of security information that includes user account names and passwords. It is administered by the Windows User Manager. See also **security accounts manager**.

scalability

The ability to adjust an operating system to a broad range of hardware platforms.

script
A system of characters used to write in one or more languages.

section object

An object that represents memory potentially shared by two or more processes. A process can also create an unnamed section object that represents private memory. See also **view**.

secure logon facility

Software in a secure operating system that monitors a particular class of logon devices to ensure that all users enter valid identification before they are allowed access to the system.

security accounts manager (SAM)

A Windows NT **protected subsystem** that maintains the **SAM database** and provides an application programming interface (API) for accessing the database.

security descriptor
A data structure attached to an object that protects the object from unauthorized access. It contains an **access control list** (ACL) and controls **auditing** on the object.

security ID

A name, unique across time and space, that identifies a logged-on user to the security system. Security IDs (SIDs) can identify either an individual user or a group of users. An individual security ID usually corresponds to a user's logon identifier.

security reference monitor

A component of the Windows NT executive that compares the access token of a process to the **access control list** (ACL) of an object to determine whether the process's threads should be allowed to open a handle to the object.

security subsystem

An **integral subsystem** that records the security policies in effect for the local computer and participates in logging on users.

server

A process with one or more threads that accept requests from client processes. It implements a set of services that it makes available to clients running either on the same computer or possibly on various computers in a distributed network. See also **client**, **local procedure call**, **network server**, and **remote procedure call**.

server message block (SMB) protocol

A network protocol used originally in Microsoft Networks and subsequently adopted in PC networking software. It defines a specific format for packets of data to be transmitted across the network. The Windows NT redirector and built-in server use SMBs to communicate with each other and with computers on LAN Manager networks. See also **network server**, **protocol**, and **redirector**.

server service

A network **service** that supplies a user-mode application programming interface (API) to manage the Windows NT **network server**.

service

A server process that performs a specific system function and often provides an application programming interface (API) for other processes to call. Windows NT services are RPC-enabled, meaning that their API routines can be called from remote machines.

service controller

The networking component that loads and starts Windows NT services. It also loads and unloads many Windows NT drivers, including device drivers and network transport drivers. See also **service**.

SID
Security ID

signaled state

An attribute of every object whose object type supports **synchronization**. When the kernel sets an object to the signaled state, threads waiting on the object are released from their waiting states (according to a set of rules) and become eligible for execution. See also **dispatcher object**, **nonsignaled state**.

single-byte coding scheme

A character encoding scheme (code set), such as Windows ANSI, that uses eight bits to represent each character. See also **Unicode**.

SMB
Server Message Block

SMP
Symmetric MultiProcessing

SNMP
Simple Network Management Protocol

spin lock

A **synchronization** mechanism used by the kernel and parts of the executive that guarantees mutually exclusive access to a global system data structure across multiple processors. A **thread** waiting to acquire a spin lock effectively stalls the processor until it gets the spin lock. See also **mutual exclusion**.

STREAMS

A driver-development environment that Windows NT supplies for creating or porting network transport drivers.

structured exception handling

A method for capturing unexpected conditions and responding to them consistently throughout the operating system. The operating system (or hardware) issues an **exception** when an abnormal system event occurs, and the kernel automatically transfers control to an **exception handler**.

stub procedure

A procedure in a dynamic-link library (DLL) that serves as an entry point for an application programming interface (API). When a client application calls the API routine, the stub procedure marshals the API parameters it receives into a message and sends them to either a local server (subsystem) or a remote server on the network. See also **local procedure call**, **marshal**, and **remote procedure call**.

symbolic link object
A Windows NT executive object that translates one object name into another.

symmetric multiprocessing (SMP)

A **multiprocessing** operating system that allows operating system code to run on any free processor in a multiprocessor computer. Symmetric multiprocessing systems generally provide better throughput and greater availability than do **asymmetric multiprocessing (ASMP)** systems.

synchronization

The ability of one **thread** to pause during execution and wait until another thread performs an operation. In Windows NT, a thread waits for another thread to set a **synchronization object** to the **signaled state**.

synchronization objects

The collection of user-mode-visible Windows NT executive objects whose object types support **synchronization**. They include threads, processes, events, event pairs, semaphores, timers, mutants, and files. A thread can wait for a synchronization object to be set to the **signaled state** by another thread. Each synchronization object contains within it a kernel **dispatcher object**.

synchronous
Occurring at a particular time as a direct result of the execution of a particular machine instruction. Compare **asynchronous**.

synchronous I/O

A model for I/O in which an application issues an I/O request and the I/O system does not return control to the application until the I/O request completes. Compare **asynchronous I/O**.

TCP/IP transport

Transport Control Protocol/Internet Protocol. Windows NT's primary wide area network transport **protocol**. It allows Windows NT to communicate with systems on TCP/IP networks and to participate in popular UNIX-based bulletin board, news, and electronic mail services.

TDI
Transport Driver Interface

termination handler

An **exception handler** that lets an application ensure that a particular block of code always executes, even if the code terminates in an unexpected way. Termination handlers often contain code that frees allocated resources so that if a procedure terminates unexpectedly, the resources are released back to the system.

thread

An executable entity that belongs to one (and only one) **process**. It comprises a program counter, a user-mode stack, a kernel-mode stack, and a set of register values. All threads in a process have equal access to the process's address space, object handles, and other resources. Threads are implemented as objects.

thread context
The volatile data associated with the execution of a thread. It includes the contents of system registers and the virtual address space belonging to the thread's process. See also **context switching**.

thread dispatching
See **context switching**.

thread object
The implementation of a **thread** in Windows NT.

thread of execution
See **thread**.

thread scheduling

The process of examining the queue of threads that are ready to execute and selecting one to run next. This task is performed by the Windows NT kernel's **dispatcher** module.

thunking

The process of converting a 16-bit API call into a 32-bit call (or vice versa). Thunking is required on systems with both 16- and 32-bit components. Thunks add system overhead and degrade performance.

tightly coupled system

A multiprocessor computer in which all processors share global memory. The operating system must synchronize its access to data structures stored in global memory.

time quantum

A preset amount of time that an operating system kernel allows a thread to execute before preempting it. See also **preempt**.

TLB
Translation Lookaside Buffer

token object
See **access token**.

topology
The physical configuration of the machines in a network.

translation lookaside buffer (TLB)

An array of memory containing the virtual-to-physical address mappings of the pages most recently used systemwide. Both MIPS processors and Intel processors have TLBs, but their structure and operation are hardware dependent.

transport driver interface (TDI)

A Windows NT interface for network redirectors and servers to use in sending network-bound requests to transport drivers. The interface provides transport independence for these components by abstracting transport-specific information.

trap

A processor's mechanism for capturing an executing thread when an unusual event (such as an exception or interrupt) occurs and transferring control to a fixed location in memory. See also **trap handler**.

trap frame

A data structure that the kernel's trap handler creates when an interrupt or exception occurs. It records the state of the processor, which allows the kernel to continue executing the thread that was interrupted after handling the condition. See also **trap handler**.

trap handler

A body of code that hardware invokes when an interrupt or exception occurs. It determines the type of condition that occurred and transfers control to a handling routine. See also **trap**.

trusted domain relationship
A **trust relationship** that exists between two **network domains**.

trust relationship

A security term meaning that one workstation or **network server** trusts a **domain controller** to authenticate a user logon on its behalf. One domain controller can also trust a domain controller in another domain to authenticate a logon.

type object

An internal system object that defines common attributes for a class of objects. Every object instance contains a pointer to its corresponding type object. See also **object type**.

UNC
Uniform Naming Convention

Unicode

A fixed-width, 16-bit character encoding standard capable of representing all the world's scripts. See also **script**.

uniform naming convention (UNC) names

Filenames or other resource names that begin with the string \\, indicating that they exist on a remote machine.

uninterruptible power supply (UPS)

A backup battery module attached to a computer that allows memory contents to remain intact long enough for the operating system to perform an orderly system shutdown if a power outage occurs.

UPS
Uninterruptible Power Supply

user mode

The nonprivileged processor mode in which application code runs. A thread running in user mode can gain access to the system only by calling system services. Compare **kernel mode**.

valid page
A virtual page that is in physical memory and immediately available. See also **invalid page** and **page**.

VDM
Virtual DOS Machine

view

The portion of a section object that a process maps into its virtual address space. A process can map multiple, and even overlapping, views of a section. See also **map** and **section object**.

virtual address space

The set of addresses available for a process's threads to use. In Windows NT, every process has a unique virtual address space of 232 bytes (4 GB). See also **virtual memory (VM)**.

virtual circuit

A virtual communication channel between two machines. Multiple network sessions are multiplexed across a single virtual circuit.

virtual DOS machine (VDM)

A **protected subsystem** that supplies a complete MS-DOS environment and a console in which to run an MS-DOS-based application. Any number of VDMs can run simultaneously. See also **console**.

virtual file

Any source or destination for I/O that is accessed like a file. In the Windows NT executive, all I/O is performed on virtual files, which are represented by **file objects** and accessed using file handles.

virtual memory (VM)
A logical view of memory that does not necessarily correspond to memory's physical structure. See also **virtual memory management**.

virtual memory management

A memory management system that provides a large address space to each process by mapping the process's virtual addresses onto physical addresses as the process's threads use them. When physical memory becomes full, it swaps selected memory contents to disk, reloading them from disk on demand. Virtual memory management allows programmers to create and run programs that use more memory than is physically present on their computers. Because the placement of data in memory is controlled by the **virtual memory (VM)** system, each process's address space can be separated and protected from the others. See also **map** and **paging**.

virtual memory (VM) manager
The Windows NT executive component that implements **virtual memory (VM)**.

VM
Virtual Memory

Win32 API

A 32-bit application programming interface for both MS-DOS/ Windows and Windows NT. It updates earlier versions of the Windows application programming interface (API) with sophisticated operating system capabilities, security, and API routines for displaying text-based applications in a window.

Windows NT

The high-end Windows operating system in a family of Windows operating systems. Along with Pen Windows and 16-bit Windows, this system allows Windows-based applications to run on computers ranging from the smallest notebooks to large multiprocessor workstations and server machines. Windows NT also runs MS-DOS, POSIX, and OS/2 applications by employing user-mode servers called protected subsystems. See also **protected subsystem**.

Windows on Win32 (WOW)

A **protected subsystem** that runs within a virtual DOS machine (VDM) process. It provides a 16-bit Windows environment capable of running any number of 16-bit Windows applications on Windows NT.

working set
The set of virtual pages that are in physical memory at any moment for a particular process.

workstation service

A network **service** that supplies user-mode application programming interface (API) routines to manage the Windows NT **redirector**.

WOW

Windows on Win32

X

There are no glossary entries beginning with the letter X.

Y

There are no glossary entries beginning with the letter Y.

Z

There are no glossary entries beginning with the letter Z.

Domain

A group of servers that share a common database of users and group accounts and security policy guidelines. You need to type in account information for a user only once for all the servers in the domain to recognize the account and allow access to it.

How to Use This Guide

This guide is intended to help you evaluate your advanced operating system needs, and to explain how Windows NT can fit into your enterprise goals.

To make this kit useful to the greatest number of people, we have included a large amount of information. Using the mouse, you can take a multilevel tour of the Windows NT operating system, extracting only the information that you want, whether it be a broad overview or a detailed technical analysis of a particular feature. We hope that this guide is a helpful tool for learning about Windows NT and how it can benefit you.

If at any time you want more information about green highlighted text, a click with the mouse will provide more detail. Also, be aware that charts and graphs often contain another layer of detail which can be accessed by clicking on specified areas.

How to Navigate through the Guide: Using Help

Customizing this Guide

How to Navigate Through the Guide

Your tour through the Windows NT Evaluation Guide can be general, detailed, or a combination of the two, depending on how you manipulate the information on the screen. Because everybody has different reading patterns, Help gives you several ways to navigate through the text: Click on one of the topics below or use the TAB button and press ENTER to see more information on:

Choosing Help Topics

Icons and Graphics

Using Help Buttons

Choosing Help Topics

Help topics can include graphics and text that link to other Help topics or to more information about the current topic. These are called jumps. Jumps are usually colored green and underlined (unless the jump is a graphic). When you point to a jump, the pointer changes to a hand shape.

To Choose a Jump

- Point to the text or graphic, and click with the mouse button.
- **Or** press TAB to select the jump, and then press ENTER. You can press SHIFT+TAB to move backward and select a jump.

If the jump you choose is linked to another topic, that topic appears in the Help window. Sometimes a jump is linked to information that appears in a pop-up window. Pop-up windows contain brief explanations of topics, glossary definitions, and examples.

To Close a Pop-Up Window

- Click anywhere on the screen, or press any key.

To Go Back to the Previous Screen

- Click on the "Back" button at the top of your screen.

Icons and Graphics

Most of the icons in this guide have information underneath them (i.e. they are "hot"), which you can access by clicking on the icon itself. An example of a "hot" icon would be any icon in the main menu. Similarly, some of the diagrams and graphs in this guide have "hot" spots, which will yield details and explanations when you click on them. An example of this can be found within the topic called "Windows NT Architecture".

Using Help Buttons

Help buttons are located along the top of the Help window and enable you to move around easily in Help. If a feature is not available, its button name is dimmed. Below is a list of the Help buttons and their functions:

[Button]	[Function]
Contents	Jumps to the main menu. Pressing the spacebar has the same effect.
Search	Lists all the words you can use to search for topics in the Guide. By typing or selecting one of these words, you can search for and go to a specific topic.
Back	Displays the last topic you viewed. You move back one topic at a time in the order you viewed the topics.
History	Displays the last 40 topics you have viewed in the Windows session. The most recent topic viewed is listed first. To revisit a topic, double-click it.
Glossary	A complete glossary of terms relating to Windows NT.
|<<	Jumps to the top of the subject that you are currently viewing. This is helpful when you jump to another subject for reference and wish to return to your original subject
>>|	Recommended Next Subject. Recognizing that there is an extensive amount of material we included this function to suggest two to three subjects you may wish to view after completing a given subject.
<< or >>	**Browse Buttons**. These buttons will jump to the next screen within a given subject. They facilitate the quick viewing of any subject. **Note** However, they do not include the popup descriptions or definitions that may exist in any subject.
Spacebar	Return to the main contents screen.

To choose a Help button

- Click the Help button you want.
- **Or** type the letter that is underlined in the Help button.

Customizing the Guide

While you are reading through the Guide, you may want to mark, copy, or print parts of it for future reference. To help you do this, Help provides tools for marking and copying within the Guide, so that you can customize it to your needs

Bookmarks

Annotation

Copying

Printing

Bookmarks

You can mark text in the Guide by placing "bookmarks" in front of subtopics that interest you.

To Place a Bookmark

- Choose "Bookmark" from the pull-down menu at the top of your screen, and select "Define". You will see the title of your selected subtopic highlighted in the dialogue box, along with a list of previously placed bookmarks.
- Choose OK to place the bookmark.

To return to that subtopic, choose "Bookmark" and select it from the pull-down menu.

To Delete a Bookmark

- Choose "Bookmark", and then choose "Define". Select the bookmark you wish to remove, and click "Delete".

Annotation

You can add notes of your own to the Guide by using the "Annotate" function.

To Annotate a Topic

- Choose "Edit" from the pull-down menu at the top of your screen, and then choose "Annotate".
- In the dialogue box, type in your note, and then click the "Save" button to put it into the help file.

A green paper clip will appear next to the first line of text. To view your notes, just click on the paper clip.

To Remove an Annotation

- Choose "Annotate" from the Edit menu, and click the delete button.

Copying

You can copy text out of the Guide and paste it into another file.

To Copy Selected Text

- Choose Edit from the pull-down menu and select "Copy". A dialogue box will appear, with the text from that screen. Highlight the text to be copied and click on the "Copy" button.

This will copy the selected text and place it on the clipboard, after which you can paste it into a new file.

Printing

You can print any topic from this Guide. A topic prints on the default printer, but if you have installed more than one printer, you can make any of them the default printer. You can also change the options for the default printer.

To Print a Topic

- Go to the topic that you want to print, choose "File" from the pull-down menu, and select "Print**"**.

Windows NT and Microsoft LAN Manager

If you currently have a Microsoft® LAN Manager™ network, integrating with the Microsoft Windows NT operating system and upgrading to Windows NT Advanced Server are both reasonably simple, with worthwhile benefits. Windows NT integrates seamlessly with LAN Manager, letting you move at your own pace; Windows NT Advanced Server reduces network administration and increases the capacity and fault tolerance capabilities of your Domain Controller.

Integrating Windows NT with MS LAN Manager

Depending on your requirements, there are several ways to incorporate a Windows NT client or server into a LAN Manager **network domain**. No additional software or licensing is required.

Integration Options:

Adding a Windows NT Workstation

To make a Windows NT workstation a member of the LAN Manager domain, you can add it to the LAN Manager user account, as you would another LAN Manager user. You can then set up permission on the Windows NT workstation to help other clients within the LAN Manager domain share resources, such as printers, CD ROMs, and folders. This permission exists independently of domain administration rules.

Adding a Windows NT Server

You can access the new Windows NT server in the same straightforward that way you access your LAN Manager servers, letting you test the power of Windows NT without making changes to your existing infrastructure, and set benchmarks against other server operating systems. A Windows for Workgroups client, for instance, can access other types of servers such as NetWare, LAN Server, LAN Manager, or Windows NT.

Adding Windows NT Advanced Server

The power and portability of Windows NT Advanced Server, combined with its intuitive administration model, makes it an excellent application server. Demonstrate this by adding it to a small department server in which Advanced Server is the primary domain controller, with knowledge of all user accounts. You will quickly experience the advantage of using its built-in monitoring and administrative functions to centrally manage both clients and servers.

How to Upgrade from LAN Manager to Windows NT Advanced Server

Windows NT Advanced Servers and LAN Manager servers can coexist and share resources in the same domain or network, allowing you to upgrade your network as your schedule permits.

The Windows NT Advanced Server Upgrade provides a complete set of automated, robust utilities, available for use from the command line, to intuitively walk you through the process and keep you informed. In addition, you can create batch files for customized work. **List of upgrade utilities**

The Windows NT Advanced Server Upgrade preserves:

- user accounts
- file and group permissions
- logon scripts
- shared directories
- connections to shared resources
- protocol settings that are applied globally
- country codes
- scheduled commands
- time source server designation

In addition, the upgrade records settings for workstation, server, messenger, alerter, netlogon, replicator, Uninterruptible Power Supply, Remote Access Services, and Simple Network Management Protocol.

There are two types of upgrades and five domain implementations to consider in planning the move to Windows NT Advanced Server.

The two types of upgrades

The five domain implementations

Windows NT Advanced Server Upgrade Utilities

- **Backup Environment (Backenv)** saves server configurations by scanning server configuration files and detecting hardware configurations.
- **Back AT (Backat)** reads scheduled commands stored in the SCHED.LOG file and writes them to a batch file as a series of commands.
- **Hcopy** copies files on the LAN Manager server to another server on the network.
- **Backacc** backs up user accounts database including file permissions (includes Remote Access accounts).
- **ACL List (Acllist)** records file permissions and other characteristics in a text file, which is checked by Aclcomp for discrepancies.
- **Backup** backs up data to a network share or tape using Sytos Plus.
- **Convert** converts FAT, HPFS, HPFS 386 to NTFS without losing data.
- **PortUAS** restores LAN Manager user account database and merges/converts it to the Windows NT Advanced Server security account database.
- **User Convert (Userconv)** merges multiple domain user accounts and maps file security along with user account changes to achieve single network logon.
- **ACL Convert (Aclconv)** restores file security and permissions.
- **Restore Environment (Restenv)** restores server configurations, network services, and provides intelligent feedback.
- **ACL Compare (Aclcomp)** compares file security and permissions of server before and after conversion and flags any changes.
- **Macintosh Conversion (Sfmconv)** restores Macintosh file volumes.

Why Upgrade?

If you use LAN Manager for OS/2, Windows NT Advanced Server will introduce significant technological advances into your MIS solution.

Windows NT Advanced Server is a **powerful application, file, and print server** that bypasses the system limitations imposed on LAN Manager by OS/2. In addition, the Windows NT Advanced Server Upgrade includes automated tools that help reduce disruptions to current network activity without compromising the availability of network resources. Only the servers need to be upgraded--it is not necessary to change the networking software on each desktop. (For more information **comparing Windows NT and OS/2**)

With Windows NT Advanced Server, management and administration overhead can be reduced in several ways. For example, users can access resources in multiple domains with a single user ID and password. Also, administrators can use its comprehensive set of administration and monitoring tools to better deploy resources and dramatically increase awareness of the system's organization and use.

Windows NT Advanced Server adds advanced protocol support for environments such as NetWare, 32-bit TCP/IP, and DLC stacks, and supports RPC and SNMP for client-server integration with UNIX. It also includes Macintosh and Remote Access Services.

Windows NT Advanced Server comes with extensive **fault tolerance** features such as disk duplexing, **disk mirroring** and built-in backup. Its support of RAID 5 (**disk striping with parity**) and the Windows NT **file systems** gives you high availability and reliability. The underlying Windows NT operating system is fully 32-bit, with **preemptive multitasking** and memory protection.

Powerful Application, File, and Print Server

Because Windows NT Advanced Server supports **SMP** and **RISC** systems, your organization can benefit from new, more cost-effective hardware, without changing important applications and development investments. Windows NT Advanced Server is able to address 4 GB of RAM and up to 17m TB of disk space.

Windows NT Advanced Server provides a comprehensive security model that can be adapted for your specific needs. The security system is powerful, takes little effort to implement, and is simple to administer.

Windows NT Advanced Server supports both 32-bit Windows applications and 16-bit OS/2 applications, enabling them to run many of the older LAN Manager server applications while providing access to new, faster, and more powerful applications, such as SQL Server for Windows NT.

Upgrade Options

There are two methods of upgrading to Windows NT Advanced Server: a clone upgrade and an in-place upgrade.

For a **clone upgrade**, install Windows NT Advanced Server on a separate computer and transfer (clone) the LAN Manager server data and services from an existing server to the new Windows NT Advanced Server. This method is recommended for your evaluation, because:

- It is useful for upgrades to Windows NT-compatible x86, Pentium, R4000 and R4400, DEC Alpha AXP systems, and multiprocessor machines.
- It preserves your source server in its original state. If you encounter problems with the upgrade, you can reinstate the source server on the network.
- Using a second computer is less disruptive to network operations. The source server can remain on-line during the upgrade process, and two separate networks can be maintained during your evaluation.

If space permits, an **in-place upgrade** can be used to upgrade an existing LAN Manager server in place, on the same machine. This method preserves a dual-boot and dual-partition configuration with OS/2 while providing full access to Windows NT Advanced Server. If your source server does not have sufficient space, back up your files to a network server or tape, from which you can restore or archive at any time. Install Windows NT Advanced Server and restore the LAN Manager environment using the upgrade utilities.

Planning Your Upgrade

The addition of **trust relationships** provides a significant number of opportunities for setting up enterprise-wide domains. Although LAN Manager allows only simple domain-wide administration, Windows NT Advanced Server offers several flexible administration models:

Single Domain Model

Separate Domains Without Trust Relationships Model

Master Domain Model

Multiple Master Domain Model

Using Complete Trust Model

Single Domain Model

When the LAN Manager primary domain controller (PDC) is upgraded to Windows NT Advanced Server, all the users in the domain immediately benefit from the new functionality and resources on the network. The other servers in the domain can be a combination of different types, such as LAN Manager for OS/2 server, LAN Manager for UNIX systems, and Windows NT Advanced Servers. When LAN Manager servers and Windows NT Advanced Servers are in the same domain, users from the Windows NT Advanced Server domain can interoperate with the LAN Manager servers. If Windows NT Advanced Server is the primary domain controller and LAN Manager is the backup domain controller, both can provide logon authentication.

Separate Domains Without Trust Relationships Model

This restrictive model closely mirrors LAN Manager domains, in which no domain trusts any other domain. It is possible to run both LAN Manager and Windows NT Advanced Server domains, giving Windows NT Advanced Server functions to at least one domain. However, this requires more administrative effort, because two user database accounts must be maintained. Users can still access resources from both domains with a single logon, but because the domains don't trust each other, user accounts must be established in both domains.

Master Domain Model

Windows NT Advanced Server supports the concept of **master domains,** which enable single-network logon across an enterprise. The master domain is effective for small to medium networks that require centralized account control and **scalability**. A master domain provides:

- Single user accounts for secure access to all corporate resources.
- Centralized control of user accounts.
- Control of resource permissions at the local administrative level.
- One way trust relationships with other network domains.

Both Windows NT Advanced Servers and LAN Manager servers can provide logon authentication. When a master domain is in place, existing LAN Manager primary domain controllers can be upgraded to Windows NT Advanced Server domain controllers. Remaining Windows NT Advanced Servers or LAN Manager servers act as backup domain controllers.

Note: For this model, a master domain must be created, using Windows NT Advanced Server. The primary domain controller from each LAN Manager domain must be upgraded, and trust relationships established with the master domain storing the master user account database.

Multiple Master Domain Model

This model is appropriate for larger organizations. It takes the benefits of the single master domain model one step further, using several Windows NT Advanced Server master domains. All master domains have trust relationships with each other. Other domains on the network trust each of the master domains, providing a single user logon from any domain in the enterprise. This model is a way to break very large user account databases into smaller, more manageable ones. It is highly scalable, supporting tens of thousands of users, and provides a great deal of flexibility for large, growing networks.

Using Complete Trust Model

In this model, each domain is locally administered. The domain administrator sets up trust relationships with all other known domains. For security reasons, establishing this trust requires the assistance of the administrators from those domains. This model eliminates the need for central administration of user accounts and is very flexible. However, as the enterprise grows, it can become more difficult to manage. Although this model provides a single logon for users, it carries a higher administrative burden than the other options.

Windows NT Services for Macintosh

An integral part of the Microsoft® Windows NT™ Advanced Server, the Windows NT™ Services for Macintosh® offer you excellent connectivity and integration between your Macintosh desktops and the Windows NT operating system. Not only do they preserve the unique and important elements of each environment, they also incorporate important new components, such as manageability and security.

For Additional Information:

What are Windows NT Services for Macintosh?

Windows NT Services for Macintosh File Server

Windows NT Services for Macintosh Print Server

Windows NT Services for Macintosh Administration

What are Windows NT Services for Macintosh?

Windows NT Services for Macintosh is a set of integrated tools facilitating better productivity and integration with Macintosh users. These include the AFP-compatible file server which allows Macintosh users to connect to a Windows NT server the same way they would connect to an AppleShare® server, a Print Server, and Print Monitor, which allows Macintosh users on the network to spool their print jobs to a Windows NT server. Finally, the services include a complete **AppleTalk® Stack**, providing seamless connectivity between Macintosh clients and Windows NT Advanced Servers. As with other system components, the Windows NT Services for Macintosh are designed for:

- **Performance**
- **Capacity**
- **Ease of configuration**
- **Ease of use**
- **Security**

The AppleTalk stack

This component is the underlying mechanism that permits these Windows NT services to talk to the Macintosh network and vice-versa. In addition, developers can use protocol independent **APIs** to the AppleTalk stack (for example, Windows Sockets) within cross-platform applications.

Windows NT Services for Macintosh File Server

This service allows you to share an **NTFS** directory tree as a volume on the Macintosh network. The Windows NT Services for Macintosh File Server is Apple File Protocol-(AFP) 2.1 compliant, and compatible with AFP 2.0-and-above clients running System 6.0.7 or higher. Because of its implementation, administrators gain access to **File Services Security**

The file server uses NTFS **STREAMS** to store the resource fork and the Finder information for each Macintosh file, so that the Windows NT Administrator sees each Macintosh file as a single Windows NT file that can be used by PCs and Macintoshes. Another convenience is that each server maintains a user-configurable database that maps MS-DOS 8.3 file name extensions to Macintosh creator/type pairs. This database enables the Finder to display the files residing in the Windows NT resident folders with the correct Macintosh icons. Also, since the correct creator/type information is associated with the files, the Finder can launch the correct application for a given document.

How the File Server Works

How the File Server Works

NTFS supports long names, which means that the file server can preserve a 31-character Macintosh name. Windows NT Services for Macintosh has a conversion tool that converts 2- or 3-part LAN Manager Services for Macintosh Mac files into single (but multiple stream) Windows NT Services for Macintosh files. This helps preserve security information and volume parameters, which become part of the **Access Control Entry**.

File Services Security

Windows NT Services for Macintosh fully support and comply with Windows NT security.

The Services will present the AFP (Apple File Protocol) security model to your Macintosh users and allow them to access files on volumes that reside on CD-ROM or other read-only media. Because of the secure file system of NTFS, file-sharing folder privileges are stored as Windows NT **permissions**, so that only one set of permissions on a **folder** or file is required. This function is enforced for users of both Windows NT and Macintosh desktops. No users will be able to access files if they do not have the required permissions.**Additional security information**

permission
A set of commands that provide access to a particular file or directory

Added Security with the UAM

A new component of Windows NT Services for Macintosh is the client-side Microsoft User Authentication Module (UAM). This AppleShare extension permits a more secure login session with a Windows NT server, while sending an encrypted, rather than clear text, password over the network.

The UAM also allows a user to specify a domain or change the user password at login time. This permits the Macintosh user to participate in the enterprise-wide login, which can be supported by the Windows NT Advanced Server features as domains and trusted domains.

How Windows NT Permissions are Granted to Macintosh Users

The same user account database authenticates Macintosh users and Windows NT users alike, and both types of users respect the same permissions on files and directories. Windows NT file and directory permissions are automatically translated into corresponding Macintosh permissions. When a user is created, the administrator may specify a Macintosh Primary Group for the user.

From the Windows NT File Manager, you can create Macintosh-accessible volumes and manage user/group accounts. An additional menu, labeled the AFP Server, appears in the File Manager, and from this menu, you can create and delete shared volumes, change volume parameters, edit the Type-Extension database, and set **folder** privileges. The Windows NT Services for Macintosh automatically creates a "Public Files" volume at installation time on an NTFS or CDFS (CD-ROM file system) partition.

folder

In graphical user interfaces, a container for programs and files, symbolized on the screen by an icon of a file folder. A folder is equivalent to a directory in that it can hold both files and additional folders and, like a directory, is a means of organizing programs and documents on a disk.

Windows NT Services for Macintosh Print Server

The Windows NT Services for Macintosh has a PostScript®-compatible engine that allows Macintosh desktop machines to print to any printer connected to Windows NT-based systems, as if they were printing to a LaserWriter®. The Windows NT Printer Services support the standard Apple LaserWriter driver; special client software is not required.

Tightly integrated with the Windows NT Print Manager, the Windows NT Services for Macintosh Print Server advertises all printers connected to Windows NT-based systems that are connected directly to the server on the AppleTalk network. It then spools all incoming jobs from the Macintoshes to the queues of those printers. AppleTalk despooling errors are corrected by the Windows NT print subsystem.

See Also:

Selecting Printers

The Windows NT Services for Macintosh Postscript Print Processor

Selecting Printers

Printers connected to Windows NT-based systems will appear in the zone that you specify in the configuration dialog for the AppleTalk stack. You can configure the AppleTalk stack using the graphical user interface within Windows NT, which allows Macintosh users to select printers connected to Windows NT-based systems through the Chooser.

Windows NT Services for Macintosh Postscript Print Processor

If the printer connected to Windows NT-based systems is not a Postscript printer, the Print Manager will mark the incoming Postscript file so that it will be processed by the Services for Macintosh Postscript Print Processor before it goes to the printer. This Print Processor rasterizes the Postscript file and sends the resulting high-resolution image to the specific printer to which the user is attached.

Administration

Setup and administration of the Windows NT Services for Macintosh is fully integrated with Windows NT through a graphical interface that is integrated with existing Windows NT administration tools. Remote administration of the Windows NT Services for Macintosh is also supported from Windows NT workstations, and Windows NT Services for Macintosh can be started transparently if the administrator configures the server to use this facility.

See Also:

Server Administration

The Control Panel

Granting Security Permissions to Macintosh Users

Server Administration

The Server Manager, which is part of the Windows NT Advanced Server, allows administration of local and remote servers, and is installed into the Administrative Tools group in the Program Manager. This additional tool gives the administrator access to the volume list, the server parameters, and information about the current state of the server. Using this same interface, administrators can send messages to users, disconnect users, and close files.

All setup and administration of printers is done using the Windows NT Print Manager. This interface allows you to browse for AppleTalk printers and view all print queues, including print jobs sent to the AppleTalk printers.

The Control Panel

The Windows NT Services for Macintosh can be administered from the Control Panel within Windows NT.

The Network application allows the user to install, remove, update, and configure Windows NT Services for Macintosh. The File Server parameters set within this application are the server name that the Macintosh network will see and the default creation of the User Authentication Module volume. The desired zone and routing parameters of the AppleTalk stack can also be configured.

The Services application within the Windows NT Control Panel permits the user to set the startup mode for all services. For the Services for Macintosh, the file and print servers can be set to either Automatic or Manual startup mode. This application also provides the ability to specify what user account you want the Print Server to run under. All print jobs from Macintosh users will be listed in the Print Manager as belonging to this account.

Microsoft Offices: General Numbers

Microsoft Certified Professional Program

U.S.	(800) 426-9400
Canada	(800) 563-9048

Microsoft Consulting Services

U.S. toll-free number	(800) 922-9446
U.S. West Region	(206) 828-2940
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U.S. toll free number	(800) 426-9400
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Microsoft TechNet	(800) 344-2121 x115
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Microsoft Online Services	
U.S.	(800) 936-3500
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Microsoft Press	
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Canada	(905) 293-8464, x340
Microsoft Solution Provider Program	
U.S.	(800) 426-9400

Canada	(800) 563-9048

Microsoft Support Network Sales Group

U.S.	(800) 936-3500
Canada	(905) 568-3503

Nationwide Building Society

When one of the United Kingdom's largest financial institutions decided to make a major change in the way it manages its business, its search for a technology to enhance its competitiveness and improve its customer service led it to the Windows NT operating system.

Nationwide Building Society Solution Summary

Industry
Financial services

Business Solution
Enterprise-wide client-server computing environment

Architecture
Servers based on the Microsoft Windows NT platform linked to mainframes on wide area network with Windows running on a total of 10,000 PCs

Products Used
Microsoft Visual Basic
Microsoft Visual C++
Microsoft Windows NT
Microsoft Windows NT Advanced Server
Microsoft Windows™ for Workgroups
PowerBuilder
Development Resources
In-house development staff
Siemens Nixdorf
Unisys
Microsoft Consulting Services

Development Time
Approximately 18 months from initial proposal to first system prototype

Benefits
Enhanced customer service, increased flexibility, reduced costs

Nationwide Building Society Case Details

Nationwide Building Society was at a crossroads. The growth of the British financial institution was quickly outpacing the capabilities of the proprietary Siemens Nixdorf minicomputer system that ran its branch operations, among others. Management decided to look at alternatives.

The second largest financial institution of its kind in the United Kingdom, Nationwide serves some six million retail customers through more than 700 branches. The company has approximately 13,000 employees and assets of more than £34 billion ($50 billion U.S.).

In the highly competitive retail financial services business, the success of a financial institution is largely determined by the quality of its customer service. That is why Nationwide's senior management decided to turn the need to replace its aging minicomputer system into an opportunity to improve the company's customer service. Management's plan: invest in technology that would allow it to respond more quickly to changing customer needs.

The multimillion-pound decision would affect 10,000 PCs over three years, and literally change the way the company manages its business.

A Commitment to Windows NT

According to Dr. Paul Feldman, Nationwide's head of Technology Management Services, management's decision evolved into a clear computing direction: a **client-server** environment with a graphical user interface throughout the organization.

The move to a client-server architecture would allow Nationwide to place data and processing of that data where it is most appropriate. For example, customer and account information may be kept on a mainframe where it is centrally secure and facilitates easy access from a distributed environment. At the same time, transaction data could be placed on PCs in front of the customer for the duration of the transaction. This change offers at least two advantages--better customer service, and streamlined business processes for Nationwide.

The choice of a graphical user interface was also critical. Dr. Feldman believes Nationwide will increase productivity by making it easier for the staff to navigate the system and integrate data. He adds that the interface also presents a more attractive image to customers than character-based screens. "We see ourselves moving to a more open environment where branch personnel could work through a loan application with a customer--right on-screen," says Dr. Feldman. "A graphical user interface looks and works better--and that makes us look better."

Windows NT Platform Selected as Server Operating System

Based on a thorough analysis of the available options, Nationwide decided to base its

future on the Windows NT™ operating system. "All of Nationwide's business systems will either run within, or interface to, Windows NT," says Dr. Feldman. Eventually, Windows NT will run all distributed systems in the organization, from branches to headquarters, providing both network services and data management, as well as vital end-to-end security. Dr. Feldman says that, while OS/2® had some of the features the company was looking for, "the applications and development tools we needed aren't there."

Nationwide's long-range plan is to consolidate mainframe operations onto Unisys® machines, which will act as large data servers to Windows NT-based servers at the next level. Nationwide expects to implement a new Microsoft® product in development code-named **Hermes** as its systems management tool.

Partners Help Develop System

Nationwide is working with several partners as they migrate to a client-server environment. Siemens Nixdorf is participating in the move from its minicomputer system to PCs, and may provide the PC systems. Unisys is working with Nationwide to ensure an effective link between its mainframes and the Windows NT-based servers.

Microsoft Consulting Services is also teaming up with Nationwide, working with the organization's in-house development staff to create prototypes of custom applications that will be used in the branches to store and process customer information. The company plans to develop the applications internally using PowerBuilder™, the Microsoft Visual Basic™ programming system, and possibly the Microsoft Visual C++™ development system.

Flexibility, Productivity Among Expected Benefits

Nationwide expects greater flexibility to be a major benefit of its Windows NT-based system. "The more flexible we are in our technological infrastructure, the more Nationwide can concentrate on developing competitive products and services," Dr. Feldman points out.

Nationwide also believes the system will make it easier to manage data, enhancing the productivity of the company's staff. "In a client-server environment," says Dr. Feldman, "data are not hidden in large mainframe applications." The result: people can accomplish more with less effort--and in less time.

And Nationwide is looking forward to extending the advantages of the Windows™ platform to its entire organization. According to Dr. Feldman, these advantages include reduced training costs and time, greater ease of use, and an improved image to Nationwide's customers.

Looking Ahead: A World of Possibilities

"Nationwide is planning to put Microsoft's technologies at the core of our next-

generation client-server systems and, therefore, at the core of our future business strategies."

Dr. Paul Feldman, Head of Technology Management Services
Nationwide Building Society, Swindon, England

While Nationwide's immediate objective is to get its Windows NT-based client-server system in place, the Building Society is already examining additional ways it can use the technology once it's implemented.

"We're talking to our automated teller machine vendors about putting Windows NT on our ATMs," says Dr. Feldman. Nationwide is also exploring the use of multimedia, voice recognition, and other advanced technologies.

"Nationwide is focused on its customers as a fair organization to deal with, and one of the largest, safest places for their money," says Dr. Feldman. "We feel this system will help us do that by providing the very best technology to support our customers using our products and services."

Nationwide's choice of Windows NT is an extension of the company's belief in Microsoft products. "They're based on the very best technology," says Dr. Feldman. "You know they are going to work."

Overview of the Windows NT Networking Architecture

Because most new personal computers are installed on networks, the Microsoft® Windows NT™ operating system has been designed to integrate the essential components for managing a network and the applications running on it. Modular network architecture makes the Windows NT built-in networking services protocol-independent, so Windows NT can be implemented in any environment. Networking in Windows NT includes built-in peer file, print, and distributed services.

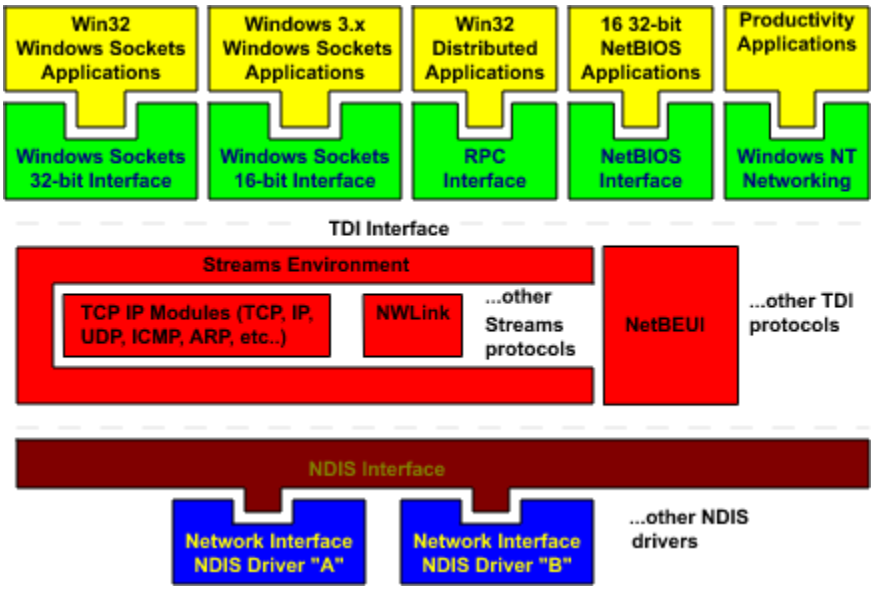
Diagram of Windows NT Networking Architecture

More About the Windows NT Networking Architecture

Microsoft TCP/IP Strategy

Frequently Asked Questions

Windows NT Network Architecture



The Windows NT architecture provides a plug-and-play framework for networking protocols. TCP/IP represents just one of several protocols which can be used to offer the capabilities of Windows NT Networking services.

More About the Windows NT Networking Architecture

STREAMS is a mechanism for building portable networking protocols in a modular fashion, allowing them to be ported to Windows NT quickly and easily. The Windows NT **TCP/IP** protocol and the Windows NT built-in NWLink software (IPX/SPX protocol support) are both based on the STREAMS architecture. Several vendors and researchers are moving other networking protocols to Windows NT using the STREAMS environment.

In addition to offering transparent access to Windows NT, Windows for Workgroups, and LAN Manager systems, TCP/IP protocol software is shared by applications used to access non-Microsoft systems in the enterprise. Using the standard built-in **Windows Sockets**, RPC, and NetBIOS interfaces, TCP/IP can also be used to access hundreds of different types of systems supporting various TCP/IP-based applications. Windows NT comes with thirteen TCP/IP-based utilities, facilitating basic terminal emulation, file transfer, and remote process execution on remote systems.

The Windows Sockets, RPC, and NetBIOS interfaces make Windows NT a great platform for heterogeneous client-server computing. For example, you could use Windows Sockets to write a Windows-based front end for your SunOS-based inventory system. The OSF/DCE RPC interface could be used to give an Ultrix® client to access your Windows NT-based market analysis system over TCP/IP. NetBIOS could provide a solution to a PC document-routing dilemma. By providing industry-standard network programming interfaces, Windows NT is the ideal participant in your enterprise network.

The inclusion of TCP/IP with Windows NT makes it an excellent scalable internetworking framework for enterprise networks. The Windows NT transport-independent architecture makes Windows NT Networking services available over TCP/IP without **encapsulation.** Windows NT includes common TCP/IP utilities, allowing users to connect to non-Microsoft TCP/IP-based systems. Additionally, Microsoft is working with dozens of independent software vendors through a development relations group offering development support of advanced TCP/IP networking applications and utilities which will be made readily available to Windows NT customers later this year. Products to be released include X Windows, NFS, terminal emulators, and more.

Streams

The STREAMS environment interacts on two levels of network service abstraction: the Transport Driver Interface (or TDI) at the top, and the Network Driver Interface (or NDIS) at the bottom. These standard interfaces make a true mix-and-match networking environment. Network protocols are written to the NDIS interface exposed by network drivers. By exposing the TDI interface, network protocols (such as TCP/IP) can be used to support the built-in networking services offered by Windows NT.

Windows Sockets

The Windows Sockets interface is compatible with Windows-based TCP/IP utilities from more than thirty vendors, including X Windows, sophisticated terminal emulation, NFS (client and server), and electronic mail packages. Windows NT offers both 16- and 32-bit Windows Sockets compatibility, so applications written for Windows 3.x Windows Sockets can run over Windows NT without modification or recompilation.

Encapsulation

Other network operating systems are often designed in a "monolithic" fashion, which means that their networking services are tightly coupled with a specific set of networking protocols. For example, Apple Computer AppleShare services are tied into the family of AppleTalk protocols, and Novell NetWare relies on the presence of IPX/SPX. To be effective in routed TCP/IP internetworks, these network operating systems must "encapsulate" their proprietary protocols into TCP/IP packets for reliable delivery. Encapsulation schemes treat the native protocols as data by TCP/IP, "wrapped" and "unwrapped" by specialized software.

The process of encapsulation degrades throughput and performance of networking services, and scales poorly in internetworked environments. Windows NT Networking services have no such restriction.

Microsoft TCP/IP Strategy

Microsoft has adopted the TCP/IP protocol suite as its strategic enterprise-internetworking protocol for Windows NT Networking services.

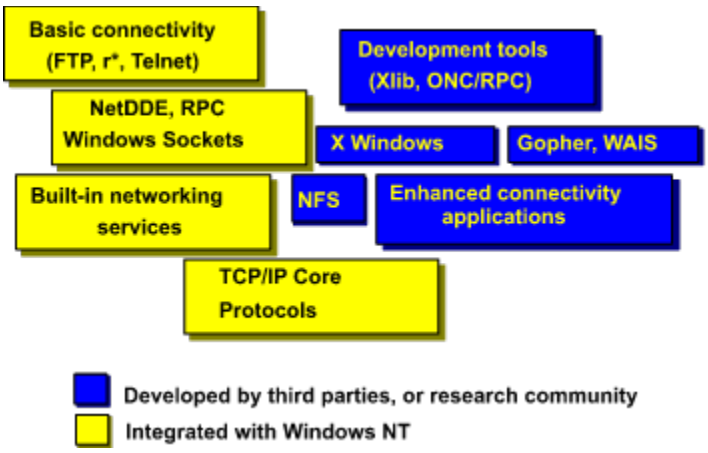
Diagram of TCP/IP Strategy

Microsoft offers TCP/IP support with its Windows NT, Windows for Workgroups, and LAN Manager networking products today, and will continue to integrate this technology with future products as appropriate. There are many ways to use Microsoft TCP/IP:

- **Scalable Windows NT Networking services:** Microsoft TCP/IP provides Windows NT Networking services with a set of proven network protocols based on open standards. TCP/IP offers a scalable internetworking technology widely supported by networking hardware and software vendors. Because TCP/IP is the enterprise networking protocol, Windows NT, Windows for Workgroups and LAN Manager customers are able to integrate Microsoft networking solutions in their existing internetwork infrastructures.
- **Connectivity in mixed environments:** Microsoft TCP/IP provides an interoperable heterogeneous networking framework. Most modern operating systems support the TCP/IP protocols. Mixed systems can share information using simple networking applications and utilities. Thirteen of these common connectivity applications come bundled with Windows NT offering file transfer, remote process execution, and terminal emulation. Additional TCP/IP applications are available in the public domain and through third parties both as 16- and 32-bit Windows-based applications taking advantage of the industry-standard Windows Sockets interface.
- **Client-Server application development:** Microsoft TCP/IP and Windows Sockets offer an excellent cross-platform client-server development framework. TCP/IP is present in enterprise networks across dozens of operating systems. Applications written to the Windows Sockets standard enable TCP/IP-aware network applications to run over any compliant vendor's TCP/IP implementation. Windows Sockets is part of the Microsoft WOSA initiative and is supported by over thirty vendors in the TCP/IP community.

Diagram of TCP/IP Strategy

Microsoft TCP/IP strategy centers on providing a solid foundation of core protocol technology on which a wide variety of applications and connectivity utilities can be built.



Frequently Asked Questions

Q: I've heard that Microsoft is developing a TCP/IP VxD (virtual device driver), is this true?

Q: Does Windows NT come with NFS support?

Q: When will Microsoft provide Windows-based TCP/IP utilities?

Q: When will Microsoft deliver the common UNIX-style TCP/IP servers (daemons) such as FTPd and Telnetd on Windows NT?

Q: What does Windows Sockets offer the Windows NT user?

Q: Can I use BOOTP with my Windows NT system?

Q: Can I use my Windows NT system as an IP router?

Q: Our engineering department uses X Windows heavily, can I run X applications on Windows NT?

A: Yes, Microsoft has been developing a TCP/IP VxD for over a year now, and plans to make this technology available to Windows for Workgroups 3.11 and Chicago users as soon as it is ready. The new stack will enter preliminary beta by year-end '93 and plans to ship in the first half of '94. Packaging plans have not been formalized, but we will make this technology available as soon as it is ready.

A: Windows NT, with its built-in TCP/IP support, provides a great framework for NFS, although we have chosen not to offer NFS support in the product. Microsoft is cooperating with third parties to provide quality NFS clients and servers under Windows NT this year. Our open networking architecture makes it easier for third parties to bring existing NFS implementations to Windows NT. We support their efforts, and will communicate the availability and details of their products as they become available. Both SunSelect and FTP Software, leaders in PC-based NFS solutions, are committed to providing NFS solutions on Windows NT and have demonstrated initial technologies at several trade events. Other TCP/IP solution companies such as Frontier Technologies, Beame and Whiteside, and NetManage have announced similar solutions.

A: Microsoft has no firm plans to package graphical TCP/IP utilities with its products at this time. Users have different needs, preferences and demands from their connectivity applications. With over thirty vendors committed to the Windows Sockets effort and several quality applications and utilities emerging every month, we feel that these vendors are addressing our customers' needs effectively. In the event our customers indicate otherwise, we will re-evaluate our decision. We will remain focused on providing an extremely reliable and compatible TCP/IP transport and Windows Sockets interface so that these applications run seamlessly on our platforms.

A: Flexibility was the most important requirement of our Windows NT networking design. Our primary focus was to build excellent transport-independent networking services into the system and to offer a suitable framework to facilitate connectivity to non-Microsoft systems. In its initial release, Windows NT offers an extremely flexible TCP/IP architecture, and basic utilities to connect to other system. Our framework, coupled with the Windows Sockets interface, makes it extremely easy for third parties to port their existing services into this environment, or to develop new ones. As the operating system matures, we will increase our support for the networking applications that our customers demand.

Windows NT and Windows NT Advanced Server do come with the Microsoft FTP Server service. This service supports all of the common FTP commands documented in RFC 959, and has some nice feature enhancements such as directory annotation and a graphical User Manager tool. The Microsoft support organization (PSS) is using this multithreaded FTP Server to provide updates and access to the Microsoft Knowledgeable to users on the Internet. (ftp.microsoft.com)

A: Windows Sockets is an open standard which provides a *binary compatible* interface for networking applications. This standard allows network application vendors to write their application to a single common interface and build a single executable (or binary) which can run over many vendors' TCP/IP implementations. Windows NT offers both 16- and 32-bit Windows Sockets support. Applications written to Win32 should take advantage of the native Windows Sockets 32-bit interface. Applications written to Windows Sockets under Windows 3.1 can run **unmodified** under Windows NT. In fact, a 16-bit X Windows server written to Windows Sockets under Windows 3.1, has been demonstrated running unmodified under Windows NT on a MIPS R4000 system!

A: We recognize that the maintenance of IP addresses and TCP/IP configuration is cumbersome for both users and network administrators. However, the BOOTP protocol (the bootstrap protocol) was designed primarily as a facility to boot an operating system remotely from a diskless workstation. TCP/IP configuration is only a part of the remote boot procedure. As a result, BOOTP merely shifts the entire management burden of IP addresses from end-user to administrators. Although a step in the right direction, we feel that BOOTP does not adequately satisfy our goals for simplifying network management. We are working with the IETF (Internet Engineering Task Force) to help establish the Dynamic Host Configuration Protocol (or DHCP). This open standard is designed with the explicit goal of truly simple TCP/IP configuration management for the enterprise. We plan to implement and offer this technology as the details become finalized. In fact, Microsoft organized an interoperability event at this year's Interop to test the interoperability of preliminary DHCP implementations between different vendors which met with great success.

A: Windows NT supports IP routing in systems with multiple network adapters attached to separate physical networks (generally called multihomed systems). Although the initial release of Windows NT will not support router-router protocols like RIP (Routing Information Protocol) or OSPF (Open Shortest Path First), it can route IP packets between locally attached networks on multihomed systems. Microsoft has prepared a technical document entitled "Advanced Internetworking with Windows NT" for network administrators who want this functionality from Windows NT today, and we are investigating router-router protocols for future releases. The document can be acquired through PSS and has been incorporated into the ***Windows NT Resource Kit***.

A: X Windows is a graphical distributed computing model developed at MIT. With X Windows, an application which runs on a server system is called the client, which sends commands over the network to display its results on the X Windows *server.* In many networks, dedicated hardware systems known as X Terminals provide the X display software and hardware to display remote X clients on a user's desk. Third parties are developing X Windows server solutions for Windows NT. This software will enable users to use Windows NT as a high-powered X server platform while retaining compatibility with Windows NT, Windows 3.1 and MS-DOS applications on the same system. Other third parties are developing X Windows client libraries for Windows NT, so developers can write X client applications on Windows NT which can be run and displayed remotely on systems providing X server capabilities.

>>| Suggested Next Subject

Integrating Windows NT and SNA Enviornments

Integrating Windows NT and Host DBMS

Windows NT as an Application Server

>>| Suggested Next Subject

Integrating Windows Digital Equipment Corp Pathworks

Integrating Windows NT and UNIX

Windows NT as an Application Server

>>| Suggested Next Subject

Integrating Windows NT and UNIX

Windows NT Architecture

System Roadtests

>>| Suggested Next Subject

Comparing Windows NT and UNIX

Windows NT as an Application Server

Windows NT as a File and Print Server

>>| Suggested Next Subject

Windows NT as an Application Server

Windows NT as a File and Print Server

>>| Suggested Next Subject

Windows NT as an Application Server

Windows NT as a File and Print Server

Comparing Windows NT and UNIX

>>| Suggested Next Subject

Windows NT as an Application Server

Windows NT as a File and Print Server

SQL Server for Windows NT

>>| Suggested Next Subject

Windows NT as an Application Server

Windows NT as a File and Print Server

Comparing Windows NT to VMS

>>| Suggested Next Subject

Integrating Windows NT and Host DBMS

Comparing Windows NT to OS/2

>>| Suggested Next Subject

Integrating Windows NT and Host DBMS

SQL Server for Windows Nt

Integrating Windows NT and IBM SNA Enviornments

>>| Suggested Next Subject

Windows NT as an Application Server

Integrating Windows NT and Novell NetWare

Windows NT Key Features

>>| Suggested Next Subject

Comparing Windows NT and UNIX

Integrating Windows NT and Novell NetWare

Windows NT Key Features

>>| Suggested Next Subject

Windows NT as an Application Server

Windows NT as a File and Print Server

Windows NT Key Features

>>| Suggested Next Subject

Windows NT Architecture

Windows NT Key Features

>>| Suggested Next Subject

Windows NT Key Features

Windows NT Key Technologies

>>| Suggested Next Subject

Windows NT Key Features

Windows NT Key Technologies

SQL Server for Windows Nt

>>| Suggested Next Subject

Windows NT Key Features

System Road Test for Evaluation

>>| Suggested Next Subject

SQL Server for Windows Nt

Other Microsoft Server Products

Integrating Windows NT and Host DBMS

>>| Suggested Next Subject

Windows NT as an Application Server

Integrating Windows NT and Host DBMS

Windows NT Administration

>>| Suggested Next Subject

Integrating Windows NT and SNA Enviornments

Integrating Windows NT and Host DBMS

Comparing Windows NT and OS/2

>>| Suggested Next Subject

Windows NT Key Technologies

Other Sources of Information on Windows NT

>>| Suggested Next Subject

Comparing Windows NT and UNIX

Comparing Windows NT and OS/2

Comparing Windows NT and VMS

>>| Suggested Next Subject

Windows Open Services Architecture

An Overview of Windows Objects

>>| Suggested Next Subject

An Overview of Windows Objects

An Overview of Client Server Computing

>>| Suggested Next Subject

SQL Server for Windows Nt

SNA Server for Windows NT

Other Microsoft Server Products

National League for Health Care

In a pioneering use of the Microsoft® Windows NT™ operating system, the National League for Health Care has developed the first automated system for nursing school accreditation--and in the process is leading the way to more cost-effective health care.

Solution Summary

Case Details

For More Information

National League For Health Care Solution Summary

Industry
Health care

Business Solution
Automated information retrieval system

Architecture
Windows NT-based network accessing SQL Server database

Products Used
Microsoft Access®
Microsoft SQL Server
Microsoft Windows NT

Development Resources
MediaServ, New York network consultant
Microsoft Solution Provider; PCSI, New Jersey-based database and network consultant

Benefits
Reduced day-long information search to less than 10 minutes; potential for expanding system to nationwide health care information resource.

National League For Health Care Case Details

The National League for Nursing accredits some 2000 schools of nursing in the United States. A division of the National League for Health Care (NLHC), the National League for Nursing periodically inspects each nursing school and publishes the information it compiles in a large book that is used by NLHC staffers to answer telephone questions about nursing programs.

Recently, the need for alternative, more affordable forms of health care has caused a renewed interest in nursing schools. As a result, NLHC's job has grown more complex, so the organization decided to make its operation more efficient than the manual book-based approach allowed.

"We wanted to automate the process," says Arthur Tisi, NLHC director of Information Systems. "Our goal was to take a lot of free-form text and turn it into logic--to create fields that would allow us to do fast searches and queries on specific categories of information about various schools."

Tisi says automation will enable NLHC to reduce the amount of time between accreditation interviews, allowing it to present more up-to-date information about the schools it accredits.

Criteria for a Solution: Cost, Performance, and Expandability

Working with a $2.2 million grant, Tisi was most concerned about the cost of NLHC's computerized database. He also wanted a system that would offer high performance, easy updating and expansion, reliability, and compatibility with the organizations existing OS/2®-Microsoft LAN Manager network.

With these criteria in mind, Tisi soon narrowed his search to four choices: a mainframe database, SYBASE® running on a UNIX® or **RISC** Hewlett-Packard® computer, a 16-bit version of Paradox® or FoxBASE® running on the existing LAN, or a Windows NT-based network with a customized front end and a database back end.

Tisi ultimately decided the mainframe would be too limiting, UNIX too expensive, and the standard LAN too slow. The solution: the Windows NT operating system with a Microsoft Access® front end directing queries to a Microsoft SQL Server database.

Windows NT: The Lowest-Cost Solution

According to Tisi, NLHC determined that Windows NT would save 40 per-cent on the server side and 30 percent to 35 percent per client compared to UNIX, the leading alternative choice. He says NLHC plans to use eight servers based on the Windows NT platform connected to 500 workstations.

The organization was also swayed by the large development support for Windows NT. "It [Windows NT] obviously has more support than OS/2 and other alternatives," says

Tisi. Usability was also a factor. "It's important that users can switch back and forth between our application and other productivity applications," he says.

Tisi says another major issue was training. "One of the biggest strengths of Windows NT is that it mirrors what we've been doing in the Windows operating system. There isn't a learning curve because the interface is the same on both platforms," he says, pointing out that Windows NT also "hides" the network functionality with a friendly front end. "Users aren't concerned with things like multiple **domains.** They just care that they can easily access the information they need to do their jobs," he explains.

"Next to cost, our chief concern is performance. That's why we're experimenting with running Windows NT on a Sequent® multiprocessor unit. We think that will give us the high-speed processing we'll need as the system grows."

Arthur Tisi, Director of Information Systems, NLHC

Microsoft Solution Provider Supplies Crucial Assistance

The National League for Health Care worked with MediaServ, a New York network consulting firm and Microsoft Solution Provider, to integrate Windows NT into the organization's existing OS/2-Microsoft LAN Manager network. MediaServ provided guidance on the overall installation of Windows NT, helped connect servers based on the Windows NT platform with the rest of the enterprise, and trained NLHC people on Microsoft products.

NLHC also worked closely with New Jersey-based database applications developer PCSI from the onset of this development cycle. PCSI President Ben Tandowski and his team were integral in developing the project's functional specifications and recommending the foundation technology of a SQL Server-based relational database.

Saved by Computing Power

The benefits of the National League for Health Care's automated information system were immediate and dramatic. Tisi says the system's increased speed and greater efficiency literally makes it possible for NLHC to continue as a service organization. "The accreditation process is integral to our mission," says Tisi. "Continuing with a manual system would have been a disservice to the schools that put their trust in us." An information search that could take as long as an entire day with the organization's manual reference book-based method can now be performed in less than 10 minutes.

"Now when a caller asks which nursing schools in the Northeast are best suited to a student interested in pediatric oncology, we can not only provide several options immediately, but also related information, such as admission requirements and tuition," explains Tisi.

The new ability to provide this added value to callers has prompted NLHC to consider turning the service into a revenue generator by charging per query or per item.

A System That Can Help Make Health Care More Cost-Effective

"Ultimately, we want the public to be able to call us for information on health care alternatives, no different from the way they might call their bar association for information about lawyers."

Arthur Tisi, Director of Information Systems, National League for Health Care

The advantages of computerized information access, combined with a critical need for affordable health care, may lead NLHC to extend its database to consumers, providing them with a simple way to get current information about alternative means of health care.

Tisi says NLHC is exploring a number of methods to deliver that information. For example, its database may be available on electronic information services such as CompuServe® and Prodigy™. "People could call in and find a nurse practitioner in their area," says Tisi. "Or a major employer could locate alternative medical insured programs that enable it to avoid paying high deductibles."

The federal government is also interested in the system. "As the government gets more involved in health care and ways to fund programs, it's performing thorough cost-benefit analyses of equal care options," notes Tisi.

What began as a way to automate nursing school accreditation data has expanded into a health care information system with far-reaching implications. The instant, easy-to-access information it provides may go a long way toward creating a more cost-effective health care system for people throughout the United States.

1 This device requires a driver from the \DRVLIB directory on the Windows NT CD-ROM, or the Windows NT Driver Library.

2 This device requires a driver from the Windows NT driver library. See the following section on accessing these drivers.

3 Refer to SETUP.TXT for information on configuring this machine/device before installation.

4 Windows NT does not currently support Advanced Power Management (APM).

5 This system requires an ABIOS.SYS driver dated after 11/1/93 to support IDE drives. Call Microsoft Product Support Services to obtain this update.

6 Contact the manufacturer for information on running Windows NT on this machine.

7 IDE drives greater than 500Mb are only supported with BIOS Version 1.23 or later, with BIOS setting for IDE in standard mode.

8 Only the NCR 53c710 SCSI Host Adapter is supported in this machine.

9 Tested with firmware revisions 3.10 and 3.20.

10 Problems may be encountered using SCSI Removable Media (cartridge) drives on this adapter on this platform.

11 This adapter requires an active terminator for proper performance.

12 This adapter must be configured for 5 MB/second asynchronous I/O to work with listed CD-ROM drives from NEC.

13 This adapter must be configured for 5 MB/second asynchronous I/O to work with listed CD-ROM drives from Chinon, Hitachi and NEC.

14 Tested with the Unisys PW2 Advantage 3256 (Flemington).

15 Tested with the Unisys PW2 Advantage Plus MPE 4668.

16 Scanners are not supported with this adapter.

17 Removable media drives are not supported with cache module installed.

18 CD-audio, tape drives and scanners are not supported on this controller.

19 To use this adapter, at least one device on the bus must provide termination power.

20 Refer to SETUP.TXT for information on configuring this adapter.

21 SCSI BIOS dated before 1991 requires PS/2 Reference Diskette version 1.21 or later.

22 This adapter cannot be used for CD Setup. To install Windows NT with this adapter, use the WINNT.EXE Setup method.

23 Tested with COMPAQ Portable 486c.

24 Tested with NCR System 3000 Model 3350.

25 This adapter is only supported on IRQ-5.

26 This adapter is only supported for use with scanners and CD-ROM drives.

27 Tested with firmware revision 005.

28 Tested with firmware revision 008.

29 This drive is not supported for use with the Adaptec AHA-1542c.

30 This drive is not supported for use with the Future Domain TMC-850M and TMC-1670 adapters.

31 This drive requires double-termination when used with the Adaptec AHA-1742A.

32 The Adaptec AHA-1640 and Ultrastor 24f support only a single disk when used with this drive. This drive is not supported for use with the Future Domain MCS-600 adapter.

33 Requires firmware revision 1.10C to function properly with Windows NT.

34 Supported with CD-ROM drives based on Panasonic CR-52x and CR-56x models only.

35 This drive is not supported with the Adaptec AHA-1640 adapter.

36 Requires firmware version 484 or later for proper operation.

37 This drive is not supported with the IBM PS/2 Microchannel SCSI Host Adapter (with cache).

38 This drive is not supported with the Future Domain TMC-850M(ER).

39 This drive is not supported with the UltraStor 24fa adapter.

40 This drive is not supported with the Adaptec AHA-1742A adapter.

41 For use with floppy controllers. Separate interface controllers for these types of drives are not supported.

42 Requires that 512-byte sector-sized media be mounted during installation.

43 Supported on x86 only.

44 This adapter is currently supported in its ESC-1/ESC-2 compatibility mode only.

45 Not supported with the the Future Domain TMC-850m.

46 This has been Fault-Tolerance (RAID) tested using Windows NT Advanced Server.

47 Tested with HP C2225B tape drive, HP C2229B disk drive and HP C2226A CD-ROM drive.

48 HP Storage Systems were tested with the appropriate HP SCSI Host Adapters.

49 Tested with appropriate StorageWorks options including CD-ROM, Tape and Hard Drives.

50 Also supported on Alpha platforms.

51 FDDI tested only.

52 Supported in Sound Blaster 1.x compatibility mode.

53 Not supported in Sound Blaster 1.x compatibility mode.

54 Error control and flow control forced on.

55 Advanced features disabled.

56 Supported as a client modem only.

57 Flow control forced on.

58 Maximum DTE speed set to 2400.

59 Maximum DTE speed set to 9600.

60 Modem compression forced on.

61 Tested as standard serial ports only.

62 In the UPS applet, check the box "Remote UPS Shutdown" and set it to high.

8 Only the NCR 53c710 SCSI Host Adapter is supported in this machine.
6 Contact the manufacturer for information on running Windows NT on this machine.

19 To use this adapter, at least one device on the bus must provide termination power.
20 Refer to SETUP.TXT for information on configuring this adapter.

16 Scanners are not supported with this adapter.
22 This adapter cannot be used for CD Setup. To install Windows NT with this adapter, use the WINNT.EXE Setup method.

19 To use this adapter, at least one device on the bus must provide termination power.
20 Refer to SETUP.TXT for information on configuring this adapter.
25 This adapter is only supported on IRQ-5.

19 To use this adapter, at least one device on the bus must provide termination power.
20 Refer to SETUP.TXT for information on configuring this adapter.
22 This adapter cannot be used for CD Setup. To install Windows NT with this adapter, use the WINNT.EXE Setup method.
26 This adapter is only supported for use with scanners and CD-ROM drives.

19 To use this adapter, at least one device on the bus must provide termination power.
25 This adapter is only supported on IRQ-5.

45 Not supported with the the Future Domain TMC-850m.
46 This has been Fault-Tolerance (RAID) tested using Windows NT Advanced Server.

47 Tested with HP C2225B tape drive, HP C2229B disk drive and HP C2226A CD-ROM drive.
48 HP Storage Systems were tested with the appropriate HP SCSI Host Adapters.

2 This device requires a driver from the Windows NT driver library. See the following section on accessing these drivers.
51 FDDI tested only.

Microsoft Windows NT Version 3.1
Hardware Compatibility List

The following computers and peripherals have passed Microsoft® Windows NT™ 3.1 Operating System compatibility testing as of November, 1993. Some computers may be sold with additional peripherals that are not yet supported by the Windows NT operating system. If your computer or device is not listed below, contact the manufacturer for more information. We have not tested every computer and/or device in all possible configurations. Please refer to the file SETUP.TXT on the install media for additional compatibility information when installing Windows NT.

Items listed with footnote number 1 require one of the device drivers available in the \DRVLIB directory on the Windows NT CD-ROM. These drivers are also available in the Windows NT Driver Library.

Items listed with footnote number 2 are supported with device drivers available in the Windows NT Driver Library. Please see the section at the end of this document on accessing this library.

Updates to this list will appear in Library 1 of the WINNT forum (GO WINNT) or Library 17 of the MSWin32 forum (GO MSWIN32) on CompuServe® Information Services.

x86 Architecture Uniprocessor Computers

The following systems have been tested.

Absolute Computer 486/66 VL/EISA
ACD OPTIMA 486 DX 33 VL
ACD OPTIMA 486 DX 50 VL
ACD OPTIMA 486 DX2 66 VL
ACER AcerAcros 486DX2/66 (Model PT66DB)
ACER AcerAltos 7000/F433TU
ACER AcerAltos 7000/FT66TU
ACER AcerFrame 1000 (Model 1733)
ACER AcerFrame 1000 (Model 1766)
ACER AcerFrame 300 (Model F433T)
ACER AcerFrame 500 (Model F433TE)
ACER AcerFrame 500 (Model FT50TE)
ACER AcerFrame 500 (Model FT66TE)
ACER AcerFrame 700
ACER AcerMate 466d (Model MT66D3)
ACER AcerPower 425s (Model PZ25D)
ACER AcerPower 433
ACER AcerPower 433e/P433E
ACER AcerPower 433s
ACER AcerPower 433v
ACER AcerPower 450d
ACER AcerPower 450de/PT50E
ACER AcerPower 466d
ACER AcerPower 466de/PT66E
ACER AcerPower 466dv
ACER AcerPower 486/33
ACER AcerPower 560e/P560E
ACER AcerPower 566e
ACMA 486/33 TI-VLB
ACMA 486/50 TS-E
ACMA 486/50-2 TI-VLB
ACMA 486/66-2 TI-VLB
ACMA 486/66-2 TS-E
ACMA 486/66-2 TS-VLB
ACS Meritel 486-50SF
ACS Meritel 486-66SF
Actech ACTion EISA 486DX-50
Actech ACTion EISA 486DX/2-66
Actech ACTion ISA 486DX-33
Actech ACTion ISA 486DX-50
Actech ACTion ISA 486DX/2-50
Actech ACTion ISA 486DX/2-66
Actech ACTion ISA 486SX-25
Actech ACTion VLB 486DX-33
Actech ACTion VLB 486DX-50
Actech ACTion VLB 486DX/2-50
Actech ACTion VLB 486DX/2-66
Actech ACTion VLB 486SX-25
Adaptive Data System Pro 3/486-40
Adaptive Data System Pro 486/33 VESA
Adaptive Data System Pro 486/33DX
Adaptive Data System Pro Series 486/50
Adaptive Data System TAI 386DX/40CF System
Adaptive Data System TAI 486DX/50CS System
ADD-X 486 All In One 33 MHz
ADD-X Systemes 486/33Mhz ISA bus
ADPS 486 Power Notebook 486DX2-50Mhz
ADPS 486 Power Notebook Color 486-33Mhz
ADPS Ambassador
ADPS Bat Computer-33MHz
ADPS Bat Computer-50MHz
ADPS Local Bus 33
ADPS Medallion
ADPS Multimedia Power House
ADPS Power Notebook 486-33Mhz
ADPS System 3000
ADPS System 4000

ADPS System 5000
ADPS System 6000 EISA
ADPS System 6000 Plus
ADPS System 6000 Plus EISA
ADS 486 EISA+VESA UPGRADEABLE
ADS 486VL UPGRADEABLE
ADS UPGRADEABLE 3/486
Advance Interface EISA VESA 486DX-50
Advance Interface EISA VESA 486DX2-66
Advance Interface VL-BUS 486DX-50
Advance Interface VL-BUS 486DX2-66
Advanced Computer SPIRAL 386DX/40
Advanced Computer SPIRAL 486/33
Advanced Computer SPIRAL 486DX2/50
AIC STM 386DX-33Mhz
AIC STM 486DX-33Mhz
AIC STM 486DX2-66Mhz
AIC STM 486DX2-66Mhz Local Bus
Alcotini AmiTech 386DX-40 STD
Alcotini AmiTech 486DX-33 STD
Alcotini AmiTech 486DX2-50 STD
Alcotini AmiTech 486DX2-66 STD
Alcotini AmiTech 486SX-25 STD
Alcotini Weston 486DX-66 TFT
Alfa DELTACOM VESA 486DX2-66
Alfa DELTACOM 486-33
Alfa DELTACOM 486-50
Alfa DELTACOM 486SX-25
Alfa DELTACOM EISA 486-50
AllWare 466-EV
ALR BusinessVEISA 3/33
ALR BusinessVEISA 4/33D
ALR BusinessVEISA 4/66D
ALR Evolution IV 4/25s
ALR Evolution IV 4/33
ALR Evolution IV 4/33s
ALR Evolution IV 4/66d
ALR Evolution IV 4E/25s
ALR Evolution IV 4E/33
ALR Evolution IV 4E/33s
ALR Evolution IV 4E/66d
ALR Evolution V-Q/60
ALR Evolution V-Q/66
ALR Evolution V/60
ALR Evolution V/66
ALR Flyer 32LCT 4/50D
ALR Flyer 32LCT 4/66D
ALR Flyer 32LCT 4DX/33
ALR Flyer SD32 4/33
ALR Flyer SD32 4/66d
ALR Flyer VL 4/33d
ALR Flyer VL 4/66d
ALR Modular Processor system 486DX2/66
ALR PowerCache 4 33e
ALR POWERPRO/MC SMP 4/50D
ALR PROVEISA V/66
ALR RANGER M4/25
ALR RANGER MC4/25S
ALR RANGER MC4DX/25
ALR RANGER MCT4/25
AMAX 486/2-50 VESAmax Power Station
AMAX 486/33 VESAmax Power Station
AMAX 486/50 EISAmax Power Station
AMAX 486/66 EISAmax Power Station
AMAX 486/66 VESAmax Power Station
Ambra 486DX/50
Ambra D466E/VL
Ambra DP66E/VL
Ambra T466E/VL
AMI Enterprise III

AMI Enterprise IV
AMI Omni Business Partner
AMI Super Voyager LC
AMI Super Voyager PCI
AMI Super Voyager VLB
AMI Super Voyager VLB II
AmPAQ Ultimate 466 VLB/S2
AMS TravelPro 5300
AMSYS UPG VLbus DX2-50 DT
Annabelle Bits ASI 486/33 Vesa Local Bus
AOX Kingston Technology Corp. MC Master 486
Applied Computer ACT 486/33 DX
Apricot® FTe 486DX2/66
Apricot FTs 486DX2/66
Apricot XEN-LS II
Aquiline NT 466c System
Ares 486-33 VLB
Ariel 486DX2-66EVS
Ariel 486DX2-66VLS2
Asem DP 486/66 II
Asem DS 486/33 II
Asem ECO-PC 4/33
Asem ECO-PC 4/66
Asem MID-SERVER 4/33
Asem PROSERVER 5/60
ASL 433
Aspect 3/486 386DX-40 ISA
Aspect 3/486DX-33 ISA
Aspect 3/486DX-50 ISA
Aspect 3/486DX2-66 ISA
Aspect EISA 486DX-33
Aspect EISA 486DX-50
Aspect EISA 486DX2-66
Aspect ISA 486DX-33
Aspect ISA 486DX-50
Aspect ISA 486DX2-66
Aspect ISA 486SX-33
Aspect VESA 486DX-33
Aspect VESA 486DX-33F
Aspect VESA 486DX-50
Aspect VESA 486DX-50F
Aspect VESA 486DX2-66
Aspect VESA 486DX2-66F
Aspect VESA 486SX-33
Aspect VESA 486SX-33F
AST® Advantage!™ Plus 486DX/33
AST Advantage! Pro 486SX/25 Model 173
AST Bravo 3/25s Model 3V
AST Bravo LC 4/25s
AST Bravo LC 4/33
AST Bravo LC 4/33s
AST Bravo LC 4/50d
AST Bravo LC 4/66d
AST Bravo LP 4/25s
AST Bravo LP 4/33
AST Bravo LP 4/66d
AST Bravo MT4/66d
AST Power Premium 4/33 EISA
AST Power Premium 4/50d
AST PowerExec 4/25SL
AST Premium 386/33T
AST Premium II 386/33 Model 213V
AST Premium II 486/33
AST Premium SE 4/33 Model 333
AST Premium SE 4/50
AST Premium SE 4/50d
AST Premium SE 4/66d
AST Premium SE 486/33
AST Premmia 4/33
AST Premmia 4/33SX

AST Premmia 4/66d
AST Premmia MTE 4/66d
AST Premmia SE 4/66d
Athena ALM 486 DX 33
Athena ALM 486 DX 50
Athena ALM 486 DX 66
Athena HQ / ISA 486DLC 40
Athena HQ / ISA 486DX 33
Athena HQ / ISA 486DX 50
Athena HQ / ISA 486DX2 66
Athena HQ / VESA 486DX 33
Athena HQ / VESA 486DX2 50
Athena HQ / VESA 486DX2 66
Austin 486/50 EISA Tower PATRIOT
Austin 486/50 VESA-LB PATRIOT
Austin 486/50 VESA-LB PATRIOT PLUS
Austin 486DLC
Austin 486DX/33 EISA Tower PATRIOT
Austin 486DX/33 VESA-LB PATRIOT
Austin 486DX/33 VESA-LB PATRIOT PLUS
Austin 486DX2/50 EISA Tower PATRIOT
Austin 486DX2/66 EISA Tower PATRIOT
Austin 486DX2/66 VESA-LB PATRIOT PLUS
Austin Winstation 486DX2/66
Axik Ace Cache 486DX-33V
Axik Ace Cache 486DX-33VG
Axik Ace Cache 486DX2-50VG
Axik Ace Cache 486DX2-66V
Axik Ace Cache 486DX2-66VG
Axik Ace Cache 486SX-33VG
Bear 486/50 Desktop
Brett ExecEISA
Brett Executive
Brett Pro VLB
Brett Station NTe EISA
C&S Computer E III 486/VLB
C. THIIM 486DX33
CAF CT-02 L737/486DX-33
Caliber 3/486 386DX-40 ISA
Caliber 3/486DX-33 ISA
Caliber 3/486DX-50 ISA
Caliber 3/486DX2-66 ISA
Caliber EISA 486DX-33
Caliber EISA 486DX-50
Caliber EISA 486DX2-66
Caliber ISA 486DX-33
Caliber ISA 486DX-50
Caliber ISA 486DX2-66
Caliber ISA 486SX-33
Caliber VESA 486DX-33
Caliber VESA 486DX-33F
Caliber VESA 486DX-50
Caliber VESA 486DX-50F
Caliber VESA 486DX2-66
Caliber VESA 486DX2-66F
Caliber VESA 486SX-33
Caliber VESA 486SX-33F
Celem 486DX/33 VL
Celem 486DX/33C
Celem 486DX/50 MC
Celem 486DX/50 VL
Chaplet HALIKAN NBD-486T/25M
Chicony Electronics 486 33P
Chicony Electronics Subnote 486SX/25
Cinet EVL Series 486DX2/66
Cinet HI Series 486DX2/66
Cinet VL Series 486DX2/66
Clone 9433
Colfax P1-486 EISA/VLB
Commodore® 486DX-33C

Commodore 486SLC-25
Commodore 486SX-25
Commodore DT 486SX-20
Commodore LB 486DX-33C
Commodore LB 486DX2-66C
Commodore LB 486SX-33C
Commodore LB T486DX2-66C
Commodore T486DX-50C
COMPAQ® Concerto 4/25
COMPAQ Contura 4/25C
COMPAQ Deskpro 386/25®
COMPAQ Deskpro 386/25e
COMPAQ Deskpro 386/33®
COMPAQ Deskpro 386/33L
COMPAQ Deskpro® 4/66i
COMPAQ Deskpro 486/25
COMPAQ Deskpro 486/25i
COMPAQ Deskpro 486/33i
COMPAQ Deskpro 486/33L
COMPAQ Deskpro 486/33M
COMPAQ Deskpro 486/50L
COMPAQ Deskpro 486/50M
COMPAQ Deskpro 5/60M
COMPAQ Deskpro 5/66M
COMPAQ Deskpro 66M
COMPAQ LTE® Lite 4/25
COMPAQ LTE Lite 4/25C
COMPAQ LTE Lite 4/33C
COMPAQ Portable 486c
COMPAQ Portable 486C/66
COMPAQ Presario 425
COMPAQ ProLiant 1000 486DX2/66
COMPAQ ProLiant 1000 Model 5/60
COMPAQ ProLineaTM 3/25s
COMPAQ ProLinea 4/50
COMPAQ ProLinea 4/66
COMPAQ ProSignia 486DX/33
COMPAQ ProSignia 486DX2/66
COMPAQ ProSignia 5/60
COMPAQ Systempro/LTTM 386/25
COMPAQ Systempro/LT 486/33
COMPAQ Systempro/LT 486DX2/50
COMPAQ Systempro/LT 486DX2/66
COMPAQ Systempro/LT 486SX/25
Comper DC486-662V
CompuAdd® 420s
CompuAdd 433
CompuAdd 433 ELB
CompuAdd 433 LB
CompuAdd 433 LP
CompuAdd 433DLC LP
CompuAdd 433E
CompuAdd 450
CompuAdd 450DX2 LP
CompuAdd 466/DX2
CompuAdd 466DX2 LB
CompuAdd 466DX2E LB
CompuAdd 486-33DLC
CompuAdd MC466EDX2
COMPUCON 386DX/40
COMPUCON 486DX/33
COMPUCON 486DX/33 ISA/VL
COMPUCON 486DX/50
COMPUCON 486DX/50 EISA/VL
COMPUCON 486DX/50 VL
COMPUCON 486DX2/66 EISA/VL
Compudyne 4DX2/50 EISA16340 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX2/50 VLB16340 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX2/66 EISA16245 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX2/66 Slimnote

Compudyne 4DX2/66 VLB16245 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX33 EISA16245 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX33 VLB16245 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX50 EISA16340 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne 4DX50 VLB16340 DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX2/50 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX2/50 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX2/66 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX2/66 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX33 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX33 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX50 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO DX50 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO SX25 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO SX25 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO SX33 2VLB DIP DESKTOP (incl. MINITOWER and SERVERTOWER)
Compudyne UM486V AIO SX33 2VLB SMT DESKTOP (incl. MINITOWER and SERVERTOWER)
CompuPartner 4D250
CompuPartner 4D33
CompuPartner 4DV266
Computer Extension CESI 486 66
Computer Resources 486DX266 ISA
Computer Resources 486DX33 FULL TOWER
Computer Resources 486DX33 LOCAL BUS
Computer Resources 486DX50 EISA
Computer Sales Prof. 486DX/33 VL
Computer Sales Prof. 486DX2/50 VL
Computer Sales Prof. 486DX2/66 EISA/VL
Computer Sales Prof. 486DX2/66 VL
Computer Sales Prof. 486SX/25 VL
Computer Sonics CSI EISA/VL 486/33
Computer Sonics CSI ISA 486/33
Computer Sonics CSI VL/ISA 486
Computrend PREMIO 486DX-33
Computrend PREMIO 486DX-50
Computrend PREMIO 486DX2-66
Cornell Computer Systems EISA_VESA PAK 486/33
Cornell Computer Systems EISA_VESA PAK 486/66
Cornell Computer Systems HOME OFFICE PAK 486/33 VLB
Cornell Computer Systems HOME OFFICE PAK 486/66 VLB
Cornell Computer Systems POWER PAK 486/33 VLB
Cornell Computer Systems POWER PAK 486/66 VLB
Cornell Computer Systems VALUE PAK 486/33 VLB
Cornell Computer Systems VALUE PAK 486/66 VLB
CPU Sir Henry NT
Crescent 486-33/33VL
Crescent 486-66VL
CSS Labs MaxSys 433MTA
CSS Labs MaxSys 433MTMGE
CSS Labs MaxSys 433TA
CSS Labs MaxSys 433TMGE
CSS Labs MaxSys 450MTMGE
CSS Labs MaxSys 450TMGE
CSS Labs MaxSys 452MTMGE
CSS Labs MaxSys 452TMGE
CSS Labs MaxSys 462MTA
CSS Labs MaxSys 462MTE
CSS Labs MaxSys 462MTMGE
CSS Labs MaxSys 462TA
CSS Labs MaxSys 462TE
CSS Labs MaxSys 462TMGE
CSS Labs Preferred 433GA
CSS Labs Preferred 433GE
CSS Labs Preferred 433MGE
CSS Labs Preferred 450MGE
CSS Labs Preferred 452MGE
CSS Labs Preferred 462GA
CSS Labs Preferred 462GE
CSS Labs Preferred 462MGE
CTM Fontek 486DX2-50 VL

CTM Fontek 486DX2-66 VL
CTM Fontek 486DX33 VL
Cube 340 ATX
Cube 433 ATX
Cube 450 ATX
Cube 466 ATX
Cube 466 ATX Local Bus
Cube 486/40
CyberStar Alliance DX2/50
CyberStar FilePro 1000
CyberStar FilePro 2000
CyberStar FilePro 2000 5/60
Daewoo 486VESA System/2700(33)
Daewoo 486VESA System/2900(33)
Daewoo Modular Desktop/2300
Daewoo Modular Mini Tower/2400
DAN for Windows 25
DAN for Windows 33
DAN for Windows 50
DAN for Windows 66
DAN Vantage/25
DAN Vantage/33
DAN Vantage/50
DAN Vantage/66
Danjen 486DLC 33 MHz
Danjen 486DX 33 MHz Local Bus
Danjen 486DX 50 MHz EISA
Danjen 486DX 50 MHz ISA
Dassault AT CUSTOMER ACTIVATED TERMINAL D633
Data Stor 386-33DX Desktop/Tower
Data Stor 386-33SX Desktop/Tower
Data Stor 486-25SX Desktop/Tower
Data Stor 486-33DX Desktop/Tower
Data Stor 486-33SX Desktop/Tower
Data Stor 486-50DX Desktop/Tower
Data Stor 486-66DX2 Desktop/Tower
Data Stor 486-66DX2E Desktop/Tower
DATAFILEN PROFF 386DX-40
DATAFILEN PROFF 486DX-33 VL
DATAFILEN PROFF 486DX2-66 VL
Datavarehuset BRICK 486 DX2-50 LocalBus
Datavarehuset BRICK 486DX-33 EISA
Datavarehuset BRICK 486DX2-66 Local Bus
DDK Soft DDK-4066/2LV
Debis DCS Minitower 486 EISA
Debis DCS Tower 486 MC
Debis DCS Tower 486 MP EISA
Deico 486DLC
Deico Predator III
DELL® 325 N Notebook
DELL 325 NC Notebook
DELL 4033/XE
DELL 4050/XE
DELL 4066/XE
DELL 425s/L
DELL 433/L
DELL 433/M
DELL 433/ME
DELL 433/T
DELL 450/M
DELL 450s/L
DELL 4560/XE
DELL 466/M
DELL 466/ME
DELL Dimension 466/T
DELL Dimension 486DX/33
DELL Dimension 486DX/50
DELL Dimension 486DX2/50s
DELL Dimension 486SX/25
DELL OptiPlex 425s/MXV

DELL OptiPlex 433/MXV
DELL OptiPlex 433s/MXV
DELL OptiPlex 450/MXV
DELL OptiPlex 466/MXV
DELL PowerLine 466DE
DELL PowerLine 466SE
DELL PowerLine System 325
DELL PowerLine System 433DE
DELL PowerLine System 433E
DELL PowerLine System 433SE
DELL PowerLine System 450/T
DELL PowerLine System 450DE
DELL PowerLine System 450DE/2 DGX
DELL PowerLine System 450SE
DELL PowerLine System 486D/33
DELL PowerLine System 486D/50
DELL PowerLine System 486P/25
DELL PowerLine System 486P/33
Delphi Olympus
Delta Micro Systems Gold Line 4D33V
Delta Micro Systems Gold Line 4D50C
DFI CCV 486-25SX
DFI CCV 486-DX2-50
DFI CCV 486DX-33
DFI CCV 486DX2-66
DFI TN 486DX-33
DFI TN 486DX2-50
DFI TN 486DX2-66
DFI TN 486SX-25
DFI UCE 486DX-33
DFI UCE 486DX-50
DFI UCE 486DX2-50
DFI UCE 486DX2-66
DFI UCE 486SX-25
DFI UCF 486DX-33
DFI UCF 486DX-50
DFI UCF 486DX2-50
DFI UCF 486DX2-66
DFI UCF 486SX-25
Digital Equipment Corp. applicationDEC 400xP
Digital Equipment Corp. DECpc 333
Digital Equipment Corp. DECpc 425
Digital Equipment Corp. DECpc 425 ST
Digital Equipment Corp. DECpc 425i
Digital Equipment Corp. DECpc 425i DX2
Digital Equipment Corp. DECpc 433
Digital Equipment Corp. DECpc 433 ST
Digital Equipment Corp. DECpc 433 Workstation
Digital Equipment Corp. DECpc 433dx DT
Digital Equipment Corp. DECpc 433dx LP
Digital Equipment Corp. DECpc 433dx MT
Digital Equipment Corp. DECpc 433dx MTE
Digital Equipment Corp. DECpc 433sx DT
Digital Equipment Corp. DECpc 433T
Digital Equipment Corp. DECpc 450 ST
Digital Equipment Corp. DECpc 450d2 LP
Digital Equipment Corp. DECpc 450d2 MT
Digital Equipment Corp. DECpc 452 ST
Digital Equipment Corp. DECpc 466 ST
Digital Equipment Corp. DECpc 466d2 DT
Digital Equipment Corp. DECpc 466d2 LP
Digital Equipment Corp. DECpc 466d2 LPx
Digital Equipment Corp. DECpc 466d2 MT
Digital Equipment Corp. DECpc 466d2 MTE
Digital Equipment Corp. DECpc 560 ST
Digital Equipment Corp. DECpc LPv 425sx
Digital Equipment Corp. DECpc LPv 433dx
Digital Equipment Corp. DECpc LPv 433sx
Digital Equipment Corp. DECpc LPv 450d2
Digital Equipment Corp. DECpc LPv 466d2

Digital Equipment Corp. DECpc LPx 433dx
Digital Equipment Corp. DECpc LPx 433sx
Digital Equipment Corp. DECpc LPx 450d2
Digital Equipment Corp. DECstation® 425c
Dolch C.P.A.C. 486-33C
Dolch C.P.A.C. 486-33E
Dolch C.P.A.C. 486-50 EISA
Dolch C.P.A.C. 486-66C
Dolch C.P.A.C. 486-66E
Dolch M.A.C.H. 486-33
Dolch M.A.C.H. 486-66
Dolch V.P.A.C. 486-33C
Dolch V.P.A.C. 486-33E
Dolch V.P.A.C. 486-66C
Dolch V.P.A.C. 486-66E
DTK 486VL
DTK FEAT03-D33
DTK FEAT03-D40
DTK FEAT03-D50
DTK FEAT03-T66
DTK FEAT04-D33
DTK FEAT33-D33
DTK FEAT33-D40
DTK FEAT33-D50
DTK FEAT33-T66
DTK FEAT34-D33
DTK FEAT34-D40
DTK FEAT34-D50
DTK FEAT34-T66
DTK FEAT35-D33
DTK FEAT36-D33
DTK FEAT5030-D33
DTK FEAT5030-D50
DTK FEAT5030-T66
DTK FEAT5031-D33
DTK FEAT5031-D50
DTK FEAT5031-T66
DTK FEAT62-D33
DTK FEAT62-T66
DTK Grafika 4A
DTK Grafika 4C
DTK Grafika 4D
DTK Grafika 4E
DTK Grafika 4F
DTK Grafika 4G
DTK Grafika 4I
DTK Grafika 4J
DTK Grafika 4V2D-D3
DTK Grafika 4V2D-T6
DTK Grafika 4V2T-D3
DTK Grafika 4V2T-T6
DTK Grafika 5V1T-60
DTK Grafika 5VID-60
DTK PENT-01 (incl. -31, -32 Models)
DTK SPAN0030
DTK SPAN01-D33
DTK SPAN01-D50
DTK SPAN01-T66
DTK SPAN3330
DTK SPAN5030
Duracom 486/25SX-CCV
Duracom 486/25SX-TN
Duracom 486/25SX-UCF
Duracom 486/33-CCV
Duracom 486/33-TN
Duracom 486/33-UCF
Duracom 486/50DX-UCF
Duracom 486/50DX2-CCV
Duracom 486/50DX2-TN
Duracom 486/50DX2-UCF

Duracom 486/66DX2-CCV
Duracom 486/66DX2-TN
Duracom 486/66DX2-UCF
Dynamic Decisions DYNEX EXEC-50 EISA
Dynamic Decisions EXECUTIVE 486-33 ISA
Dynamic Decisions EXECUTIVE 486-33 ISA/PCI
Dynamic Decisions EXECUTIVE 486-33 VL/EISA
Dynamic Decisions EXECUTIVE 486-33 VL/ISA
Dynamic Decisions EXECUTIVE 486-33SX
Dynamic Decisions EXECUTIVE 486-50 VL/EISA
Dynamic Decisions EXECUTIVE 486-66 DX2 VL/ISA
Dynamic Decisions EXECUTIVE 486-66 VL/EISA
Dynamic Decisions EXECUTIVE ISA-486-33 SV2
Dynamic Decisions EXECUTIVE ISA-486-50 SV2
Dynamic Decisions EXECUTIVE ISA-486-66D2 SV2
Dynamic Decisions PROFESSIONAL 486-33 VL/ISA
Dynamic Decisions PROFESSIONAL 486-33DX VL/EISA E3
Dynamic Decisions PROFESSIONAL 486-33DX VL/EISA E4
Dynamic Decisions PROFESSIONAL 486-50DX VL/EISA E4
Dynamic Decisions PROFESSIONAL 486DX66 EISA VLB E4
ECE DATA i486/VLB
ECG Unitron 340
ECG Unitron 425
ECG Unitron 433
ECG Unitron 450
ECG Unitron 450 DX/2
ECG Unitron 466 DX/2
ECG Unitron 466 DX/2 EISA
Elite Industries MB-1433AEA-V 486/33
Elite Industries MB-1433AEA-V 486/50
Elite Industries MB-1433AEA-V 486DX2/66
Elitegroup UC4917-G
Elitegroup UM4910
Elitegroup VL486
Elonex PC-400 Series Computer
Eltech Model 4660VB
Epson® ActionDesk 4000 (4DX2/66-LB)
Epson Endeavor VL66
Epson Endeavor WG 4DX2/50
Epson Endeavor WG 4DX2/66
Epson Endeavor WG 4SX33
Epson Equity 4DX/33
Epson Equity 4DX2/50
Epson Equity 4SX/25
Epson PowerSpan 486DX2/66
Epson Progression 486DX/33
Epson Progression 486DX2/66
Epson Progression 486SX/25
Epson Progression 4DX2/50
Epson Progression 4SX/33
Ergo Ultra Moby Brick 486/66
ERIDAN Onyx DE433
Erre 486DX2-66 VLB
EverCom ISA 486SR/33
EverCom VL 486SV2/66
Everex™ Cube DX/33
Everex Step 486/33 ISA
Everex Step DP
Everex Step VL EISA 486DX2/50
Everex Step VL EISA 486DX2/66
Everex Step VL ISA 486DX2/50
Everex Step VL ISA 486DX2/66
Everex Tempo 486/33
Everex Tempo 486/33E
Everex Tempo 486DX2/50
Everex Tempo 486SX/25
Evergreen Systems CAPcard 425e
Evesham Micros VALE PREMIER + 486DX2-66
Evesham Micros VALE PREMIER 486DX2-66
Evesham Micros VALE PRESTIGE 486DX2-66

Expo-Tech 386 Ultra Slim
Expo-Tech 486DX/3 Desktop
Expo-Tech 486DX/3 Desktop (w/LBVGA)
Expo-Tech 486DX/3 Desktop (w/VLBUS)
Expo-Tech 486DX/3 Tower
Expo-Tech 486DX/3 Tower (w/VLBUS)
Expo-Tech 486DX2/4 Desktop
Expo-Tech 486DX2/4 Desktop (w/LBVGA)
Expo-Tech 486DX2/4 Desktop (w/VLBUS)
Expo-Tech 486DX2/4 Tower
Expo-Tech 486DX2/4 Tower (w/VLBUS)
Expo-Tech 486DX2/6 Desktop
Expo-Tech 486DX2/6 Desktop (w/LBVGA)
Expo-Tech 486DX2/6 Desktop (w/VLBUS)
Expo-Tech 486DX2/6 Tower
Expo-Tech 486DX2/6 Tower (w/VLBUS)
Expo-Tech 486SX/3 Desktop
Expo-Tech 486SX/3 Desktop (w/LBVGA)
Expo-Tech 486SX/3 Tower
Expo-Tech 486SX/3 Ultra Slim
Expo-Tech 486SX/3 Ultra Slim (w/LBVGA)
Expo-Tech 486SX/4 Desktop
Expo-Tech 486SX/4 Desktop (w/LBVGA)
Expo-Tech 486SX/4 Desktop (w/VLBUS)
Expo-Tech 486SX/4 Tower
Expo-Tech 486SX/4 Ultra Slim
Expo-Tech 486SX/4 Ultra Slim (w/LBVGA)
Expo-Tech LT322 Notebook
Expo-Tech LT421 Notebook
Express Micro EISA VESA 486DX-50
Express Micro EISA VESA 486DX2-66
Express Micro VL-BUS 486DX-50
Express Micro VL-BUS 486DX2-66
Fast 486DY66S520
Federal Technologies Guardian WinMaster 486/33SX
First Jupiter 486DX66 All In One ISA Bus
First Krypton 486DX50 VL-Bus
First LEO 4386VCV DX33
First LEO 486DX66-VL
First LEO 486VC DX/50
First LEO 486VC DX2/66
First LEO DESKTOP 486/33
First LEO DESKTOP 486/50
First LEO DESKTOP 486/66
First LEO MINITOWER 486/33
First LEO MINITOWER 486/50
First LEO MINITOWER 486/66
First Venus 486DX2/66 EISA and VL-Bus
First Venus 486DX2/66 VL-Bus
Fountain Technology 486DX/33 VL
Fountain Technology 486DX2-66 EISA/VL
Fountain Technology 486DX2/50 VL
Fountain Technology 486DX2/66 VL
Fountain Technology 486SX/25 VL
Free VESA23X50
Fujitech 486DX/50 E
Fujitech 486DX2/50 VL
FUTURE COMPUTERS 486 Eisa/Vesa NTPC
Gain TITON WORKSTATION
Gateway 2000 386/33
Gateway 2000 486/33C
Gateway 2000 486/33E
Gateway 2000 486DX2/50
Gateway 2000 486DX2/50E
Gateway 2000 486DX2/50V
Gateway 2000 486DX2/66V
Gateway 2000 4DX/33
Gateway 2000 4DX2/66E
Gateway 2000 4SX/25
Gateway 2000 4SX/33V

Gateway 2000 Nomad 425DXL 3
Gateway 2000 Nomad 450DXL 3
GCH AEGIS 433
GCH AEGIS 466
GCH EasyData 433HI
GCH EasyData 466HI
GCH EasyDate 466HI VL
GCH EiSYS Ei433DX
GCH EiSYS Ei466DX
Genitech Capricorn JF/33
Genitech Capricorn JF2/66
GES DATAMINI MF 486DX-33
GES DATAMINI MF 486DX2-66
GES DATAMINI MF 486SX-25
Getek 486 DX 50 LOCAL BUS
GMX EISAMB 486DX2/66
GoldStar 425SXE
GoldStar GS425SX
GoldStar GS466DX
GoldStar GS466DXE
GRiD® 486ei-25 SVR
GRiD 486ei-33
GRiD APT/425se
GRiD APT/450e
GRiD MFP 425s+
GRiD MFP 433+
GRiD MFP 433s+
GRiD MFP 450+
GRiD MFP 466+
GRiD MFP/420s
GRiD MFP/425s
GRiD MFP/450
GRiD MFP/540
GVH 486DX2 66 Vesa Bus
Hacker 486DX2/66 for NT
Hancke & Peter 386w Professional
Hancke & Peter 486/33w Professional
Hancke & Peter 486/50w Professional
Hancke & Peter 486/66w Professional
Hancke & Peter 486w EISA Professional
Harris Epoch 486/33 VESA
Harris Epoch 486/50 EISA
Harris Epoch 486/50 ISA
Hauppauge 4860 EISA DX2-66
Hauppauge 486M Local Bus DX2-66
Hertz 486/D50e
Hertz 486/D50Ee
Hertz 486/D66X2e
Hertz 486/D66X2Ee
Hewlett-Packard® NetServer 4/33 LE
Hewlett-Packard NetServer 4/33 LM
Hewlett-Packard NetServer 4d/66 LE
Hewlett-Packard NetServer 4d/66 LM
Hewlett-Packard NetServer 4s/33 LE
Hewlett-Packard NetServer 5/60 LM
Hewlett-Packard Vectra® 386/25
Hewlett-Packard Vectra 486/25T
Hewlett-Packard Vectra 486/25U
Hewlett-Packard Vectra 486/33N
Hewlett-Packard Vectra 486/33ST
Hewlett-Packard Vectra 486/33T
Hewlett-Packard Vectra 486/33U
Hewlett-Packard Vectra 486/50U
Hewlett-Packard Vectra 486/66 XM
Hewlett-Packard Vectra 486/66ST
Hewlett-Packard Vectra 486/66U
Hewlett-Packard Vectra 486S/20
Hewlett-Packard Vectra 486s/25 MI
Hewlett-Packard Vectra EtherLite 386
Hewlett-Packard Vectra EtherLite 486

Hewlett-Packard Vectra RS/25C
HM Systems Minstrel Xpresso 486
Hyundai 425s
Hyundai 433DDV
Hyundai 466d2
Hyundai Prestige 433d
IBM® Eduquest™ Model 50 486DX/33 (9605-040)
IBM PS/1® 2133-xxx 486SX/25
IBM PS/1 2133-xxx 486SX/33
IBM PS/1 2133A-xxx 486DX/33 [4]
IBM PS/1 2133A-xxx 486DX2/66 [4]
IBM PS/1 2133A-xxx 486SX/25 [4]
IBM PS/1 2133A-xxx 486SX/33 [4]
IBM PS/1 2155-xxx 486DX/33
IBM PS/1 2155-xxx 486DX2/50
IBM PS/1 2155-xxx 486DX2/66
IBM PS/1 2155-xxx 486SX/25
IBM PS/1 2155-xxx 486SX/33
IBM PS/1 2155A-xxx 486DX2/66 [4]
IBM PS/1 2155A-xxx 486SX/25 [4]
IBM PS/1 2155A-xxx 486SX/33 [4]
IBM PS/1 2168-xxx 486DX/33
IBM PS/1 2168-xxx 486DX2/50
IBM PS/1 2168-xxx 486DX2/66
IBM PS/1 2168-xxx 486SX/25
IBM PS/1 2168-xxx 486SX/33
IBM PS/1 2168A-xxx 486DX2/66 [4]
IBM PS/1 2168A-xxx 486SX/25 [4]
IBM PS/1 2168A-xxx 486SX/33 [4]
IBM PS/2® Model 50/50Z System Board Upgrade 486SLC2/50 [5]
IBM PS/2 Model 55/55SX System Board Upgrade 486SX/25 [5]
IBM PS/2 Model 56 8556-xxx 486SLC/20
IBM PS/2 Model 56 9556-xxx 486SLC2/50
IBM PS/2 Model 57 8557-xxx 486SLC/20
IBM PS/2 Model 57 9557-xxx 486SLC2/50
IBM PS/2 Model 60/80 System Board Upgrade 486DX/33 [5]
IBM PS/2 Model 70 8570-xxx 386DX/25
IBM PS/2 Model 70 8570-xxx 486DX/25
IBM PS/2 Model 70 System Board Upgrade 486DX/33 [5]
IBM PS/2 Model 76 9576-xxx 486DX2/66
IBM PS/2 Model 76 9576-xxx 486SX/33
IBM PS/2 Model 77 9577-xxx 486DX2/66
IBM PS/2 Model 77 9577-xxx 486SX/33
IBM PS/2 Model 80 8580-xxx 386DX/25
IBM PS/2 Model 90 XP 486 8590-0H* 486SX/25
IBM PS/2 Model 90 XP 486 8590-0J* 486DX/25
IBM PS/2 Model 90 XP 486 8590-0K* 486DX/33
IBM PS/2 Model 90 XP 486 8590-0L* 486DX2/50
IBM PS/2 Model 90 XP 486 8590-xxx with 486DX2/66 processor upgrade
IBM PS/2 Model 90 XP 486 8590-xxx with Enhanced 486DX/50 processor upgrade
IBM PS/2 Model 90 XP 486 8590-xxx with Enhanced 486DX2/66 processor upgrade
IBM PS/2 Model 90 XP 486 8590-xxx with processor upgrade with Pentium™ Technology
IBM PS/2 Model 90 XP 486 9590-0L* 486DX2/50
IBM PS/2 Model 90 XP 486 9590-xxx with 486DX2/66 processor upgrade
IBM PS/2 Model 90 XP 486 9590-xxx with Enhanced 486DX/50 processor upgrade
IBM PS/2 Model 90 XP 486 9590-xxx with Enhanced 486DX2/66 processor upgrade
IBM PS/2 Model 90 XP 486 9590-xxx with processor upgrade with Pentium Technology
IBM PS/2 Model 95 XP 486 8595-0H* 486SX/25
IBM PS/2 Model 95 XP 486 8595-0J* 486DX/25
IBM PS/2 Model 95 XP 486 8595-0K* 486DX/33
IBM PS/2 Model 95 XP 486 8595-0L* 486DX2/50
IBM PS/2 Model 95 XP 486 8595-0M* 486DX/50
IBM PS/2 Model 95 XP 486 8595-xxx with 486DX2/66 processor upgrade
IBM PS/2 Model 95 XP 486 8595-xxx with Enhanced 486DX/50 processor upgrade
IBM PS/2 Model 95 XP 486 8595-xxx with Enhanced 486DX2/66 processor upgrade
IBM PS/2 Model 95 XP 486 8595-xxx with processor upgrade with Pentium Technology
IBM PS/2 Model 95 XP 486 9595-0L* 486DX2/50
IBM PS/2 Model 95 XP 486 9595-0M* 486DX/50
IBM PS/2 Model 95 XP 486 9595-xxx with 486DX2/66 processor upgrade
IBM PS/2 Model 95 XP 486 9595-xxx with Enhanced 486DX/50 processor upgrade

IBM PS/2 Model 95 XP 486 9595-xxx with Enhanced 486DX2/66 processor upgrade
IBM PS/2 Model 95 XP 486 9595-xxx with processor upgrade with Pentium Technology
IBM PS/2 Model P75 8573-xxx 486DX/33
IBM PS/2 Server 85 433 9585-0K*
IBM PS/2 Server 85 466 9585-0N*
IBM PS/2 Server 85 9585-0X* 486SX/33
IBM PS/2 Server 85 9585-0X* with 486DX2/66 processor upgrade
IBM PS/2 Server 95 466 9595-1N*
IBM PS/2 Server 95 560 9595-0PT
IBM PS/2 UltimediaTM DV M57 9557-xxx 486SLC2/50
IBM PS/2 Ultimedia M57 8557-xxx 486SLC/20
IBM PS/2 Ultimedia M57 9557-xxx 486SLC2/50
IBM PS/2 Ultimedia M77 9577-xxx 486DX2/66
IBM PS/2 Ultimedia M77 9577-xxx 486SX/33
IBM PS/ValuePoint 425SX/D 6384-Fxx
IBM PS/ValuePoint 425SX/S 6382-Fxx
IBM PS/ValuePoint 433DX/D 6384-Mxx
IBM PS/ValuePoint 433DX/S 6382-Mxx
IBM PS/ValuePoint 433DX/T 6387-Mxx
IBM PS/ValuePoint 433SX/D 6384-Kxx
IBM PS/ValuePoint 433SX/S 6382-Kxx
IBM PS/ValuePoint 466DX2/D 6384-Wxx
IBM PS/ValuePoint 466DX2/T 6387-Wxx
IBM ThinkPadTM 300
IBM ThinkPad 700C [3]
IBM ThinkPad 720C [3]
ICL Alfaskop Deskside m458
ICL ErgoPRO C4/33
ICL ErgoPRO D4/25
ICL ErgoPRO D4/33d
ICL ErgoPRO D4/66d XG
ICL ErgoPRO D5/60
ICL ErgoPRO E4/66d
ICL System Platform CXe486/66
ICL System Platform CXe486i
ICL System Platform CXe486s
ICL System Platform FX486/33
ICL System Platform FX486/50
ICL System Platform FX486/66
Image 486DX/50 EISA
Image 486DX2/66 VESA
Index INDEXPORT 486 OVD 66 LOCAL BUS CACHE
Index INDEXPORT 486/33
Index INDEXPORT 486/33 VL VESA CACHE
Index INDEXPORT 486/50 I CACHE
Index INDEXPORT 486/50 VL VESA CACHE
Inelco INTEL® XPRESS 50MHZ
Innovax Aurora 486DX/33
Insight 66 MHz EISA/VESA 486DX2
Insight 66 MHz ISA/VESA 486DX2
Intel Classic R-Series
Intel L486 Series Professional Workstation
Intel L486-Series/Professional GX
Intel X486/50E
Intel Xpress 486
Intelicom 486DX/33 EISA
Intelicom 486DX/33 ISA
Intelicom 486DX/33 VESA EISA
Intelicom 486DX/33 VLB
Intelicom 486DX/50 EISA
Intelicom 486DX/50 ISA
Intelicom 486DX/50 VESA EISA
Intelicom 486DX/50 VLB
Intelicom 486DX2/50 EISA
Intelicom 486DX2/50 ISA
Intelicom 486DX2/50 VESA EISA
Intelicom 486DX2/50 VLB
Intelicom 486DX2/66 EISA
Intelicom 486DX2/66 ISA
Intelicom 486DX2/66 VESA EISA

Intelicom 486DX2/66 VLB
Intelicom 486SX/25 ISA
Intelicom 486SX/25 VLB
Intelicom 486SX/33 ISA
INTERCOMP Digit 486SLC/25
INTERCOMP Entry 486/33
INTERCOMP Master 486DX/50
INTERCOMP Planet 486/50 EISA
INTERCOMP Planet 486DX2/66 EISA
INTERCOMP Planet LC 486/33 EISA
INTERCOMP Target 486/33
INTERCOMP Target 486/50 VLB
INTERCOMP Target 486DX/50
Intergraph PC 433
Intergraph PC 466
Intergraph Technical Desktop 1220
International Data DGI 486DX-66
International Data DGI ISA O/D 20
Investronica INVES BS-486
Investronica INVES BS-486 VL
Investronica INVES IFS-486
Investronica INVES IFS-900
Investronica INVES MP-900 XM UniProcessor
Investronica INVES WS-900 EVL
Investronica INVES WS-900 VL
IPC DYNASTY G-PC 486DX-33CV
IPC DYNASTY G-PC 486DX2-50CV
IPC DYNASTY G-PC 486DX2-66CV
IPC DYNASTY G-PC 486SX-25CV
IPC DYNASTY HE 486DX-33C
IPC DYNASTY HE 486DX2-66C
IPC DYNASTY HE 486DX2-50C
IPC DYNASTY HE 486SX-25C
IPC DYNASTY LE 486DX-33 (incl. 33C)
IPC DYNASTY LE 486DX2-50 (incl. 50C)
IPC DYNASTY LE 486DX2-66 (incl. 66C)
IPC DYNASTY LE 486SX-25 (incl. 25C)
IPC DYNASTY S-PC 586DX-60CV
IPC DYNASTY SE 486DX-33C
IPC DYNASTY SE 486DX2-50C
IPC DYNASTY SE 486DX2-66C
IPC DYNASTY SE 486SX-25C
Ipex 486DX2-66 Centra 1000
Ipex 486DX2-66 Centra 1000 EISA
Ipex 486DX2-66 Centra 1000 EISA (Entry Level)
Ipex 486DX2-66 Centra 1000 EISA/VL-BUS
Ipex 486DX2-66 Centra 1000 VESA
Ipex 486DX2-66 Centra 2000
Ipex 486DX2-66 Centra 2000 EISA
Ipex 486DX2-66 Centra 2000 EISA (Entry Level)
Ipex 486DX2-66 Centra 2000 EISA/VL-BUS
Ipex 486DX2-66 Centra 2000 VESA
Ipex 486DX2-66 Desktop
Ipex 486DX2-66 Desktop (EISA)
Ipex 486DX2-66 Desktop EISA (Entry Level)
Ipex 486DX2-66 Desktop EISA/VL-BUS
Ipex 486DX2-66 Desktop VESA
Ipex 486DX2-66 Mini Tower
Ipex 486DX2-66 Mini Tower EISA
Ipex 486DX2-66 Mini Tower EISA (Entry Level)
Ipex 486DX2-66 Mini Tower EISA/VL-BUS
Ipex 486DX2-66 Mini-Tower VESA
Ipex 486DX2-66 Slimline
Ipex 486DX2-66 Slimline (WD Form Factor)
Ipex 486DX33 Centra 1000
Ipex 486DX33 Centra 1000 EISA
Ipex 486DX33 Centra 1000 EISA (Entry Level)
Ipex 486DX33 Centra 1000 EISA/VL-BUS
Ipex 486DX33 Centra 1000 VESA
Ipex 486DX33 Centra 2000

Ipex 486DX33 Centra 2000 EISA
Ipex 486DX33 Centra 2000 EISA (Entry Level)
Ipex 486DX33 Centra 2000 EISA/VL-BUS
Ipex 486DX33 Centra 2000 VESA
Ipex 486DX33 Desktop
Ipex 486DX33 Desktop EISA
Ipex 486DX33 Desktop EISA (Entry Level)
Ipex 486DX33 Desktop EISA/VL-BUS
Ipex 486DX33 Desktop VESA
Ipex 486DX33 Mini Tower
Ipex 486DX33 Mini Tower EISA
Ipex 486DX33 Mini Tower EISA (Entry Level)
Ipex 486DX33 Mini Tower VESA
Ipex 486DX33 Mini-Tower EISA/VL-BUS
Ipex 486DX33 Slimline
Ipex 486DX33 Slimline (WD Form Factor)
Ipex 486DX50 Centra 1000
Ipex 486DX50 Centra 1000 EISA
Ipex 486DX50 Centra 1000 EISA (Entry Level)
Ipex 486DX50 Centra 1000 EISA/VL-BUS
Ipex 486DX50 Centra 1000 VESA
Ipex 486DX50 Centra 2000
Ipex 486DX50 Centra 2000 EISA
Ipex 486DX50 Centra 2000 EISA (Entry Level)
Ipex 486DX50 Centra 2000 EISA/VL-BUS
Ipex 486DX50 Centra 2000 VESA
Ipex 486DX50 Desktop
Ipex 486DX50 Desktop EISA
Ipex 486DX50 Desktop EISA (Entry Level)
Ipex 486DX50 Desktop EISA/VL-BUS
Ipex 486DX50 Desktop VESA
Ipex 486DX50 Mini Tower
Ipex 486DX50 Mini Tower EISA
Ipex 486DX50 Mini Tower EISA (Entry Level)
Ipex 486DX50 Mini Tower VESA
Ipex 486DX50 Mini-Tower EISA/VL-BUS
Ipex 486DX50 Slimline
Ipex 486DX50 Slimline (WD Form Factor)
Ipex 486SX25 Centra 1000
Ipex 486SX25 Centra 1000 EISA
Ipex 486SX25 Centra 1000 EISA (Entry Level)
Ipex 486SX25 Centra 1000 EISA/VL-BUS
Ipex 486SX25 Centra 1000 VESA
Ipex 486SX25 Centra 2000
Ipex 486SX25 Centra 2000 EISA
Ipex 486SX25 Centra 2000 EISA (Entry Level)
Ipex 486SX25 Centra 2000 EISA/VL-BUS
Ipex 486SX25 Centra 2000 VESA
Ipex 486SX25 Desktop
Ipex 486SX25 Desktop EISA
Ipex 486SX25 Desktop EISA (Entry Level)
Ipex 486SX25 Desktop EISA/VL-BUS
Ipex 486SX25 Desktop VESA
Ipex 486SX25 Mini Tower
Ipex 486SX25 Mini Tower (EISA)
Ipex 486SX25 Mini Tower EISA (Entry Level)
Ipex 486SX25 Mini Tower VESA
Ipex 486SX25 Mini-Tower EISA/VL-BUS
Ipex 486SX25 Slimline
Ipex 486SX25 Slimline (WD Form Factor)
Ipex 486SX33 Centra 1000 EISA
Ipex 486SX33 Centra 1000 EISA (Entry Level)
Ipex 486SX33 Centra 1000 EISA/VL-BUS
Ipex 486SX33 Centra 1000 ISA
Ipex 486SX33 Centra 1000 VESA
Ipex 486SX33 Centra 2000 EISA
Ipex 486SX33 Centra 2000 EISA (Entry Level)
Ipex 486SX33 Centra 2000 EISA/VL-BUS
Ipex 486SX33 Centra 2000 ISA
Ipex 486SX33 Centra 2000 VESA

Ipex 486SX33 Desktop
Ipex 486SX33 Desktop EISA
Ipex 486SX33 Desktop EISA (Entry Level)
Ipex 486SX33 Desktop EISA/VL-BUS
Ipex 486SX33 Desktop VESA
Ipex 486SX33 Mini Tower EISA
Ipex 486SX33 Mini Tower EISA (Entry Level)
Ipex 486SX33 Mini Tower ISA
Ipex 486SX33 Mini Tower VESA
Ipex 486SX33 Mini-Tower EISA/VL-BUS
Ipex 486SX33 Slimline
Ipex 486SX33 Slimline (WD Form Factor)
ITG NT 486DX-50 ISA
ITOS KT 486/33
ITOS MT 386DX/40
JAI PC 845-66-32VL
JDR V486-33
JDR V486-66
JDR V486SX-33
KT Technology KT386DX-33
KT Technology KT386DX-40
KT Technology KT486DX-33
KT Technology KT486DX-50
KT Technology KT486DX2-50 VESA
KT Technology KT486DX2-66 VESA LB
L.E.M. Technologies Sys38640/M
Leading Edge® D4/DX-33 Plus DeskTop
Leading Edge D4/DX-50 Plus DeskTop
Leading Edge D4/DX2-50 Plus DeskTop
Leading Edge D4/MTDX-33 MiniTower
Leading Edge D4/MTDX-50 MiniTower
Leading Edge D4/MTDX2-50 MiniTower
Leading Edge D4/MTDX2-66 MiniTower
Leading Edge D4/MTSX-25 MiniTower
Leading Edge D4/MTSX-33 MiniTower
Leading Edge D4/SX-25 Plus DeskTop
Leading Edge D4/SX-33 Plus DeskTop
Leading Edge WinPro 486/SLC33
Leading Edge WinPro 486/SX-25
Leading Edge WinPro 486e/DX-33
Leading Edge WinPro 486e/DX-33(VL)
Leading Edge WinPro 486e/DX-50
Leading Edge WinPro 486e/DX2-50
Leading Edge WinPro 486e/DX2-50(VL)
Leading Edge WinPro 486e/DX2-66
Leading Edge WinPro 486e/DX2-66(VL)
Leading Edge WinPro 486e/SX-25
Leading Edge WinPro 486e/SX-25(VL)
Leading Edge WinPro 486e/SX-33
Leading Edge WinPro 486e/SX-33(VL)
Legacy 486DLC-33 SYSTEM
Legacy VLB 486DX-33
Lucky Star System w/ Cyrix 486S-33
Lundin 400 Series 486 EISA w/ 486DX/50
Lundin 400 Series 486 ISA w/ 486DX/33
Lundin 400 Series 486 VESA w/ 486DX/33
Magitronic G-MD433L-170-4M
Magitronic G-MD440G-130-4M
Magitronic G-MD466L-210-4M
Magitronic G-MS466L-10-16M
Master Cascade 386-40 Small Desktop
Master Cascade 486-33 Mini-Tower
Maximus 486-50MHz Maxi-CAD
Maximus Cyrix 486/40 VESA Local Bus
MetaTech 486DX/33 ISA
MetaTech 486DX/33 VESA
MetaTech 486DX/50 EISA
Microbyte Lyrebird Model 451
Microbyte Lyrebird Model 455
Microbyte Lyrebird Model 457

Micron 486VL Magnum 433 DX
Micron 486VL Magnum 433 SX
Micron 486VL Magnum 450 DX2
Micron 486VL Magnum 466 DX2
Micron 486VL MagServer 433 DX
Micron 486VL MagServer 450 DX2
Micron 486VL MagServer 466 DX2
Micron 486VL PowerStation™ 433 DX
Micron 486VL PowerStation 433 SX
Micron 486VL PowerStation 450 DX2
Micron 486VL PowerStation 466 DX2
Micron 486VL ValueLine 466 DX2
Micron 486VL WinServer 433 DX
Micron 486VL WinServer 450 DX2
Micron 486VL WinServer 466 DX2
Micron 486VL WinStation 433 DX
Micron 486VL WinStation 433 SX
Micron 486VL WinStation 450 DX2
Micron 486VL WinStation 466 DX2
Midgards Micro ISA 486DX-33
Midwest Micro 486DX2/50 Vesa/ISA
MIKROLOG OY Osborne 4280G-66
MIKROLOG OY Osborne IX5-60E
MIKROLOG OY Osborne LP4D-33CLB
MIKROLOG OY Osborne LP4D-33N
MIKROLOG OY Osborne LP4D-50C
MIKROLOG OY Osborne LP4D-50CLB
MIKROLOG OY Osborne LP4D-50N
MIKROLOG OY Osborne LP4D-66CLB
MIKROLOG OY Osborne LP4D-66N
MIKROLOG OY Osborne LP4S-25N
MIKROLOG OY Osborne LP4S-33CLB
MIKROLOG OY Osborne LP4S-33N
MIKROLOG OY Osborne MT4D-33CLB
MIKROLOG OY Osborne MT4D-33N
MIKROLOG OY Osborne MT4D-50CLB
MIKROLOG OY Osborne MT4D-50N
MIKROLOG OY Osborne MT4D-66CLB
MIKROLOG OY Osborne MT4D-66N
MIKROLOG OY Osborne MT4S-25N
MIKROLOG OY Osborne MT4S-33CLB
MIKROLOG OY Osborne MT4S-33N
MIND 386DX/33 ISA
MIND 486DX/33 EISA
MIND 486DX/33 ISA
MIND 486DX/50 EISA
MIND 486DX/50 ISA
MIND 486DX2/50 EISA
MIND 486DX2/50 ISA
MIND 486DX2/66 EISA
MIND 486DX2/66 ISA
MIND 486SX/25 EISA
MIND 486SX/25 ISA
MIND 486SX/33 EISA
MIND 486SX/33 ISA
MiTAC DM4066
Modular MST/200
Monydata Entry 486/33
Monydata Modula 200/80
Monydata Station 486/80
Multitech ProSpec 486DX-50 PS450DE-ST
Mustek BROTHER BCM3486DX2-VL
Mustek BROTHER BCM4486DX-VL
Mustek MECER3486-VL
Mustek MECER7486-VL
National Instruments™ VXIpc-486 Model 200
National Instruments VXIpc-486 Model 500
NCR StarStation
NCR System 3000 Model 3230
NCR System 3000 Model 3314

NCR System 3000 Model 3330
NCR System 3000 Model 3333
NCR System 3000 Model 3335
NCR System 3000 Model 3345
NCR System 3000 Model 3350
NCR System 3000 Model 3355
NCR System 3000 Model 3410
NCR System 3000 Model 3445
NCR System 3000 Model 3447
NEC® Express II
NEC Image 425
NEC Image 433
NEC Image 466
NEC PowerMate 386/25S
NEC PowerMate 425
NEC PowerMate 433
NEC PowerMate 466
NEC PowerMate 486/33e
NEC PowerMate 486/33i
NEC PowerMate 486/50e
NEC PowerMate 486/50i
NEC PowerMate 486sx/25e
NEC PowerMate DX2/66e
NEC UltraLite™ Versa
NETiS 386DX/40 ISA
NETiS 486DX/33 ISA
NETiS 486DX/33 VL
NETiS 486DX/33 VL EISA
NETiS 486DX/50 VL
NETiS 486DX/50 VL EISA
NETiS 486DX2/50 VL EISA
NETiS 486DX2/66 ISA
NETiS 486DX2/66 VL
NETiS 486DX2/66 VL EISA
NETiS 486SX/33 VL
NETiS Ultra 486DX/33 ISA
NETiS Ultra 486DX/50 ISA
NETiS Ultra 486DX2/66 ISA
NETiS Ultra 486DX2/66 VL
NETiS Ultra 486SX/25 ISA
NETiS Ultra N433VL
NETiS Ultra N450VL
Network Connection M2
Network Connection T-3000
Network Connection T-4000
Network Connection TNX
Network Connection Triumph T.R.A.C.
Network Connection Triumph T.S.C.V
Nimrod DESKTOP 486DX/33 VESA VL
Nimrod DESKTOP 486DX2/66 ISA
Nimrod LC-DESKTOP 486DX/33 VESA VL
Nimrod LC-DESKTOP 486DX2/66 ISA
Nimrod MINI-TOWER 486DX/33 VESA VL
Nimrod MINI-TOWER 486DX2/66 ISA
Nimrod TOWER 486DX/33 VESA VL
Nimrod TOWER 486DX2/66 ISA
NORTH-EAST NE Micro 433LV
NORTH-EAST NE Micro 450LV
NORTH-EAST NE Micro 466LV
Northern Micro NM486/66VL
Northgate® 486/33
Northgate 486/33 Slimline ZXP
Northgate 486/33 VESA ISA
Northgate 486/33e Baby AT
Northgate Elegance 333
Northgate Elegance 425i
Northgate Elegance 433e
Northgate Elegance 433i
Northgate Elegance SP 386/33
Northgate Elegance SP 433

Northgate Elegance ZXP
Northwest Micro Signature I 4/33
Northwest Micro Signature II 4/33 VLB
OKI if Server 466/SL
OKI if Station 425/DL
OKI if Station 433/DE
OKI if486VX550D
Olidata P/60
Olivetti® LSX5010
Olivetti LSX5015
Olivetti LSX5020
Olivetti LSX5025
Olivetti LSX5025 E
Olivetti M300-28
Olivetti M300-30
Olivetti M300-30P
Olivetti M380-40
Olivetti M4-46
Olivetti M4-62
Olivetti M4-65
Olivetti M4-66
Olivetti M400-10
Olivetti M400-40
Olivetti M400-60
Olivetti M480-10
Olivetti M480-20
Olivetti M480-40
Olivetti M6-420
Olivetti M6-440
Olivetti M6-460
Olivetti M6-620
Olivetti M6-860
Olympia Olystar 300D-33
Olympia Olystar 400D-33
Olympia Olystar 400D-33 EISA
Olympia Olystar 400D-50
Olympia Olystar 400D-66
Olympia Olystar 400D-66 EISA
Olympia Olystar 400S-25
Olympia Olystar 400S-33SL
Omni Tech 9600 486DX2-66
Optima OCT 486DX2-50 VL
Optima OCT 486DX250 EISA
Optima OCT 486DX266 EISA
Optima OCT 486DX266 VL
Optima OCT 486DX33 EISA
Optima OCT 486DX33 VL
Optima OCT 486DX50 EISA
Optima OCT 486DX50 VL
Optima OCT 486SX25 EISA
Optima OCT 486SX25 VL
Optima SPRINTER 486DX250 EISA
Optima SPRINTER 486SX25 EISA
Optimus 486DX/50 EISA
Optimus 486DX/50 LocalBus
Optimus 486DX2/50 VL
Optimus 486DX2/66
Optimus 486SX/25 VL
Osborne EISA 486DX50 Fileserver
Osborne Mpower 486DX2-66
Osborne Mpower3 486DX33
Osborne Mpower3 486SX33
Osborne Mpower4 486DX33
Osborne Mpower4 486SX33
Osicom 4133L 486/DX266 VESA LB
Osicom 4133L 486/DX33 VESA LB
Packard Bell 1110
Packard Bell 1120
Packard Bell 1150
Packard Bell 2050

Packard Bell 400T
Packard Bell 470
Packard Bell 485
Packard Bell 486CDM
Packard Bell 486DX/33
Packard Bell 486SX/25
Packard Bell 495
Packard Bell 515E
Packard Bell 525E
Packard Bell 545E
Packard Bell 550
Packard Bell 560
Packard Bell 565E
Packard Bell AXCEL 1033
Packard Bell AXCEL 105
Packard Bell AXCEL 1066
Packard Bell AXCEL 130
Packard Bell AXCEL 2005
Packard Bell AXCEL 2015
Packard Bell AXCEL 2033
Packard Bell AXCEL 205
Packard Bell AXCEL 2066 MINITOWER
Packard Bell AXCEL 230
Packard Bell AXCEL 405 (incl. H model)
Packard Bell AXCEL 410
Packard Bell AXCEL 410E (incl. H, F and W G models)
Packard Bell AXCEL 420
Packard Bell AXCEL 450G (incl. H, J and TJ models)
Packard Bell AXCEL 460
Packard Bell AXCEL 460H (incl. TJ model)
Packard Bell AXCEL 486/33
Packard Bell AXCEL 486A66
Packard Bell AXCEL 486SX
Packard Bell AXCEL 530
Packard Bell AXCEL 533H (incl. J and TJ models)
Packard Bell AXCEL 533STJ
Packard Bell AXCEL 550
Packard Bell AXCEL 550MT/J
Packard Bell AXCEL 570
Packard Bell AXCEL 630 MINITOWER
Packard Bell AXCEL 666J (incl. TJ and TL models)
Packard Bell AXCEL 850
Packard Bell EXECUTIVE 486/33 (incl. ELITE model)
Packard Bell EXECUTIVE 486/33 G (incl. J model)
Packard Bell EXECUTIVE 486DX2/JW (incl. TY model)
Packard Bell EXECUTIVE 486SX (incl. -2F and -G models)
Packard Bell EXECUTIVE 486SX ELITE (incl. SERIES SI model)
Packard Bell EXECUTIVE 486SX-EC
Packard Bell EXECUTIVE 486SX/FW (incl. /HW model)
Packard Bell EXECUTIVE 486SX250
Packard Bell EXECUTIVE 486XE (incl. C and S models)
Packard Bell EXECUTIVE Elite Series 486SXCC
Packard Bell FORCE 1066
Packard Bell FORCE 107
Packard Bell FORCE 110
Packard Bell FORCE 1135
Packard Bell FORCE 1137
Packard Bell FORCE 117
Packard Bell FORCE 200
Packard Bell FORCE 2010
Packard Bell FORCE 2020
Packard Bell FORCE 2040 MINITOWER
Packard Bell FORCE 2233 MINITOWER
Packard Bell FORCE 2376 (incl. F model)
Packard Bell FORCE 2386 MINITOWER
Packard Bell FORCE 250
Packard Bell FORCE 405
Packard Bell FORCE 425
Packard Bell FORCE 486 SX (incl. E, -M1, and -M130 models)
Packard Bell FORCE 486/25

Packard Bell FORCE 486/33 (incl. +, E, -M1, and -M210 models)
Packard Bell FORCE 486/33G (incl. J, JW, and PLUS models)
Packard Bell FORCE 48625 (incl. EX model)
Packard Bell FORCE 486CDM-1/TV
Packard Bell FORCE 486DX/DJ-W (incl. G-W, H, H2, J and JT-W models)
Packard Bell FORCE 486DX2 -WG
Packard Bell FORCE 486DX2/EJT (incl. W model)
Packard Bell FORCE 486DX2/F JT (incl. JT-W, J-W and LT-W models)
Packard Bell FORCE 486DX2/G-W
Packard Bell FORCE 486MT50J
Packard Bell FORCE 486SX (incl. /20, /20G, E, M1, and M130 models)
Packard Bell FORCE 486SX-WG
Packard Bell FORCE 486SX/25 (incl. G and W models)
Packard Bell FORCE 486SX/BE (incl. FW, FW-2, M, MM and H2 models)
Packard Bell FORCE 486SX/OH-W
Packard Bell FORCE 515
Packard Bell FORCE 515S (incl. PLUS model)
Packard Bell FORCE 525 (incl. B and S models)
Packard Bell FORCE 545 (incl. B and S models)
Packard Bell FORCE 565 (incl. S model)
Packard Bell FORCE 600 (incl. B and S models)
Packard Bell FORCE 715 MINITOWER
Packard Bell FORCE T66
Packard Bell LEGEND 102H (incl. ELITE model)
Packard Bell LEGEND 1066 WG ELITE
Packard Bell LEGEND 1133
Packard Bell LEGEND 1134 ELITE
Packard Bell LEGEND 1135
Packard Bell LEGEND 1136
Packard Bell LEGEND 115
Packard Bell LEGEND 1166
Packard Bell LEGEND 1176
Packard Bell LEGEND 120
Packard Bell LEGEND 125
Packard Bell LEGEND 126 ELITE
Packard Bell LEGEND 127
Packard Bell LEGEND 128
Packard Bell LEGEND 135 (incl. H model)
Packard Bell LEGEND 140
Packard Bell LEGEND 1900
Packard Bell LEGEND 1910
Packard Bell LEGEND 2000
Packard Bell LEGEND 2001
Packard Bell LEGEND 2002 ELITE
Packard Bell LEGEND 2011 SUPREME
Packard Bell LEGEND 2025
Packard Bell LEGEND 207
Packard Bell LEGEND 2133 MINITOWER
Packard Bell LEGEND 2135 MINITOWER
Packard Bell LEGEND 2176 ELITE MT
Packard Bell LEGEND 2266 MINITOWER
Packard Bell LEGEND 2270 MINITOWER
Packard Bell LEGEND 2276 MINITOWER
Packard Bell LEGEND 2300 MINITOWER
Packard Bell LEGEND 233
Packard Bell LEGEND 234 ELITE
Packard Bell LEGEND 245
Packard Bell LEGEND 33T SUPREME
Packard Bell LEGEND 33T SUPREME MINITOWER
Packard Bell LEGEND 430 G (incl. WG and F models)
Packard Bell LEGEND 430 WG ELITE
Packard Bell LEGEND 430E (incl. E2 and EL models)
Packard Bell LEGEND 435E ELITE (incl. 2 ELITE model)
Packard Bell LEGEND 440G
Packard Bell LEGEND 445 G ELITE (incl. G 2 ELITE model)
Packard Bell LEGEND 486CDM-1/TV
Packard Bell LEGEND 486T/50
Packard Bell LEGEND 510H
Packard Bell LEGEND 605H ELITE
Packard Bell LEGEND 625

Packard Bell LEGEND 635J
Packard Bell LEGEND 635TJ ELITE
Packard Bell LEGEND 660 (incl. H and ELITE models)
Packard Bell LEGEND 660H
Packard Bell LEGEND 660TJ (incl. H model)
Packard Bell LEGEND 66D SUPREME
Packard Bell LEGEND 66T SUPREME
Packard Bell LEGEND 670
Packard Bell LEGEND 695 SUPREME
Packard Bell LEGEND 700 (incl. ELITE model)
Packard Bell LEGEND 740
Packard Bell LEGEND 747 MINITOWER
Packard Bell LEGEND 750 SUPREME
Packard Bell LEGEND 760 SUPREME
Packard Bell LEGEND 770 (incl. ELITE model)
Packard Bell LEGEND 780
Packard Bell LEGEND 780 SUPREME
Packard Bell LEGEND 790
Packard Bell LEGEND 800 SUPREME (incl. 800+)
Packard Bell LEGEND 800 SUPREME/50
Packard Bell LEGEND 840 MINITOWER
Packard Bell LEGEND 845 MINITOWER
Packard Bell LEGEND 848 MINITOWER
Packard Bell LEGEND 900 F (incl. F-ELITE and G models)
Packard Bell LEGEND 920SX SUPREME
Packard Bell LEGEND 925 G (incl. G ELITE and J model)
Packard Bell LEGEND 933 G (incl. G ELITE, J, J ELITE and J+)
Packard Bell LEGEND 950 ELITE (incl. J and J ELITE models)
Packard Bell LEGEND 960TJ
Packard Bell LEGEND 966J (incl. ELITE model)
Packard Bell LEGEND 966TJ (incl. TJ ELITE, TJ2 ELITE, TJ-W ELITE, WG and TZ models)
Packard Bell LEGEND M950
Packard Bell LEGEND MT950 (incl. J model)
Packard Bell LEGEND T66
Packard Bell PACKMATE 486/33G (incl. J model)
Packard Bell PACKMATE 486/E
Packard Bell PACKMATE 48625
Packard Bell PACKMATE 486DX/33 Y (incl. Y-W and X models)
Packard Bell PACKMATE 486DX2/50TY (incl. TY-W model)
Packard Bell PACKMATE 486DX2/T Z - W (incl. Y model)
Packard Bell PACKMATE 486DX33/T Y (incl. /TY-W model)
Packard Bell PACKMATE 486SX
Packard Bell PACKMATE 486SX/20 E (incl. F, and G models)
Packard Bell PACKMATE 486SX/25G
Packard Bell PACKMATE 486SX/25W (incl. TG model)
Packard Bell PACKMATE 486SX/33X (incl. X2 and TM models)
Packard Bell PACKMATE 486SX25U (incl. U2 and X models)
Packard Bell PACKMATE 733 C MT
Packard Bell PACKMATE X225
Packard Bell PACKMATE X230
Packard Bell PACKMATE X233
Packard Bell PACKMATE X240
Packard Bell PACKMATE X250 (incl. Y model)
Packard Bell PACKMATE XT266
PC House Micro Q 486dx2-66
PC Tech Zeos® Upgradable
PC-Brand Leader 486dx/33 Cache
PC-Brand Leader 486dx2/66 Cache
PC-Brand NB 486slc
Peacock 486DX 50
Pionex 486DX/33 VL
Pionex 486DX2/50 VL
Pionex 486DX2/66 EISA/VL
Pionex 486DX2/66 VL
Pionex 486SX/25 VL
Poly 486-33VZ
Poly 486-50E
Poly 486-66E
Poly 486-66EV
Poly 486-66VI

Poly 486-66VL
Poly 486SX-25Y
Poly 486SX-33VL
Positive by Tandon 486dx/33
Positive by Tandon 486dx2/66
Precision 486/50 EISA
Precision 486/50F
Precision 486/66 EISA VL-Bus
Precision 486/66 VL-Bus
Precision 486/66E
Primax 425SVI
Primax 433VI
Primax 450VE
Primax 450VI
Primax 466VI
Primax 486/33E
Primax 486/66E
Procomp TW 9300
Professional Concepts Beeker 4-33/VL2
Professional Concepts Beeker 4-50/VL2
Professional Concepts Beeker 4-66/VL2
Professional Concepts Beeker 6900
Professional Concepts Quinn 4-33/VLE
Professional Concepts Quinn 4-50/VLE
Professional Concepts Quinn 4-66/VLE
Professional Concepts Saavij 4-33/VL3
Professional Concepts Saavij 4-50/VL3
Professional Concepts Saavij 4-66/VL3
Progen 466
Protech 486-66Mhz EISA
Protech 486-66Mhz EISA/VL
Protech 486-66Mhz ISA
Protech 486-66Mhz ISA/VL
QNIX OMNI486DX2/66
Quadrant 486DX/33 VESA LOCAL BUS
Quadrant 486DX/50 VESA LOCAL BUS
Quadrant 486DX2/66 VESA LOCAL BUS
Quadrant 486SX/25 VESA LOCAL BUS
Quadrant 486SX/33 VESA LOCAL BUS
Quantex 486DX/33 VL
Quantex 486DX2/50 VL
Quantex 486DX2/66 EISA/VL
Quantex 486DX2/66 VL
Quantex 486SX/25 VL
Quattro Prompt4
Radisys EPC-23
Radisys EPC-4
Radisys EPC-5
Radisys EPC-7
Rask REC 486-50F
RDIpc i486DX2/66c Eisa
RDIpc i486DX2/66c Isa
RDIpc i486DX2/66c VL Bus
Repco Data R33B486
Repco Data Turbo APM-420 DX
Repco Data Turbo APM-425 DX
Repco Data Turbo APM-433
Reply Model 32
Reply PS/2 Model 50/50Z System Board Upgrade 486SLC2/50 [5]
Reply PS/2 Model 55/55SX System Board Upgrade 486/25 [5]
Reply PS/2 Model 60/80 System Board Upgrade 486/33 [5]
Reply PS/2 Model 70 System Board Upgrade 486/33 [5]
Research Machines RM E Series QE-486/33
Research Machines RM S Series PC-486/25SX
Research Machines RM SystemBase 486/33
Research Machines RM V Series V466
Rolta ROLTASTATION 433E
Rose Computer Cidex 386DX-40 ISA(AMD)
Rose Computer Cidex 486DX-40 ISA
Samsung DeskMaster 486/33P

Samsung DeskMaster 486D2/66E
Samsung DeskMaster 486S/25N
Sanyo MBC-19te
SCA Professional 3486DX2/66 VLB
SCA Professional 486DX 50 VLB
SCA Professional 486DX2/66 VLB
Seanix ASI 948633VM
Seanix ASI 948650VM
Seanix ASI 9DX266VM
Sequent® WinServer 1000up 6
Sequent WinServer 1500up 6
Sequent WinServer 3000up 6
Shuttle 486VL 50
Sidus Formula 486/33i
Sidus Formula 486/50e
Siemens-Nixdorf PCD-3M/25
Siemens-Nixdorf PCD-3T/33
Siemens-Nixdorf PCD-4G/33
Siemens-Nixdorf PCD-4G/66
Siemens-Nixdorf PCD-4GSX/25
Siemens-Nixdorf PCD-4H/66
Siemens-Nixdorf PCD-4HSX
Siemens-Nixdorf PCD-4LSL
Siemens-Nixdorf PCD-4LSX
Siemens-Nixdorf PCD-4T/33
Siemens-Nixdorf PCD-4T/66
Siemens-Nixdorf PCE-4C/DX2-66
Siemens-Nixdorf PCE-4C/SX25
Siemens-Nixdorf PCE-4R/33
Siemens-Nixdorf PCE-4RSX/25
Siemens-Nixdorf PCE-4T/66
Siemens-Nixdorf PCE-5S/60
Silicon Star AV4 486DX2/66
Silicon Star AV4 486DX33
Silicon Star AV4 50MHz
Sirex Eaton 486DX-33 EISA/LocalBus
Sirex PowerMaster 486DX-33 EISA/VLB
Sirex PowerMaster 486DX2-50 EISA/VLB
Sirex PowerMaster 486DX2-66 EISA/VLB
Sirex SpeedMaster 486DX-33 ISA
Sirex SpeedMaster 486DX-33 LocalBus
Sirex SpeedMaster 486DX-50 ISA
Sirex SpeedMaster 486DX2-50 ISA
Sirex SpeedMaster 486DX2-50 LocalBus
Sirex SpeedMaster 486DX2-66 ISA
Sirex SpeedMaster 486DX2-66 LocalBus
Sirex SpeedMaster 486SX-33 LocalBus
SKAI 486DX/50VL
SKAI 486DX2/66EVL
Softworks Citus MDC 386-33
Softworks Citus MDC 486DX-33
Softworks Citus MDC 486DX-50
Softworks Citus MDC 486DX2-50
Softworks Citus MDC 486DX2-66
Softworks Citus MDC X 486 50
SRC Systems 486DX2/66 VESA LOCAL BUS
SRC Systems GRAPHICSTATION
SRC Systems High Performance SCSI 66MHz
Standard Computronics HIPPO-VL 486DX2-66 VESA LOCAL BUS
STD 4D250
STD 4D33
STD 4DV266
SuperCom Touch TI433
SuperCom Touch TI450
SuperCom Touch TI466
Svensk LAPLINE DeskTop 462 (incl. MiniTower Model)
Swan 486/33DB
Swan 486/33V
Swan 486/50ES
Swan 486/66ES

Swan 486DX/33 EISA-DB
Swan 486DX2/50DB
Swan 486DX2/66 EISA-DB
Swan 486DX2/66DB
Swan 486SX/25DB
Swan 486SX/25V
Syncomp Mega+386i 40 PC
Syncomp Mega+486DX2/50e PC
Syncomp Mega+486DX2/50i PC
Syncomp Mega+486DX2/66e PC
Syncomp Mega+486DX2/66i PC
Syncomp Mega+486e-33 PC
Syncomp Mega+486e-50 PC
Syncomp Mega+486i-33 PC
Syncomp Mega+486i-50 PC
Syncomp Mega+486SXe-25 PC
Syncomp Mega+486SXi 33 PC
Syncomp Mega+486SXi-25 PC
Syncomp Micro 386i 40 PC
Syncomp Micro 486DX2/50i PC
Syncomp Micro 486i-33 PC
Syncomp Micro 486i-50 PC
Syncomp Micro 486SXi-25 PC
Syncomp Mini 386i-40PC
Syncomp Mini 486-50i PC
Syncomp Mini 486DX2/50e PC
Syncomp Mini 486DX2/50i PC
Syncomp Mini 486DX2/66e PC
Syncomp Mini 486DX2/66i PC
Syncomp Mini 486e-33 PC
Syncomp Mini 486e-50 PC
Syncomp Mini 486i-33 PC
Syncomp Mini 486SXe-25 PC
Syncomp Mini 486SXi-25 PC
Syncomp Mini 486SXi-33 PC
Syncomp Mini+386i 40 PC
Syncomp Mini+486DX2/50e PC
Syncomp Mini+486DX2/50i PC
Syncomp Mini+486DX2/66e PC
Syncomp Mini+486DX2/66i PC
Syncomp Mini+486e-33 PC
Syncomp Mini+486e-50 PC
Syncomp Mini+486i 33 PC
Syncomp Mini+486i-50 PC
Syncomp Mini+486SXe-25 PC
Syncomp Mini+486SXi 33 PC
Syncomp Mini+486SXi-25 PC
Sys Technology ST486DX-33VM
T-DATA LIN 486-33 DX
T-DATA LIN 486-50 DX
Tandon 486dx/33
Tandon 486dx2/66
Tandon MCSII 486dx/33
Tandon MCSII 486dx/33c
Tandon MCSII 486dx2/66c
Tandon NII 486dx/33
Tandon PACII plus 486dx2/66
Tandon PCAII 486dx2/66
Tandon PCAII 486sx/25
Tandon Profile 486dx/33
Tandon TargetII 486dx2/66
Tandon TargetII 486sx/25
Tandon Tower 486dx2/66e
Tandon TowerII 486dx2/66
Tandy® 3100
Tandy 425 SX
Tandy 433 DX
Tandy 433 SX
Tandy 450 DX2
Tandy 466 DX2

Tandy 4825 SX
Tandy 4833 LX/T
Tandy 4850 EP
Tandy 4866 LX/T
Tandy Omni Profile II 425 SX
Tandy Omni Profile II 433 DX
Tandy Omni Profile II 433 SX
Tandy Omni Profile II 450 DX2
Tandy Omni Profile II 466 DX2
Tandy Onmi II MT 425 SX
Tandy Onmi II MT 433 DX
Tandy Onmi II MT 433 SX
Tandy Onmi II MT 450 DX2
Tandy Onmi II MT 466 DX2
Tangent 486DX/33 EISA
Tangent 486DX/33 ISA
Tatung TCS-8460S 386SX/25
Tatung TCS-9300T 486DX2/66
Tatung TCS-9360T 486DX/33
Tatung TCS-9370T 486DX2/66
Tatung TCS-9510 486DX/33
Tatung TCS-9540 486DX/33
Tatung TCS-9620E 486DX2/66
Tatung TCS-9650E 486DX2/66
Tatung TCS-9700 486DLC/40
Tatung TCS-9910S 486SLC/33
Techway Endeavour E62
Techway Endeavour E62VL
Techway Endeavour E77
Techway Endeavour E77VL
Techway Endeavour E84
Techway Endeavour E84VL
TELEMECANIQUE FTX507-6B
TELEMECANIQUE FTX507-8C
Texas Instruments® TravelMate™ 4000 Color Series [3]
Texas Instruments TravelMate 4000 Series [3]
Texas Instruments TravelMate 4000 WinDX2 [3]
TFE Atlantic 486 DX 50Mhz
Tiki-Data PC UNIVERSAL
Toshiba® Satellite T1900C
Toshiba T4400SX
Toshiba T4500
Toshiba T4600C
Toshiba T6400SX
Toshiba T6600C Multimedia Computer [7]
Tri-Star Tri-Win Station
Tri-Star TriCAD 486/66
TriGem 486/33MM (incl. 486 /P (Type 30) model)
TriGem 486/50F
TriGem 486/66F
TriGem 486/66VC
TriGem 486DX2/50MM (incl. 486 /P (Type 40) model)
TriGem 486DX2/66MM (incl. 486 /P (Type 50) model)
TriGem 486P/T15V
TriGem 486P/T25V
TriGem 486P/T35V
TriGem 486P/T55V
TriGem 486VC
TriGem 4DX/33 ML
TriGem 4DX/33ME
TriGem 4DX2/50
TriGem 4DX2/50ME
TriGem 4DX2/66 ML
TriGem 4DX2/66ME
TriGem 4SX/25 ML
TriGem 4SX/25ME
TriGem 4SX/33 ML
TriGem 4SX/33ME
TriGem 586T
TriGem SX486/25C

TriGem SX486/25MM (incl. 486 /P (Type 10 and 12) models)
TriGem SX486/33MM (incl. 486 /P (Type 20) model)
Tulip® Vision Line DS 486 dx/50i
Tulip Vision Line DS/DE 486 dx/33i
Tulip Vision Line DT/DC 486 DX/33i
Tulip Vision Line DT/DC 486 DX/50i
Tulip Vision Line DT/DC 486 DX/66i
Tulip Vision Line series 486DX-33i
Tulip Vision Line series 486DX-50i
Tulip Vision Line series 486DX-66e
Tulip Vision Line Series 486DX-66i
TWINHEAD Superset 700
U.S. Micro Jet 386-33
U.S. Micro Jet 386-40
U.S. Micro Jet 486-33
U.S. Micro Jet 486-50
U.S. Micro Jet 486DLC-33
U.S. Micro Jet 486DX2-50
U.S. Micro Jet 486DX2-66
U.S. Micro Jet 486SX-25
U.S. Micro Jet EISA 486-33
U.S. Micro Jet EISA 486-50
U.S. Micro Jet EISA 486DX2-50
U.S. Micro Jet EISA 486DX2-66
U.S. Micro Jet EISA 486SX-25
U.S. Micro Jet VL 486-50
U.S. Micro Jet VL 486DX2-50
U.S. Micro Jet VL 486DX2-66
U.S. Micro Jet VL 486SX-25
U.S. Micro Jet VL486-33
Ultra-Comp 486DX-33
Ultra-Comp 486DX-33 EISA VLB
Ultra-Comp 486DX-33 VLB
Ultra-Comp 486DX-50
Ultra-Comp 486DX-50 EISA VLB
Ultra-Comp 486DX-50 VLB
Ultra-Comp 486DX2-66
Ultra-Comp 486DX2-66 EISA VLB
Ultra-Comp 486DX2-66 VLB
Unidata 486 66 Mhz ISA
Unisys® PW2 3336
Unisys PW2 Advantage 3256
Unisys PW2 Advantage 3336
Unisys PW2 Advantage 4163
Unisys PW2 Advantage 4253
Unisys PW2 Advantage 4256
Unisys PW2 Advantage 4336
Unisys PW2 Advantage 4506
Unisys PW2 Advantage 46662
Unisys PW2 Advantage Plus 4668
Unisys PW2 Advantage Plus 5606
Unisys PW2 Advantage Plus 5608
US Logic Falcon II Single Board Computer
Vektron VL 486DX/33
Vektron VL 486DX2/50 Business Multimedia
Vektron VL 486DX2/66 Professional Multimedia
Victor 400 DX/50
Victor 400 SX/25
Victor 486 DX/66
Victor 486DX/33
Victor DX/50
Victor V486DSX/25
Viglen Contender 4DX33
Viglen EX-Series 4DX50
Viglen Genie 4DX66
Vobis 4386 VIO SX25
Vobis 486 VC-HD 33
Vobis 486 VC-HD 50
Vobis 486 VIO 66
Vtech Expo-Tech 486DX/3 Mini (w/VLBUS)

Vtech Expo-Tech 486DX2/6 Mini (w/VLBUS)
Vtech Expo-Tech 486SX/4 Mini (w/VLBUS)
Vtech LASER 386 Ultra Slim
Vtech LASER 486DX/3 Desktop
Vtech LASER 486DX/3 Desktop (w/LBVGA)
Vtech LASER 486DX/3 Desktop (w/VLBUS)
Vtech LASER 486DX/3 Mini (w/VLBUS)
Vtech LASER 486DX/3 Tower
Vtech LASER 486DX/3 Tower (w/VLBUS)
Vtech LASER 486DX2/4 Desktop
Vtech LASER 486DX2/4 Desktop (w/LBVGA)
Vtech LASER 486DX2/4 Desktop (w/VLBUS)
Vtech LASER 486DX2/4 Tower
Vtech LASER 486DX2/4 Tower (w/VLBUS)
Vtech LASER 486DX2/6 Desktop
Vtech LASER 486DX2/6 Desktop (w/LBVGA)
Vtech LASER 486DX2/6 Desktop (w/VLBUS)
Vtech LASER 486DX2/6 Mini (w/VLBUS)
Vtech LASER 486DX2/6 Tower
Vtech LASER 486DX2/6 Tower (w/VLBUS)
Vtech LASER 486SX/3 Desktop
Vtech LASER 486SX/3 Desktop (w/LBVGA)
Vtech LASER 486SX/3 Desktop (w/VLBUS)
Vtech LASER 486SX/3 Tower
Vtech LASER 486SX/3 Ultra Slim
Vtech LASER 486SX/3 Ultra Slim (w/LBVGA)
Vtech LASER 486SX/4 Desktop
Vtech LASER 486SX/4 Desktop (w/LBVGA)
Vtech LASER 486SX/4 Desktop (w/VLBUS)
Vtech LASER 486SX/4 Mini (w/VLBUS)
Vtech LASER 486SX/4 Tower
Vtech LASER 486SX/4 Ultra Slim
Vtech LASER 486SX/4 Ultra Slim (w/LBVGA)
Vtech LASER LT322 Notebook
Vtech LASER LT421 Notebook
Vtech Platinum SMP
Wang® Microsystems ASI-CPU-E266
Wang Microsystems DTE-33
Wang Microsystems PC 350/40C
Western 486V25 SX VESA LOCAL BUS
Western 486V33 DX EISA
Western 486V33 DX ISA
Western 486V50 DX EISA
Western 486V50 DX ISA
Western 486V50 DX2 ISA
Western 486V66 DX2 EISA
Western 486V66 DX2 ISA
WIPRO LANDMARK E
WIPRO LANDMARK E SQUARE MODEL - 560
WIPRO Super Genius 386DX
WIPRO Super Genius 386SX
WIPRO Super Genius 486DX
WIPRO Super Genius 486SX
Wyle Laboratories Intel Xpress Deskside w/486DX-50MHz
Wyle Laboratories Intel Xpress DeskTop w/486DX2-66MHz
Wyle Laboratories Intel Xpress DeskTop w/486DX-50MHz
Wyse® Decision 386/25
Wyse Decision 386/40
Wyse Decision 386SX/25C
Wyse Decision 486/25
Wyse Decision 486/33
Wyse Decision 486/33E
Wyse Decision 486/33T
Wyse Decision 486DX2/50
Wyse Decision 486se-25SX
Wyse Decision 486se-33DX
Wyse Decision 486se-33SX
Wyse Decision 486se-50DX2
Wyse Decision 486se-66DX2
Wyse Decision 486si-25SX

Wyse Decision 486si-33DX
Wyse Decision 486si-33SX
Wyse Decision 486si-50DX2
Wyse Decision 486si-66DX2
Wyse Series 6000i Model 640
Wyse Series 6000i Model 645
Wyse Series 7000i Model 740
Xycom XVME-674
Zenith Data Systems Z-386/33E
Zenith Data Systems Z-425/SX
Zenith Data Systems Z-425S+
Zenith Data Systems Z-433/DX
Zenith Data Systems Z-450X+
Zenith Data Systems Z-486/33ET
Zenith Data Systems Z-486SX/20
Zenith Data Systems Z-486SX/25E
Zenith Data Systems Z-Note 425Ln
Zenith Data Systems Z-SERVER 425SE
Zenith Data Systems Z-SERVER 433DE
Zenith Data Systems Z-SERVER 450DE
Zenith Data Systems Z-SERVER EX 433DE Model 1000A (incl. Model 2000A)
Zenith Data Systems Z-SERVER EX 433DE Model 500 (incl. Model 1000)
Zenith Data Systems Z-SERVER EX 450DE Model 1000A (incl. Model 2000A)
Zenith Data Systems Z-SERVER EX 450DE Model 500 (incl. Model 1000)
Zenith Data Systems Z-SERVER EX P60E Model 1000A (incl. Model 2000A)
Zenith Data Systems Z-SERVER EX P60E Model 500 (incl. Model 1000)
Zenith Data Systems Z-SERVER LT 433DE Model 245 (incl. Model 1000)
Zenith Data Systems Z-SERVER LT 466XE Model 500 (incl. Model 1000)
Zenith Data Systems Z-SERVER LT P60E Model 1000A (incl. Model 2000A)
Zenith Data Systems Z-SERVER LT P60E Model 500 (incl. Model 1000)
Zenith Data Systems Z-Station 420SEh
Zenith Data Systems Z-Station 420SEn
Zenith Data Systems Z-Station 420Sh
Zenith Data Systems Z-Station 420Sn
Zenith Data Systems Z-Station 425Sh
Zenith Data Systems Z-Station 425Sn
Zenith Data Systems Z-Station 433DEh
Zenith Data Systems Z-Station 433DEn
Zenith Data Systems Z-Station 433Dh
Zenith Data Systems Z-Station 433SEh
Zenith Data Systems Z-Station 450XEh
Zenith Data Systems Z-Station 450Xh
Zenith Data Systems Z-Station 450Xn
Zenith/INTEQ TEMPEST 486 WORKSTATION / SERVER
Zenon Z-Dream IIII EISA/VESA 486DX/66
ZEOS 486DX/33CDT
ZEOS 486DX/33EISA
ZEOS 486DX/33ISA
ZEOS 486DX/50
ZEOS 486SX/20DT
ZEOS Freestyle 386SL 25
ZEOS Upgradable 486 DX/33 Cache
ZEOS Upgradable 486 DX2/66 Cache
ZEOS Upgradable 486 SX/33 Cache
ZEOS Upgradable Local Bus DX2/66

x86 Architecture Multiprocessor Computers

The following x86 architecture multiprocessor systems have been tested.

ACER AcerFrame 3000MP 33 (Model 3255) [3]
ACER AcerFrame 3000MP 50 (Model 3257) [3]
ALR POWERPRO DMP 4/66D
ALR PROVEISA DMP 4/33
ALR PROVEISA DMP 4/50D
ALR PROVEISA DMP 4/66D
AST Manhattan SMP
AST Manhattan SMP (Pentium)
COMPAQ ProLiant 2000 Model 5/66
COMPAQ ProLiant 4000 Model 5/66
COMPAQ Systempro Dual 386/25
COMPAQ Systempro Dual 486/33
COMPAQ Systempro Dual 486/50 XL
COMPAQ Systempro Dual 486DX2/66
Corollary Extended C-bus 486DX2/66
ICL System Platform MX486/50
NCR System 3000 Model 3360
NCR System 3000 Model 3450 [8]
NCR System 3000 Model 3455
NCR System 3000 Model 3550 [8,6]
Olivetti LSX5030
Olivetti LSX5040
Sequent WinServer 1000 [6]
Sequent WinServer 1500 [6]
Sequent WinServer 3000 [6]
Sequent WinServer 5000 [6]
Siemens-Nixdorf PCE-4T/33
Siemens-Nixdorf PCE-4T/50(Dual)
Wyse Series 7000i Model 740MP/33
Wyse Series 7000i model 740MP/66
Wyse Series 7000i Model 760MP

MIPS® ARC/R4000™ Series Computers

The following ARC R4000 systems have been tested.

ACER ARC1
AcerFormula
Carerra R4000
DESKStation Evolution RISC PC
MIPS ArcSystem Magnum PC-50
MIPS ArcSystem Magnum SC-50
MIPS Millenium PC-50
MIPS Millenium SC-50
NeTPower RISCpc Series 100
Olivetti M700-10
Olivetti PWS4000
Shuttle RiscPC

Digital Alpha AXP™ Systems

The Following Digital Alpha AXP systems have been tested.

Digital Equipment Corporation DECpc AXP 150
Digital Equipment Corporation DECpc AXP 150 Universal Platform
Digital Equipment Corporation DECpc 2000-500 AXP Server
Digital Equipment Corporation DEC 2000-300 AXP Server

SCSI Host Adapters

The following SCSI adapters have been tested on the indicated platforms with the following scanner, CD-ROM, tape, fixed and removable drives (except as noted): ArchiveST 4000 DAT, CD-Technologies CD Porta-DriveTM T-3401, Hewlett-Packard ScanJet® IIc, NEC Intersect CDR-74, Micropolis 1924, Peripheral Land Infinity 88, Procom Technology MCD-DS, Syquest® 5110, Toshiba TXM-3401E, WangTek 5150es.

x86	MIPS	ALPHA	SCSI Host Adapter
X			AdaptecTM AHA-1510
X	X	X	Adaptec AHA-1520
X	X	X	Adaptec AHA-1522
X	X	X10	Adaptec AHA-1540B 9
X		X10	Adaptec AHA-1540C 11
X	X	X10	Adaptec AHA-1542B 9
X		X10	Adaptec AHA-1542C 11
X			Adaptec AHA-1640
X			Adaptec AHA-1740 12
X			Adaptec AHA-1742 12
X	X	X	Adaptec AHA-1740A 13
X	X	X	Adaptec AHA-1742A 13
X	X	X	Adaptec AHA-2740
X	X	X	Adaptec AHA-2742
X14			Adaptec AIC-6260
X15			Adaptec AIC-7770
X			Always IN-2000
X			BusLogic BT-445S
X	X	X	BusLogic BT-542B
X		X	BusLogic BT-545S
X			BusLogic BT-640A
X			BusLogic BT-646S 16
X			BusLogic BT-742A
X	X	X	BusLogic BT-747S
X			COMPAQ Fast SCSI-2 Controller
X			COMPAQ 6260 SCSI-2 Controller
X			DPT PM2011b
X			DPT PM2011b (with cache) 17
X		X	DPT PM2012b
X		X	DPT PM2012b (with cache) 17
X	X	X10	Data Technology Corp. 3290
X			Data Technology Corp. 3292 18
X			Future Domain MCS-600
X			Future Domain MCS-700
X			Future Domain TMC-845 19,20
X	X	X	Future Domain TMC-850 19,20
X	X	X	Future Domain TMC-850M(ER) 20
X			Future Domain TMC-860 19,20
X			Future Domain TMC-860M 20
X			Future Domain TMC-885 19,20
X			Future Domain TMC-885M 20
X	X	X	Future Domain TMC-1650
X	X	X	Future Domain TMC-1660
X	X	X	Future Domain TMC-1670
X	X	X	Future Domain TMC-1680
X	X	X	Future Domain TMC-7000EX
X21			IBM PS/2 Microchannel SCSI Host Adapter
X21			IBM PS/2 Microchannel SCSI Host Adapter (with cache)
X			Maynard 16-bit SCSI Adapter 16,22
X			MediaVision Pro Audio Spectrum-16
X			NCR 53C700 SCSI Adapter
X			NCR 53C710 SCSI Adapter
X23			NCR 53C90 SCSI Controller
X24	X		NCR 53C94 SCSI Controller
X			Olivetti ESC-1
X			Olivetti ESC-2
X			Trantor T-128 19,20,25
X			Trantor T-228 19,20,22,26
X			Trantor T-130B 19,25
X			Trantor T-348 MiniSCSI Plus 1
X	X	X	UltraStor 14f 27
X	X	X	UltraStor 24f 28

X	X	UltraStor 24fa
X		UltraStor 34f

SCSI CD-ROM Drives

The following SCSI CD-ROM drives have been tested with the following adapters: Adaptec AHA-1510, AHA-1542C, AHA-1640 and AHA-1742A; Future Domain TMC-1670, TMC-850M and MCS-600; IBM PS/2 Microchannel SCSI Host Adapter (with cache); Ultrastor 24fa. Drives have been tested for data access as well as for the audio capabilities indicated.

Standard (CD) Audio	MultiMedia Audio	SCSI CD-ROM Drive
X	X	CD-Technology CD Porta-Drive T-3301
X	X	CD-Technology CD Porta-Drive T-3401
		Chinon 431
X	X	Chinon 535
X	X	COMPAQ DualSpeed CD-ROM Drive
X	X	DEC RRD42
X		Denon® DRD 253 [29]
X		Hitachi® CDR-1750S
X	X	Hitachi CDR-3750S
		IBM 3510
X	X	IBM Enhanced Internal CDROM II Drive 32G2958
X	X	IBM Enhanced External CDROM II Drive 3510005
X	X	IBM PS/2 CDROM II Drive
X	X	Laser Magnetic Storage CM-215 [30]
X	X	NEC Intersect CDR-73M [31]
X	X	NEC Intersect CDR-83M
X	X	NEC Intersect CDR-74
X	X	NEC Intersect CDR-84
X	X	NEC Intersect CDR-74-1
X	X	NEC Intersect CDR-84-1
		Panasonic® CR-501
X	X	Pioneer® DRM-600 [32]
X	X	Procom Technology MCD-DS
X	X	Sony® CDU-541
X	X	Sony CDU-561
X	X	Sony CDU-6211
X	X	Sony CDU-7211
X	X	Sony CDU-7811
		Texel DM-5021
X	X	Texel DM-5024 [33]
		Toshiba TXM-3201
X	X	Toshiba TXM-3301E
X	X	Toshiba XM-3301B
X	X	Toshiba TXM-3401E
X	X	Toshiba XM-3401B

Other CD-ROM Drives

The following CD-ROM drives with proprietary interfaces have been tested. All drives listed support Standard (CD) Audio and MultiMedia Audio. All drives listed require drivers supplied in the driver library (\DRVLIB) on the Windows NT CD-ROM.

x86	MIPS	ALPHA	CD-ROM Drive
X			Creative Labs Sound Blaster Pro™ 34
X			Panasonic CR-521
X			Panasonic CR-523
X			Panasonic CR-563
X	X		Sony CDU 31a

SCSI Tape Drives

The following SCSI tape drives have been tested with the following adapters using the Windows NT Backup program: Adaptec AHA-1510, AHA-1542C, AHA-1640 and AHA-1742A; Future Domain TMC-1670, TMC-850M and MCS-600; IBM PS/2 Microchannel SCSI Host Adapter (with cache); Ultrastor 24fa. Drives are listed under their appropriate Tape entry in SETUP.

4 Millimeter DAT

ArchiveST 2000DAT (4520NT)
ArchiveST 2000DAT (EAX4350) 35
ArchiveST 4000DAT (4324NP)
ArchiveST 4000DAT (4352XP)
DEC TLZ06 36
Exabyte 4200 37
Exabyte 4200c 38
Hewlett-Packard JetStor 2000
Hewlett-Packard JetStor 5000
Hewlett-Packard 35470a
Hewlett-Packard 35480a
Hewlett-Packard C1503a
Hewlett-Packard C1504a
Hewlett-Packard C2224c
Hewlett-Packard C2225b
IBM 2.0Gb 4mm Tape Drive Option (part number 8191192) 1
Maynard Maynstream 1300DAT 35
Maynard 2000 DAT 35
Tecmar® DataVault 2000
Tecmar DataVault 4000
WangDAT Model 1300XL
WangDAT Model 3100
WangDAT Model 3200

Archive® 2150S, 2525S, 2750

Archive 2150/2250 39
Archive 2525
Archive 2750
Archive 2800

Exabyte 8200 Series (SCSI-1)

Exabyte EXB-8200 40
Exabyte EXB-8200ST 40
Exabyte EXB-8205 37
Exabyte EXB-8205ST 37

Exabyte 8500 Series (SCSI-2)

Exabyte EXB-8500
Exabyte EXB-8500ST
Exabyte EXB-8500c 40
Exabyte EXB-8500cST 40
Exabyte EXB-8505
Exabyte EXB-8505ST
IBM 5.0Gb 8mm Tape Drive Option
IBM 3445 Model 001 5.0Gb 8mm Tape Drive

Tandberg 3660, 3820, 4120, 4220

DEC TZK10
DEC TZK12
IBM 3450 1.2Gb Tape Drive Model 001
Tandberg 3660
Tandberg 3820
Tandberg 4120
Tandberg 4220

Wangtek 525, 250

Tecmar QT-525ES
Wangtek 5150ES
Wangtek 5525ES
Wangtek 51000ES

Other Tape Drives

The following tape drives have been tested using the Windows NT Backup program.

QIC-40/QIC-80 Floppy Tape Drive [41]

- Archive 5150Q (SuperHornet)
- Archive 5540
- Archive 5580
- Colorado Memory Systems Jumbo 250
- Iomega Tape 250
- Summit Express SE120
- Summit Express SE250
- WangTek 3040
- WangTek 3080

SCSI Removable Media

The following removable media (cartridge) drives have been tested with the following adapters: Adaptec AHA-1510, AHA-1542C, AHA-1640 and AHA-1742A; Future Domain TMC-1670, TMC-850M and MCS-600; IBM PS/2 Microchannel SCSI Host Adapter (with cache); Ultrastor 24fa. Media must be mounted when installing Windows NT.

Hewlett-Packard Series 6300 650/C 42
Hewlett-Packard 1300T Rewritable Optical drive
IBM 0632 Model C2* 42
Insite 21mb Floptical
Iomega 21mb Floptical
Iomega Bernoulli Transportable 90 Pro
Iomega Bernoulli Transportable 150
Maxtor TMT 2m MO drive
Peripheral Land Infinity 40 Turbo
Peripheral Land Infinity 88
Pinacle Micro PMO-650 37
Quantum Passport XL 85
Quantum Passport XL 127
Sony SMO-S511A-11 42
Sony RMO-S350
Syquest 555 44mb cartridge
Syquest 5110 88mb cartridge

SCSI Scanners

The following scanners have been tested with the following adapters: Adaptec AHA-1510, AHA-1542c, AHA-1640 and AHA-1742A; Future Domain TMC-1670, TMC-850M and MCS-600; IBM PS/2 Microchannel SCSI Host Adapter (with cache); Ultrastor 24fa.

HP® ScanJet IIc 43
HP ScanJet IIp 43

Disk Controllers

The following disk controllers have been tested.

COMPAQ Intelligent Drive Array Controller
COMPAQ Intelligent Drive Array Controller-2
COMPAQ SMART Array Controller
DELL Drive Array Controller
DELL SCSI Array Controller 3
Olivetti EFP-2 44
UltraStor 124f EISA Disk Array Controller
Western Digital™ 1003 (ESDI, IDE)

Hard Drives

The following hard drives have been tested. SCSI hard drives have been tested with the following SCSI adapters: Adaptec AHA-1510, AHA-1542C, AHA-1640 and AHA-1742A; Future Domain TMC-1670, TMC-850M and MCS-600; IBM PS/2 Microchannel SCSI Host Adapter (with cache); Ultrastor 24fa.

SCSI Hard Drives

Maxtor 7120SR
Maxtor 7213SR
Maxtor 7245SR
Maxtor 7345SR
Maxtor LXT340SY
Maxtor MXT1240S
Micropolis 1924
Micropolis Raidion LT 2100 [45,46]

IDE Hard Drives

Maxtor LXT340A
Maxtor 7345AT
Maxtor 7245AT
Maxtor 7213AT
Maxtor 7131AT
Maxtor MXT-540AL
Maxtor 7120AT

Storage Cabinets

The following peripheral storage cabinets have been tested.

Hewlett-Packard Storage System with HP EISA HBA [47,48]
Hewlett-Packard Storage System with HP MCA HBA [47,48]
StorageWorks Deskside Expansion Unit [49]
StorageWorks Desktop Expansion Unit [49]

Video Display Support

The following display adapters have been tested. Most common scan frequencies are supported. Your video monitor should support the same resolutions and scan frequencies as your display adapter. Please refer to README.WRI for more information on display support.

		640x480		800x600		1024x768		
Display Adapter	**Driver**	**x16**	**x256**	**x16**	**x256**	**x16**	**x256**	**Other Modes**
ACTIX GRAPHICS ENGINE	S3		NI		NI		NI	
ACTIX GRAPHICS ENGINE 32 PLUS	S3		NI		NI		NI	
ATI 8514 ULTRA	ATI		NI		NI		NI	
ATI GRAPHICS ULTRA PRO	ATI		NI		NI		NI	2,3,4,5,6,7,11
ATI GRAPHICS ULTRA PRO VLB	ATI		NI		NI		NI	2,3,4,5,6,7,11
ATI GRAPHICS ULTRA PLUS	ATI		NI		NI		NI	2,3,4,5,6,7,11
ATI GRAPHICS ULTRA	ATI		NI		NI		NI	
ATI GRAPHICS VANTAGE	ATI		NI		NI		NI	
COMPAQ AVGA	AVGA1	NI	NI	NI				
COMPAQ QVISION 1024/I	QV		NI		NI		NI	
COMPAQ QVISION 1024/E 50	QV		NI		NI		NI	
COMPAQ QVISION 1024/I (ENHANCED)	QV		NI		NI		NI	
COMPAQ QVISION 1024/E (ENHANCED)	QV		NI		NI		NI	
COMPAQ QVISION 1280/I	QV		NI		NI		NI	11
COMPAQ QVISION 1280/E	QV		NI		NI		NI	11
DELL DGX	DGX		NI		NI		NI	2,5,7,9,10,11
DIAMOND SPEEDSTAR	ET4000	NI	NI	NI	NI	B	B	
DIAMOND SPEEDSTAR 24X	WD	NI	NI	NI	NI	B	B	
DIAMOND SPEEDSTAR PRO	CIRRUS	NI	NI	NI	NI	NI	NI	
DIAMOND SPEEDSTAR PRO VLB	CIRRUS	NI	NI	NI	NI	NI	NI	
DIAMOND STEALTH 24	S3		NI		NI		NI	
DIAMOND STEALTH 24 VLB	S3		NI		NI		NI	
DIAMOND STEALTH PRO	S3		NI		NI		NI	
DIAMOND STEALTH PRO VLB	S3		NI		NI		NI	
DIAMOND STEALTH VRAM	S3		NI		NI		NI	
ELSA WINNER 1000	S3		NI		NI		NI	
GENOA VLB	CIRRUS	NI	NI	NI	NI	NI	NI	
IBM XGA	XGA®		NI				I	
IBM XGA-2	XGA		NI		NI		B	1,8
MEDIAVISION THUNDER & LIGHTNING	CIRRUS	NI	NI	NI	NI	NI	NI	
METHEUS PREMIER 928	S3		NI		NI		NI	
METHEUS PREMIER VL-BUS 928	S3		NI		NI		NI	
MICRONICS VL-BUS	S3		NI		NI		NI	
NCR 77C22	NCR77C22	NI	NI	NI	NI	NI		
NCR 77C22E	NCR77C22	NI	NI	NI	NI	NI	NI	
NUMBER 9 GXE 50	S3		NI		NI		NI	11
ORCHID FAHRENHEIT 1280	S3		NI		NI		NI	
ORCHID FAHRENHEIT VA	S3		NI		NI		NI	
ORCHID FAHRENHEIT VA/VLB	S3		NI		NI		NI	
ORCHID PRODESIGNER 2	ET4000	NI	NI	NI	NI	B	B	
ORCHID PRODESIGNER IIS	ET4000	NI	NI	NI	NI	B	B	
PARADISE WINDOWS GRAPHICS ACCELERATOR	WD	NI	NI	NI	NI	B	B	
STB POWERGRAPH X-24	S3		NI		NI		NI	
STB POWERGRAPH VL-24	S3		NI		NI		NI	
STB WIND/X HC	S3		NI		NI		NI	
TRIDENT 8900C	TRIDENT	NI	NI	NI	NI	B	B	
TRIDENT 9000	TRIDENT	NI		NI		B		
VIDEO SEVEN™ VRAM	VIDEO7	NI	NI	NI		NI		
VIDEO SEVEN VRAM II	VIDEO7	NI	NI	NI	NI	NI	NI	

Common Modes in Table Above

NI	Non-Interlaced
I	Interlaced
B	Both Interlaced and Non-Interlaced

Other Resolutions

1	640x400x256	5	800x60065k	9	1152x900x256
2	640x480x65k	6	800x600x16m	10	1152x900x65k
3	640x480x16m	7	1024x768x65k	11	1280x1024x256
4	640x480, true color	8	1040x768x256		

Display adapters not listed above are expected to work if they use the following supported chip sets. Install first as Standard VGA, then select the corresponding driver from the Setup application in Program Manager.

Chip Set	Driver
ATI Mach 8	ATI
ATI Mach 32	ATI
Compaq QVision	QV
ET4000	ET4000
S3 801, 805, 911, 911A, 924, 928	S3
WD90C30	Western Digital/Paradise
WD90C31	Western Digital/Paradise
VGA	VGA

The following table shows the maximum display and color resolutions available with each video driver using different amounts of video RAM. Most display adapters can use the standard VGA driver for 16-color modes.

		Colors				
Drivers	**Video RAM**	**16**	**256**	**65k**	**16m**	**True Color**
ATI	1Mb		1024x768	640x480	640x480	
	2Mb		1280x1024	1024x768	800x600	640x480
Cirrus	1Mb	1024x768	1024x768			
AVGA	512Kb	800x600	640x480			
QV	512Kb		640x480			
	1Mb		1024x768			
	2Mb		1280x1024			
DGX	2Mb		1280x1024	1152x900		
ET4000	512Kb	1024x768	640x480			
	1Mb	1024x768	1024x768			
NCR 77C22	1Mb	1024x768	1024x768			
S3	1Mb		1024x768			
	3Mb		1280x1024			
Trident	512Kb	1024x768				
	1Mb	1024x768	1024x768			
Video7	512Kb	1024x768	640x480			
	1Mb	1024x768	1024x768			
VGA	256Kb	640x480				
	512Kb	800x600				
WD	1Mb	1024x768	1024x768			
XGA	1Mb		1040x768			

Network Adapters

The following network adapters have been tested on the indicated platforms.

x86	MIPS	ALPHA	Network Adapter
X	X	X	3Com® 3C503 EtherLink II® (Coax & TP)
X	X	X	3Com 3C503/16 EtherLink® II/16 (Coax & TP)
X	X		3Com 3C507 EtherLink 16 (Coax & TP)
X	X	X	3Com 3C509 EtherLink III Parallel Tasking Adapter - ISA (Coax, TP and Combo)
X			3Com 3C523 EtherLink/MC (Coax & TP)
X			3Com 3C527 EtherLink/MC 32 Bus Mastering Adapter 2
X			3Com 3C529 EtherLink III Parallel Tasking Adapter - MCA (Coax & TP)
X	X	X	3Com 3C579 EtherLink III Parallel Tasking Adapter - EISA (Coax & TP)
X			3Com 3C770 FDDILink-F for Optical, UTP & STP 2,51
X			Advanced Micro Devices Am1500T Ethernet Adapter
X			Advanced Micro Devices Am2100 Ethernet Adapter
X			Advanced Micro Devices PCnet
X			Advanced Micro Devices PCnet-ISA Single Chip Ethernet Controller
X	X	X	COMPAQ 32-Bit Dualspeed Token Ring Controller
X		X	COMPAQ 32-Bit Netflex Controller
X		X	COMPAQ 32-Bit Netflex Controller with Token Ring Module
X			COMPAQ Ethernet 16TP Controller
X			COPS LTI ISA
X			Crescendo C321M-PC EISA FDDI ADAPTER/PC 2,51
X	X	X	DEC DE100 EtherWORKS LC
X	X	X	DEC DE101 EtherWORKS LC/TP
X	X	X	DEC DE200 EtherWORKS Turbo
X	X	X	DEC DE201 EtherWORKS Turbo/TP
X	X	X	DEC DE202 EtherWORKS Turbo TP/BNC
X	X	X	DEC DE422 EtherWORKS EISA TP/BNC
X			Hewlett-Packard 27246A MC LAN Adapter/16 TP 2
X			Hewlett-Packard 27245A PC LAN Adapter/8 TP 2
X			Hewlett-Packard 27250A PC LAN Adapter/8 TL 2
X			Hewlett-Packard 27247A PC LAN Adapter/16 TP 2
X			Hewlett-Packard 27247B PC LAN Adapter/16 TP Plus 2
X			Hewlett-Packard 27252A PC LAN Adapter/16 TL Plus 2
X	X	X	IBM Token Ring Adapter 16/4
X			IBM Token Ring Adapter 16/4 /A
X			Intel 82595 Ethernet Adapter 2
X			Intel EtherExpress™ 16 MCA PCLA8110
X			Intel EtherExpress 16 MCA TP PCLA8120
X	X	X	Intel EtherExpress 16 PCLA8110
X	X	X	Intel EtherExpress 16C PCLA8100
X	X	X	Intel EtherExpress 16TP PCLA8120
X	X	X	Intel EtherExpress FlashC PCLA8105
X			Intel TokenExpress™ ISA/16S 2
X			Intel TokenExpress MCA 16/4 2
X			Intel TokenExpress EISA 16/4 2
X			Intel TokenExpress EISA/32 2
X			Madge Smart 16/4 AT Ringnode 2
X			Madge Smart 16/4 EISA Ringnode 2
X			Madge Smart 16/4 MC Ringnode 2
X			Madge Smart 16/4 MC32 Ringnode 2
	X		National Semiconductor DP83932 (SONIC) Motherboard Ethernet Controller on MIPS ARC/R4000 systems
X			NCR WaveLAN/AT 2
X			NCR WaveLAN/MC 2
X	X	X	Network Peripherals NP-EISA/S FDDI
X			Network Peripherals NP-MCA/S FDDI
X			Novell®/Eagle Technology NE1000
X	X	X	Novell/Eagle Technology NE2000
X	X	X	Novell/Eagle Technology NE3200
X	X	X	Proteon ProNET-4/16 p1390 ISA Adapter
X			Olicom Token-Ring,PowerMAC MCA WS,OC-3129 2
X			Olicom Token-Ring,PowerMAC EISA WS,OC-3133 2
X			Olicom Token-Ring,PowerMAC ISA WS,OC-3117 2

x86	MIPS	ALPHA	Network Adapter
X			Olicom Token-Ring,PowerMAC EISA SRV,OC-3135 2
X			Proteon ProNET-4/16 p1390 2
X			Proteon ProNET-4/16 p1392 2

X			Proteon ProNET-4/16 p1392plus [2]
X			Proteon ProNET-4/16 p1892 [2]
X[2]		X	Proteon ProNET-4/16 p1990 EISA Adapter
X			Proteon ProNET-4/16 p1990plus [2]
X	X	X	Standard Microsystems 8003EP EtherCard™ PLUS
X	X	X	Standard Microsystems 8013EBT EtherCard PLUS16
X	X	X	Standard Microsystems 8013EP EtherCard PLUS Elite16
X			Standard Microsystems 8013EP/A EtherCard PLUS Elite/A
X	X	X	Standard Microsystems 8013EPC EtherCard PLUS Elite16
X	X	X	Standard Microsystems 8013EW EtherCard PLUS EliteCombo
X	X	X	Standard Microsystems 8013EWC EtherCard PLUS EliteCombo
X	X	X	Standard Microsystems 8013W EtherCard PLUS Elite16T
X	X	X	Standard Microsystems 8013WB EtherCard PLUS
X	X	X	Standard Microsystems 8013WC EtherCard PLUS Elite16T
X			Standard Microsystems 8013WP/A EtherCard PLUS Elite10T/A
X			Ungermann-Bass® NIUpc
X	X		Ungermann-Bass NIUpc/EOTP
X			Ungermann-Bass NIUps/EOTP

Multimedia Audio Adapters

The following multimedia audio adapters have been tested.

x86	MIPS	ALPHA	Multimedia Audio Adapter
X			COMPAQ Business Audio
X	X	X	Creative Labs Sound Blaster™ 1.x
X	X	X	Creative Labs Sound Blaster Pro [52]
X	X	X	Media Vision™ Pro AudioSpectrum-16 [53]
X	X	X	Media Vision Pro AudioStudio [53]
X	X	X	Media Vision Thunder Board [52]
X	X	X	Microsoft Windows™ Sound System
	X		Built-in audio adapter on MIPS ARC/R4000 systems

Modems

The following modems have been tested for use with Remote Access Services.

ATI 2400 etc/e
ATI 9600 etc/e
AT&T® 2224 CEO
AT&T Comsphere 3810
AT&T Comsphere 3811
AT&T Comsphere 3820
AT&T Comsphere 3830
AT&T Dataport
AT&T 4024
Bocamodem M1440
Cardinal 2400e
Cardinal 9600
Cardinal 14400
Cardinal 14400 Internal
Codex 2264
Codex 3220
Codex 3260
Codex 3261
Codex 3262
Codex 3263
Codex 3265
Codex 3260 Fast
Codex 3261 Fast
Codex 3262 Fast
Codex 3263 Fast
Codex 3265 Fast
Codex 3220 Plus
CXR Telcom 1445
DataRace RediModem V.32bis [54]
Datatrek 2424AMH
Datatrek Elite 624D [55]
Datatrek V.32 [56]
DEC PCXBF-AA 2400/9600FAX, V.42+BIS (Data only)
DEC PCXCF-AA 2400/9600FAX, V.42+BIS (Data only)
DEC PCXDF-AA 2400/9600FAX, V.42+BIS (Data only)
Digicom Scout
Digicom Scout Plus
DSI 9624LE Plus
DSI 9624E
ETech UFOMATE P1496MX
Evercom 24
Evercom 24E
Evercom 24E+
Gateway 2000 Telepath Internal
GVC SM2400
GVC SM96
GVC FM14400
Hayes® Compatible 1200
Hayes Compatible 2400
Hayes Compatible 9600
Hayes Pocket Modem® 2400
Hayes Smartmodem™ 2400
Hayes Smartmodem 9600
Hayes Optima 9600
Hayes Optima 14400
Hayes Ultra 9600
Hayes Ultra 14400
Hayes V Series 9600
Intel SatisFaxtion® 100
Intel SatisFaxtion 400e
Intel 9600EX
Intel 14400EX
Macronix Maxlite Fax 9696
Macronix VOMAX 2000
Megahertz P2144 Pocket Faxmodem
Megahertz T3144 for Toshiba
Megahertz Z3144 for Zenith

Megahertz C5144 for COMPAQ LTE
MicroCom® QX 4232bis 55
MicroCom QX 4232HS
MicroGate MG96 54
MicroGate MG144 54
MicroPorte 1042
MultiTech MultiModem 224 57
MultiTech MultiModem MT932
NEC 9635E Plus
Octocom 8324 54
Octocom 8396
PDI-1000 56
Practical Peripherals 2400 Pocket
Practical Peripherals 2400SA 56
Practical Peripherals 2400MNP 55
Practical Peripherals 9600SA
Practical Peripherals 14400SA
Racal-RMD 2412
Racal-RMD 2412/2 58
Racal-RMD 3221
Racal-RMD 3222
Racal-RMD 3226
Racal-RMD 3223
Racal-RMD 9632PA
Racal-RMD 9642PA
SupraModem 2400
Supra Fax Modem 9624 Internal
Supra Fax Modem V32
Supra Fax Modem V32bis
Supra Fax Modem Plus
Telebit® QBlazer
Telebit T1000
Telebit T1500 56
Telebit T1600 55
Telebit T2000
Telebit T2500
Telebit T3000
Telebit TrailBlazer® Plus
Telebit WorldBlazer
Telebit WorldBlazer-Rackmount
UDS Motorola® V.3225 55
UDS Motorola V.3227 59
UDS Motorola V.3229
UDS Motorola FasTalk V.32/42b 59
US Robotics Courier Dual
US Robotics Courier HST
US Robotics Courier V.32bis
US Robotics Sportster 2400
US Robotics Sportster 9600
US Robotics Sportster 14400
Ven-Tel 9600 Plus II 60
Ven-Tel Pocket 24 V.42bis FAX
Ven-Tel 14400 Fax
Ven-Tel 14400 Fax Internal
Western Datacom Worldcom V32bis 56
Zoom AFX
Zoom FX 9624V
Zoom VFX V.32bis
ZyXel U-1496
ZyXel U-1496E

Hardware Security Hosts

The following hardware security hosts have been tested for use with Remote Access Services.

Digital Pathways Defender 1000D
Racal Gaurdata GSM
Security Dynamics ACM400

ISDN Adapters

The following ISDN adapters have been tested for use with Remote Access Services.

DigiBoard PCIMAC ISA Adapter
DigiBoard PCIMAC/4 Adapter

Multi-port Serial Adapters

The following multi-port serial adapters have been tested for use with Remote Access Services.

Comtrol Hostess 550 61
DigiBoard 2Port
DigiBoard 4Port
DigiBoard 8Port
DigiBoard CX Adapter
DigiBoard DigiCHANNEL PC/X Host Adapter for ISA bus 61
DigiBoard PC/4e Adapter
DigiBoard PC/8e Adapter
DigiBoard PC/8i Adapter
DigiBoard PC/Xem Adapter
Stargate Technologies Plus 8 61

Uninterruptible Power Supplies

The following uninterruptible power supplies have been tested.

American Power Conversion Back-UPS
American Power Conversion Smart-UPS
Para Systems MinuteMan
Tripp Lite BC800LAN [62]
Unison (Tripp Lite) UNIPower PS

Keyboards

Any keyboard that is 100% compatible with those listed below.

101/102-key

IBM AT (84-key) [43]

Pointing Devices

The following pointing devices have been tested. The Alpha platform supports mouseport-based pointing devices. The MIPS platform supports mouseport and serial pointing devices.

A4 Tech Serial Mouse
Acer M-SG14
AT&T 320 Mouse CA-93-6MD
CompuAdd Serial Mouse
Dexxa MF21-9F
Digital Equipment PCXAS-AA
Hewlett-Packard C1413A
Honeywell 2HW53-3E
IBM 33G3835
IBM 33G5430
ICL M-SF14-6MD
Kensington Expert Mouse Ver. 2.0
Kensington Expert Mouse Ver. 4.0
Key Tronic Trak101
Logitech™ CA-93-6MD
Logitech M-MD14-2
Logitech M-MD14-9F
Logitech M-MD15L
Logitech M-SF14-6MD
Logitech M-SF15-6MD
Logitech Mouseman, Bus
Logitech Mouseman, Cordless
Logitech Mouseman, Serial
Logitech PA-82-9MI
Logitech Series 9 CC-93-9F
Logitech Trackman Mouse
Logitech Trackman Portable Mouse
Logitech Trackman Stationary Mouse
Microsoft Bus Mouse (Original - Green Buttons)
Microsoft Mouse, BallPoint®
Microsoft Mouse, Inport
Microsoft Mouse, PS/2 Compatible
Microsoft Mouse, Serial
Microsoft Mouse, Serial / PS/2
Microsoft Mouse 2.0, BallPoint
Microsoft Mouse 2.0, Bus
Microsoft Mouse 2.0, MousePort
Microsoft Mouse 2.0, Serial
Microsoft Mouse 2.0, Serial-MousePort
MotorMouse
Olivetti M-SE9-6MD
Sejin Electronics SWB-200
Ultra Mouse 260

Printers

*Drivers are included for the following printers. Tested models are listed with *.*

Adobe® LaserJet® II Cartridge v52.3
Agfa Compugraphic 400PS
Agfa Compugraphic Genics
Agfa Matrix® ChromaScript v51.8
Agfa TabScript C500 PostScript® Printer v50.3
Agfa-Compugraphic 9400P v49.3
Apple® LaserWriter® II NT v47.0
*Apple LaserWriter II NTX v47.0
Apple LaserWriter II NTX v51.8
Apple LaserWriter II NTX-J v50.5
Apple LaserWriter IIf v2010.113
Apple LaserWriter IIg v2010.113
Apple LaserWriter Plus v38.0
Apple LaserWriter Plus v42.2
Apple LaserWriter v23.0
Apple Personal LaserWriter NTR v2010.129
Apricot Laser
APS-PS PIP with APS-6-108 v49.3 or 52.2
APS-PS PIP with APS-6-80 v49.3 or 52.2
APS-PS PIP with LZR 1200 v49.3 or 52.2
APS-PS PIP with LZR 2600 v49.3 or 52.2
AST TurboLaser-PS v47.0
AT&T 470/475
AT&T 473/478
Brother® HJ-100
Brother HJ-100i
Brother HJ-770
Brother HL-10DV
Brother HL-10V
*Brother HL-4
Brother HL-4V
Brother HL-4Ve
*Brother HL-8
*Brother HL-8D
*Brother HL-8e
Brother HL-8V
Brother M-1309
Brother M-1324
Brother M-1809
Brother M-1818
Brother M-1824L
Brother M-1909
Brother M-1918
Brother M-1924L
*Bull Compuprint PageMaster 1025
Bull Compuprint PageMaster 413
Bull Compuprint PM 201
Canon® Bubble-Jet BJ-10e
Canon Bubble-Jet BJ-10ex
Canon Bubble-Jet BJ-10sx
Canon Bubble-Jet BJ-130
Canon Bubble-Jet BJ-130e
Canon Bubble-Jet BJ-20
Canon Bubble-Jet BJ-200
*Canon Bubble-Jet BJ-230
Canon Bubble-Jet BJ-300
*Canon Bubble-Jet BJ-330
Canon Bubble-Jet BJC-800
Canon LBP-4 PS-2 v51.4
Canon LBP-8III PS-1 v51.4
Canon LBP-8IIIR PS-1 v51.4
Canon LBP-8IIIT PS-1 v51.4
Canon PS-IPU Color Laser Copier v52.3
Canon PS-IPU Kanji Color Laser Copier v52.3
Citizen 120D
Citizen 120D+
Citizen 124D

Citizen 180D
Citizen 200GX
Citizen 200GX/15
Citizen 224
Citizen GSX 240 Scalable Font
Citizen GSX-130
Citizen GSX-140
Citizen GSX-140+
Citizen GSX-145
Citizen GSX-230
Citizen HSP-500
Citizen HSP-550
Citizen PN48
Citizen Prodot 24
Citizen Prodot 9
Citizen Prodot 9x
Citizen PROjet
Citizen Swift 200
Citizen Swift 24
Citizen Swift 240 Scalable Font
Citizen Swift 24e
Citizen Swift 24x
Citizen Swift 9
Citizen Swift 9x
C-Itoh 8510
Colormate PS v51.9
COMPAQ PAGEMARQ 15 v2012.015
COMPAQ PAGEMARQ 20 v2012.015
Dataproducts LZR 1260 v47.0
Dataproducts LZR 1560 v2010.127
Dataproducts LZR 960 v2010.106
Dataproducts LZR-2665 v46.2
Diconix 150 Plus
Digital Colormate PS v51.9
Digital DEClaser 1100 (LJ)
*Digital DEClaser 1100
Digital DEClaser 1150 v51.4
Digital DEClaser 1152 17 fonts
Digital DEClaser 1152 43 fonts
*Digital DEClaser 2100
Digital DEClaser 2100 plus (LJ)
Digital DEClaser 2150 plus v51.4
Digital DEClaser 2150 v51.4
*Digital DEClaser 2200
Digital DEClaser 2200 plus (LJ)
Digital DEClaser 2250 plus v51.4
Digital DEClaser 2250 v51.4
Digital DEClaser 3200 (LJ)
*Digital DEClaser 3200
Digital DEClaser 3250 v47
Digital DECmultiJET 1000
Digital DECmultiJET 2000
Digital DECwriter 95
Digital LA310
Digital LA324
Digital LA424
Digital LA70
Digital LA75
Digital LA75 Plus
Digital LN03R ScriptPrinter
Digital PrintServer 17 v48.3
Digital PrintServer 20 v48.3
Digital PrintServer 32 v48.3
Digital PrintServer 40 Plus v48.3
Digital turbo PrintServer 20
EPSON ActionLaser II
EPSON AP-3250 Scalable Font
EPSON AP-5000 Scalable Font
EPSON AP-5500 Scalable Font
EPSON Compatible 24 Pin

EPSON Compatible 9 Pin
EPSON DFX-5000
EPSON DLQ-2000
EPSON EPL-4000
EPSON EPL-4300
EPSON EPL-6000
EPSON EPL-7000
EPSON EPL-7500 v52.3
EPSON EPL-8000
EPSON EPL-8100
EPSON EX-1000
EPSON EX-800
EPSON FX-100
EPSON FX-100+
EPSON FX-1000
EPSON FX-105
EPSON FX-1050
EPSON FX-185
EPSON FX-286
EPSON FX-286e
EPSON FX-80
EPSON FX-80+
EPSON FX-800
*EPSON FX-85
EPSON FX-850
EPSON FX-86e
EPSON GQ-3500
EPSON JX-80
EPSON L-1000
EPSON L-750
EPSON LP-3000PS F2 v52.3
EPSON LP-3000PS F5 v52.3
EPSON LQ-100 Scalable Font
EPSON LQ-1000
EPSON LQ-1010
EPSON LQ-1050
EPSON LQ-1060
EPSON LQ-1070 Scalable Font
EPSON LQ-1170 Scalable Font
EPSON LQ-1500
EPSON LQ-200
*EPSON LQ-2500
*EPSON LQ-2550
EPSON LQ-400
EPSON LQ-450
EPSON LQ-500
*EPSON LQ-510
EPSON LQ-550
EPSON LQ-570 Scalable Font
EPSON LQ-800
EPSON LQ-850
EPSON LQ-850+
EPSON LQ-860
EPSON LQ-870 Scalable Font
EPSON LQ-950
EPSON LX-1050
EPSON LX-400
EPSON LX-80
EPSON LX-800
EPSON LX-810
EPSON LX-850
EPSON LX-850+
EPSON LX-86
EPSON MX-100
EPSON MX-80
EPSON MX-80 F/T
EPSON PostScript CARD v52.5
EPSON RX-100
EPSON RX-100+
EPSON RX-80

EPSON RX-80 F/T
EPSON RX-80 F/T+
EPSON SQ-1170 Scalable Font
EPSON SQ-2000
EPSON SQ-2500
EPSON SQ-2550
EPSON SQ-850
EPSON SQ-870 Scalable Font
EPSON T-750
EPSON T-1000
Fujitsu® Breeze 100
Fujitsu Breeze 200
Fujitsu DL 1100
Fujitsu DL 1100 Colour
Fujitsu DL 1150
Fujitsu DL 1200
Fujitsu DL 1250
Fujitsu DL 2400
Fujitsu DL 2600
Fujitsu DL 3300
Fujitsu DL 3350
Fujitsu DL 3400
Fujitsu DL 3450
Fujitsu DL 3600
Fujitsu DL 4400
Fujitsu DL 4600
Fujitsu DL 5600
Fujitsu DL 900
Fujitsu DX 2100
Fujitsu DX 2200
Fujitsu DX 2300
Fujitsu DX 2400
Fujitsu RX7100PS v50.3
GCC BLP Elite v52.3
GCC BLP II v52.3
GCC BLP IIS v52.3
GCC Business LaserPrinter v49.2
GCC Business LaserPrinter v51.4
Generic IBM Graphics 9pin wide
Generic IBM Graphics 9pin
Gestetner GLP800-Scout v52.3
Hermes H 606 PS (13 Fonts)
Hermes H 606 PS (35 fonts)
*Hermes H 606
HP DeskJet®
*HP DeskJet 1200C
*HP DeskJet 500
HP DeskJet 510
HP DeskJet 500C
HP DeskJet 500C (Monochrome)
HP DeskJet 550C
HP DeskJet Plus
HP DeskJet Portable
HP LaserJet
HP LaserJet 2000
*HP LaserJet 4
HP LaserJet 4 PostScript v2011.110
*HP LaserJet 4Si
HP LaserJet 4Si/4Si MX PS
HP LaserJet 500+
HP LaserJet ELI PostScript v52.3
HP LaserJet IID PostScript Cartridge v52.2
*HP LaserJet IID
HP LaserJet III PostScript Cartridge v52.2
HP LaserJet III PostScript Plus v2010.118
*HP LaserJet III
HP LaserJet IIID PostScript Cartridge v52.2
HP LaserJet IIID PostScript Plus v2010.118
*HP LaserJet IIID
*HP LaserJet IIIP PostScript Cartridge v52.2

HP LaserJet IIIP PostScript Plus v2010.118
*HP LaserJet IIIP
*HP LaserJet IIISi PostScript v52.3
*HP LaserJet IIISi
HP LaserJet IIP Plus
*HP LaserJet IIP PostScript Cartridge v52.2
*HP LaserJet IIP
HP LaserJet Plus
*HP LaserJet Series II
*HP PaintJet®
*HP PaintJet XL
HP PaintJet XL 300
HP PaintJet XL 300 v2011.112
HP QuietJet®
HP QuietJet Plus
HP ThinkJet® (2225 C-D)
IBM 4019 LaserPriner PS17
*IBM 4019 LaserPrinter PS39
IBM 4029 LaserPrinter PS17
IBM 4029 LaserPrinter PS39
*IBM 4039 LaserPrinter
IBM 4039 LaserPrinter PS39
IBM 4070 IJ
IBM 4079 Color Jetprinter PS
IBM 4216-020 v47.0
IBM 4216-030 v50.5
IBM ExecJet® 4072
IBM Graphics
IBM Personal Page Printer II-31
IBM Personal Printer II 2380
IBM Personal Printer II 2381
IBM Personal Printer II 2390
IBM Personal Printer II 2391
IBM Portable 5183
*IBM Proprinter®
*IBM Proprinter II
IBM Proprinter III
IBM Proprinter X24
IBM Proprinter X24e
*IBM Proprinter XL
IBM Proprinter XL II
IBM Proprinter XL III
IBM Proprinter XL24
IBM Proprinter XL24e
IBM PS/1 2205
*IBM QuickWriter® 5204
IBM QuietWriter® III
Kodak® EktaPlus 7016
Kyocera® F-1000
Kyocera F-1000A
Kyocera F-1010
Kyocera F-1200S
Kyocera F-1800
Kyocera F-1800A
Kyocera F-2000A
Kyocera F-2010
Kyocera F-2200
Kyocera F-2200S
Kyocera F-3000
Kyocera F-3000A
Kyocera F-3010
Kyocera F-3300
Kyocera F-5000
Kyocera F-800
Kyocera F-800A
Kyocera F-820
Kyocera FS-1500 / FS-1500A
Kyocera FS-3500 / FS-3500A
Kyocera FS-5500 / FS-5500A
Kyocera FS-850 / FS-850A

LaserWriter Personal NT v51.8
Linotronic™ 100 v42.5
Linotronic 200 v47.1
Linotronic 200 v49.3
Linotronic 200/230
Linotronic 300 v47.1
Linotronic 300 v49.3
Linotronic 330 v52.3
Linotronic 330-RIP 30 v52.3
Linotronic 500 v49.3
Linotronic 530 v52.3
Linotronic 530-RIP 30 v52.3
Linotronic 630 v52.3
Mannesmann Tally® MT 130/24
Mannesmann Tally MT 131/24
Mannesmann Tally MT 150/24
Mannesmann Tally MT 151/24
Mannesmann Tally MT 230/24
Mannesmann Tally MT 330
Mannesmann Tally MT 350
Mannesmann Tally MT 360
Mannesmann Tally MT 730/735
Mannesmann Tally MT 82
Mannesmann Tally MT 90
Mannesmann Tally MT 904 Plus
Mannesmann Tally MT 908
Mannesmann Tally MT 91
Mannesmann Tally MT 92
Mannesmann Tally MT 92C
Mannesmann Tally MT 93
Mannesmann Tally MT 94
Mannesmann Tally MT 98/99
Microtek TrueLaser
Minolta SP 3000
Minolta SP 3500
Monotype® ImageMaster 1200 v52.3
Monotype Imagesetter v52.2
NEC Colormate PS/40 v51.9
NEC Colormate PS/80 v51.9
*NEC Jetmate 400
*NEC Jetmate 800
NEC Pinwriter CP6
NEC Pinwriter CP7
NEC Pinwriter P20
NEC Pinwriter P2200
NEC Pinwriter P2plus
NEC Pinwriter P30
NEC Pinwriter P3200
NEC Pinwriter P3300
NEC Pinwriter P5200
*NEC Pinwriter P5300
NEC Pinwriter P5XL
NEC Pinwriter P6
NEC Pinwriter P60
NEC Pinwriter P6200
NEC Pinwriter P6300
NEC Pinwriter P6plus
NEC Pinwriter P7
NEC Pinwriter P70
NEC Pinwriter P7plus
NEC Pinwriter P90
NEC Pinwriter P9300
NEC Pinwriter P9XL
NEC SilentWriter 95 v2010.119
NEC Silentwriter 95 v2011.111
NEC Silentwriter 97 v2011.111
NEC Silentwriter LC 860
NEC Silentwriter LC 860 Plus
NEC Silentwriter LC890 v47.0
NEC Silentwriter LC890XL v50.5

NEC Silentwriter S102
NEC Silentwriter2 290 v52.0
NEC Silentwriter2 90 v52.2
NEC Silentwriter2 990 v52.3
OceColor G5241 PS
OceColor G5242 PostScript Printer v50.3
Oki MICROLINE 801PS+F v52.3
Oki ML 182 Elite (IBM)
Oki ML 192 Elite (IBM)
Oki ML 193 Elite (IBM)
Oki ML 280 Elite (IBM)
Oki ML 320 Elite (IBM)
Oki ML 321 Elite (IBM)
Oki ML 3410 Elite (IBM)
Oki ML 380 Elite
Oki ML 390 Elite
Oki ML 391 Elite
Oki ML 393 Elite
Oki ML 393C Elite
Oki ML 590
Oki ML 591
Oki OL-400
Oki OL-410
Oki OL-800/840
Oki OL-810
Oki OL830-PS v52.5
Oki OL840-PS v51.8
Okidata® LaserLine 6
Okidata ML 192
*Okidata ML 192-IBM
Okidata ML 192 Plus
Okidata ML 193
*Okidata ML 193-IBM
Okidata ML 193 Plus
Okidata ML 292
*Okidata ML 292-IBM
Okidata ML 293
*Okidata ML 293-IBM
Okidata ML 320
*Okidata ML 320-IBM
Okidata ML 321
*Okidata ML 321-IBM
Okidata ML 380
Okidata ML 390
Okidata ML 390 Plus
Okidata ML 391
Okidata ML 391 Plus
Okidata ML 393
Okidata ML 393 Plus
Okidata ML 393C
Okidata ML 393C Plus
Okidata ML 92-IBM
Okidata ML 93-IBM
Okidata OL-400
Okidata OL-800
Olivetti DM 109
Olivetti DM 124
Olivetti DM 124 C
Olivetti DM 124 L
Olivetti DM 309
Olivetti DM 309 L
Olivetti DM 309 S
Olivetti DM 309 SL
Olivetti DM 324
Olivetti DM 324 L
Olivetti DM 324 S
Olivetti DM 324 SL
Olivetti DM 600
Olivetti DM 600 S
Olivetti DM 624

Olivetti ETV 5000
Olivetti JP 150
Olivetti JP 350
Olivetti JP 350S
Olivetti PG 108
Olivetti PG 208 M2
Olivetti PG 306
Olivetti PG 306 PS (13 Fonts)
Olivetti PG 306 PS (35 Fonts)
Olivetti PG 308
Olivetti PG 308 HS
Olivetti PG 308 HS PostScript
Olivetti PG 404
Olivetti PG 408
Panasonic KX-P1081
Panasonic KX-P1123
Panasonic KX-P1124
Panasonic KX-P1124i
Panasonic KX-P1180
Panasonic KX-P1624
Panasonic KX-P1695
Panasonic KX-P2123
Panasonic KX-P2124
Panasonic KX-P2180
Panasonic KX-P2624
Panasonic KX-P4410
Panasonic KX-P4420
Panasonic KX-P4430
*Panasonic KX-P4450
Panasonic KX-P4450i
Panasonic KX-P4451
Panasonic KX-P4455 v51.4
QMS® 1725 Print System
QMS 2025 Print System
QMS 3225 Print System
QMS 420 Print System v2011.22 r15
QMS 4525 Print System
QMS 860 Print System v2011.22 r15
*QMS ColorScript 100 Model 10 v50.3
QMS ColorScript 100 Model 20 v50.3
QMS ColorScript 100 Model 30 v50.3
QMS ColorScript 100 Model 30si
QMS ColorScript 100 v49.4
QMS ColorScript 210 v2011.22
QMS ColorScript 230 v2011.22
QMS PS Jet Plus v46.1
QMS PS Jet v46.1
QMS-PS® 1700 v52.4
QMS-PS 2000 v52.4
QMS-PS 2200 v51.0 or 52.3
QMS-PS 2210 v51.0 or 52.3
QMS-PS 2220 v51.0 or 52.3
QMS-PS 410 v52.4
QMS-PS 800 Plus v46.1
QMS-PS 800 v46.1
*QMS-PS 810 Turbo v. 51.7
*QMS-PS 810 v47.0
QMS-PS 815 MR v52.4
QMS-PS 815 v52.4
QMS-PS 820 Turbo v51.7
QMS-PS 820 v51.7
QMS-PS 825 MR v52.4
QMS-PS 825 v52.4
QuadLaser I
Qume ScripTEN v47.0
Ricoh LP-1200
Ricoh PC Laser 6000-PS v50.5
*Royal CJP 450
Scantext 2030-51 v49.3 or 52.2
Schlumberger 5232 Color PostScript Printer v50.3

Seiko ColorPoint PS Model 04
Seiko ColorPoint PS Model 14
*Seiko Professional ColorPoint 8BPP
Seikosha LT-20
Seikosha SL-80 IP
Seikosha SL-92
Seikosha SL-92 Plus
Seikosha SP-1900
Seikosha SP-1900+
Seikosha SP-2000
Seikosha SP-2400
Seikosha SP-2415
Sharp JX-9300
Sharp JX-9500
Sharp JX-9500E
Sharp JX-9500H
Sharp JX-9600
Sharp JX-9700
Sharp JX-9700E
Shinko Color CHC-746PSJ PostScript Printer v52.2
Star FR-10
Star FR-15
Star LaserPrinter 4
Star LaserPrinter 4 III
Star LaserPrinter 5
Star LaserPrinter 5 EX
Star LaserPrinter 8
Star LaserPrinter 8 DB
Star LaserPrinter 8 DX
Star LaserPrinter 8 II
Star LaserPrinter 8 III
Star LC-10
Star LC-10 Colour
Star LC-100 Colour
Star LC-15
Star LC-20
Star LC-200
Star LC24-10
Star LC24-100
Star LC24-15
Star LC24-20
Star LC24-200
Star LC24-200 Colour
Star NB24-10
Star NB24-15
Star NL-10
Star NX-1000
Star NX-1000 Rainbow
Star NX-1001
Star NX-1020 Rainbow
Star NX-1500
Star NX-2400
Star NX-2410
Star NX-2415
Star NX-2420
Star NX-2420 Rainbow
Star NX-2430
Star SJ-48
Star XB-2410
Star XB-2415
Star XB-2420
Star XB-2425
Star XB24-10
Star XB24-15
Star XB24-200
Star XB24-250
Star XR-1000
Star XR-1020
Star XR-1500
Star XR-1520

Star ZA-200
Star ZA-250
Tandy LP-1000
Tegra Genesis
Tektronix® Phaser™ 200e with 17 fonts v2011.108(3)
Tektronix Phaser 200e with 39 fonts v2011.108(3)
Tektronix Phaser 200i v2011.108(3)
Tektronix Phaser II PX
Tektronix Phaser II PXe v2010.128 with 17 fonts
Tektronix Phaser II PXe v2010.128 with 39 fonts
Tektronix Phaser II PXi v2010.116
Tektronix Phaser II PXi v2011.108
Tektronix Phaser II PXiJ v2011.108
Tektronix Phaser III PXi v2010.116
*Tektronix Phaser III PXi v2011.108
Tektronix Phaser III PXiJ v2011.108
Tektronix Phaser IISD v2011.108
Tektronix Phaser PX
TI® 2115 13 fonts v47.0
TI 2115 35 fonts v47.0
TI 850/855
TI microLaser PS17 v.52.1
TI microLaser PS35 v.52.1
TI microLaser XL PS17 v.52.1
TI microLaser XL PS35 v.52.1
TI microLaser16 Turbo v2010.119
TI microLaser6 Turbo v2010.119
TI microLaser9 Turbo v2010.119
TI OmniLaser 2108 v45.0
TI Omnilaser 2115 v47.0
Toshiba GX-400
Toshiba PageLaser12
Triumph Adler SDR 7706
Triumph Adler SDR 7706 PS13
Triumph Adler SDR 7706 PS35
Unisys AP9210
Unisys AP9210 17 Fonts v52.1
Unisys AP9210 39 Fonts v52.1
Unisys AP9415 v47.0
Varityper 4000-L300 v52.3
Varityper 4000-L330 v52.3
Varityper 4000-L500 v52.3
Varityper 4000-L530 v52.3
Varityper 4200B-P v49.3 or 52.2
Varityper 4300P v49.3 or 52.2
Varityper Series 4000-5300 v49.3 or 52.2
Varityper Series 4000-5330 v49.3 or 52.2
Varityper Series 4000-5500 v52.2
Varityper VT-600P
Varityper VT 600P v48.0
Varityper VT 600W v48.0
Varityper VT4_510A v52.3
Varityper VT4990 v52.3
VT4_530A v52.3
VT4_530B v52.3
VT4_530C v52.3
VT4_533B v52.3
VT4_533C v52.3
VT4_53EA v52.3
VT4_53EB v52.3
VT4_550A v52.3
VT4_550B v52.3
VT4_550C v52.3
VT4_551A v52.3
VT4_563A v52.3
VT4_563B v52.3
Wang LCS15 FontPlus
Wang LCS15
Wang LDP8
Xerox® DocuTech 135 v2010.130

Xerox DocuTech 85 v2010.130
Xerox DocuTech 90 v2010.130

Technical Notes

The Windows NT Driver Library is provided on the Windows NT CD-ROM in the \DRVLIB directory, as well as several locations for electronic transmission. Please see the section at the end of this document for instructions on downloading and accessing Windows NT Driver Library drivers.

1 This device requires a driver from the \DRVLIB directory on the Windows NT CD-ROM, or the Windows NT Driver Library.
2 This device requires a driver from the Windows NT driver library. See the following section on accessing these drivers.
3 Refer to SETUP.TXT for information on configuring this machine/device before installation.
4 Windows NT does not currently support Advanced Power Management (APM).
5 This system requires an ABIOS.SYS driver dated after 11/1/93 to support IDE drives. Call Microsoft Product Support Services to obtain this update.
6 Contact the manufacturer for information on running Windows NT on this machine.
7 IDE drives greater than 500Mb are only supported with BIOS Version 1.23 or later, with BIOS setting for IDE in standard mode.
8 Only the NCR 53c710 SCSI Host Adapter is supported in this machine.
9 Tested with firmware revisions 3.10 and 3.20.
10 Problems may be encountered using SCSI Removable Media (cartridge) drives on this adapter on this platform.
11 This adapter requires an active terminator for proper performance.
12 This adapter must be configured for 5 MB/second asynchronous I/O to work with listed CD-ROM drives from NEC.
13 This adapter must be configured for 5 MB/second asynchronous I/O to work with listed CD-ROM drives from Chinon, Hitachi and NEC.
14 Tested with the Unisys PW2 Advantage 3256 (Flemington).
15 Tested with the Unisys PW2 Advantage Plus MPE 4668.
16 Scanners are not supported with this adapter.
17 Removable media drives are not supported with cache module installed.
18 CD-audio, tape drives and scanners are not supported on this controller.
19 To use this adapter, at least one device on the bus must provide termination power.
20 Refer to SETUP.TXT for information on configuring this adapter.
21 SCSI BIOS dated before 1991 requires PS/2 Reference Diskette version 1.21 or later.
22 This adapter cannot be used for CD Setup. To install Windows NT with this adapter, use the WINNT.EXE Setup method.
23 Tested with COMPAQ Portable 486c.
24 Tested with NCR System 3000 Model 3350.
25 This adapter is only supported on IRQ-5.
26 This adapter is only supported for use with scanners and CD-ROM drives.
27 Tested with firmware revision 005.
28 Tested with firmware revision 008.
29 This drive is not supported for use with the Adaptec AHA-1542c.
30 This drive is not supported for use with the Future Domain TMC-850M and TMC-1670 adapters.
31 This drive requires double-termination when used with the Adaptec AHA-1742A.
32 The Adaptec AHA-1640 and Ultrastor 24f support only a single disk when used with this drive. This drive is not supported for use with the Future Domain MCS-600 adapter.
33 Requires firmware revision 1.10C to function properly with Windows NT.
34 Supported with CD-ROM drives based on Panasonic CR-52x and CR-56x models only.
35 This drive is not supported with the Adaptec AHA-1640 adapter.
36 Requires firmware version 484 or later for proper operation.
37 This drive is not supported with the IBM PS/2 Microchannel SCSI Host Adapter (with cache).
38 This drive is not supported with the Future Domain TMC-850M(ER).
39 This drive is not supported with the UltraStor 24fa adapter.
40 This drive is not supported with the Adaptec AHA-1742A adapter.
41 For use with floppy controllers. Separate interface controllers for these types of drives are not supported.
42 Requires that 512-byte sector-sized media be mounted during installation.
43 Supported on x86 only.
44 This adapter is currently supported in its ESC-1/ESC-2 compatibility mode only.
45 Not supported with the the Future Domain TMC-850m.
46 This has been Fault-Tolerance (RAID) tested using Windows NT Advanced Server.
47 Tested with HP C2225B tape drive, HP C2229B disk drive and HP C2226A CD-ROM drive.
48 HP Storage Systems were tested with the appropriate HP SCSI Host Adapters.
49 Tested with appropriate StorageWorks options including CD-ROM, Tape and Hard Drives.
50 Also supported on Alpha platforms.
51 FDDI tested only.
52 Supported in Sound Blaster 1.x compatibility mode.
53 Not supported in Sound Blaster 1.x compatibility mode.
54 Error control and flow control forced on.
55 Advanced features disabled.
56 Supported as a client modem only.
57 Flow control forced on.
58 Maximum DTE speed set to 2400.
59 Maximum DTE speed set to 9600.
60 Modem compression forced on.
61 Tested as standard serial ports only.
62 In the UPS applet, check the box "Remote UPS Shutdown" and set it to high.

How To Find New Drivers in the Windows NT Driver Library (WNTDL)

COMPUSERVE

A. If you are using WinCIM:
   1. From the Services Menu, select GO.
   2. Type MSL in the GO dialog box.
   3. Select 2 to scan.
   4. Search for WNTDL to view the whole WNTDL list or another key word to view specific files.

B. If you are not using WinCIM, log onto CompuServe, type GO MSL, then follow instructions 3 and 4 above.

ONLINE

A. Log onto OnLine.
   1. From the Database Menu, select the option to Select DB.
   2. Choose the Software Library option.
   3. From the Software Library option, select the option Host Items.
   4. In the Query box, type WNTDL to review the whole WNTDL list or another key word to view a specific file.

B. To get more information on a specific file, highlight the file with the cursor and press <Enter>. This brings up more details about the file.

GENIE™

Log onto Genie.
   1. From the main menu, select option 5 - Computing Services.
   2. From the Computing Services menu, select option 6 - IBM PC/TANDY Roundtables.
   3. From the IBM PC/TANDY Roundtables menu, select option 3 - Software Libraries.
   4. From the Software Libraries Menu, select option 3 - Search File Directory.
   5. Type WNTDL as the search string to view the WNTDL list or any other key word to view a specific file.

MICROSOFT DOWN LOAD SERVICES

Log onto MSDL by calling (206) 936-6735.
   1. Enter name and location.
   2. From the main menu, press F for File index.
   3. Select L to list the whole WNTDL list or E to examine a specific file.

IF YOU DO NOT HAVE A MODEM

You can obtain an individual driver from the WNTDL on a disk by calling Microsoft Product Support Services at (206) 637-7098.

While we have endeavored to supply as complete and accurate a list as possible, MICROSOFT MAKES NO WARRANTIES, EXPRESS OR IMPLIED, AS TO THE COMPLETENESS AND ACCURACY OF THIS LIST. This list does not constitute an endorsement of any particular manufacturer.

Windows NT Reference Books (listed by Author) 

Windows NT Unleashed

Sams : 01/1994 (940101)
Trade - $39.95 incl. CD ROM
ISBN: 0-672-30380-9

Programming Windows NT with C & C

Andrews, Mark
MIS Press : 11/1993 (931101)
$29.95
ISBN: 1-55828-300-5

Optimizing Windows NT

Blake, Russ
Microsoft : 10/1993 (931001)
$34.95
ISBN: 1-55615-619-7

Windows NT Companion

Borland, Russell
Microsoft : 06/1993 (930601)
$27.95
ISBN: 1-55615-554-9

Windows NT Administration: Single Systems to Heterogeneous Networks

Brain, Marshall
PRENTICE HALL : 10/1993 (931001)
$40.00
ISBN: 0-13-176694-5

Windows NT Programming: An Introduction Using C Plus Plus

Brain, Marshall; Campbell, Kelly
PRENTICE HALL : 01/1994 (940101)
Trade - write for info.
ISBN: 0-13-097833-7

Using Windows NT: The Essentials for Professionals

Brain, Marshall; Campbell, Kelly
PRENTICE HALL : 01/1994 (940101)
Trade - write for info.
ISBN: 0-13-091977-2

Microsoft Windows NT Step by Step

Catapult Inc. Staff
Microsoft : 10/1993 (931001)
$29.95
ISBN: 1-55615-573-5

Windows NT Client-Server Developer's Guide

Clark, Jeffrey
Sams : 08/1993 (930801)
Trade - $39.95
ISBN: 0-672-30302-7

Learn Windows NT In a Day

Columbus, Louis
PUBLISHER: Wordware Pub : 06/1993 (930601)
$14.95
ISBN: 1-55622-365-X

OS/2 2.X vs. Windows NT

Computer Technology Research Corp. Staff
Computer Tech Res : 1994 (940101)
$180.00
ISBN: 1-56607-021-X

Microsoft Foundation Class Primer: Programming Windows & Windows NT with MFC

Conger, Jim
Waite Group Pr : 03/1993 (930301)
$29.95
ISBN: 1-878739-31-X

Distributing Applications across DCE & Windows NT

DCE Staff; Rosenberry, Ward; Teague, Jim
O'Reilly & Assocs : 09/1993 (930901)
$25.00
ISBN: 1-56592-047-3

PC Magazine Windows NT Networking

Derfler, Frank
Ziff-Davis : 02/1993 (930201)

$29.95
ISBN: 1-56276-114-5

Network Remote Procedure Calls: Windows NT, Windows, DOS

Eddon, Guy
PRENTICE HALL : 11/1993 (931101)
$30.00
ISBN: 0-13-100223-6

Windows NT 3.1 Graphics Programming

Ezell, Ben
Ziff-Davis : 07/1993 (930701)
$34.95 incl. disk
ISBN: 1-56276-113-7

Help Windows NT 3.1

Ezzell, Ben
Ziff-Davis : 10/1993 (931001)
$29.95
ISBN: 1-56276-151-X

Windows NT 3.1 Programming

Ezzell, Ben
Ziff-Davis : 06/1993 (930601)
$34.95 incl. disk
ISBN: 1-56276-112-9

Voodoo Windows NT: Tips & Tricks with an Attitude

Feldman, Len
Ventana Press : 1994 (940101)
$24.95
ISBN: 1-56604-069-8

Windows NT: The Next Generation

Feldman, Leonard
Sams : 03/1993 (930301)
$22.95
ISBN: 0-672-30298-5

Windows NT: Making the Move

Forney, Jim
TAB Bks 02/1993 (930201)
$24.95
ISBN: 0-8306-4391-5

Windows NT: A Developer's Guide

Goodman, Kevin
M&T Bks : 09/1993 (930901)
$39.95 incl. disk
ISBN: 1-55851-306-X

Windows NT Answer Book

Groves, James A.
Microsoft : 04/1993 (930401)
Trade - write for info.
ISBN: 1-55615-562-X

Seven Keys to Learning Windows NT

Houlette, Forrest
New Riders Pub : 06/1993 (930601)
$12.95
ISBN: 1-56205-156-3

Migrating to Windows NT: The Insider's Integration Guide

Kennedy, Randall C.
Brady Compu Bks : 09/1993 (930901)
$26.95
ISBN: 1-56686-103-9

Windows NT in a Day

Knox, Weber
Weber Systems : 01/1994 (940101)
$27.95
ISBN: 0-929704-25-8

Moving into Windows NT Programming

Leavens, Alex
Sams : 05/1993 (930501)
$39.95 incl. disk
ISBN: 0-672-30295-0

Windows NT Power Tools

Leblond Group
Bantam : 07/1993 (930701)
$49.95
ISBN: 0-553-37206-8

Windows NT Power Tools

Leblond Group Staff

Random House : 07/1993 (930701)
$50.00 incl. disk
ISBN: 0-679-79142-6

Windows NT Developers Treasure Chest

McCord, James
Sams : 03/1993 (930301)
$49.95 incl. disk
ISBN: 0-672-30294-2

Microsoft Windows NT Resource Guide

Microsoft
Microsoft : 08/1993 (930801)
$49.95 incl. disks
ISBN: 1-55615-598-0

Microsoft Windows NT Messages Reference

Microsoft
Microsoft Press 09/1993 (930901)
$39.95 incl. disks
ISBN: 1-55615-600-6

Microsoft Windows NT TCP-IP Guide

Microsoft
Microsoft Press : 07/1993 (930701)
$19.95
ISBN: 1-55615-601-4

Microsoft Windows NT Resource Kit

Microsoft
Microsoft Press 09/1993 (930901)
$99.99 incl. 6 disks & CD-ROM
ISBN: 1-55615-602-2

MicroSoft LAN Manager for Windows NT

MicroSoft Staff
Microsoft : 02/1993 (930201)
$39.95
ISBN: 1-55615-543-3

Application Programming for Windows NT

Murray, William
Osborne-McGraw : 05/1993 (930501)
Text ed. - $39.95
ISBN: 0-07-881933-4

Mastering Windows NT Programming

Myers, Brian; Hamer, Eric
Sybex : 08/1993 (930801)
$44.99
ISBN: 0-7821-1264-1

Ultimate Windows NT

New Riders Development Staff
New Riders Pub : 01/1993 (930101)
$39.95 incl. disk
ISBN: 1-56205-135-0

Customizing & Optimizing Windows NT

Pappas, Chris H.; Murray, William H.
Addison-Wesley : 01/1993 (930101)
Call for more info
ISBN: 0-201-62624-1

Cross-Platform Power Tools: Application Development for the Macintosh, Windows, & Windows NT

Petrucci, Steven J.
Random House : 12/1993 (931201)
$45.00
ISBN: 0-679-79147-7

Windows NT Instant Reference

Powell, James E.
Sybex : 09/1993 (930901)
$12.95
ISBN: 0-7821-1219-6

Multitask Windows NT

Powell, Joel
Waite Group Pr : 10/1993 (931001)
$34.95 incl. disk
ISBN: 1-878739-57-3

Using Windows NT: Special Edition

Que Development Group Staff; Columbus; Eidoson; Woeher; Person
Que : 05/1993 (930501)
$29.95
ISBN: 1-56529-101-8

Teach Yourself. . . Windows NT

Rao, Hy
MIS Press : 07/1993 (930701)
$21.95
ISBN: 1-55828-269-6

Advanced Windows NT

Richter, Jeffrey
Microsoft : 10/1993 (931001)
$39.95
ISBN: 1-55615-567-0

Networking Windows NT

Ruley, John D.
Wiley : 11/1993 (931101)
$27.95
ISBN: 0-471-31072-7

Windows NT: Programming Handbook

Schildt, Herb
Osborne-McGraw : 04/1993 (930401)
$29.95
ISBN: 0-07-881873-7

Windows NT

Schwartz, Karl
DDC Pub : 06/1993 (930601)
$8.95
ISBN: 1-56243-114-5

Windows NT Inside & Out

Sheldon, Tom
Osborne-McGraw : 07/1993 (930701)
$27.95
ISBN: 0-07-881826-5

Mastering Windows NT

Simpson, Alan
Sybex : 05/1993 (930501)
$29.99
ISBN: 0-7821-1352-4

Mastering Windows NT Special Edition

Simpson, Alan
Sybex : 01/1994 (940101)
$29.99

ISBN: 0-7821-1128-9

Windows NT Advanced Server

Spencer, Kenneth
PRENTICE HALL : 06/1994 (940601)
$30.00
ISBN: 0-13-107046-0

Practical Guide to Windows NT

Spencer, Kenneth L.; Schoeniger, Eric-Editor
CBM Bks : 1994 (940101)
$25.00
ISBN: 1-878956-39-6

Running Windows NT

Stinson, Craig
Microsoft : 08/1993 (930801)
$27.95
ISBN: 1-55615-572-7

Inside Windows NT

Stoddard Staff
New Riders Pub : 08/1993 (930801)
$34.95
ISBN: 1-56205-124-5

Van Wolverton's Guide to Windows NT: Easy Directions for Immediate Results

Van Wolverton
Random House : 09/1993 (930901)
$16.00
ISBN: 0-685-66618-2

Windows NT: Microsoft's New Operating System Strategy

Varhol, Peter D.
Computer Tech Res : 02/1993 (930201)
Trade - $190.00
ISBN: 1-56607-007-4

Windows NT: The Complete Reference

Wyatt, Allen
Osborne-McGraw : 06/1993 (930601)
$29.95
ISBN: 0-07-881832-X

Borland C ++ 4.0 Programming for Windows & Windows NT

Yao, Paul
Random House House: 01/1994 (940101)
$34.00
ISBN: 0-679-75146-7

There are no entries that begin with the letter I

There are no entries that begin with the letter J

There are no entries that begin with the letter O

There are no entries that begin with the letter T

There are no entries that begin with the letter U

There are no entries that begin with the letter X

There are no entries that begin with the letter Z

Questions and Answers on Windows NT

These questions were compiled from customers visiting Microsofts Executive Briefing Center in 1993.

What is the difference between Windows NT and Windows NT Advanced Server?

If I run a 16-bit Windows-based application on Windows NT and it crashes, can I re-run it without restarting Windows NT?

Can I use the Windows NT administration tools across the network?

Does Windows NT Advanced Server support X.25 and ISDN?

Does Windows for NT support RPC (Remote Procedure Calls)?

Does Windows NT support a MAC file server?

How many 32-Bit applications currently ship for Windows NT?

Can Windows NT use IPX instead of NETBEUI?

When will there be production NetWare Connectivity for Windows NT?

Can you log events to a different machine on an Windows NT-based system?

How can server utilization be determined and maximized?

What is the maximum number of processor supported by Windows NT ?

Does Windows NT come with NFS support?

Does Windows NT support X applications?

What are the recommended hardware resources for a Windows NT workstation?

Is it true that some MS-DOS and Windows-based applications will not run on Windows NT?

How compatible is Windows NT with DCE?

When Will Windows NT incorporate a scripting language such as REXX, the Korn Shell or Hamilton C-Shell

- **What is the difference between Windows NT and Windows NT Advanced Server**

Answer: Microsoft® Windows NT Advanced Server is a superset of the Windows NT, operating system, and is designed to be the best solution for file, print, and application servers. Components included in Windows NT Advanced Server that are not part of Windows NT include:

- Advanced fault tolerance (disk mirroring, disk duplexing, RAID 5, and UPS)
- Centralized user management
- Enterprise directory and naming and replication services
- Multi-user Remote Access Services for Macintosh®

If I run a 16-bit Windows-based application on Windows NT and it crashes, can I re-run it without restarting Windows NT?

Answer: Yes - Because the Windows subsystem runs 16-bit applications in the same address space it is possible for one application to bring down the subsystem. However, the subsystem itself runs as a protected process separate from other subsystems or system components. One can shut down the Windows Subsystem and restart it. This should enable the user to restart their application.

In the next version of Windows NT, users can elect to run 16-bit Windows-based applications in their own virtual machine. This effectively isolates each 16-bit Windows-based application.

Can I use the Windows NT administration tools across the network?

Answer: All Administration tools except Disk Manager can be used remotely to control remote networked-connected Windows NT-based workstations or servers -provided the individual has security access to that machine. The administration tools can even be used over dial-up connections initiated through Remote Access Services.

More Information on Windows NT Administration

Does Windows NT Advanced Server offer X.25 and ISDN support?

Answer: Windows NT supports both ISDN and X.25 for network and host connectivity. Both can be utilized for Remote Access Services or SNA Server for Windows NT.

More on Windows NT Networking

Does Windows NT support RPC (Remote Procedure Calls)

Answer: Yes. It is built in natively to Windows NT; It complies with the DCE (Distributed Computing Environment) specifications. The administration tools in Windows NT use RPC to derive system information from remote systems.

Does Windows NT support a MAC file server?

Answer: Windows NT Services for Macintosh (included with Windows NT Advanced Server) is a set of integrated tools facilitating better productivity and integration with Macintosh users. These include the AFP-compatible file server which allows Macintosh users to connect to a Windows NT-based server the same way they would connect to an AppleShare® server, a Print Server, and Print Monitor, which allows Macintosh users on the network to spool their print jobs to a Windows NT-based server. Finally, the services include a complete AppleTalk® Stack, providing seamless connectivity between Macintosh clients and Windows NT Advanced Servers

More on Windows NT services for the Macintosh

How many applications are shipping for Windows NT?

Answer: There are currently over 200 32-bit applications for Windows NT.

32-Bit Application catalog for Windows NT

Does Windows NT have an IPX transport?

Answer: Windows NT includes an IPX transport for both peer sharing and the ability to access NetWare servers for file and print sharing. redirectors for Windows NT-based client access to NetWare file and print services are available from both Novell and Microsoft.

More on integrating Windows NT with NetWare

Can you log events to a different machine on an Windows NT system?

Answer: Yes, since the Event Viewer can track remote machines, an administrator can track multiple Windows NT-based clients or servers and log system events.

More Information on Windows NT Administration

How can server utilization be determined and maximized?

Answer: Using Performance Monitor one can graphically analyze over 200 system functions. You can then use the remote capabilities of the Windows NT administration tools to manually adjust the necessary system settings remotely.

The Windows NT Resource Kit also provides a tool called PView. This examines individual processes and allows administrators to end a specific process.

More Information on Windows NT Administration

How many processors can Windows NT take advantage of?

Answer: Currently Windows NT Advanced Server can address up to 32 processors.

More on Symmetric Multiprocessing

Can I run X Windows applications on Windows NT?

Answer: X Windows is a graphical distributed computing model developed at MIT. With X Windows, an application which runs on a server system is called the client, which sends commands over the network to display its results on the X Windows *server.* In many networks, dedicated hardware systems known as X Terminals provide the X display software and hardware to display remote X clients on a user's desk. Third parties are developing X Windows server solutions for Windows NT. This software will enable users to use Windows NT as a high-powered X server platform while retaining compatibility with Windows NT, Windows 3.1 and MS-DOS-based applications on the same system. Other third parties are developing X Windows client libraries for Windows NT, so developers can write X client applications on Windows NT which can be run and displayed remotely on systems providing X server capabilities.

Does Windows NT come with NFS support?

Answer: Windows NT, with its built-in TCP/IP support, provides a great framework for NFS, although we have chosen not to offer NFS support in the product. Microsoft is cooperating with third parties to provide quality NFS clients and servers under Windows NT this year. Our open networking architecture makes it easier for third parties to bring existing NFS implementations to Windows NT. We support their efforts, and will communicate the availability and details of their products as they become available. Both SunSelect and FTP Software, leaders in PC-based NFS solutions, are committed to providing NFS solutions on Windows NT and have demonstrated initial technologies at several trade events. Other TCP/IP solution companies such as Frontier Technologies, Beame and Whiteside, and NetManage have announced similar solutions.

What are the recommended hardware resources for a Windows NT workstation?

Answer: To run Windows NT as a workstation Microsoft recommends the following:

486 25MHz or greater	150 MB Hard drive 16 MB RAM	Recommended: high resolution monitor and CD ROM Drive

Is it true that some MS-DOS and Windows-based applications will not run on Windows NT?

Answer: Yes. In order to fully protect the operating system, Windows NT isolates application subsystem from the hardware. Any MS-DOS or Windows-based application that makes direct hardware calls will need some adaptation to run under Windows NT. Some of the more notable applications were 3270 emulation or FAX products that directly call hardware adapters. In many cases, the third party developers wrote Windows NT device drivers for the hardware.

How compatible is Windows NT with DCE? What is your compatibility with DCE?

Answer: Windows NT 3.1 includes RPC that is compatible with DCE. This is not a complete implementation of the DCE/RPC but it is fully interoperable with DCE/RPC and Windows NT has been demonstrated interoperating with RPC running under VMS as an example of the potential for heterogeneous connectivity.

In future releases of Windows NT, support for DCE will be strengthened to include name services and kerberos security.

When will there be production NetWare Connectivity for Windows NT?

Answer: Currently, both the Novell and Microsoft redirectors for Windows NT are in beta testing. Microsoft currently plans to ship the NetWare Workstation Compatible Services (NWCS) in May 1994. The prolonged beta test period is designed to address the vast number of environments and to ensure excellent bug-free delivery of the redirector. Novell is taking the same steps and announced a similar delivery time frame. Both redirectors are available on CompuServe. See *Integrating Windows NT and Novell NetWare* section.

When Will Windows NT incorporate a scripting language such as REXX, the Korn Shell or Hamilton C-Shell

Answer: The Windows NT operating system and shell are programatically exposed through the WIN32 API. While Windows NT, itself, does not include a scripting language Microsoft plans to introduce a 32-Bit version of Visual Basic which will be tightly integrated into the Windows NT operating system.

Today, the Korn Shell the Hamilton C-Shell and REXX are all available for Windows NT. While preserving the expertise in these specific environments, they provide access to the system and its customization, configuration and administrative functions. These tools can be used to automate both end-user and administrative functions such as starting and running applications or configuring user accounts or compiling performance benchmarks of remote servers.

Integrating Windows NT and Novell NetWare

The Microsoft® Windows NT™ operating system can act as a client, a server, or both to an existing Novell® NetWare® environment. As a client, it allows developers or "power users" seamless access to NetWare file and print servers through an intuitive yet flexible interface. For current NetWare users, Windows NT Advanced Server provides the advanced performance and fault tolerance components necessary for mission-critical client server applications. Microsoft helps you get the most out of your existing investment in NetWare, while using or evaluating the advanced features of Windows NT.

Using Windows NT-based Clients in a NetWare Environment

Because networking is a fundamental part of the Windows NT operating system, access to department or enterprise resources such as file servers and printers is transparent. Consequently, the architecture of Windows NT allows users to connect to many different server resources such as Banyan® Vines®, IBM® LAN Server, Windows™ for Workgroups, and UNIX® servers simultaneously.

This transparency allows you to focus on information and problem-solving, rather than the underlying network operating system. It also means that as you evaluate Windows NT you can easily attach to NetWare servers, Map drives and access NetWare print queues as you would under the MS-DOS® or Windows™ operating systems.

For Additional Information:

The Novell NetWare Redirector for Windows NT

The Microsoft NetWare-Compatible Redirector for Windows NT

NWLink for Windows NT

The Novell NetWare Redirector for Windows NT

Novell currently supports a beta version of their redirector for Windows NT. Like similar requestors for MS-DOS, Windows and OS/2®, the client software supports:

- **Connectivity to NetWare servers**
- **NetWare server drive maps**
- **Use of NetWare file services**
- **Access to NetWare print queues**
- **Access to NetWare APIs**
- **Support for NDIS and ODI Drivers**

Support Specific to Windows NT

- **Support for DEC Alpha and MIPs version of Windows NT**
- **Username and password from MS Windows NT machine login may be used to authenticate to a NetWare server.**
- **Uses the Windows NT Network Settings Control Panel installation interface.**
- **Unlimited number of concurrent connections**
- **Enables communication to future NetWare servers running on protocols other than IPX.**

More about the Novell Netware Redirector:

Installing the NetWare Redirector for Windows NT

Accessing NetWare Services

Supported Network Adapters

Limitations in the current Novell NetWare Requestor

Supported Network Cards for NetWare Redirector as of 11/3/93

ODI drivers for the following network cards are supported:

3Com EtherLink II (DIX)
3Com EtherLink II/16 (DIX)
3Com EtherLink III
AMD AM2100
Ansel M1500 All-In-One-Networking
Microdyne EXOS 105
IBM Token Ring
Novell NE2000
Novell NE2000PLUS (Shared RAM Mode)
Novell NE1500T
Proteon p1391 RapiDriver
Pure Data PDI8023
Pure Data PDI8023-16
Pure Data PDI8023PLUS-16
SMC (WD) 8003EP
SMC Elite 8013EWC
SMC Elite 8013EPC
SMC Elite 8013EP
SMC Elite Ultra 8216
SMC Elite Ultra 8216T
Wearnes 2107C
WD 8003EBT
WD 8003W
WD 8013EBT

3Com EtherLink II (BNC)
3Com EtherLink II/16 (BNC)
3Com EtherLink III TP
AMD AM1500T
Ansel M2100 All-In-One-Networking
HP J2405
Novell NE1000
Novell NE2000PLUS (I/O Mode)
Novell NE2100
Novell NTR2000
Proteon p1392 RapiDriver
Pure Data PDI8023T
Pure Data PDI8023T-16
Pure Data PDI8023TPLUS-16
SMC (WD) 8003WC
SMC Elite 8013WC
SMC Elite 8013EW
SMC Elite 8013W
SMC Elite Ultra 8216C
Wearnes 2110T
WD 8003E
WD 8003WT
WD 8003EB

Micro Channel Architecture:

3Com EtherLink 16 MC
3Com EtherLink III MC
IBM Token Ring MC
Novell NE2_32 MC
Pure Data PDuC8023-16 MC
SMC (WD) 8003W/A MC
SMC 8013WP/A MC

3Com EtherLink 16 MC TP
3Com EtherLink III MC TP
Novell NE2 MC
Proteon p1892 RapiDriver Token-Ring MC
SMC (WD) 8003E/A MC
SMC 8013EP/A MC

EISA

ODI 3Com EtherLink III EISA
ODI DEC FDDIcontroller/EISA
ODI Novell NF32000 FDDI EISA
ODI INTEL EtherExpress32 EISA

ODI 3Com EtherLink III EISA TP
ODI Novell NE3200 EISA
ODI Proteon p199X RapiDriver Token-Ring EISA
ODI Microdyne EXOS235T EISA

Limitations in the Current Novell NetWare Requester

As of this writing (November 3 release of NetWare Requester), the NetWare Requester available on CompuServe fixes a number of problems in previous releases. However, there are still some limitations in this release including:

- The NetWare Requester cannot map a drive letter to a NetWare volume and then reshare it to other clients on the network. This makes it virtually impossible to use a Windows NT-based machine as gateway to a group of NetWare servers.
- The NetWare Requester is not able to redirect print queues from a Windows NT-based machine shared by others to existing print servers on NetWare.
- This version of the NetWare Client does not include support for MS-DOS-based applications which use NetWare APIs, such as SYSCON, MAP, FILER, etc. This support will be added in future versions.

While NWCS has some limitations in its support of NetWare APIs, it will support all of the above functions.

The Microsoft NetWare-Compatible Redirector for Windows NT

Installing the NetWare Redirector for Windows NT

Before you can proceed, you must download the software from CompuServe onto your machine running Windows NT, putting it either on a disk or in a directory.

Included with the software that you will download from CompuServe® is a NWTI.TXT file. If you follow its instructions, you should encounter no problems installing the products. Unlike previous versions, you are not required to make registry changes, and many bugs were fixed.

How to Download the Redirector Software

Go to NOVFILES and select the client kits. Under this you will find the option to download the Windows NT-based client software. You will be downloading one large file, named NWTI.EXE. Executing this file will expose a variety of files needed for the installation.

Password Hints

We strongly suggest that you use the same word for your username and password on Windows NT as it exists in NetWare. By doing this you will be able to log into Windows NT and then connect to a NetWare server, without further validation from NetWare. Windows NT will pass through your user name and password when requesting connection services.

Accessing NetWare Services

NetWare Services are available through the Control Panel, Print Manager, and File Manager.

The NetWare icon in the Control Panel lists your connections, username, and connection ID. You can add network connections by selecting "NetWare" from the Control Panel and hitting "Insert." Type in Username, Password, and Server, then choose "Login." To delete a network connection, simply select the connection and hit "Delete." That connection will be logged out.

Redirection of a local printer port to a NetWare print queue is now supported. The NetWare Requester allows you to print directly to NetWare print queues or redirect from the command line. To print to a NetWare queue, choose "Print Manager" from the "Main" window. Then from the "Printer" menu, choose "Connect Printer." Browse the NetWare servers for the queue to which you wish to print. The redirector now allows you to drag and drop documents from the file manager directly to the NetWare queue.

NetWare Workstation Compatible Service for Windows NT

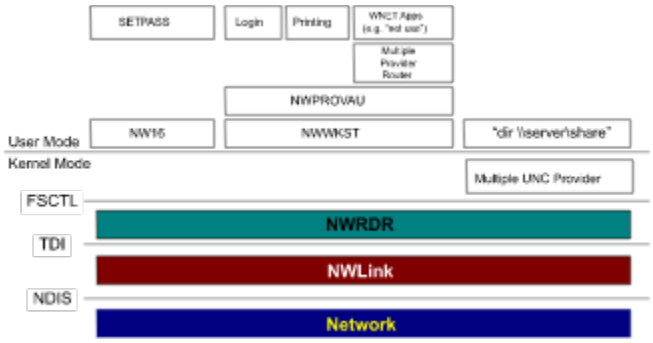
The NetWare Workstation Compatible Service (NWCS) for Windows NT is Microsoft's solution for allowing Windows NT-based workstations to access files, directories, and printers on NetWare servers.

After NWCS is installed, the service can be configured, or it can be used immediately for accessing the files, directories and print queues that reside on NetWare 2.*x*, 3.*x* and 4.0 (with bindery emulation) file servers.

NWCS is a fully native implementation of a NetWare-compatible redirector for Windows NT. It is implemented as a 32-bit service, taking full advantage of the advanced communications architecture of Windows NT. As a native, Windows NT-based networking application, it provides a well-integrated and seamless extension of the Windows NT native networking environment.

In addition to supporting an unlimited number of connections, NWCS also supports an auto-reconnect feature, which remembers previously-established connections for you. Like the default Windows NT Redirector, NWCS is implemented as a file system driver, giving it access to other file system drivers such as **FAT** and **NTFS**. NWCS takes advantage of several file-system services offered by Windows NT, such as **cache management**.
NWCS communicates with transport protocols through **TDI**. It also supports both IPX and SPX II protocols, which use the Open Driver Interface (ODI). The Windows NT default protocols, including TCP/IP, NBF, and DLC, use **NDIS**.

How to Get the NWCS Beta



NetWare Compatible Service for Windows NT Architecture

Cache Management

helps increase the performance of your system by reading ahead during sequential file access and buffering multiple operations to reduce the amount of network traffic.

Why Use Windows NT Advanced Server as an Application Server

Windows NT Advanced Server is a high-end operating system that offers the advanced features that MIS managers, software developers, and systems integrators have come to expect on platforms designed for business solutions.

Windows NT Advanced Server includes all of the networking capabilities found in network operating systems such as NetWare, without actually being a network operating system. Instead, it is a high-end server operating system with built-in networking, designed to provide the best features of UNIX, VMS®, and other high-end operating systems in a package that is consistent and compatible across a variety of hardware implementations.

Novell NetWare includes support for server-based applications, called NetWare Loadable Modules (NLMs), but the NLM-running environment is based on the functions that Novell used to build its file and print server product. Consequently, while Novell NetWare is well designed for file and print services, its architecture is not optimal for running server applications.

NetWare Has Limitations as an Application Server

The Advanced Features of Windows NT Advanced Server

NetWare Has Limitations as an Application Server

NetWare's limitations as an application server stem from these shortcomings:

1. **NetWare does not scale beyond single CPU Intel based systems.**
2. **NetWare does not provide preemptive multitasking.**
3. **NetWare does not provide virtual memory.**
4. **NetWare provides only limited memory protection in NetWare 4.0 and no protection in NetWare 3.11.**

Business solutions based on the client-server model require these features, which are standard on most advanced operating systems designed to support mini-computers and mainframes. However, Novell's focus with NetWare is on the network, not on the operating system. Like other network operating systems, NetWare is effective at adding networking capabilities to operating systems that do not include these services.

The Advanced Features of Windows NT Advanced Server

Windows NT Advanced Server offers these advanced features:

1. **Preemptive multitasking**, to provide the responsiveness required to support multiple applications and multiple users on a single server
2. **Multithreading**, to facilitate the design and development of complex applications
3. **Symmetric multiprocessing**, to build solutions that benefit from scalable power effectively without limits
4. **Portability to RISC-based systems**, which gives you a choice of hardware architectures
5. **Advanced fault tolerance**, to provide the data integrity required for important business information
6. **Virtual memory with protection**, so that multiple applications can run on a server without corrupting each other or the system
7. **Distributed inter-process communications mechanisms**, which enable client-server applications to be written easily and independently of the underlying network
8. **Security model**, which provides full discretionary access so that business data can be accessed by the right people in the right way

Windows NT Advanced Server in NetWare Environments

To facilitate the integration of Windows NT Advanced Server with existing NetWare clients, Microsoft has included its own transport fully compatible with the IPX/SPX transport called **NWLink**.

With NWLink, your clients that are in a NetWare LAN environment can have easy access to the Windows NT Advanced Servers and the server applications running on them, without any additional software. You can also access Windows NT Advanced Servers client systems running MS-DOS, Microsoft Windows, Microsoft Windows™ for Workgroups, Windows NT, OS/2, and Macintosh® systems. Access to the Windows NT Advanced Server does not conflict with access to Novell NetWare in any way.

More on NW Link

NWLink for Windows NT

The NetWare Link (NWLink) is compatible with IPX, SPX, and NetBIOS, which are used in Novell NetWare networks. NWLink provides communication between a Windows NT-based computer and either another Windows NT-based computer, or a NetWare workstation. Two networking Application Programming Interfaces (APIs) are supported to allow this:

- **Windows Sockets**
- **NetBIOS**

Similar to the Windows NT TCP/IP implementation, NWLink is a **STREAMS**-based protocol. Because the STREAMS environment on Windows NT supports **TDI** at the top, and **NDIS** on the bottom, NWLink can seamlessly coexist with other protocols on the same network adapter.

TDI

Transport Driver Interface: a 32-bit interface to which Windows NT transports adhere, to isolate networking applications from the specifics of a transport.

NDIS

Network Driver Interface Specification: a standard interface that network adapter drivers and transports follow to isolate each other from the specifics of the card or the transport. NDIS 3.0 is implemented on Windows NT.

STREAMS

A protocol interface and environment, originally developed for UNIX systems, that standardizes communication with adjacent software layers. By implementing STREAMS within Windows NT, transports can be easily ported from UNIX systems.

NetBIOS

The NetBIOS support can be used to send and receive NetBIOS packets either between a NetWare workstation and a computer running Windows NT, or between two Windows NT-based computers. You will see a significant performance gain in cases where all computers are Windows NT-based computers, because of Microsoft enhancements to the NetBIOS protocol.

The Microsoft-enhanced NetBIOS protocol not only conforms to the standard single request/reply implementation, but also uses to its advantage the knowledge that it is conversing with another computer that understands the enhancements. The enhancements increase efficiency by:

- Allowing the sender to send multiple NetBIOS packets before receiving an acknowledgment (a sliding window)
- Supporting the "piggybacking" of NetBIOS acknowledgments

NetBIOS acknowledgments are sent by the receiver after receiving the last packet of a NetBIOS message, and "piggybacking" of acknowledgments saves network bandwidth and processing time on the computers, since a separate acknowledgment frame does not need to be processed and sent. This is especially noticeable during times of heavy two-way traffic between sender and receiver.

Windows Sockets

The Windows Sockets interface is ideal for supporting existing NetWare applications written to comply with the NetWare IPX/SPX Sockets interface. The Windows NT-based computer acts as an application server responding to the IPX or SPX packets, which are sent to or received from workstations running MS-DOS, Windows, or OS/2 NetWare. **Example**

Examples of programming, using the Windows Sockets interface for sending and receiving IPX and or SPX packets through NWLink, are available through the Win32® Software Developers Kit (SDK).

Example

SQL Server running on Windows NT takes advantage of the Windows Sockets interface to SPX, to allow existing NetWare SQL Server clients using the NetWare Redirector and IPX transport supplied by Novell, to communicate with the server that is listening to requests via the Windows Sockets interface.

How to Get More Information about Windows NT and NetWare

There are several locations for the latest information on Windows NT/NetWare Integration. They include:

The Windows NT Resource Guide	**Volume 1** Chapters 16 and 20
CompuServe:	Go to NOVFILES and select the client kits. Under this you will find the option to download the Windows NT-based client software. You will be downloading one large file, named NWTI.EXE. Executing this file will expose a variety of files needed for the installation.

How to Get the NWCS Beta

You must first install the Microsoft Windows NT and Windows NT Advanced Server Service Pack 1 before installing the Microsoft NetWare Workstation Compatible Service software. You may obtain the U.S. Version of Service Pack 1 electronically from the following locations.

Internet: FTP to ftp.microsoft.com. Login as Anonymous and please use your email address as your password. Service Pack 1 can be found in \advsys\winnt\sup-ed\fixes\ussp1.

CompuServe: Connect via Compuserve and go to the WINNT Forum (see "CompuServe Support" details below) where Service Pack 1 can be found.

You may also obtain the Microsoft Windows NT and Windows NT Advanced Server (U.S. Version) Service Pack 1 (update to build 528: CSD002) in the United States, by calling Microsoft Sales and Service at (800) 426-9400. The Service Pack is available for $14.95 including shipping and handling. In Canada, please call (800) 563-9048. Outside the United States and Canada, please contact your local Microsoft Subsidiary. If you are utilizing a localized installation of Windows NT or Windows NT Advanced Server, your system will require a localized version of Service Pack 1. Please contact your local Microsoft Subsidiary for additional information concerning localized versions of the Service Pack.

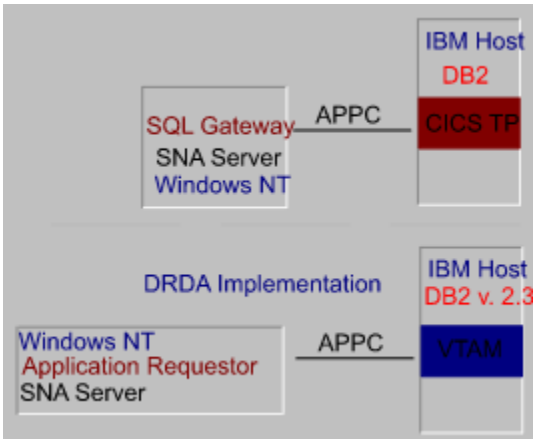
Installing Service Pack 1 is quickly and easily accomplished and will maintain previous system settings and user groups. Simply insert Disk 1 and at the Windows NT command prompt, execute UPDATE.EXE from the floppy disk. The Setup program will be invoked to guide you through the update procedure, prompting for each disk until the update is complete. This entire process will take approximately 5 minutes.

If you require a CD-ROM update for MIPS systems, please contact Microsoft Sales and Service as specified above. DEC Alpha AXP systems do not require this update and should already be running the Alpha AXP retail release. Please note README.TXT on Disk 1 of Service Pack 1 for further information.

Extending and Enhancing Mainframe DBMS to the LAN

While Windows NT™ provides excellent connectivity to mainframe applications, it also facilitates better cooperative processing between mainframe databases and the desktop. Through ODBC or Open Database Connectivity, Windows NT allows DBAs on the LAN to more easily access and manipulate mainframe data and provides integration with Windows™ or Windows NT based-applications. This section outlines the various methods of integrating Windows desktops with host DBMS. It highlights both Microsoft® Windows NT as a communications and databse gateway as well as the use of ODBC to integrate applications.

The Gateway Component of Host Database Connectivity



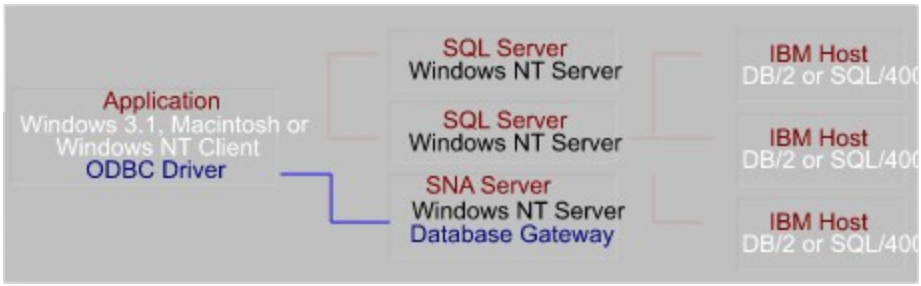
The diagram above represents two methods of host integration. In the first scenario, the gateway or ODBC driver communicates via APPC to CICS transaction program. The SQL translation occurs on the client and the request is issued by the CICS transaction program. If the requirements include making queries that return very large result sets, or if there is a need to invoke stored procedures this method provides a high degree of reliability and flexibility.

The second part of the diagram illustrates the connectivity where the host contains IBMs DRDA. DRDA facilitates the retrieval and integration from a variety of IBM relational data sources. While this solution does not provide the high degree of flexibility as the former method, it does not require the customer to purchase additional host code if they have DB2/MVS ver 2.3, DB2/VM ver 3.3.

Extending Decision Support and ad-hoc Query to the Desktop

As connectivity and integration of host and LAN-based RDBMS improves, customers benefit in terms of costs and flexibility. By distributing host data to LAN RDBMS organizations can increase response time, reduce expensive network traffic and provide decision-makers with a greater variety of information. The diagram below shows how users can read, write and query LAN-based RDBMS during the day, reconciling tables with respective hosts at night.

Additionally, by using ODBC, developers can easily integrate database sources into both desktop applications like Microsoft® Excel and Lotus® 1-2-3, as well as high level development tools like Microsoft® Visual Basic®. It also improves IS department responsiveness by reducing development time.



The client can use any application which supports ODBC to communicate either with a LAN RDBMS or mainframe database. The database gateway interprets the request or command and sends it to the host. The gateway approach to receiving host data is especially effective if there is a lot of information to be moved to the LAN. Most database gateways provide advanced functions such as the ability to run remote stored procedures on the host. A user may request some information that is stored in several sources. By using the gateway, a SQL request may be initiated against a DB2 host, and then a remote stored procedure is launched against a non-relational source such as IMS or a proprietary application.

Many companies use database gateways both to access host data in real time and to move some subset of the database down to a local level for decision support.

For More information on Host DBMS integration contact:

Information Builders	(800) 969 INFO
MicroDecisionware	(303) 443-2706
XDB Systems	(301) 317-6800

On-Line Transaction Processing from Desktop to Host

Often, there is a need for direct host database access with real-time data. Reservation systems, for example, need to read and write against the latest table information. Until recently, there were few effective methods of directly accessing DB2 data from the desktop. However, through the use of ODBC, any application can now incorporate live DB2 information from Windows or Windows NT desktops. The diagram below illustrates a powerful implementation of an ODBC driver that incorporates both APPC

communications and SQL translation at the desktop so the PC can communicate directly with DB2 using IBMs DRDA protocol.

Obviously, the direct connection method is more viable in less transaction intensive scenarios, or where the economies of scale derived from a gateway implementation would not be recouped from a small number of workstations. Examples include travel agencies or branch offices that need real-time access at minimal resource costs.

Wall Data, a leading mainframe connectivity ISV provides an ODBC driver, APPC engine and DRDA Application Requester in a single package. This solution requires no additional host code other than that supplied by IBM for DB2/MVS ver 2.3, DB2/VM ver 3.3 or OS400 2.1.

Because the driver is ODBC-compliant, it integrates easily with applications like Microsoft Excel, Microsoft Word, Microsoft Visual Basic® and Microsoft Access® as well as Lotus 1-2-3 and other productivity and development applications. This significantly reduces development time for front-end applications and allows users to integrate information from various sources. Unlike terminal emulation, direct DBMS access simplifies access to the data and allows users to focus on working with information.

For more information on direct Client/Host DRDA connectivity please contact:

Wall Data (206)-881-5995

Available ODBC Drivers

Company Name	Sales Phone	Databases Supported
ASK Group	800 4INGRES	or 1-800-4INGRES
Beneteau Consulting	514-486-5534	Allbase
Born Software Development Group	800-624-5102	AS/400
Bull Worldwide Information Systems	602-862-6062	Oracle
CCA - Computer Corporation of America (PRAXIS International)	617-492-8860	Model 204
Cincom Systems	800-662-2300	SUPRA Server
CNA Computer Systems Engineering Inc.	206-861-4736	
Computer Associates	800-CALL-CAI	IDMS & Datacom
Coromandel	718-793-7963	Integra-SQL
CROSS ACCESS Corporation	703-684-2345	DB2
Datafit Limited	+44-480-454-604	Datafit DP4
DEC	800-DIGITAL	DEC Rdb
Dharma Systems	603-886-1400	BASISplus
FFE Software	510-232-6800	FirstSQL
gfs - Gesellschaft für Informationssysteme	+49-40/48-06-32-0	
Hewlett Packard	800-637-7740	HP AllBase
IBM	Contact local sales office	AS/400
Independence Technologies	510-438-2000	DB2
Information Builders	800-969-INFO	DB2
Informix	415-926-6688	Informix
Liberty Software Corporation	604-682-8239	PICK DBMS
MDBS	317-447-1122	MDBS IV

MDI	800-221-3634	DB2
Microrim	800-628-6990	R:BASE
Microsoft	800-227-4679	SQL Server
Must Software	800-441-MUST	DB2
NCR Corporation	Contact NCR Representative or NCR office	Teradata Database System
Neon Systems	800-466-2990	DB2
Objectivity	415-688-0939	Objectivity/DB
Oracle	800-633-0583; 415-506-7000	Oracle 7
PageAhead Software Corp	800-967-9671	Software kits for developing ODBC Drivers
OpenLink Software	313-642-1890	Progress
Progress Software	617-280-4000	Progress RDBMS v7.0
Quadbase Systems Inc.	408-738-6989	Quadbase-SQL for Windows
Quark Research	203-666-3870	DBase III
Raima	800-327-2462	Raima DBS Server 1.1
Red Brick Systems	408-399-3277	Red Brick Warehouse
SAS Institute	919-677-8000	SAS
ShowCase Corporatioin	800-829-3555	AS/400
SMC	612-452-9270	DMS-1100 on Unisys 1100 & 2200 series hosts
Software AG	800-423-2227	ADABAS
Sybase	800-879-2273	SQL Server
Tandem	800-482-6336	Tandem Non-stop SQL
Techgnosis Inc.	617-229-6100	
Trinzic	617-891-6500	CA-IDMS
UniSQL	800-451-DBMS	UniSQL/M
Vertisoft Research Inc.	416-321-0933	
Visionware	+44-532-788858	Informix

Wall Data	800-881-5995	DB2
WATCOM	1-800-265-4555	Watcom SQL
White Cross Systems Inc.	+44-344-700700	
XDB Systems	301-317-6800	XDB

ODBC Drivers that Support DB2

Company	Shipping	Comments
Cross Access	Available Now	Host Component Required
Digital Equipment Corp	Available Now	Host Component Required
Information Builders	Available Now	Host Component Required
Ingress	Available Now	Host Component Required
Micro Decisionware	Q 3 '94	DRDA Compliant: No Host Component Required
MicroDecisionware	Available Now	Host Component Required
Must Software	Available Now	Host Component Required
Neon Systems	Available Now	Host Component Required
Netwise	Available Now	Host Component Required
Q+E Software	Available Now	No Host Component Required w/ DRDA version
Rocket Software	Q3 '94	No Host Component Required; Supports DRDA
Sybase OmniSQL Gateway	Q1 '94	Host Component Required
Trinzic InfoHub	Available Now	Host Component Required
Wall Data	Q1 '94	No Host Component Required
XDB Systems	Available Now	No Host Component required w/ DRDA version

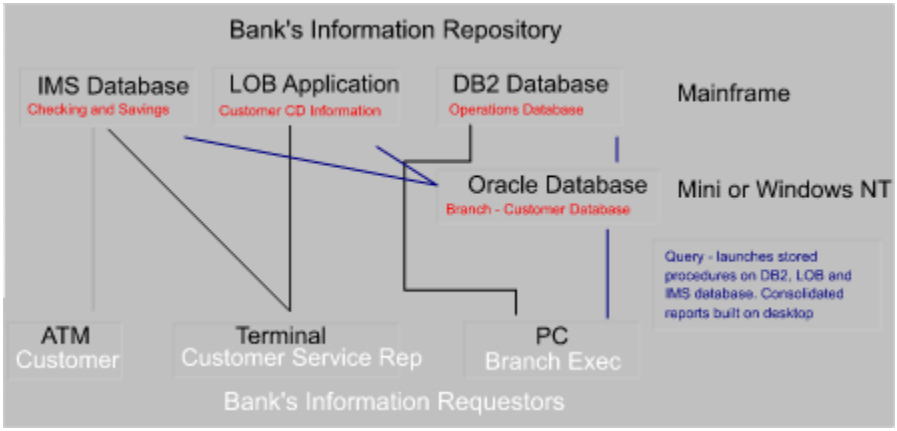
Using Windows NT as a Communications and Database Gateway

(Click on diagram for more details)

There are several advantages of using Windows NT as the platform for host-DBMS connectivity and integration.

- Flexible connectivity options provide a range of concurrent host connections.
- You can easily integrate both communications services (APPC) and database gateway functions on to single machine.
- Centralized administration and performance monitoring of all components.
- Scalability - Ability to utilize SMP hardware and scale as demands increase.
- Ease of configuration. Windows NT has a graphical configuration utility that simplifies user management.
- Can be easily integrated with NetWare, LAN Manager or LAN Server environment.

Empowering Decision Makers Through Client Server Implementations



In this banking scenario, most of the key customer information is stored in non-relational sources. In a given ***down-sizing*** program, mission critical data is seldom the first to move to client server implementations. Instead, firms will look to newer, more profitable programs or services such as personal banking. By creating a RDBMS that contains customer information, the bank can migrate relevant information from non-relational sources to create a comprehensive set of views on a particular customer. Using graphical Executive Information System tools, the personal banker can obtain detailed reports on specific customer segments. Using components such as database gateways. The user can obtain information from both relational and non-relational sources. The database gateway can launch remote stored procedures to query non-relational applications and handle the complexity of information retrieval. The user is fed valuable data which, when presented in graphical format, can dramatically improve productivity and responsiveness.

APPC Transport for Database Gateway Connectivity

Advanced Program to Program Communications is the transport mechanism most database gateways use to communicate to either IBMs DRDA host component or their own proprietary host component which usually runs as a CICS transaction program. SNA Server for Windows NT provides this transport both at the gateway but also at the client. In the case of the latter, no emulation software is required at the client.

LAN Protocols Supported from Client to Database Gateway

Because Windows NT is protocol independent, it can support all major network protocols including:

- TCP/IP
- IPX
- NETBEUI
- DecNet
- IP
- XNS
- OSI

Client Architecture for Host DBMS Integration

Because most database gateways work in conjunction with LAN RDBMS, there are numerous methods of accessing host data. In this case we have illustrated two interfaces for Microsoft SQL Server. Using either ODBC or DB-Library™, applications can access SQL Server. Database gateways such as MicroDecisionware interpret both ODBC and DB-Library™ calls (as well as others from other RDBMS vendors). The gateway is intelligent and determines if the client request is bound for the host. If so, it makes the syntactical changes and forwards the request to the host.

ODBC is currently supported by a number of applications and programming languages including Microsoft Visual Basic and Microsoft Visual C++. By Using ODBC, the developer removes much of the complexity of host communication from the development effort. It helps companies get more use from productivity applications such as spreadsheets and word processors which are familiar to end-users.

Host Components of Client/Host DBMS Integration

In most database gateway configurations, there is both a server and host component. The host component often runs as a CICS transaction program that in turn communicates with the database. The advantage of this implementation is the speed and throughput especially where large transactions are necessary.

In some case such as the Micro Decisionware Access Server (their host component to the MDI gateway), the host software enables the host to take on a proactive role and launch remote stored procedures on other hosts or on LAN-based RDBMS. This is effective both in decision support where the host can update LAN sources, and in distributed.

Client Server Architecture for Distributed Database Applications

The basic architecture for client-server systems consists of separate client and server platforms. The platforms can have different machine architectures and operating systems; however, the interfaces and protocol linking the platforms together must be compatible.

On the client platform, the application is programmed to a client interface (also known as an API). The client interface accepts requests from the application, usually in the format of SQL statements, and emits a specific protocol over the network transport. For example, a Microsoft SQL Server application programmed to the DB-Library™ API, accepts requests in the format of Transact-SQL™, and emits the tabular data stream (TDS) protocol over a named pipe to the server platform.

On the server platform, requests are received by the server interface and processed by the server engine. Results are then returned to the client using the same protocol. The server interface is usually considered to be an integral part of the database system, but it can be used separately (as in the case of database gateways). Continuing with the above example, the Open Data Services component of SQL Server receives the requests and returns results, both in the TDS protocol.

Note the differences between the client and server interfaces. The client interface is the typical API consisting of a set of procedural calls; the server interface is highly eventdriven, involving procedures within the server as needed.

Also note the differences between the interfaces and the protocol. The interfaces provide the mechanism to emit and receive the protocol; the protocol is simply a set of data structures (or control blocks) that flow between the platforms over some communications transport.

Approaches to Database Connectivity

As you scale client-server systems up to the enterprise level, the problem of database connectivity becomes critical. Enterprise data exists in a heterogeneous environment. There are many different databases, servers, interfaces, and protocols that must interconnect with client applications. How can you minimize the effort of developing client applications but still use enterprise data in whatever environment its in?

Problems with connectivity with SQL database servers occur because of differences in SQL dialects, system catalog tables, datatype definitions and conversions, status codes and messages, and collating sequences of ORDER BY clauses.

There are three basic approaches to solving these connectivity problems (described in Hackathorn, 1993):

Common interface

Common gateway

Common protocol

The goal for all three approaches is to localize the knowledge of specific database servers so that the application code does not change as different database servers are used. In these three approaches, this knowledge should be embedded in the interface, gateway, and protocol, respectively. In most real situations, these approaches are often used in combination with one another.

Common-interface approach

Common-gateway approach

Common protocol approach

Common-Interface Approach

The common-interface approach separates the client interface into two layers, similar to the Microsoft **Windows Open Services Architecture**. The API in front of the client interface is the set of procedures that the application sees; the SPI in back of the client interface (also called the driver manager) is the set of procedures that the client driver sees. The client drivers contain the code that is unique to a specific database server. The application code need not change as different client drivers are used.

Within the Microsoft Windows NT based architecture, the common-interface approach is used for the WOSA component of Open Database Connectivity (ODBC). Evolved from the call-level interface specification of the SQL Access Group, ODBC supports a vendor-neutral means for accessing heterogeneous databases in the enterprise. Using the SQL language as a connectivity language, ODBC can access both relational and non-relational data.

Note that ODBC itself is independent of the protocol used by client drivers. Each ODBC driver can send its requests to various database servers using different protocol and gateway configurations. ODBC with drivers using the DRDA common protocol are a plausible (and maybe even desirable) combination.

Common Gateway Approach

The common-gateway approach adds a new layer to the client-server architecture the database gateway. By combining a server interface with a client interface, a database gateway can add value with code unique to a specific database server. Again, the application code need not change as different gateways connect to various servers.

Within the Microsoft-based architecture, the common-gateway approach is used by the Microsoft Open Data Services package that extends WOSA to multilevel architectures. Applications that use ODBC to access enterprise data can be interconnected with various gateways using Open Data Services, as shown in the following illustration. These gateways can be developed and marketed by independent software vendors to support important databases, such as the Database Gateway family by Micro Decisionware, Inc. Or custom gateways can be developed by corporate developers to support functions unique to their systems.

Common Protocol Approach

The common-protocol approach, uses a protocol in common with various database servers. As long as client interfaces and server interfaces emit and receive the same protocol, applications can plug and play with various database servers. Again, the application code need not change as different database servers are used. The common-protocol approach has the greatest potential for greater database connectivity, but a good protocol for database connectivity is very difficult to correctly define and implement.

DRDA is an excellent example of a common-protocol approach. As such, DRDA can have numerous interconnects with common-interface approaches (such as ODBC) and with common-gateway approaches (such as those using Open Data Services).

ODBC Driver Tools

The following Represent a list of driver tools for developing custom ODBC Drivers:

Dharma Systems

PageAhead

Syware

ODBC Development Tools - Dharma Systems

15 Trafalgar Square
Nashua, NH 03063
Phone: 603-886-1400
Fax: 603-883-6904
Outside of the U.S.
Phone: 603-886-1400 x21

Dharma SQL Product Family

The Dharma SQL Product Family is available to DBMS providers, corporate end-users and vertical application vendors

utilizing proprietary DBMS technology. Users of proprietary DBMS's can now maintain high performance and specialized functionality while gaining openness and accessibility to industry standard database technologies. Dharma's products comply with international SQL standards including ANSI SQL, Oracle SQL, and National Institute of Standards (NIST) FIPS 127-1. Dharma Systems' products will conform to emerging standards such as SQL 92, SQL III, SQL Access Group, X/Open and ODBC.

The Dharma SQL interface transforms proprietary DBMS through its portability across diverse proprietary DBMS storage environments, its capability to work in client/server environments, sophisticated SQL optimization technology, and modular implementation in object-oriented C++.

The Dharma SQL Product Family is ideally suited to transform proprietary DBMS's, including on-line transaction processing (OLTP), PICK, engineering, textual, and object-oriented databases. With Dharma, users can continue to use mature proprietary database systems along with industry standard RDBMS's.

ODBC Development Tools - PageAhead

2125 Western Avenue, Suite 301
Seattle, WA 98121 USA
Phone: 206-441-0340
Fax: 206-441-9876
Sales: 1-800-967-9671

PageAhead Software's Simba ODBC Driver Tools provide you with all of the source code you need to quickly develop your own high-quality, fully-functional ODBC driver. With the Simba tools, you can build an ODBC driver in less time and at less cost than drivers developed in-house or using another vendor. Companies like IBM, Apple, Hewlett-Packard, Bull HN, Microsoft, Oracle, Ingres, Timberline, and Red Brick have all chosen to use the Simba tools to produce their ODBC drivers.

Simba SQL Engine for ODBC

If you have a non-SQL data source, you will need to add SQL functionality in order to implement ODBC. The Simba SQL Engine for ODBC Software Development Kit provides the fully-optimized SQL engine and related components needed to create high-performance ODBC drivers for non-SQL data sources. The Simba SQL Engine was specially designed to add SQL capabilities to a variety of non-SQL data sources such as accounting data, VAX/VMS information, COBOL data, and project management data. More than eight person years of testing went into the Simba SQL Engine, so you can be sure that you are getting the most reliable ODBC technology available today. The Simba SQL Engine also protects your investment in SQL technology. Using the Simba SQL Engine SDK, you can have a fully-functional, high-performance ODBC driver in just a few months.

Simba Interface for ODBC

If you have a SQL data source, you may want to use the Simba Interface for ODBC to create your ODBC driver. The Simba Interface provides a comprehensive driver development framework and all the source code needed to quickly develop an ODBC driver for a SQL data source.

If you prefer, PageAhead's ODBC Development Services Group can build your driver for you. Whether you use the Simba ODBC Driver Tools to create your ODBC driver in-house or have PageAhead build it for you, you'll have a finished ODBC driver faster, at significantly less cost, and of higher quality than through any other alternative.

The PageAhead Mission

PageAhead Software provides connectivity and data access software and services for users and developers with multiple data sources in desktop and server environments.

ODBC Development Tools - Syware

P.O. Box 91 Kendall
Cambridge, MA 02142
(617) 497-1376

Dr. Deebee is a RE-DISTRIBUTABLE utility that generates trace logs that are 100% compatible with ODBC Spy.(see ODBC SDK v2.0) Dr. DeeBee was developed by SYWARE, inc., the same company that developed ODBC Spy for Microsoft.

Your customer support organization will find Dr. DeeBee invaluable as an aid to tracking down problems your customers are having with your ODBC applications and drivers. Dr. DeeBee monitors the activity between an ODBC enabled application and an ODBC driver, and creates a log of the calls. Your customer support organization can then examine these logs and replay them using ODBC Spy's replay capabilities.

Windows Objects

The key to an effective object technology is simplicity. Objects are merely reusable components designed to:

- **Create cost effective reusable components**
- **Deliver customized solutions**
- **Reduce development time**
- **Simplify code maintenance**

The Windows™ Objects Strategy describes a long term **component software** strategy that includes a general model for how **components** cooperate with one another. It also encompasses the operating system, programming tools, and programming interfaces through which the vision of component software can be achieved and delivered to users and creators.

What is Component Software?

As its name suggests, component software is based on the notion of a component, which is a reusable piece of software that you can "plug into" other components from other vendors, with relatively little effort. (**See Example**)

In contrast, traditional applications are **monolithic**, which means that they come pre-packaged with a wide range of features, most of which can't be removed or replaced with alternatives.

If different software packages could talk to one another, it would not only be possible for one application to use another application's data, but applications could automatically control the actions of other packages, and automate many tasks that users now perform manually.

Benefits for Corporations

Building Component Software

Example

A component might be a spelling checker, sold by one vendor, that can be plugged into several different word processing applications from multiple vendors.

Object Linking and Embedding 2.0

OLE 2.0 is a breakthrough for component software, because it provides a standard way of defining what an **object** is and how objects can interact with each other. With OLE 2.0, objects written by programmers from different companies can interact with each other in a synergistic manner--without knowing anything about the specifics of how individual objects work.

Although an evolutionary step, component software represents a "quiet revolution" that will transform the way software is produced and used. The concept is similar to networking, which allows two computers to exchange data without having to know anything about each other.

See Also:

An Evolutionary Path to the Future

Third Party Supporters of OLE 2.0

Building Component Software

Component software offers a more efficient and productive model for the software industry. It is a superior alternative to building **monolithic applications**, enabling vendors to construct software, with the aid of readily available building blocks, that can be plugged into current applications that support the same standard for component communications.

Using components, building an application consists of two jobs:

1. Creating the software engine and unique application features that differentiate the product from all others (this is usually done from scratch)
2. Integrating off-the-shelf components into the application to provide all the "extras" that most customers expect, but which are not necessary to implement from scratch

The Benefits of a Component Software Market

The "componentization" of the software market will benefit all vendors, from the smallest to the largest.

Just a few of the advantages of a component software market are:

Decreased Development Costs
Better Industry Efficiency
Faster Time-to-Market
More Niche Markets
Better Maintainance
Open Programming Architecture

A large number of vendors are already supporting Windows Objects by incorporating OLE 2.0 capabilities into their applications. These vendors will be able to take advantage of a large quantity of off-the-shelf component software from third party vendors as it becomes available. **Third Party Supporters of OLE 2**

Significantly, Windows Objects allows programmers to plug their applications or components into other components without knowing the details of how these components were built. Instead, it is only necessary to know something about the capabilities supported by a component for an application to communicate with it. As a result, the new generation of applications will be more modular, more easily revised, more easily customized, and much better able to meet the demands of users.

Benefits for End-Users

Objects eliminate many of the current boundaries between applications, allowing you as a user to perceive your computing environment as a single, large application that looks and acts in a consistent manner. In most cases, you will not even realize that you are using several applications from different vendors. The document-centric approach provides a more natural and intuitive way to work with computers, increasing your productivity while decreasing training and support costs.

A sampling of some of the new features offered by OLE 2.0 includes:

Visual Editing
Drag and Drop
Nested Object Support
Automation

The document-centric approach is an excellent method for combining productivity applcations; the **object model** is extensible and includes interfaces for services, such as vendors, to extend the object model and include useful features, such as real time stock quotes. By standardizing the interface to these services, any application can be extended to include external value-added services.

Example of a Compound Document

Benefits for Corporations

Windows Objects will improve the way corporations purchase, distribute, manage, and maintain software packages.

Here are just a few ways that Windows Objects will improve the state of corporate computing:

More Choices
Better Quality
Better Integration
Easier Custom Solutions
Reduced Training And Support
Better Return On Investment

The "glue" that holds these systems together is OLE 2.0, which provides a standard means of communication among all the modules, and offers a layer of "insulation" between modules, which allows them to be flexibly plugged and unplugged from the system. As a result, future modules can be added without disrupting the system or modifying existing modules. Also, since OLE 2.0 is the standard for object linking and embedding in the Microsoft® Windows environment, a wide range of off-the-shelf OLE 2.0 products will be available.

Cairo: Advanced Object Technology

The next step after the distributed version of OLE 2.0 will be an operating system known as "Cairo." Based on the recently released Microsoft Windows NT operating system, Cairo is a new operating environment that is designed to make creating, accessing, manipulating, organizing, and sharing information easier for computer users. It offers an advanced, object-oriented environment that lets you focus on manipulating information, not on manipulating applications or navigating networks. To do this, Cairo integrates a number of new and existing technologies that change the way people use computers while making computers much more intuitive to use.

More on Cairo

More on Cairo

With Cairo, the complexity of networking disappears.

Cairo completely hides the boundaries between physical objects, such as computers and disk drives, allowing you to easily and confidently locate or access any information anywhere in your organization--even on non-Cairo machines. With Cairo, an organization's entire computing resources appear as if they were contained locally within every user's computer.

Cairo also offers a new paradigm for accessing data. Instead of searching for information, Cairo users "ask" for it, supplementing the traditional "search and browse" paradigm that most computers employ today. To enable this, powerful query capabilities are built directly into Cairo's file system, allowing you to find objects anywhere in your organization by entering a few simple search criteria. For example, you could query for all documents written by Jill Smith after June 11, 1994 that contain the text "ray tracing on spherical surfaces." This kind of searching is made possible by the way in which Cairo stores information--as objects, rather than as simple streams of data commonly found in traditional files. It is therefore possible to query for documents, printers, services, users, machines, and almost everything else in this manner.

An Evolutionary Path to the Future

Currently, OLE 2.0 offers integration within the boundaries of a single machine. Soon, Microsoft plans to release a new version of OLE that will work across networks, allowing you to tie information together on different personal computers no matter where those computers reside. This new "distributed" version of OLE will require no changes to existing OLE 2.0-based applications. An existing OLE 2.0 application can immediately begin connecting to other applications on other machines, in a manner that is completely transparent to users.

Although the evolution from the current version of OLE 2.0 to Cairo offers dramatic changes in the way computers will be used, it will not require changes to existing applications. Much of the advanced technology that will be available in the future will simply be "inherited" by existing applications, with no changes to the applications themselves. Independent software vendors and corporate IS engineers can begin implementing solutions today using OLE 2.0 and be assured that this solution can tap into the power of future systems.

Related Topics:

Cairo: Advanced Object Technology

For Vendors

Component software will reduce the skyrocketing complexity of software development, reduce software development costs, and create a more diverse set of market segments and niches for small, medium, and large vendors.

For Users

Component software means a much greater range of software choices, and better productivity. As users recognize the possibilities of component software, demand is likely to increase for specialized components that you can purchase at a local software retail outlet and "plug into" applications.

For Corporations

Component software means lowering the cost of corporate computing, helping IS departments work more efficiently, and enabling your users to be more productive. This is likely to drive an even greater demand for software among businesses, especially for specialized components that solve business-specific needs.

More Choices

Since Windows Objects enables the proliferation of a large number of components from all vendors, corporations will be able to choose from a larger pool of technologies that can be tailored to meet highly specific business needs.

Better Quality

Broad-based participation in the component software market by small, medium, and large vendors will increase competition for discrete functions, which should produce more innovative and higher quality software.

Better Integration

Because software will support a standard method of component-level communication, products from a wide range of vendors will interoperate more fully than today's applications. As a result, your users will find it easier to exchange data between applications, and systems analysts will be able to more easily build custom business solutions with off-the-shelf applications.

Easier Custom Solutions

The Windows Objects framework will enable you to easily plug a wide range of components into applications, allowing a much greater range of application customization than is available today.

For example, you will be able to plug custom modules into a database application to provide a range of custom functions such as specialized financial modules, equation editing, scientific analysis, run-time tutorials, charting, and data compression. You will be able to get the functions that you need, in a more cost-effective manner. Likewise, IS technical staff will be able to build custom solutions in far less time by taking advantage of capabilities such as cross-application macro languages, which are enabled by OLE automation.

Reduced Training and Support

OLE 2.0 ushers in a new era of ease-of-use for applications.

Although users will always need some level of support, OLE 2.0 applications will be more intuitive for your users, enabling them to be less reliant on training and support resources. The greater integration among applications will also allow you to more easily build your own integrated business solutions using off-the-shelf products, an advantage that will remove some of the workload from already overburdened IS support staffs.

Better Return on Investment

Corporate software investments will not be wasted. Most larger corporations spend millions of dollars on software, only to use it in a highly inefficient manner. Since component software allows you to get the functions you need in a cost-efficient manner, software budgets are not wasted on capabilities that you won't use. As a result, corporate software investments will yield a higher rate of return than today's investments.

Decreased Development Costs

As more components become available, the complexity (and hence the cost) of software development and maintenance should drop, especially for larger vendors with complex products. Component software allows vendors to more effectively tap into the vast resources of other vendors.

Better Industry Efficiency

With a large quantity of readily available components, the burden of reinventing common technologies will be lifted, allowing vendors to concentrate on new, and more innovative features. As a result, advances in technology can occur at a faster pace, and vendors can be more productive and selective in their development efforts.

Faster Time-to-Market

In addition to the more rapid turn-around for new product versions, the functions available to you should increase because of the greater number of compatible components that can be supplied with the application or purchased at their local retailer.

More Niche Markets

All vendors should experience a new renaissance by building innovative components that can be licensed to other vendors or sold directly to users.

Better Maintainance

Because component-based applications are built using plug-in elements, it is possible to upgrade part of an application instead of replacing the entire application with a completely new version.

This means that vendors can deliver upgrades to you on a component basis--without waiting for the "next version" of the entire application to be completed.

Open Programming Architecture

Components can be created using different programming languages such as C++, FORTRAN, COBOL, and Assembly, and then combined to form a complete application.

This gives vendors and users much greater flexibility to combine different types of software from various sources, and also enables programmers with different areas of expertise to cooperate more closely.

Visual Editing

This feature allows you to directly activate objects within documents without switching to a different window. This includes operations such as editing, displaying, recording, and playing.

For example, you can double-click on a spreadsheet in a document and edit it right there, without switching to a new window. All the menus and buttons necessary to edit the object are merged with the controls of the document window.

Drag and Drop

This feature enables you to drag objects from one application window to another, or to drop objects inside other objects.

Nested Object Support

This feature allows you to build new objects from existing ones by embedding objects within other objects.

For example, you could embed a graphic within a range of cells in a spreadsheet that is itself embedded in a document.

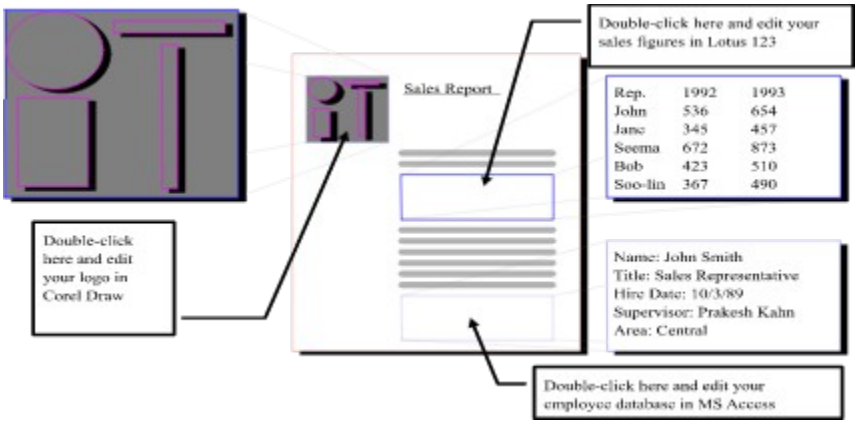
Automation

This feature enables the creation of command sets that operate across applications, as well as within them.

For example, a you could invoke a command from a word processing program that sorts a range of cells in a spreadsheet.

Example of a Compound Document

The compound document metaphor is excellent if you are working with productivity applications. It represents the information and applications that created or retrieved that data as a single application. This simplifies your interaction with the application, and can abstract the details associated with data retrival, or even data manipulation.



Third Party Supporters of OLE 2.0

The following independent software vendors (ISVs) are either currently shipping products supporting OLE 2.0 or plan to release before Spring Comdex.

Above Software, Inc.	Future Labs, Inc.	Lenel Systems International	ReportSmith Corporation
AudioFile	Gilbert & Associates	Looking Glass Software, Inc.	Saqqara Technology
Blue Sky Software	Gold Software Engineering Co	Looking Glass Software, Inc.	Scopus Technology, Inc.
Brio Technology	GST Software	LPC, A Pitney Bowes Company	Sequoia Software Systems
Buzzwords International, Inc.	Helix Systems, Inc.	McLain Imaging	Shapeware
Caliper Corporation	IdentiTech, Inc.	Metaphor	Simulation Technologies, Inc.
Chrisalan Designs, Inc.	ImageFast Software Systems, Inc.	METZ Software, Inc.	Softbridge, Inc.
Cimmetry Systems Inc. (C.S.I.)	ImageWave Software, Inc.	Micro Logic, Inc.	SoftSolutions Technology Corporation
Claris Corp.	InfoPower Corporation	Microcom, Inc.	SPSS Inc.
CompuHelp	Informative Graphics Corporation	Micrografx	STEFRA Enterprise
Corel Systems Corporation	Interleaf	MicroLogic, Inc.	Straylight Software
Crystal Services	Interlinear Technology, Inc.	Microsoft Corp	Summit Software Company
DCA, Inc.	InterTech Imaging Corp.	Morrison Knudsen	Systems Compatibility

		Corporation	Corporation
Design Science	Iris Associates	Object Productivity, Inc.	TeleFile, Inc.
Digital Design, Inc.	JetForm Corporation	Patrick Consult, Inc.	The Athena Group
Digital Equipment Corporation	Kaseworks	PC Quote	Thuridion Software Engineering
DigiVox Corporation	Kedwell Software, Inc.	PCvoice, Inc.	Traffic Software
Dynaware USA, Inc.	Keyfile	Pectronics Corporation	Trax Softworks, Inc.
Dynaware USA, Inc.	KIDASA Software, Inc.	PenKnowledge, Inc.	Walker Richer & Quinn, Inc.
Feith Systems and Software, Inc.	LABTECH (Laboratory Technologies Corp.)	Q+E Software	Watermark Software
		Q/Media Software Corporation	WK Information Systems Ltd

Online Services for Windows NT

Microsoft provides a variety of online services for end users and developers. In addition to the Microsoft TechNet and Developer Network forums on CompuServe, Microsoft sponsors the Microsoft Connection: 24 CompuServe forums that provide information and support for Microsoft products. Facilitated by Microsoft, these forums provide the means for interactive dialog with a large community of other Microsoft customers worldwide, as well as remote access to product information, sample programs, utilities, drivers, and developer tools. Microsoft also supports electronic service requests and provides product support information via modem.

The options described below are available for users who need unlimited access to technical support via modem.

The Microsoft Connection on CompuServe

Current CompuServe users can access the Microsoft Connection by typing GO MICROSOFT at any "!" prompt. To connect to a specific forum or area, type GO <forum or area name>. For more information on the CompuServe information service, call (800) 848-8199.

The Microsoft Connection on CompuServe provides the following services:

The Microsoft Developer Services Area

This centralized area provides developers with technical support and information services for all Microsoft developer products.

End User Services, Networking, MS Windows and MS-DOS, and Developer Forums

Technical support is available on more than 24 CompuServe forums that allow an interactive dialog between users as well as remote access to the Microsoft Knowledge Base of product information, which is updated daily. Microsoft support engineers monitor and participate in all forums to ensure complete and accurate information flow.

Windows Vendors forums

This set of forums provides customers with access to more than 40 companies that produce applications for Windows.

The Microsoft Knowledge Base

This database of technical information on Microsoft products includes bug lists, fix lists, records of documentation errors, and common questions and answers.

The Microsoft Software Library

This library includes binary files, sample code, technical notes, and utilities that users can search by keyword and download locally.

Suggestion/Problem Report
Clients use this form to make product suggestions or to report bugs in Microsoft products. There is no connect-time charge for providing this information to Microsoft.

The Microsoft Central Europe Forum
This unique forum provides support for localized products.

The Microsoft Benelux Forum
This unique forum provides support for localized products.

The Microsoft Italy Forum
This unique forum provides support for localized products.

Other Services

The Microsoft Download Service

This service provides access to printer drivers, technical notes, and supplementary files covering common Microsoft product support issues via modem, 24 hours a day, seven days a week. Call (206) 936-6735.

America Online

Users can access the Microsoft Knowledge Base database of technical product information via America Online. For more information on America Online, call (800) 827-6364.

GE Information Services

Users can also access the Microsoft Knowledge Base database of technical product information and the Microsoft Software Library via GE Information Services. For more information on GE Information Services, call (800) 334-2255.

Internet

Users can access the Microsoft Knowledge Base and the Microsoft Software Library. The Microsoft Internet FTP archive host FTP.MICROSOFT.COM supports anonymous log-in. When logging on as anonymous, please provide your complete e-mail name as your password.

Microsoft Network Product Forums

MSNETWORKS
Client-server computing forum with sections on LAN Manager and other networking issues

MSSQL
Support for Microsoft SQL Server

Users can also access this forum from the developer services area.

MSWRKGRP
Support for Microsoft Windows for Workgroups and Microsoft Mail

Topics include setup, connectivity, sharing, accessories, and File Manager.

Microsoft Windows and MS-DOS Forums

WINNT
Information on Windows NT and support for the beta program

WINSHARE
Utilities and general information about Windows for new users

Support topics include installation, running MS-DOS applications, and printing.

Microsoft Developer Services Forums

MSDNLIB
Microsoft Developer Network technical library forum with a collection of technical articles and sample code

MSDR
Microsoft Developer Relations forum

Discussion of a variety of developer topics; no support.

MSLANG
Language support for C/C++, COBOL, FORTRAN, Macro Assembler, Pascal, and QuickC

MSLANG32
Timely and useful information on the 32-bit language products

WINOBJ
Provides an open platform for discussion and technical assistance on Microsoft Windows Object products, such as OLE

MSNETWORKS
Client-Server Computing forum with sections on LAN Manager and other networking issues

MSSQL
Support for Microsoft SQL Server

End users can also access this forum from the developer services area.

MSWin32
Microsoft Win32 support forum

PROGSMA
Support for WordBasic and the Excel Software Developer's Kit (SDK)

End users can also access this forum from the developer services area.

WINEXT
Windows Extensions forum with support for the Pen Software Developer's Kit and OLE

WINSDK
Windows Software Development Kit support forum

Windows NT Compared to OS/2

If you are considering purchasing an OS/2® 2.1 system or expanding your present system to include OS/2 2.1, it is worthwhile to evaluate how OS/2 2.1 compares with the Windows NT™ operating system. Although they do share some design and implementation goals to solve common business problems, Windows NT and OS/2 2.1 are very different architecturally. This subject discusses both the similarities and the differences between the two systems and examines their suitability for key roles in the enterprise.

Why Windows NT is of Special Interest to OS/2 Customers

Windows NT and OS/2 share a common lineage.

In 1988, Microsoft and IBM made the strategic decision to completely rewrite OS/2 and create a portable, scaleable, and powerful new operating system for the 1990s and beyond. This was the beginning of the project to design Windows NT. Unlike OS/2 2.1, which is based largely on its OS/2 1.x predecessors, Windows NT would leave behind the legacy 16-bit code written primarily for the Intel® 286 processor. Former VMS architect, **Dave Cutler**, and his development team were brought in to develop a modern, 32-bit, portable operating system. At one time, Windows NT was to be OS/2 version 3.0.

Development for OS/2 3.0 began in 1988. While design specifications were submitted by both IBM and Microsoft, development for the product was done at Microsoft.

For OS/2 1.X users, the Presentation Manager user interface is similar in many ways to Windows NT, making it easy for users to navigate through the system. Additionally, character-based and presentation manager programs written for OS/2 1.X are supported under the OS/2 subsystem in Windows NT.

Key Support for OS/2 1.X users Include:

Single Command Prompt - This command prompt supports all OS/2, LAN Manager and most LAN Server commands.

OS/2 application Support - Support for OS/2 1.X character and PRESENTATION MANAGER-based applications.

Migration Tools - Microsoft offers a complete set of migration tools to move LAN Manager users easily to Windows NT Advanced Server.

Support for HPFS -Windows NT supports existing HPFS Volumes. Should you wish to migrate to the Windows NT File System (NTFS) Windows NT provides graphical migration utilities for this process.

Features Common to Both Windows NT and OS/2

The goal of both Windows NT and OS/2 2.1 is to improve your productivity through innovative technology.

This allows you to focus on information and results, not the process of gathering that information, or the tools necessary to manipulate it. However, the implementation of Windows NT gives you greater flexibility to choose from a wider range of hardware and software, as well as better access to data that may exist in legacy systems or on other PCs.

Multithreading and Preemptive Multitasking

Robust System

Support for MS-DOS, 16bit Windows-based and OS/2 1.X Applications

Integration with SNA Environments

Flat Memory Model

Support for FAT, HPFS File Systems

Multithreading: Comparing Windows NT and OS/2

Both OS/2 and Windows NT support multithreading and multitasking.

This means that you can design an application, a spreadsheet for instance, to simultaneously recalculate a large volume of cells, print a large report, and rearrange cells. Windows NT can distribute each **thread context** of each **process** over multiple processors, allowing applications to scale over multiple processors for efficient capacity planning. (See **Example**) OS/2 cannot provide the same multithreading capability because it only supports single processor, Intel-based machines.

The multitasking capabilities of Windows NT are also designed to prevent message queues from monopolizing the processor. Because OS/2 employs a synchronous input queue, the system can freeze or appear to halt due to the fact that input queue must wait for an application to finish its routine. An ill-behaved application may not give back processor time to other applications.

Why Multitasking is More Effective Under Windows NT Than OS/2

Example

An excellent example of this is SQL Server for Windows NT. SQL Server creates a new thread for each user on the system, allowing Windows NT to schedule the threads to use whichever processor is available, improving response time from the database server. Windows NT handles the thread-scheduling of all applications, thus eliminating many of complexities that arise with multi-user server applications.

Why Multitasking is More Effective Under Windows NT than OS/2

Multitasking operating systems with windowing capabilities manage messages from simultaneously-running applications with message queues. Problems can occur, however, if one single message queue manages both internal system tasks and application tasks, which is the situation with OS/2. In this case, an application can monopolize, and even crash the system by blocking the message queue. Busy applications can also freeze the system (when printing a long document, for example), and make you wait for them to finish. When this happens, the main benefit of multitasking, namely higher productivity, is lost.

To prevent this, Windows NT separates the system message queue from the application/window queue. The operating system can then shut down any application that no longer responds to system requests, and the user's service continues uninterrupted.

Robust System: Comparing Windows NT and OS/2

Both OS/2 and Windows NT offer better reliability than the MS-DOS® operating environment. However, because Windows NT is a completely new, modular 32-bit operating system built on the experience of OS/2, it offers you:

- **Better protection**
- **Better performance**
- **Higher reliability for business applications**

How Windows NT achieves these benefits:

32bit operating environment

Hardware Isolation

Application Isolation

Application Isolation: Windows NT and OS/2

By running each application in its own protected subsystem, Windows NT ensures that no application can crash the system. 32-Bit applications run in their own protected address space and therefore cannot crash each other. The only exception to this model currently exists in the Windows subsystem. Because 16-bit Windows-based applications are cooperatively multitasked and run in a common address space, it is possible for an ill-behaved 16-bit Windows application to crash another 16-bit Windows application. However, at no time can a 16-bit Windows application corrupt any other part of the system or any other application.

OS/2 2.1 also prohibits applications from using memory that belongs to other applications. The key difference, however, is that all interactive OS/2 applications (that is, applications that have a user interface) do share areas of memory with parts of the operating system. This design makes it possible for an errant application to corrupt memory on which the operating system depends, which might result in the failure of the operating system. In other words, OS/2 2.1 protects applications from each other but does not protect itself from those applications. This design can pose risks when mission-critical information is at stake.

32-bit Operating Environment: Comparing Windows NT and OS/2

Windows NT has a true 32-bit architecture with all new 32-bit APIs, kernel, subsystems, and device drivers.

In contrast, OS/2 2.1 is internally a mixed 16- and 32-bit operating system. Major 16-bit portions include the device drivers, window manager, file system, and many utilities. This hybrid design results in reduced system performance, less efficient applications, wasted memory, and arbitrary limits on applications. (See **Example**)

Why 32-bit Systems are More Productive Than 16-bit Systems

An operating system that has a true 32-bit architecture delivers increased performance by supporting both 32-bit operations and a 32-bit data path. It can also run 32-bit applications, which have more advanced features (such as multithreading), better performance, and better memory utilization than 16-bit applications. The tradeoffs are usually found in that 32-bit applications are larger and require greater system resources to derive the benefits.

Example

OS/2 2.1 requires extensive thunking to perform basic system operations. Thunking is the process of converting a 16-bit API call into a 32-bit call (or vice versa) required on systems with both 16- and 32-bit components. Thunks add system overhead and degrade performance.

Hardware Isolation: Comparing Windows NT and OS/2

Windows NT is protected from errant applications through hardware isolation, so that operating system to failure is drastically reduced.

With Windows NT, applications cannot directly access hardware. Instead, they must make all hardware requests to the Windows NT operating system. And, because Windows NT does not allow applications to access any memory that belongs to the operating system, no application can cause the operating system to fail.

Integration with SNA Environments: Comparing Windows NT and OS/2

Both OS/2 and Windows NT provide support for SNA systems such as AS/400® midrange, as well as System 390 mainframe class machines. OS/2 uses IBM's Communications Manager for SNA environments, whereas Microsoft provides SNA Server for Windows NT. SNA Server is a communications system that facilitates seamless, well-managed connectivity from LANs or remotely connected PCs to IBM® host and midrange systems.

SNA Server for Windows NT gives you these benefits over OS/2's integration with SNA environments

- **Windows NT has more administration tools.**
- **Windows NT offers an intuitive and graphical configuration and management facilities.**
- **Windows NT has broad support from third parties.**
- **Windows NT is tightly integrated with SNA Server.**

More on SNA Server for Windows NT

More on Integrating Windows NT with IBM Host Systems

Application Support: Comparing Windows NT and OS/2

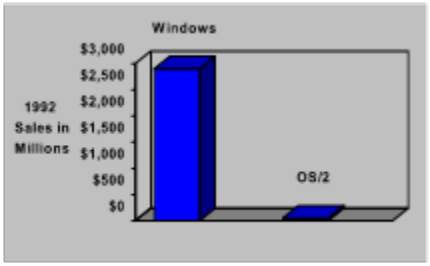
An important distinction between Windows NT and OS/2 is that Windows NT allows 16-bit and 32-bit applications for Windows to integrate seamlessly through facilities such as OLE and WOSA. OS/2 does not.

Windows NT provides backward and forward compatibility for applications, allowing you to run MS-DOS- and Windows™-based applications on both Intel and RISC platforms without modification. It also supports both 16-bit and 32-bit Windows-based, character-based OS/2, and POSIX-compliant applications.

OS/2 support for applications is limited. Since the market for Presentation Manager applications and tools is also limited (See **graph**), OS/2 must rely on its ability to run applications for MS-DOS and Windows. Even here, however, OS/2 is significantly limited because it does not run Windows-based applications as well as Windows does. Today, OS/2 2.1's support for key Windows features such as DDE, OLE, and even cut- and paste-between separate Windows **VDMs** do not work consistently.

Data from Microsoft internal testing of the shipping version of OS/2 2.1

Comparing Sales of Applications for Windows and OS/2



Source: Dataquest *1993*

Windows NT Unique Features

One of the fundamental differences between OS/2 and Windows NT is that each one was designed to fulfill different enterprise roles.

OS/2, as a component of SNA and SAA, is most often managed by IBM's NetView®, and for companies that subscribe to the host-centric view, OS/2 provides good integration and is consistent with the host-centric models. Windows NT is designed for the client-server model, although it provides excellent SNA integration and management capabilities.

Only Windows NT Gives You the Benefits of These Components:

Portable Design

SMP Support

Security

Advanced Fault Tolerance

Network Integration

Comprehensive Administration Facilities

Access to Enterprise and Legacy Data

Support for POSIX Applications

Support for 32Bit Windows-based applications

Built in Messaging and Scheduling

Integrated Setup

Portable Design: Comparing Windows NT and OS/2

Unlike previous PC operating systems, which are designed and hard-coded for a single platform, the Windows NT operating system is portable across multiple platforms.

The source of this portability is its layered architecture: within the Windows NT Executive there is a compact, 50K micro **kernel** that handles:

- **Low-level, machine-dependent functions**
- **Multiprocessor synchronization**
- **Thread dispatching**
- **Windows NT kernel object management**

To port Windows NT to a new platform, only the Hardware Abstraction Layer needs to be changed.

In comparison, OS/2 2.1 is not portable; it supports only Intel 386, 486 and Pentium™ processors.

SMP Support: Comparing Windows NT and OS/2

Machines that support multiple CPUs use symmetric multiprocessing (SMP) to distribute tasks evenly among processors, so that you can scale your hardware to meet the changing performance requirements of both your servers and your desktop systems.

The Windows NT **kernel** supports SMP, distributing both kernel threads and application threads among available processors, so that multiple processors can work on a single task. OS/2 2.1 does not currently support SMP-based systems though IBM has demonstrated prototypes of limited Intel-based SMP support and have announced SMP support for future versions of OS/2.

Windows NT supports a broad range of **third party SMP systems**. Including both Intel and RISC-based systems.

More on Symmetric Multiprocessing

Third Party SMP Systems Supported By Windows NT

- Acer
- ALR
- AST
- Compaq
- Corollary
- DEC
- ICL
- Micronics
- NCR
- Olivetti
- Sequent
- Siemens-Nixdorf
- Wyse

Security: Comparing Windows NT and OS/2

Windows NT is designed to meet C2 level Security Specifications.

The Windows NT security system protects critical system resources from tampering, and allows system administrators to restrict user access to sensitive information resident on a desktop or server machine. Additionally, with Windows NT, you cannot accidentally delete system files or critical configuration data.

In contrast, OS/2 2.1 does not provide protection for critical system resources. The only file protection available is offered with LAN Server, an additional package available at additional cost. Consequently, one can accidentally delete key system resources, crash the system, and delete valuable data.

More Information on Windows NT Security

Fault Tolerance: Comparing Windows NT and OS/2

The Windows NT operating system delivers both performance and protection for user data with a new and innovative 32-bit file system called Windows NT File System (NTFS).

In addition to providing effectively unlimited file sizes, NTFS provides faster data input/output (I/O) with dynamic disk-caching, and full data recoverability.

In contrast, OS/2 2.1 does not provide a file system comparable to NTFS. It only supports **FAT**, which is limited to 2 GB disks, and **HPFS**, which is limited to 8 GB disks and does not support the autogenerated short filenames that are essential for backwards compatibility. Additionally, HPFS lacks the transaction log and security functions necessary for complete fault tolerance or integrated security.

How NTFS Works

NTFS Features

How NTFS Works

NTFS works by storing each file-system transaction in a log file. When the system reboots with the file system in an inconsistent state, the Windows NT operating system can refer to the log file to reconstruct the directory structure, and return the file system to its original state.

NTFS Features

NTFS supports both long filenames and MS-DOS-style 8.3 filenames, the High-Performance file system (HPFS), and the FAT file system (FAT). Built-in conversion programs are included with the Windows NT Setup program to convert FAT and HPFS partitions to NTFS. Additionally, Windows NT includes completely non-interruptible power supply and disk backup software as standard features.

Network Integration: Comparing Windows NT and OS/2

Windows NT provides secure and integrated peer-to-peer networking capabilities for both servers and clients, plus Workgroup application services such as an integrated mail system and group-scheduling package.

All Windows NT-based workstations can function as servers, sharing files on local hard disks with users running MS-DOS, Windows, or Windows NT operating systems. Windows NT can make local printers available to other users on the network. To access and share information on local and remote networks, Windows NT can support both local area network transports, such as NetBEUI, DLC, and the industry-standard routable TCP/IP transport, all of which are standard features of Windows NT. Windows NT also facilitates the development of true distributed applications by including a **remote procedure call (RPC)**.

While OS/2 can act as client or server, no basic networking functions are built into the system and hence must be purchased at additional cost. In addition, OS/2 provides no peer sharing capabilities and no workgroup functions to facilitate group productivity.

Windows NT RPC

Windows NT RPC is compatible with the Open Systems Foundation (OSF) Distributed Computing Environment (DCE) standard. It also supports any DCE-compliant server running Windows NT, UNIX®, or VMS, as well as NetBIOS and named pipes, the industry-standard interprocess communications protocols. To facilitate these processes, Windows NT includes the TCP/IP, DLC and NetBEUI protocols as standard features.

Administration: Comparing Windows NT and OS/2

Windows NT can significantly broaden the capabilities of system administration across your entire enterprise, while simplifying the tools and making them accessible to both administrators and applications.

These administration tools include:

- **Comprehensive system monitoring, both locally and across the network**
- **Security auditing**
- **System auditing**
- **User management**
- **Disk management**

Windows NT also addresses configuration management with the **registration database**.

OS/2 possesses few of the administration or management components of Windows NT. While you can have some level of static management from IBM host-based systems, getting it would require you to make major infrastructure and additional purchasing decisions. If you are considering implementing LAN based client server solutions, you will find that OS/2 provides neither the tools nor the facilities to centrally and effectively manage an enterprise with OS/2 desktops, servers, or applications.

More on Windows NT Administration

Windows NT Registration Database

System objects are stored in a database, which allows rollback or replication. All of the Window NT administration tools are available to applications from the Win32® API and may be integrated with larger Network administration tools such as IBM's NetView, or SNMP based systems from companies such as SUN or HP. Applications can add specific items to the performance-monitoring utility such as Transactions per Second, or they can signal administrators if a problem exists.

Access to Enterprise Data: Comparing Windows NT and OS/2

While OS/2 provides very good connectivity to SNA environments, it cannot match the enterprise integration components (WOSA) of Windows NT.

Windows NT, like Windows 3.1 utilizes the Windows Open Services Architecture or WOSA to interoperate with external information sources and services such as database, messaging and networking.

More On the Windows Open Systems Architecture

More on integrating Windows NT and IBM Host DBMS

User Perspective on OS/2 and Windows NT - Single Command Prompt

Both OS/2 and Windows NT allow users to work from the command prompt. In fact, Windows NT supports all MS-DOS, OS/2, POSIX and Windows NT commands from the command line. However, Windows NT provides one universal command prompt that can interpret and run applications.

Users can receive on-line help for any command as well as customize the specific MS-DOS or OS/2 environment to reflect specific application requirements.

Comparing Windows NT and OS/2 From an End-User Perspective

First time users of Windows NT will be pleasantly surprised at the number of features and operating system components inherent in Windows NT that come from both the Windows 3.1 and OS/2 environments.

Subjects in this section:

User Interface

Multitasking Applications

Application Integration

System Requirements

Single Command Prompt

Comparing Windows NT and OS/2 from a Systems Administrator's Perspective

Because both Windows NT and OS/2 were designed as enterprise platforms, it is important that they be easily managed, configured and provide detailed information to system administrators. Windows NT responds through a number of key components including built-in networking, integrated setup and powerful administration tools.

Networking is inherently part of the system. Thus, accessing resources on the network are much easier than they are under OS/2. Windows NT includes a number of intuitive and powerful administration tools designed to make managing the Windows NT system easier and more secure. Aside from providing detailed information on system performance, errors and security, all tools can be used remotely to monitor Windows NT workstation and servers across the Enterprise.

Because the user interface is almost identical to that of Windows 3.1, system administrators will be familiar with the system itself and therefore many of the new functions are inherently easier to learn.

Windows NT Administration Tools

Remote Administration of Windows NT

Windows NT Networking

Features in OS/2 not Contained in Windows NT

There are few components of OS/2 which are not already part of Windows NT. Several of the technologies that IBM have announced for OS/2 such as OpenDoc are not yet available.

As part of its object strategy, IBM have elected to support OpenDoc and SOM instead of Object linking and Embedding (OLE) and COM. However, OpenDoc remains undefined and no applications currently exist to exploit its facilities. Similarly, because there are so few Retail Presentation Manager-based applications (**graph**) and most of the applications such as WordPerfect 5.2 for OS/2 and Lotus 1-2-3 for OS/2 are ports from older Windows 3.1 versions we did not classify that as a unique feature.

The following Features are Currently Unique to OS/2:

Windows 16Bit Applications run in their own Virtual MS-DOS Machine

Support for REXX or other built-in Scripting Language

Comparing the User Interface of OS/2 and Windows NT

Windows NT and OS/2 differ greatly in their user interface. While IBM introduced a new object oriented-like UI called the Workplace Shell, Windows NT utilizes the familiar Windows 3.1 interface. There are over 40 million users of Windows 3.1, and a high degree of familiarity and predictability with the interface. It therefore makes navigating through Windows NT much easier, especially for first time users.

While the Workplace Shell employs numerous usability components such as drag and drop and the ability to store objects on the desktop, it forces the user to shift between application paradigms since most OS/2 users run at least some Windows-based applications.

User Perspective of Multitasking Under OS/2 and Windows NT

The asynchronous message queue in Windows NT provides the benefits of multi-tasking to users.

Both OS/2 and Windows NT support preemptive multitasking which can significantly improve productivity. It allows users to begin a process and instead of waiting for the process to end, the user may work on something else while the first task completes in the background.

The multitasking capabilities of Windows NT are also designed to prevent message queues from monopolizing the processor. Because OS/2 employs a synchronous input queue, the system can freeze or appear to halt due to the fact that input queue must wait for an application to finish its routine. An ill-behaved application may not give back processor time to other applications. Windows NT avoids this problem by employing asynchronous input queues. The benefit to application creators is that Windows NT eliminates the need to programatically release the system while the application processes.

User Perspective of Application Integration in OS/2 and Windows NT

The increased demand for application suites such as Microsoft Office, Lotus Smartsuite and Borland/WordPerfect Office signal a fundamental change in the way users interact with applications. Users expect that they can integrate spreadsheet and word processing documents with other LOB applications. Additionally, it is expected that messaging and data access be available to applications.

Today, Windows and Windows NT provide these services through Object Linking and Embedding (OLE) and the Windows Open Services Architecture (WOSA). These services are available to all applications and provide excellent integration services (Microsoft, Lotus, Borland and WordPerfect all employ OLE technology in their applications).

While Windows NT provides OLE and WOSA services to both 16bit and 32bit applications, OS/2 uses its own object model called SOM which currently has limited support. While SOM provides a framework for developing objects, it provides no end-user features comparable to OLE. In fact, IBM looks to Apple and their OpenDoc framework for application integration functions. However, OpenDoc is just beginning its Alpha testing with developers and it is unlikely applications supporting OpenDoc will ship any time soon.

OLE is only supported in a limited mode of OS/2 between 16bit Windows-based applications. Consequently, users do not get the same functionality they would derive under Windows or Windows NT.

More on Object Linking and Embedding

More on Windows Open Services Architecture

User Perspective of System Requirements for OS/2 and Windows NT

Because OS/2 and Windows NT solve different business problems they have different system requirements. Windows NT is portable, secure and supports symmetric multiprocessing whereas OS/2 is not secure or portable and is designed for the single processor Intel PC. The optimal requirements for both systems as workstations with two to three applications is listed below.

OS/2 2.1:	386 25MHz or greater	150 MB Hard drive 8MB RAM
Windows NT:	486 25MHz or greater	150 MB Hard drive 16 MB RAM

Comparing Performance Monitoring In OS/2 and Windows NT

As an advanced operating system, Windows NT provides an extensive array of built-in tools and programming interfaces designed to make the system manageable. The **Performance Monitor** application allows you to examine over 100 per-process and system-wide counters on your local system as well as remote systems. Many of the counters have names you will readily identify, like page faults, pagefile usage, disk I/O counters, etc.

There are three modes of operation:

Display counters graphically in real time.

Log counter values to a file for later processing.

Alert the system manager if certain counters go above or below a preset value.

More on Performance Monitoring

OS/2 and Windows NT Support for Flat Memory Model

Both OS/2 and Windows NT significantly improve the development environment by providing very large virtual memory addressing for application developers. Windows NT supports up to 2 gigabytes of memory for applications.

Perspective on Windows NT and OS/2

While OS/2 and Windows NT are often compared in terms of features and benefits they are hardly close substitutes. Technically both advanced operating systems, OS/2 provides a limited subset of the Windows NT feature set and unlike Windows NT is nearing the end of its product life cycle. IBM recently announced that the Workplace OS will replace OS/2 as its flagship PC operating system.

The Workplace OS, a new operating system built around a modified Mach kernel, represents a departure from the legacy (Microsoft/IBM) OS/2 code base and IBMs first operating system. The Workplace OS is slated to run protected subsystems such as OS/2, MS-DOS and 16bit Windows, and fix many of the current problems that face OS/2 such as portability, SMP support and an integrated security model.

Windows NT on the other hand is beginning a product life cycle that will incorporate many enhancements including a distributed file system, object-oriented interface and built-in programming language. The following table breaks down some of the advanced operating system components.

Component	Windows NT	IBM OS/2
Platform Supported	**Runs on Intel, R400,R4400, Alpha, PowerPC**	Intel only
Processors Supported	32	1*
Security	Yes (C2 certifiable)	No
Built in Networking	Yes (includes NETBEUI, TCP/IP, IPX and DLC)	No
Application integration model	Object Linking and Embedding	None currently - announced support for OpenDoc**
Application Environment Supported	Windows 32, Windows 16, MS-DOS, OS/2 1.x and POSIX	Windows 16, MS-DOS, OS/2 1.x and OS/2 2.x
Internal OS Components	32 Bit C and C++	approx. 45% 16Bit; Assembly, C and C++
Enterprise Integration model	Windows Open Services Architecture(Database, Messaging, Fax, Networking	add-on support for VIM, DRDA

etc.)

* IBM recently demonstrated a prototype of multiprocessing on limited Intel PCs

**As of 2/1/94 OpenDoc Development Kits are in Alpha testing with no applications shipping

Windows NT Support for POSIX Applications

In the mid-to-late 1980s, U.S. government agencies began specifying POSIX as a procurement standard for government computing contracts. POSIX, an acronym rather loosely defined as "a portable operating system interface based on UNIX," refers to a collection of international standards for UNIX-style operating system interfaces. The POSIX standard (IEEE Standard 1003.1-1988) encourages vendors implementing UNIX-style interfaces to make them compatible, so that programmers can move their applications easily from one system to another. To meet the government's POSIX procurement requirements, Windows NT would be designed to provide a POSIX application execution environment.

OS/2 and Windows NT - File System Support

Both OS/2 and Windows NT provide support for the MS-DOS - FAT and OS/2 HPFS file systems. This means that as you upgrade users from FAT to HPFS both systems can read and write to systems that support both.

However, only Windows NT supports the NTFS system which provides security, fault tolerance and greater disk volume support. Windows NT can also translate long file names into 8.3 names so that users of FAT systems can read files on NTFS volumes.

Integrated Setup of Windows NT

Unlike OS/2, where each component - Networking, security, messaging etc. needs to be purchased and installed as a separate application, Windows NT provides a completely integrated setup that allows for installation of networking, administration tools, mail and scheduling. Because the setup program can be customized by network administrators, it makes deploying Windows NT in an enterprise much easier.

Windows NT Unique Features - Support for 32Bit Windows-based applications

Aside from its support for MS-DOS, 16bit Windows, OS/2 1.x and POSIX applications, Windows NT supports an emerging market of 32Bit applications through its Win32 API. Native to Windows NT, the Win32 interface provides applications with such functions as security, threads and administration as well as advanced graphics. Many of the early adopters include traditional UNIX developers such as Intergraph, Informix, Digital, Sybase and Oracle. OS/2 does not support Win 32.

More on 32Bit Windows-based applications for Windows NT

Comparing Windows NT and OS/2 - Windows NT Support for Messaging

Like Windows for Workgroups, Windows NT includes full support for messaging and group scheduling. Included in the package is an integrated copy of Microsoft Mail and Schedule Plus. These applications can be used for simple store and forward messaging tools or for more advanced workgroup integration. Microsoft Mail can be used with a variety of back-end mail services including HP Open Mail, X.400 systems, SMTP or others.

OS/2 Unique Features - 16-Bit Windows Application Run in Separate VDMs

In targeting the market for Windows 16-bit applications, OS/2 intelligently employs the use of separate VDMs(Virtual MS-DOS Machines) to run these applications in their own address space. The advantage to this approach is that unlike the native Windows 3.1 environment where all application runs in a shared memory environment, OS/2 protects each Windows application from crashing other 16-bit applications. Currently Windows NT does not support this feature.

However, there is one serious drawback in IBMs implementation of this feature. IBM failed to enable application integration technology - OLE across VDMs. This means that if one tries to embed a spreadsheet object from one VDM into a word processor running in another VDM the link will fail. Suite integration from companies such as Microsoft, Lotus and Borland is increasingly strategic to both developers and end-users. It enables users to focus more on projects and tasks and uses components from several applications. From the development perspective, it facilitates the creation of components or objects which can be easily plugged into retail applications. Since the underlying OLE technology that makes this possible is unavailable across VDMs in OS/2 users face limited application functionality.

Recognizing the customer requirements for separate VDMs for 16-Bit Windows-based applications, Microsoft will include this support (including OLE support across VDMs) in the next release of Windows NT.

More on Object Linking and Embedding

Support for REXX or other built-in Scripting Language

Unlike Windows NT, OS/2 provides a built-in scripting language called REXX. However, The Windows NT operating system and shell are programatically exposed through the WIN32 API. While Windows NT, itself, does not include a scripting language Microsoft plans to introduce a 32-Bit version of Visual Basic which will be tightly integrated into the Windows NT operating system.

Today, the Korn Shell the Hamilton C-Shell and REXX are all available for Windows NT. While preserving the expertise in these specific environments, they provide access to the system and its customization, configuration and administrative functions. These tools can be used to automate both end-user and administrative functions such as starting and running applications or configuring user accounts or compiling performance benchmarks of remote servers.

Paragon Trade Brands

Faced with a price war and intense competition, North America's largest private label diaper manufacturer has been aggressively reengineering every phase of its business. In the process, Paragon Trade Brands is using information technology as a strategic weapon to cut costs, improve product quality, and slash response times.

Solution Summary

Case Details

For More Information

Paragon Trade Brands Solution Summary

Industry
Manufacturing and distribution

Business Solution
Manufacturing quality assurance and inventory control systems

Architecture
Custom Microsoft® Windows™-based client application routing manufacturing and inventory data among six sites, over a wide area network, and providing electronic data interchange with key customers.

Products Used
Microsoft® LAN Manager
Microsoft Visual Basic®
Microsoft Windows NT™
Microsoft Windows operating system
Microsoft Excel
Microsoft Word
Paradox® for Windows™

Development Resources
In-house

Development Time and Cost
10 months

Benefit
Expected to improve product quality, reduce product returns, enhance customer relationships, cut product delivery times from 21 to 5 days, and provide a minimum 29 percent return on investment

For More Information

To learn more about Microsoft products, call the Microsoft Sales Information Center at **(800) 426-9400** in the United States. In Canada, call the Microsoft Canada Customer Support Centre at **(800) 563-9048**. If you require text telephone services (TT/TDD), call **(800) 892-5234** in the U.S.A. or **(905) 568-9641** in Canada. Outside the 50 United States and Canada, please contact your local Microsoft subsidiary.

Paragon Trade Brands Case Details

The management at Paragon Trade Brands, North America's largest private label diaper manufacturer, decided it was time for a change.

The company, which was formerly a division of wood and paper products giant Weyerhaeuser, was spun off as an autonomous business unit in an initial public offering in early 1993. That's when Rich Matthews, vice president of management information services and chief information officer, went to work. "If something didn't have a purpose, we eliminated it," explains Matthews.

"Many of the systems in any company have evolved to work around something which no longer exists. We're changing that and slashing costs as a result."

Rich Matthews, Vice President, Management Information Services, Paragon Trade Brands

Paragon's private label diapers are manufactured at five plants across the United States and Canada. The diapers are sold to retail chains, which put their own brand name on them.

In order to compete more effectively with better known brand-name products, Paragon decided to make a fundamental change in the way it does business. Its goal: to cut the time it took to fulfill a customer's order from three weeks to five days--all while providing a higher quality product.

Retailers put their own demands on private label manufacturers. They are reluctant to hold large inventories of private label goods, resulting in smaller batch sizes, shorter response times, and more complexity in manufacturing for their suppliers. For example, Paragon produces more than 1100 stock keeping units (SKUs), compared to just 50 for most branded diaper companies.

Information Delay Affects Quality

As Matthews assessed the situation, he determined that the company's computer system would need to be rebuilt from the ground up. This decision formed the basis for a complete reengineering of Paragon's business.

According to Matthews, the company's reengineering effort, including its plans for accelerated order response times, hinged on flawless manufacturing. As Matthews put it, "If you don't have your manufacturing process under extremely tight control, then all of your quick response plans are irrelevant. For example, if we're running defective diapers and don't find out about it until two weeks later, then we would violate our three-day ship target."

It's up to each Paragon plant to maintain quality, and it's not an easy job. Each machine is different and production of the same type of diaper may require different methods. "Private label customers can specify the features they want," explains Matthews. "So the 'same' diapers may have different tapes, backers, colors, and

designs."

In the worst case, the company might even have to reclaim faulty product from grocery stores. With no extra inventories to serve as a safety buffer, the retail stores would wind up with no product on their shelves, resulting in lost sales. According to Matthews, the mass market channel is extremely demanding. "You can stock out once, maybe twice, and then you have lost the entire account, forever," he says.

Yet Matthews found himself with a mainframe-based computer system that was plagued by an inability to provide timely information about manufacturing processes. "The old system of getting information from the manufacturing floor to headquarters and back just wasn't feasible," he says. "They were trying to collect the data on diskettes, send them back to the corporate office, and generate reports. It took up to two weeks to get quality control information back to the plant." During that time, says Matthews, the company "could have product out there that has already been shipped, used, and complained about."

The magnitude of Matthew's reengineering task was enormous: Paragon produces some 3.5 billion diapers a year. He set to work looking for a solution on which to build the company's future.

Downsizing to a Windows-Based Solution

According to Matthews, the job of creating a new computer system began by downsizing from a mainframe environment. "When I started here, we were a mainframe shop and still part of Weyerhaeuser. We would be losing mission-critical systems when we separated from Weyerhaeuser, and had reached the limit of our computer capacity anyway," recalls Matthews. "It was a major turning point--management had the strategic option of outsourcing our information systems or dramatically upgrading our legacy systems."

The company ported its transaction processing software from the System/38 platform to AS/400® minicomputers at its five manufacturing facilities in the United States and Canada, and began developing analysis systems on PCs. Matthews says the overriding objective was to consolidate information and make it available to everyone who needed it. "We had islands of mainframe data throughout the organization that would have to be manually retyped into spreadsheets every time anyone wanted to write a report," he says. "We realized that if we could somehow link these islands with a common user interface, not only would productivity improve, but the quality of decision-making would also increase with the increased analytical sophistication."

Matthews wanted to link minicomputers, PCs, and **RISC**-based machines into one seamless network, one in which the location of the actual databases would be transparent to the end user. And he had some other objectives. "Our most important criterion was to gather and analyze information about the manufacturing process quickly," says Matthews. That would allow the quality assurance supervisor to halt production in time to cut losses to a minimum. Other important considerations for the

system: it had to be easy enough for any of the floor workers on any shift to use; it had to allow for several different computers to be connected, since there's an average of eight production lines in each of the company's five plants; and it had to be easy to expand as the company grew.

Deciding on a Client-Server Direction

"We wanted to reduce cultural change by implementing a computer system just once. We tested Windows NT and have worked with it enough to know it's a key part of our strategic direction."

Rich Matthews, Vice President, Management Information Services,
Paragon Trade Brands

After evaluating a number of options, including OS/2®, UNIX®, R/6000™, and an expansion of the company's existing AS/400 minicomputer system, he decided to move to a **client-server** environment based on the Microsoft Windows NT operating system. "We looked for the best system--period," says Matthews. "At the same time, we asked ourselves what we're using today and what computing standards we want for the future." The company was already committed to the Microsoft Windows operating system in its administrative area, and used a number of applications for Windows, including Microsoft Word for Windows and Microsoft Excel.

Matthews says the graphical interface offered by the Windows operating system would be ideal for personnel on the manufacturing floor since they could work more quickly and with less chance for errors by pointing and clicking with the mouse instead of using a keyboard. In addition, points out Matthews, Windows allows the company to change its underlying information structure without changing the systems Windows-based interface--and without retraining hundreds of workers.

Matthews also saw Windows NT as an operating system he could build on for the future. "We wanted to reduce cultural change by implementing a computer system just once. We tested Windows NT and have worked with it enough to know it's a key part of our strategic direction." The company plans to use Windows 3.1, Windows™ for Workgroups, and Windows NT on client machines.

Step 1: Improving Quality Assurance

Since Matthews' goal of implementing a three-day turnaround time on orders would place an extremely high stress on Paragon's entire manufacturing organization, he started his computer reengineering on the manufacturing floor.

The manufacturing quality assurance system Matthews is implementing will use Windows NT as the operating system with a data-gathering application created with the Visual Basic programming system. Using a light pen, production workers perform up to 100 measurements of diapers taken randomly from the production line.

The measurements, which are done on a regular basis during each shift, provide

immediate information about the products' characteristics, including thickness, tape placement, leg gathering, and fluff height. This information is relayed to the Windows NT server and stored in a Paradox for Windows database.

With the PCs connected with a LAN Manager local area network, the plant's quality assurance manager can review the information on his or her PC in both text and graphical form within minutes of the measurements. The information is compared to standard measurements to ensure production is up to the company's quality standards. "If a production machine has gotten out of sync, we can find out much more quickly, reducing the amount of substandard product," says Matthews. According to Matthews, each plant will have an average of eight workstations on the production floor running Microsoft Windows.

In addition, the Paragon plants will be connected on a wide area network, allowing a superintendent on a manufacturing line in Georgia, for example, to quickly check a database in California to see if another facility has been having similar problems producing a new product. The superintendent won't have to worry about what machine the data resides on, or even the state in which the machine is located.

Step 2: Assuming Inventory Responsibility

By the first quarter of 1994, Paragon's new Windows NT-based information system will enable key customers to push inventory management responsibility back onto Paragon, just as Paragon will push the responsibility for managing its key raw materials back to its suppliers.

Each morning, Paragon will remotely access the databases of appropriate customers via modem to determine what products were sold the previous day in each of the customer's stores across the country. By midafternoon, these customers will receive electronic confirmation on any new orders that might be necessary. Within three days the product will be shipped from the nearest manufacturing facility in order to appear on store shelves two days later.

Investment Returns Time and Dollar Savings

Overall, Matthews projects a 29 percent return on the company's technology investment in the quality assurance module alone--more than enough to justify the move. Just as important, Paragon is counting on its compressed response times and large inventory reductions to add up to big savings fast. The company's current order cycle can take up to five weeks, requiring retailers to hold up to two weeks of buffer inventories. Matthews says the Windows NT-based system should cut that to five days.

Paragon's major raw material suppliers often hold as much as three weeks' worth of inventory as well. But a pilot project using Windows NT now underway with one of Paragon's key suppliers should result in a two-thirds reduction of raw material inventories. Retailers have shown such interest in the pilot project that significant revenue increases are expected as well, as the company attracts more customers.

Matthews is also pleased with the way the Windows NT-based system makes information transparent to users. The new system complements the company's existing AS/400s, allowing the midrange system to act as another server. "Databases will reside on a master server, but the users won't have to know--or care--where it is," he points out.

The Future: Extending the Technology Throughout the Company

"Paragon, our customers, and our suppliers will all be closely interconnected, enabling us to provide the ultimate in just-in-time product deliveries and customer service--all while reducing our own costs."

Rich Matthews, Vice President, Management Information Services, Paragon Trade Brands

Paragon is already working on the next step in its long-range reengineering plan. Internally, Matthews plans to integrate capital budgeting and financial planning modules as quickly as possible. And he's looking forward to the day when Paragon's Windows NT-based inventory control system extends outside the company. "Paragon, our customers, and our suppliers will all be closely interconnected, enabling us to provide the ultimate in just-in-time product deliveries and customer service--all while reducing our own costs."

That, he says, will go a long way toward helping Paragon Trade Products remain the continent's premier provider of private label diaper products.

PATHWORKS for Windows NT

PATHWORKS for Windows NT, as a member of the PATHWORKS family of PC networking and integration software, expands the interoperability potential of Windows NT based systems with other leading network operating systems, desktop and departmental systems, and enterprise-wide data and applications.

Windows NT provides out-of-the-box networking based on LAN Manager compatible file and print services and the NetBEUI and TCP/IP transports. As an add-on product, customers may purchase the Windows NT Advanced Server. This Microsoft product enables a Windows NT based system to be configured as a server providing dial-up services (Remote Access Service), Macintosh connectivity, and system management (based on SNMP and Domain administration services).

PATHWORKS for Windows NT provides and uses the DECnet transport and is designed to use any combination of DECnet and the other transports provided with Windows NT.

If you only want file and print access to PATHWORKS servers throughout the network, you must purchase a PATHWORKS Version 5 FPA license. If you want to use the DECnet transport, you must purchase a PATHWORKS for Windows NT Version 4.1 CNS license. If you want to do both of the above, you can purchase the PATHWORKS for Windows NT Version 4.1 CCS license at a significant cost saving over the combined cost of the FPA and CNS licenses described above..

PATHWORKS for Windows NT is a layered application designed for Alpha AXP, Intel, and MIPS R4000 systems that have been properly configured to run the Windows NT operating system.

Integrating diverse systems and networks

Integrating all your network management

Programming to industry standard APIs

Integrating diverse systems and networks

PATHWORKS for Windows NT enhances your Windows NT interoperability with other networks and systems you may already have in place. PATHWORKS for Windows NT provides:

Full support for Windows NT file and print services, connectivity and management features

Integration of emerging technology with existing systems: PATHWORKS for OpenVMS, ULTRIX, OSF/1, SCO Unix, OS/2, and DOS/Windows.

DECnet transport including source routing over Token Ring in addition to TCP/IP and NetBEUI

Support for FDDI (via Digital's FDDI EISA card) and asynchronous connection in addition to Ethernet and Token Ring.

Remote and local printserver support

Replacement for OS/2 servers - Digital Alpha AXP or Intel systems with PATHWORKS for Windows NT provide a high-performance upgrade or replacement for OS/2 servers.

Integrating all your network management

PATHWORKS for Windows NT expands your network management capabilities through:

Seamless integration of DECnet network management support with Windows NT management: DECnet events appear in the NT Event Viewer and Performance Monitor

Remote management of Windows NT systems

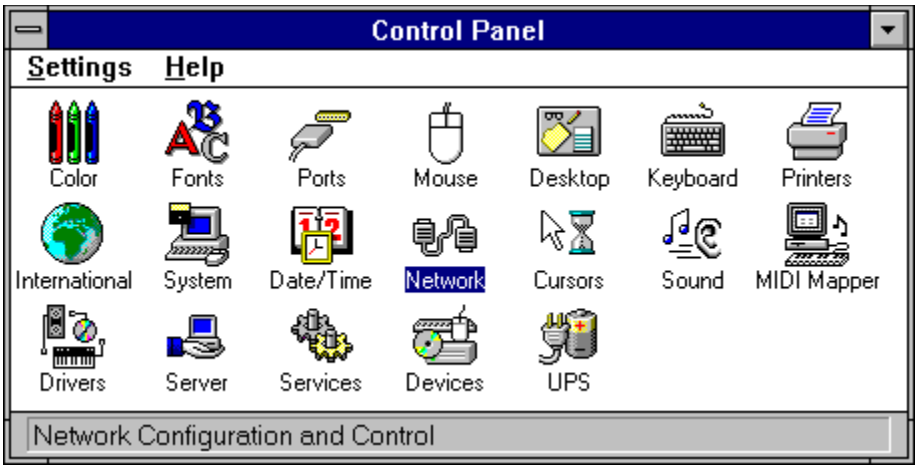
Programming to industry standard APIs

PATHWORKS for Windows NT with DECnet support for Winsock, NetBIOS, LAN manager, and DCE Remote Procedure Call, APIs together with the tools for developers (in the separate developers kit) to write and port custom applications - the PATHWORKS Socket API, DNETLIB, and XTI - provides a rich set of industry standard APIs to the network developer.

The OpenVMS, ULTRIX, Windows and MS-DOS-based applications and tools available for Windows NT, such as the PATHWORKS Socket API Library, enable you to port DOS, Windows, and ULTRIX PATHWORKS-based 16-bit applications to the 32-bit Windows NT environment. This allows you to avoid compatibility mode and its disadvantages and helps you to transition smoothly to the new Windows NT operating system.

In the interim you also have MS-DOS binary compatibility mode for PATHWORKS-specific APIs allowing existing MS-DOS and MS-Windows applications to run without change (this applies only to Alpha AXP and Intel systems).

The DECnet support for Winsock and DCE Remote Procedure Call APIs ensures future compatibility with the leading industry environments.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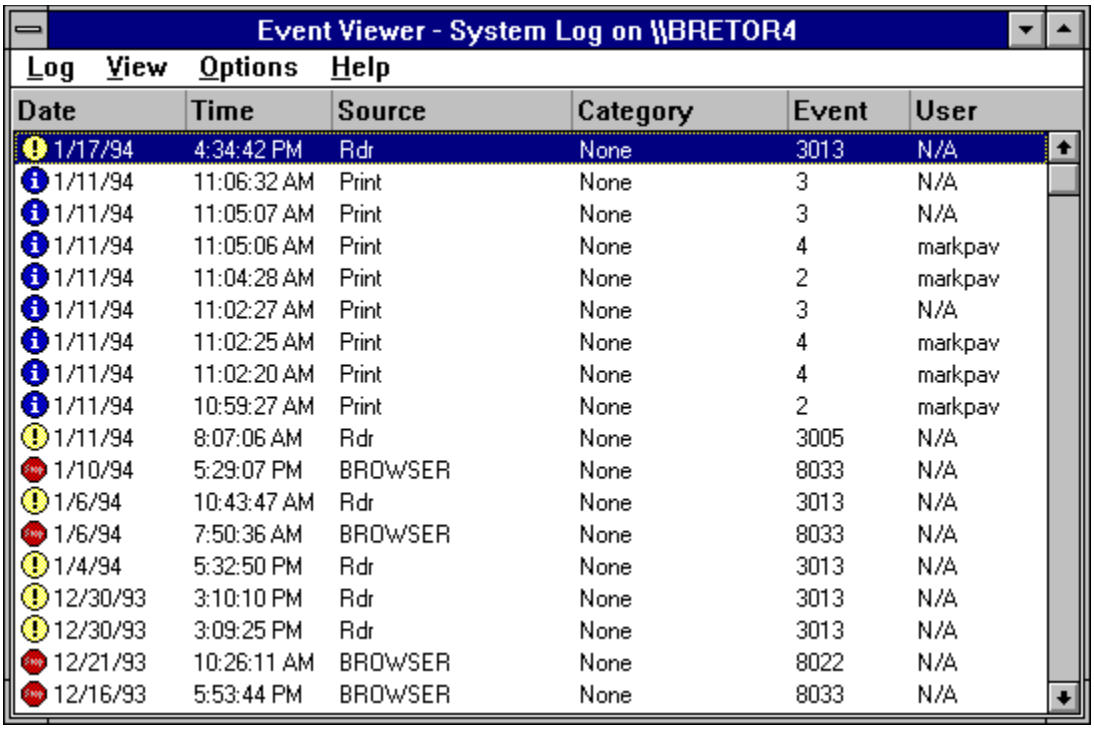
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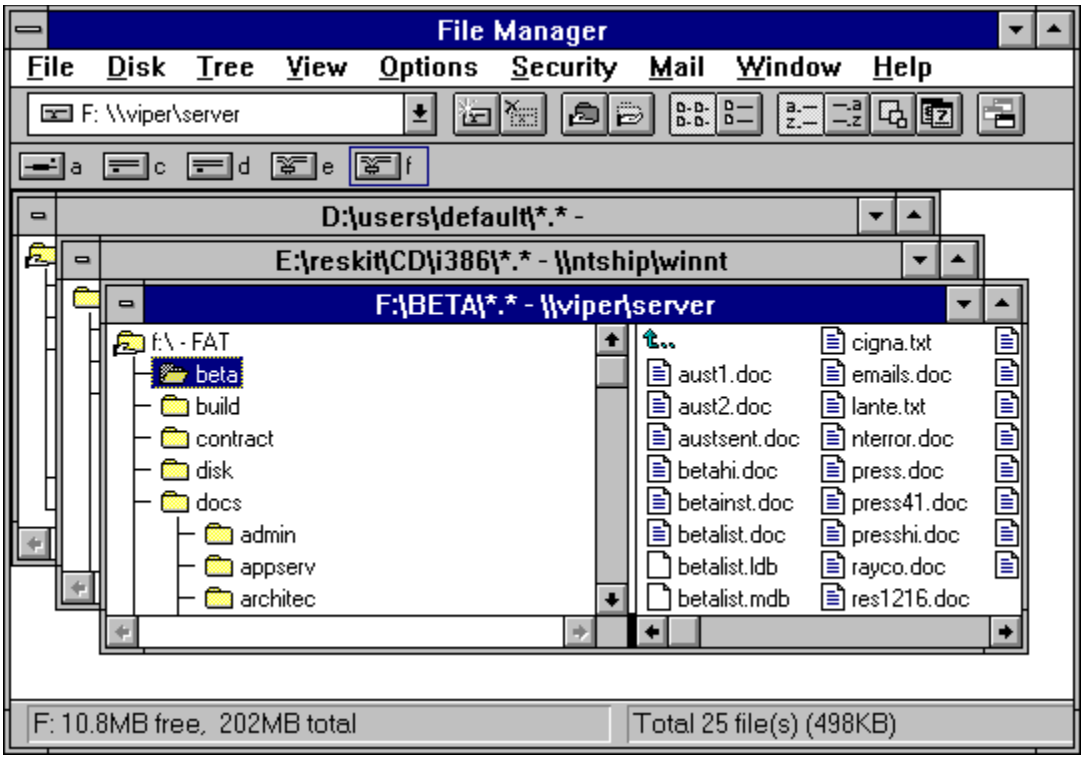
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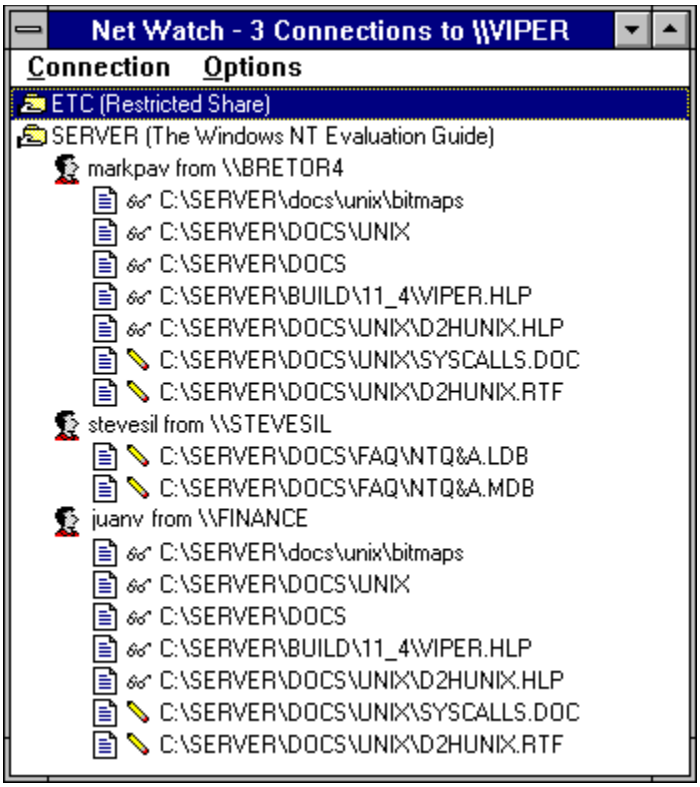
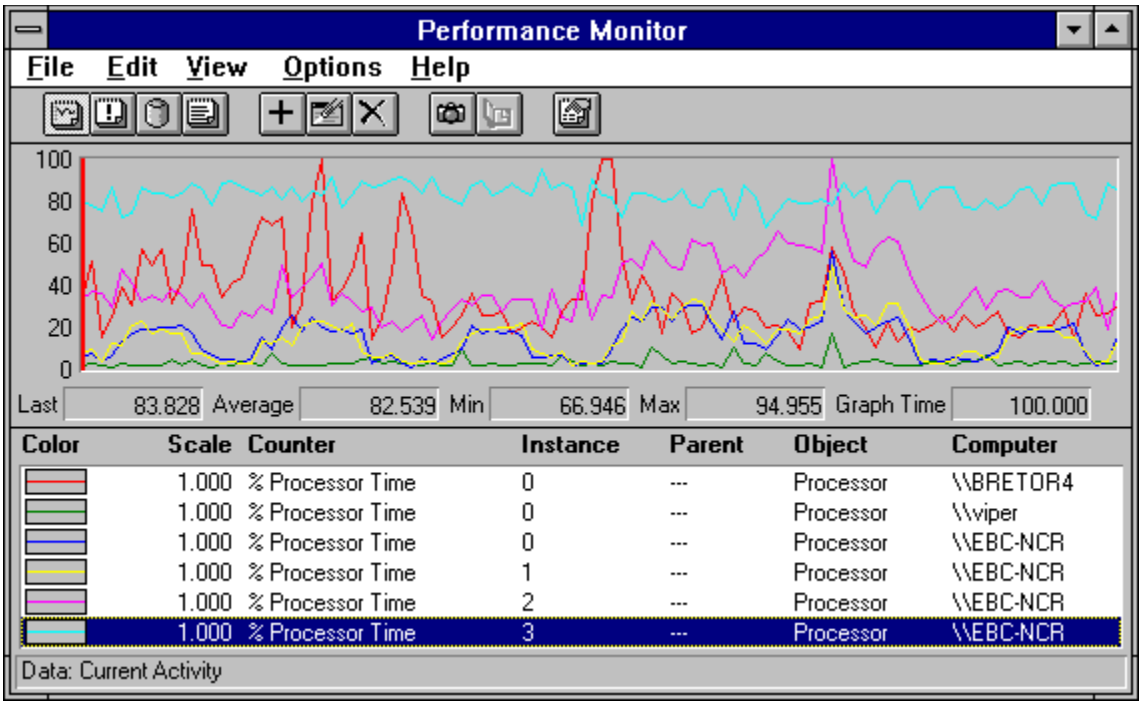


* included in the Windows NT Resource Kit.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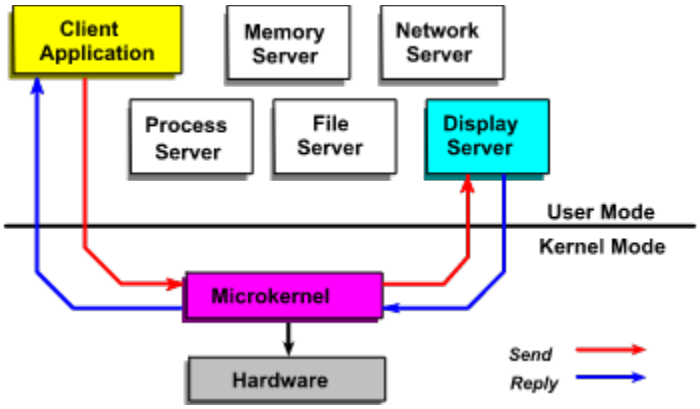
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File Server
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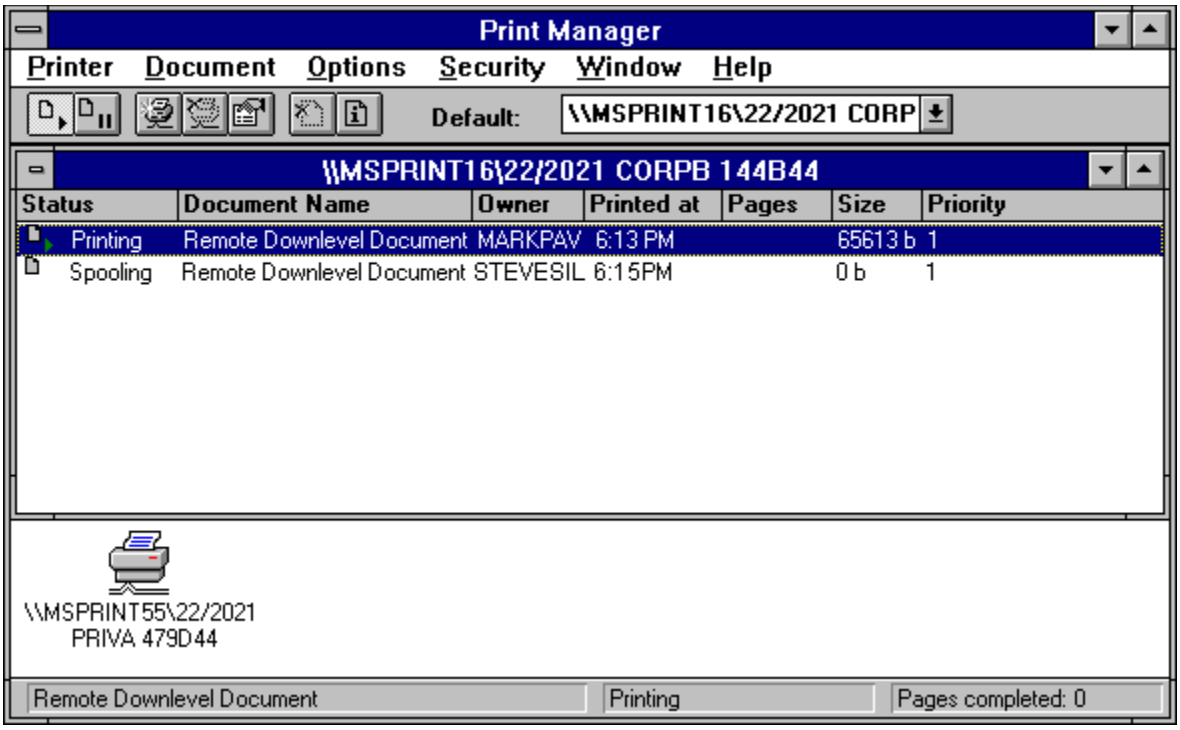
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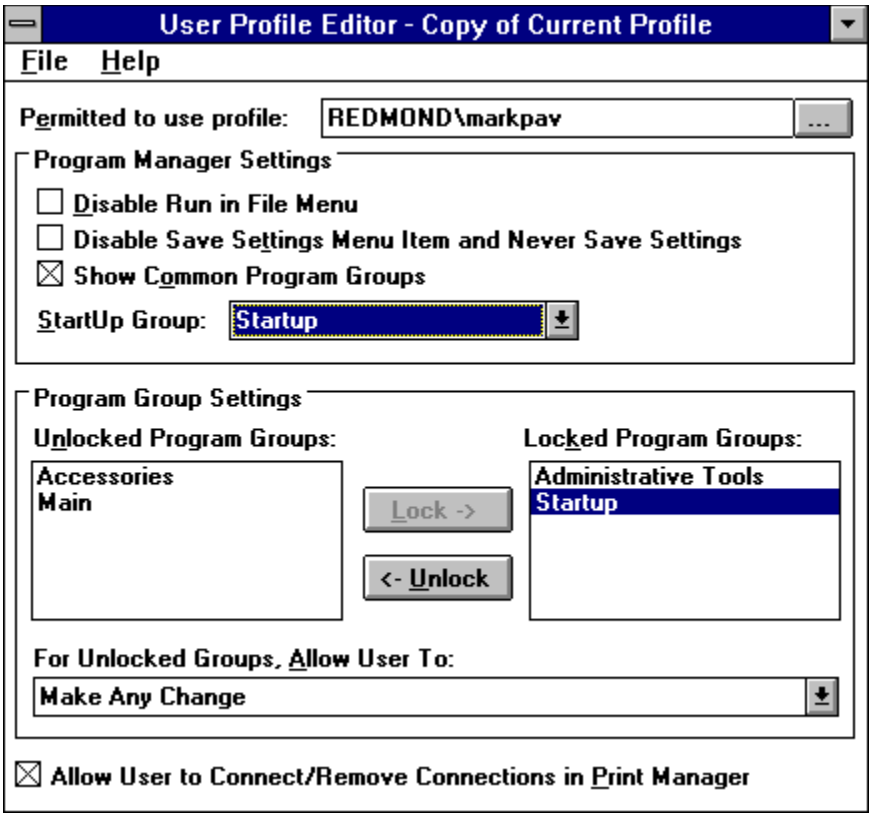
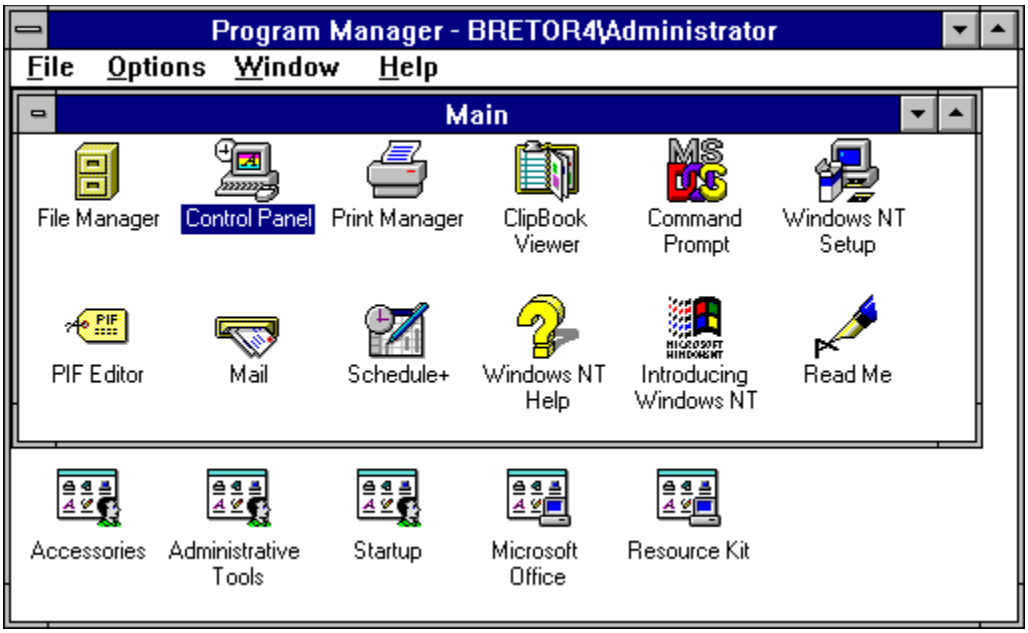
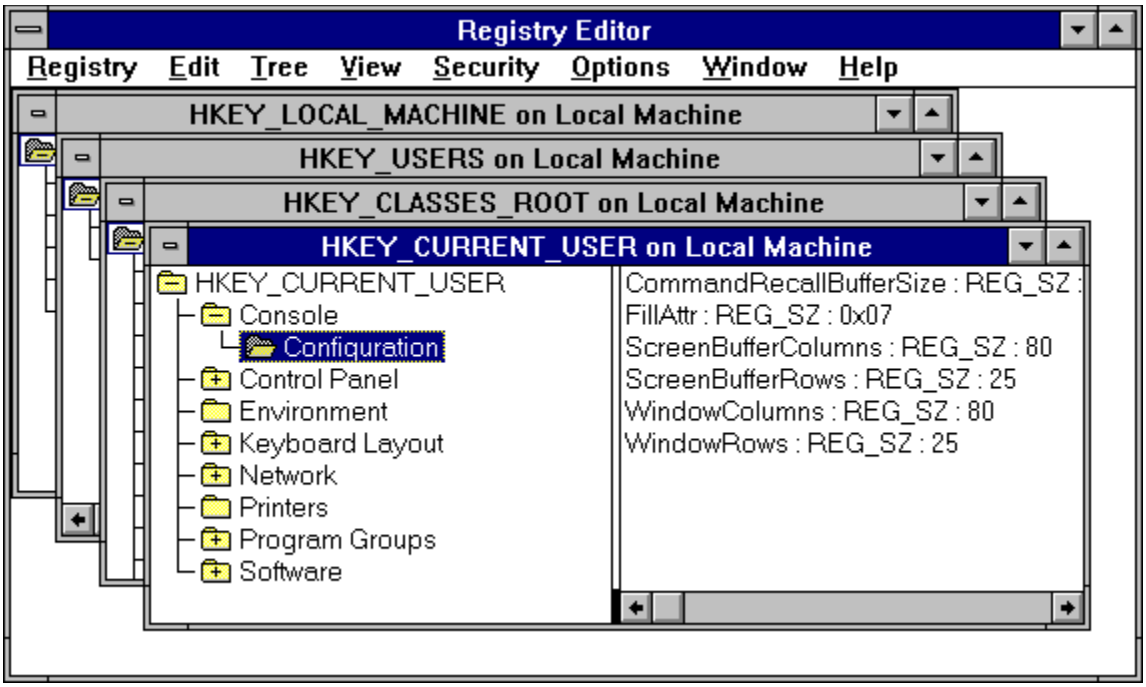
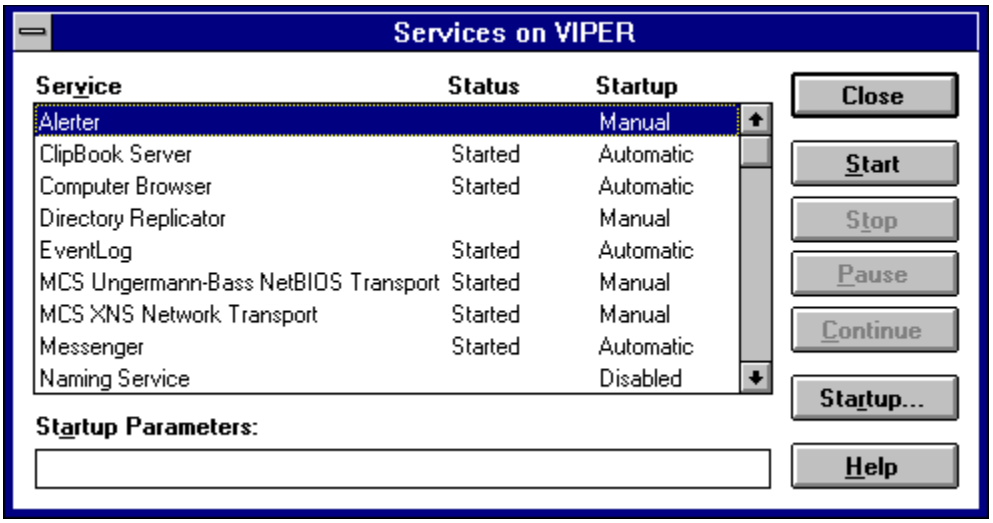
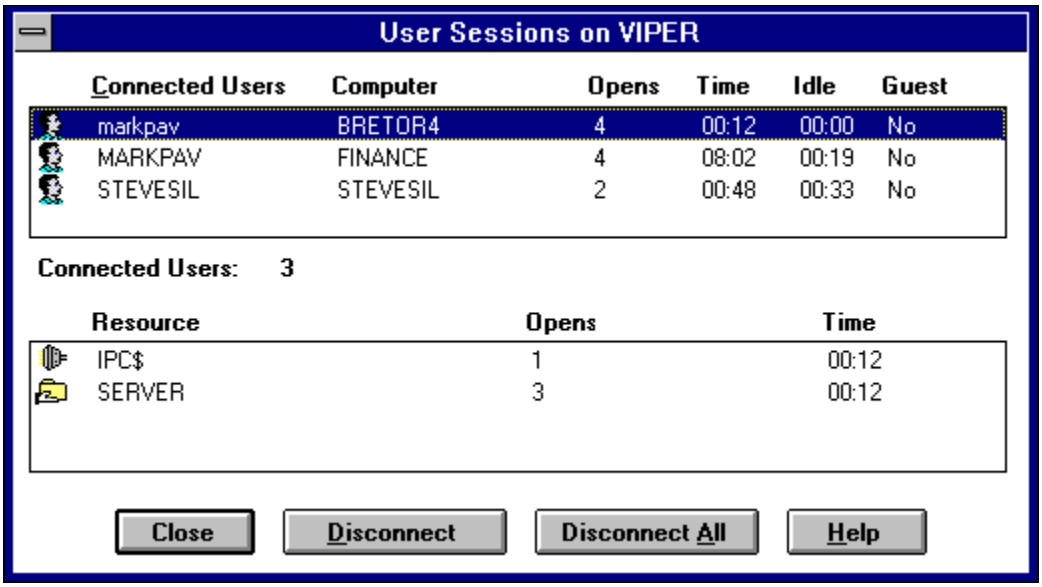
Printing Remote Downlevel Document MARKPAV 6:13 PM 65613 b 1
Spooling Remote Downlevel Document STEVESIL 6:15PM 0 b 1
\\MSPRINT55\22/2021
PRIVA 479D44
Remote Downlevel Document
Printing
Pages completed: 0


User Profile Editor - Copy of Current Profile
File Help
Permitted to use profile: REDMOND\markpav ...
Program Manager Settings
Disable Run in File Menu
Disable Save Settings Menu Item and Never Save Settings
Show Common Program Groups
StartUp Group: Startup
Program Group Settings
Unlocked Program Groups:
Accessories
Main
Lock ->
<- Unlock
Locked Program Groups:
Administrative Tools
Startup
For Unlocked Groups, Allow User To:
Make Any Change
Allow User to Connect/Remove Connections in Print Manager


Program Manager - BRETOR4\Administrator
File Options Window Help
Main
File Manager
Control Panel
Print Manager
ClipBook Viewer
Command Prompt
Windows NT Setup
PIF Editor
Mail
Schedule+
Windows NT Help
Introducing Windows NT
Read Me
Accessories
Administrative Tools
Startup
Microsoft Office
Resource Kit


Registry Editor
Registry Edit Tree View Security Options Window Help
HKEY_LOCAL_MACHINE on Local Machine
HKEY_USERS on Local Machine
HKEY_CLASSES_ROOT on Local Machine
HKEY_CURRENT_USER on Local Machine
HKEY_CURRENT_USER
Console
Configuration
Control Panel
Environment
Keyboard Layout
Network
Printers
Program Groups
Software
CommandRecallBufferSize : REG_SZ :
FillAttr : REG_SZ : 0x07
ScreenBufferColumns : REG_SZ : 80
ScreenBufferRows : REG_SZ : 25
WindowColumns : REG_SZ : 80
WindowRows : REG_SZ : 25


Services on VIPER
Service
Status
Startup
Alerter
Manual
ClipBook Server
Started
Automatic
Computer Browser
Started
Automatic
Directory Replicator
Manual
EventLog
Started
Automatic
MCS Ungermann-Bass NetBIOS Transport
Started
Manual
MCS XNS Network Transport
Started
Manual
Messenger
Started
Automatic
Naming Service
Disabled
Close
Start
Stop
Pause
Continue
Startup...
Help
Startup Parameters:


User Sessions on VIPER
Connected Users
Computer
Opens
Time
Idle
Guest
markpav
BRETOR4
4
00:12
00:00
No
MARKPAV
FINANCE
4
08:02
00:19
No
STEVESIL
STEVESIL
2
00:48
00:33
No
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Opens
Time
IPC$
1
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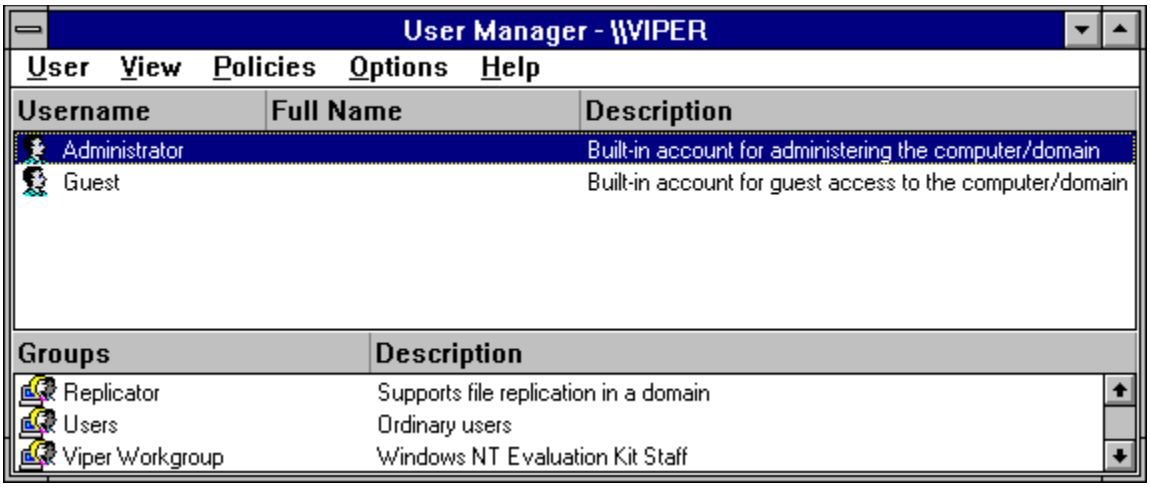
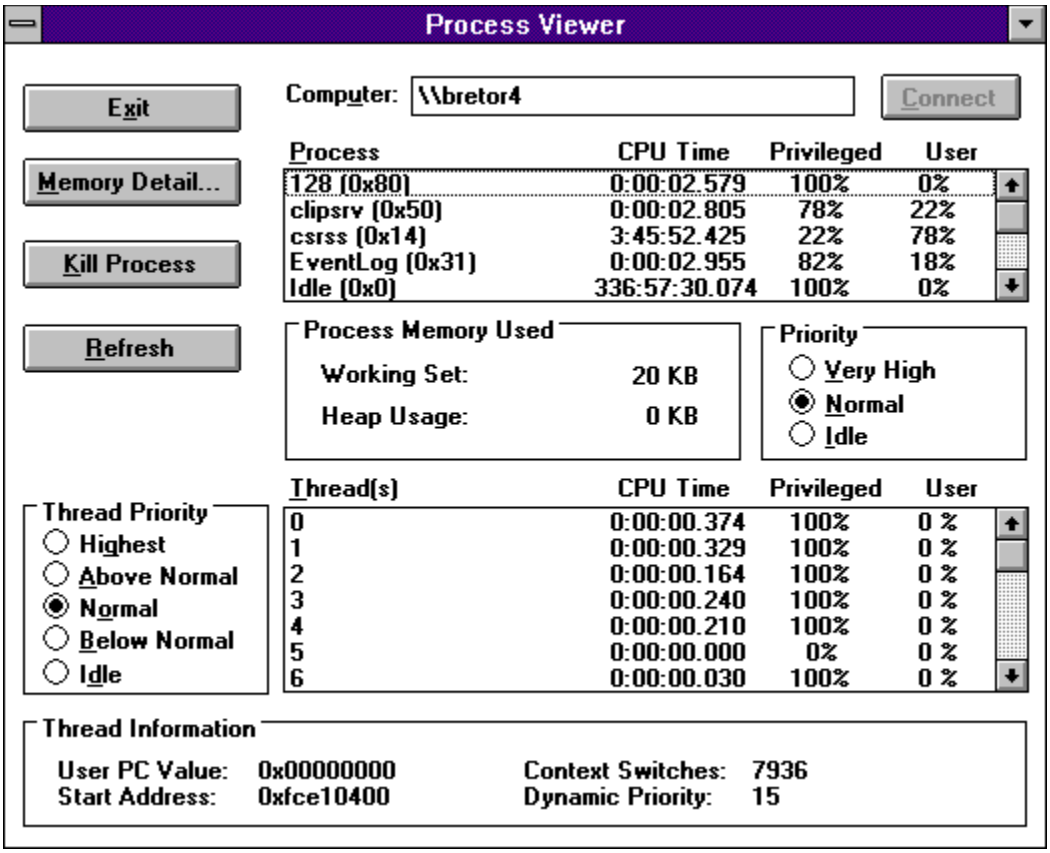
SERVER
3
00:12
Close
Disconnect
Disconnect All
Help


User Manager - \\VIPER
User View Policies Options Help
Username Full Name Description
Administrator Built-in account for administering the computer/domain
Guest Built-in account for guest access to the computer/domain
Groups Description
Replicator Supports file replication in a domain
Users Ordinary users
Viper Workgroup Windows NT Evaluation Kit Staff


Process Viewer
Exit
Computer: \\bretor4
Connect
Memory Detail...
Kill Process
Refresh
Process CPU Time Privileged User
128 (0x80) 0:00:02.579 100% 0%
clipsrv (0x50) 0:00:02.805 78% 22%
csrss (0x14) 3:45:52.425 22% 78%
EventLog (0x31) 0:00:02.955 82% 18%
Idle (0x0) 336:57:30.074 100% 0%
Process Memory Used
Working Set: 20 KB
Heap Usage: 0 KB
Priority
Very High
Normal
Idle
Thread Priority
Highest
Above Normal
Normal
Below Normal
Idle
Thread(s) CPU Time Privileged User
0 0:00:00.374 100% 0 %
1 0:00:00.329 100% 0 %
2 0:00:00.164 100% 0 %
3 0:00:00.240 100% 0 %
4 0:00:00.210 100% 0 %
5 0:00:00.000 0% 0 %
6 0:00:00.030 100% 0 %
Thread Information
User PC Value: 0x00000000
Start Address: 0xfce10400
Context Switches: 7936
Dynamic Priority: 15


Windows NT Help
File Edit Bookmark Help
Contents Search Back History Find
Welcome to Microsoft® Windows NT™ Operating System Help
Search Windows NT Help Files
Command Reference Help
Windows NT Glossary
Microsoft Support Services
Microsoft Access & Disability Support
Instructions

Remote Access Service for Windows NT

Remote Access Service (RAS) for the Microsoft® Windows NT™ operating system enables users to participate fully as a network client from remote locations. With RAS, several functions can be performed transparently on remote workstations, including:

- **File and Print Sharing**
- **Electronic Mail**
- **Scheduling**
- **SQL Database Access**
- **Emulation**

In addition, if the remote workstation has peer-to-peer file or printer sharing capabilities, LAN workstations can access files and printers on the remote workstation. Network administrative tasks, such as monitoring server performance, managing user accounts, starting and stopping of the Windows NT operating system, software inventory, and distribution services, can also be performed from remote workstations.

Requirements

Benefits

User Interfaces

Requirements

Remote Access Service for Windows NT enables remote users to dial into network resources. RAS can be set up on any Windows NT-based machine; you do not need to install Windows NT Advanced Server, and it does not require a dedicated Windows NT-based machine.

Benefits

Remote Access Service for Windows NT provides several benefits:

A Scalable Platform

Advanced Modem Support

Extensive WAN (Wide Area Network) Support

Protocol Independence

Improved Performance

Advanced Security

A Scalable Platform

RAS for Windows NT has a scalable design that allows the product to scale from a single remote connection to multiple simultaneous remote connections.

RAS is available on Intel®- and MIPS®-based computers simultaneously, and takes full advantage of the symmetric multiprocessing capabilities within Windows NT.

Advanced Modem Support

RAS for Windows NT provides support for advanced features in modems such as MNP/5 and V.42bis compression and error control. In addition, RTS/CTS and XON/XOFF flow control is also supported. The command file can easily be modified to set up your appropriate modem. RAS will support up to 64 simultaneous modem connections on a Windows NT-based machine.

Extensive WAN (Wide Area Network) Support

Microsoft Windows NT Remote Access Service supports X.25 networks, ISDN (Integrated Services Digital Networks), and PSTN (Public Switched Telephone Networks) for high-bandwidth communications. The ISDN adapter or the X.25 card is treated as an Ethernet card, and thus provides remote computers with a direct data feed across the Wide Area Network to the LAN.

All remote workstations will be able to use the X.25 network by dialing in X.25 PADs (Packet Assemblers/Dissemblers). Remote Access Service will have direct X.25 access via X.25 adapters, and Windows NT-based workstations will have direct X.25 connectivity in addition to asynchronous access to X.25 PADs.

Protocol Independence

The Remote Access server works on diverse LAN topologies, such as Ethernet, Token-Ring, Arcnet, and FDDI.

Remote Access Service for Windows NT is protocol independent, using NetBIOS protocols such as NetBEUI, TCP/IP, XNS™, and NBP.

Advanced Security

Remote Access Service for Windows NT is fully integrated with the domain structure within Windows NT. Remote Access Service uses the same user account database on the local server running Windows NT or Windows NT Advanced Server. In addition, network administrative tasks such as monitoring server performance, managing user accounts, and starting and stopping services of the Windows NT operating system, can be performed from a remote workstation.

RAS uses the DES (Data Encryption Standard) encryption scheme to prevent password discovery by wire tapping. There are two levels of callback security supported:

- A predetermined number is assigned for each user
- Mobile users are allowed to tell the server where they wish to be called back. This type of callback allows the company to cover the cost of telecommuting for employees who are not always calling from the same location.

A central administration tool enables system administrators to identify connected remote users, regardless of which Remote Access servers those users are connected through. Extensive audit records in the Windows NT event log enable system administrators to identify illegal attempts to access the network. For additional dial-in security needs, Windows NT Remote Access Service also provides support for third-party, user-authentication hardware devices.

Improved Performance

Windows NT RAS takes advantage of the Windows NT platform to provide increased performance, using data compression to double the transmission throughput. The average compression ratio is 2:1. Bitmaps and files that can be easily compressed may achieve greater compression ratios.

User Interfaces

Remote Access Service for Windows NT has a character-based phone book for MS-DOS® and a graphical phone book for the Windows™ operating system. The phone book will accept parameters to initiate or terminate connections, and users will be able to run batch mode processes to connect to remote networks.

Remote Access Service is also integrated with the graphical tools included with Windows NT. These tools can be used to administer the service and monitor performance on RAS 1.0 servers or Remote Access Service for Windows NT-based servers. The user account information is merged with the Windows NT User Manager. MS-DOS has a character setup; Windows 3.x, Windows™ for Workgroups, and Windows NT have a graphical setup. In addition, RAS for Windows NT includes a small graphical desktop configuration program for the Windows phone book.

Windows NT Fault Tolerant Components

As you evaluate the reliability of the Microsoft® Windows NT™ operating system, and that of other operating systems, it is important to differentiate between the fault tolerant components that are included with the system, and those that must be purchased separately from third parties.

The Windows NT microkernel architecture provides a high degree of system fault tolerance: applications run in protected subsystems, and all communication with hardware devices must go through the Windows NT **Executive**. In addition, Windows NT also includes a number of standard fault tolerant tools:

Internal System Recovery Components

System Reliability Tools Included With Windows NT

System Reliability Tools Included with Windows NT Advanced Server

Internal System Recovery Components

Within the Windows NT system itself, there a numerous facilities that protect both data and the system from errant applications or external issues such as hardware failure.

How the Windows NT Kernel Protects Data

The Windows NT Kernel has an intelligent shutdown routine that is executed in the event of a power failure. Should the Windows NT machine not have an attached UPS system, there are recovery procedures that protect data even if it is unsaved. When the Windows NT Executive senses a loss of power, it begins the shutdown process. Should the power level drop below a certain threshold, Windows NT immediately notifies system objects of the failure. I/O devices automatically send notifications objects to the kernel which points to recovery and shutdown routines. The Kernel also monitors device drivers. Should the system be in the process of writing data to a disk, the kernel can inhibit the write thus protecting any loss of disk.

System Reliability Tools Included With Windows NT

Windows NT includes an array of graphical fault tolerant tools. The first three, UPS, Tape Backup and Registration Database are part of both Windows NT and Windows NT Advanced Server. The latter three, Disk Duplexing, Disk Mirroring and Disk Striping with Parity are unique to Windows NT Advanced Server. Like the rest of the Windows NT System, these tools are intuitive and easy to manage.

Uninterruptible Power Supply (UPS)

Tape Backup

Windows NT Protects Your Information From Power Failures

An uninterruptible power supply (UPS) in Windows NT provides two levels of information protection:

1. It keeps the machine active during temporary power outages, allowing the machine to continue processing data without loss of time.
2. It allows an orderly shutdown before the machine's battery power is fully depleted.

The main advantage of the both of these is that a file system can flush its internal cache buffers to the disk before the power to the machine is lost. The Windows NT UPS service is sensitive to signals from the UPS unit and performs orderly shutdowns of applications, services, and file systems if the UPS power is depleted. The UPS service is built into the base operating system itself, facilitating access to file systems in the event of a power problem.

Implementing a UPS System

How Windows NT Simplifies UPS Configuration

UPS Hardware Support for Windows NT

Implementing a UPS System

As with other components in a distributed system, connectivity during a power outage is only as good as the weakest link.

Placing a UPS unit on a machine will keep it up and active: If the machine is a server, the server will remain up; If the machine is a workstation, it will remain active. However, if there is no UPS on hubs, concentrators, routers, or bridges, the workstation and the server may still be unable to communicate.

Planning which pieces of the environment should be protected by a UPS device depends on expectations for their use. If preventing data loss at the server is the only priority, then placing a UPS system only on the server will be enough. If business functions need to continue at some level during a temporary power loss, then a number of workstations and printers should also be on a UPS. If there are electrically active components in the network, they too may have to be on a UPS to keep the business running during power outages.

How Windows NT Simplifies UPS Configuration

The Windows NT UPS Control Panel controls the configuration of the interface between the UPS device and the UPS service.

If the UPS device can generate the power failure signal, then additional characteristics can be entered:

- **Life expectancy and the battery recharge time:** This feature informs Windows NT of the amount of time the battery can be expected to keep the system up and tells Windows NT the amount of time it will take to recharge the battery to that level. These fields are not enabled if the UPS has a low battery signal, because the UPS device can inform the UPS service directly.
- **Warning alert lag time and frequency:** If the UPS can signal immediately that there was a power failure, it is advisable that someone be alerted to the problems. Consequently, the UPS has been designed so that the amount of time between the power failure and the initial alert can be set. Thus, if the power failure is of a short duration, no error messages are generated, but if the power failure is persistent, additional warning messages are sent at a set frequency.
- **Automatic command file execution:** In addition to shutting down the file systems, the UPS system can be instructed to execute a command file when the low battery signal is received. This command file is useful to run special shutdown routines which may be needed in your environment. An example would be a command file which automatically logs off users from a mainframe session.

Windows NT Includes Complete Tape Backup Support

The first line of defense for fault tolerance is a good tape backup scheme. Windows NT provides a full-function tape backup system based on the Maynard tape system. Tape backup is also provided with Windows NT Advanced Server. In addition to the user interface provided, the Win32 API has a rich set of tape APIs for further development of this vital technology.

How to Use Windows NT Tape Backup Support

Windows NT Backs Up Remote Machines

Backing Up Configuration Information

How to Use Windows NT Tape Backup Support

Choosing an optimum tape backup strategy depends on two things: the amount of data to be backed up, and the frequency with which file modifications are made.

- **Normal backups** copy all selected files and mark each file as having been backed up. This gives you the ability to restore files quickly from the most recent tape, but increases the time required to make the backups, because even files that have not changed since the last backup will be written to the tape.
- **Incremental backups** back up only the files that have changed since the last normal or incremental backup. Each file is marked as backed up once it is copied. This saves time during the backup process. If you combine normal backups with incremental backups, restoring requires that you start with your last normal backup and work forward through all the incremental tapes.
- **Differential backups** also back up only the files that have changed since the last normal or incremental backup. The difference is that the files are not marked as backed up. Combining normal backups with differential backups means that restoration needs only the last normal backup and the last differential backup.
- With **Daily backups,** only files that have been modified on the same day as the backup will be written to tape.

Windows NT Backs Up Remote Machines

Peer services greatly ease the burden of backing up remote machines. If the machine is Windows NT- or Windows for Workgroups-based, a centralized backup server can back up remote machines by establishing a "net use" relationship and backing up the files using the redirected drive letter. The shared directory on the remote machine can be an entire drive or a subdirectory. If the remote machine does not have sharing capabilities, then the workstation must establish a relationship with the backup server or another server. Once the "net use" has been established, the workstation copies the data to the server. When the data is on the server, the backup server may either back up the data from a local disk, or establish a relationship to the intermediary server and back up the data.

peer

Any of the devices on a layered communications network that operate on the same protocol level.

Backing Up Configuration Information

In addition to backing up and restoring normal files, the tape backup utility can be used to back up and restore the local Registry. The Registry is the warehouse of all of the configuration, security, and system operations information, and can be backed up using the Backup Local Registry check box. A registry stored on tape may also be restored using the "Restore" option. The files backed up are System, Software, Default, Security, SAM, as well as the UserDef file and individual user information files.

System Reliability Tools Included with Windows NT Advanced Server

Disk Fault Tolerance

Disk Mirroring and Disk Duplexing

Disk Striping with Parity

Comprehensive Configuration Management System

Windows NT Provides Comprehensive Disk Fault Tolerance

To provide comprehensive disk fault tolerance, each disk is given a unique signature, which is stored in the Master Boot Record (MBR) area on the disk (physical sector 0). This signature is used by Windows NT to identify disks, and allows disks to be moved from controller to controller, or within a SCSI (Small Computer System Interface) chain without problems. The signature is used to look up the disk and the partitions on those disks in the registry, where an entry called DISK informs Windows NT of the participation of each partition on each disk. This eliminates reliance on hidden information on the disk.

How Disk Mirroring and Disk Duplexing Protect Your Data

Disk mirroring protects against hard disk failure, by using two partitions on different drives connected to the same disk controller. All data on the first (primary) partition is mirrored automatically onto the secondary partition. Thus if the primary disk fails, no data is lost; the partition on the secondary disk is used. Mirroring does not have to be done at the drive level. Unallocated space on the primary drive can be allocated into a logical drive, as can any unallocated space on the secondary drive. With disk mirroring, both partitions have the same drive letter, and the user is usually not aware of the mirrored disk.

Disk duplexing is simply a mirrored pair with an additional adapter on the secondary drive, which provides fault tolerance for both disk and controller failure. The use of multiple adapters connecting to one drive is not supported. Like disk mirroring, disk duplexing is also performed at the partition level. From the standpoint of Windows NT, there is no difference between mirroring and duplexing. It is simply a matter of where the other partition can be found.

More About How Disk Mirroring Works

How to Create Mirrored and Duplexed Sets

More About How Disk Mirroring Works

Any file system can make use of disk mirroring FAT, HPFS, or NTFS files. Mirroring is not restricted to a partition of identical geometry to the primary partition (size, number of heads, cylinders, tracks, sectors). This eliminates the problem of acquiring an identical model drive to replace a failed drive when an entire drive is being mirrored. For practical purposes, the mirrored partition will usually be made the same size as the primary partition--a mirrored partition cannot be smaller than the primary, and if it is larger, the extra space will be not be used.

How to Create Mirrored and Duplexed Sets

The Disk Manager utility can be used to create both mirrored and duplexed sets. Select the partitions that you want to duplicate and an area of free space of the same size or greater on another hard disk--first select the partition to be mirrored, then select the free space on another disk while holding down the CTRL key. From the Disk Manager menu, select the Fault Tolerance menu option. Then choose Establish Mirror. The Disk Manager creates an equal-sized partition in the free space for the mirror and assigns the drive letter to the set.

Disk Striping With Parity: the Most Comprehensive Backup

Disk striping with parity is based on concepts put forth in RAID 5. A number of different partitions on different disks are combined to make one large logical drive. The partitions are used and arranged to allow multiple single points of failure in the array. Disk striping with parity is supported only by Windows NT Advanced Server.

There must be at least 3 and no more than 32 disks in a striped set. A partition of approximately the same size must be selected from each disk. The disks can be on the same or different controllers. SCSI disks are best because advanced recovery features such as bad block remapping can be used during the recovery process. Data is written in stripes across all partitions in the set.

In addition to the data, a parity stripe is written, interleaved with the data stripes. The parity stripe is simply a byte parity of the data stripes at a given stripe level or row. Assume you have five disks in the striped set. At level 0 you have stripe block 0 on disk 0, 1 on 1, 2 on 2, and 3 on 3, and the parity (eXclusive OR) of the stripe blocks on disk 4. The size of the stripes (striping factor) is currently 64K. The size of the parity stripe is the size of the data stripes. On the next row the parity stripe is on disk 0. Data is on the rest of the disks.

How Disk Striping Works

How Parity Striping Works

Fault Tolerance with Parity Striping

How Disk Striping Works

When using any of the fault-tolerance disk schemes, Windows NT uses a device driver called FTDISK.SYS to receive commands and respond appropriately based on the type of fault tolerance that is being used. Thus when the file system generates a request to read a given section of a file, the normal disk system receives the request from the file system and passes it to the FTDISK.SYS driver. This driver then determines the stripe the data is in. From this and the information on the number of disks in the set, the disk and location on the disk are located. The data is read into memory. Striping can actually increase read performance, since each disk in the set can have an outstanding read at the same time.

How Parity Striping Works

Writing to a parity striped set is a little more difficult. First the original data from the stripe that is to be written must be read along with the parity information for that stripe level. Then the differences to the parity information are calculated and are added to the parity stripe. Finally, both the parity and the new information are written to disks. The reads and the writes can be issues concurrently, since they must be on different disks, by design.

Fault Tolerance with Parity Striping

The two general cases of fault tolerance with parity striping involve **reading** and **writing.** Even though a data stripe may no longer be readable, the system can still function. When the bad data stripe is to be read, all of the remaining good data stripes are read along with the parity stripe. Each data stripe is subtracted (XORed) from the parity stripe--the order isn't important. The result is the missing data stripe! Writing works very much the same way. All the data stripes are read and backed out of the parity stripe, leaving the missing data stripe. Parity stripe modifications can now be calculated and made. Because the system knows the data stripe is bad, only the parity stripe is written.

How Windows NT Solves Configuration Complexity

Through a modern configuration management system, Windows NT solves the three main issues of configuration: security, centralization and remote management. A long-standing problem with personal computers (PCs) has been the management of their operating system and application configuration information. For almost every new application or hardware device you add to your system, you add another configuration file. Without protection or standard location for configuration information, systems can become unstable or worse, unusable.

Consolidation of Configuration Information: The Registry

Registry Data Organization

The Registry Editor

Windows NT Recovery: Last Known Good State

How Windows NT Protects the Configuration Information

Consolidation of Configuration Information: The Registry

To simplify system configuration, Windows NT consolidates all startup and system information into a database. The registry is a database that contains secure configuration information. It is structured as a disjoint set of multi-way trees. Each node in the tree is named, and each tree is rooted at a predefined, known node. These are known as predefined key handles. The registry appears very much like a hierarchical file system where each node is called a "key," and each key may contain zero or more data items, called "value entries," that are associated with the key. Keys are analogous to directories, and the value entries are analogous to files.

Registry Data Organization

The registry is divided into per-user and per-machine data. **Per-user data** contains information such as a user's preferred screen colors, desktop arrangement of windows, application preferences, and more—basically, all the data that would personalize a session for an individual user. **Per-machine data** is configuration information that is consistent across multiple user logons, for example, the hardware configuration of a machine and the loaded device drivers that support installed devices or the install time application data that is common to all users. None of this information changes when a different user logs on to the system.

The Registry Editor

The Registry Editor is a graphical tool that allows you to view and manipulate the configuration registry. The registry appears very much like a hierarchical file system where each node is called a "key," and each key may contain zero or more data items, called "value entries," that are associated with the key. Keys are analogous to directories, and the value entries are analogous to files. Therefore, the registry looks much like the File Manager. As with File Manager, you can apply security to registry keys to prevent users from modifying registry entries. The Registry Editor is primarily used to assist with troubleshooting and problem resolution. You can save sections of the registry on disk and transport them to another disk for analysis, or you can connect to a computer over the network and view its configuration information remotely.

Windows NT Recovery: Last Known Good State

LastKnownGood (LKG) is the last known good state of a Windows NT configuration. For instance, if you load a driver that causes the system to fail at boot time, the LKG facility allows you to return to a previous state in which the boot was successful. The LKG can work with or without user intervention. For example, if any of the services encounters a problem loading during boot, it can automatically tell the system to revert to the LKG system parameters--without any user intervention. If user intervention is preferred, hit the spacebar immediately after selecting to boot Windows NT from the multi-boot screen, and you will be taken into a menu that allows you to choose an instance of boot data.

How Windows NT Protects the Configuration Information

Windows NT maintains a complete redundant copy of the Registry , and is used to provide protection against registry information stored on a bad sector. When a Windows NT system boots and reads the registry, it will automatically switch to the backup, should the system be unable to read the primary registry.

Windows NT Security

Microsoft® Windows NT™ operating system security is built into every part of the system--it cannot be bypassed. The system is designed so that it can be extended and integrated into existing security environments, providing secure sharing of desktop resources. Windows NT has extensive built-in auditing capabilities for centralized management and security setting. The Windows NT security system is designed to meet the government's **Class C2 security level**, with the following features:

A Secure Logon Facilitywhich requires users to enter a unique logon identifier and a password before they are allowed to access the system.

Account Management to give administrators the ability to control system access by user or groups of users.

Discretionary Access Control to give the owner of a resource the ability to determine who can access the resource and what they can do with it.

Security Auditing to detect and record important security-related events or any attempt to create, access, or delete system resources.

Memory Protection to prevent anyone from reading information written by someone else after a data structure has been released back to the operating system.

U.S. Department of Defense Security Levels

The DOD has identified features of an operating system that make it secure. These features are categorized into seven levels of security, each one more stringent than the last. Not all installations will require the Class C2 security mechanisms that Windows NT provides. The security system has been designed to be streamlined, for example, by changing the logon sequence or adjusting how much information is collected in an audit log. If a higher level of security is required, such as with military installations, Windows NT is designed to evolve toward Class B2 security in which each user is assigned a security clearance level and is prevented from giving lower-level users access to protected resources.

Discretionary Access Control

The most valuable part of your computer is the data it stores. With discretionary access control, you can protect your computer's files and directories by controlling who has access to them and how they can be used.

Access Control List (ACL): When you create a file or directory, the file system maintains a list of permissions associated with the file or directory granted to individual users and group members. This list specifies whether a user is allowed certain actions such as viewing or changing the contents of a file or listing a directory.

Setting Permissions: Most often, the permissions that protect files are applied by setting the default file permissions for the directory in which they reside. You will rarely need to change these default permissions. Directory permissions also determine whether a user can list the contents of a directory or add files to the directory.

Ownership: To maintain maximum security, the ability to set permissions for a file or directory is restricted to a single user, the "owner." The owner of a file or directory is usually the user who creates the file or directory. Only a user logged on as a member of the Administrators group can take ownership of a file or directory without permission by the owner. The owner can place maximum protection on a file or directory by using **No Access permission** to block access by any user or group.

The Difference Between Rights and Permissions

No Access Permission

No Access permission always takes precedence over other permissions. Specifying the No Access permission for a file or directory for your own user account or for any group to which your user account belongs, blocks your own ability to use the file or directory, regardless of any other permissions you might have. By the same token, giving the Everyone group No Access permission for a file or directory blocks everyone's ability to use it, even yours. In such a case, no one can open the file to view or change its contents or list the files in the directory. Note that No Access permission does not interfere with your ability to set permissions for a file or directory that you own--you retain the ability to reset permissions to regain access to those files and directories.

The Difference Between Rights and Permissions

Permissions protect specific objects--usually a directory, file, or printer. A permission is a rule associated with an object that regulates the users who can have access to the object and the manner in which they can gain access to it.

Rights protect the system as a whole. Rights can give a user the ability to bypass specific security controls associated with an object and authorize a user to perform certain actions on the system. For example, an Administrator has the right to back up the system. System back-up requires the right to take precedence over all file and directory permissions. Rights can also be used to prevent certain users from performing actions on the system. For example, by default everyone who logs on to the computer can shut down the system. It might be a good idea to prevent users on the Guest account from doing so.

Security Identifier

A security identifier, or SID, is a unique identifier used to represent a user, a group, or some type of security authority. SIDs are nontransferable--once a SID has been used to represent an account, it cannot be used again to represent another account.

SIDs have two levels of hierarchy: the domain name, and the user or group name. Rather than deal with the unwieldy SID representation, SIDs are translated to the human-readable form, DomainName\UserName or DomainName\GroupName.

Windows NT Accounts

Windows NT provides for two types of accounts: user accounts and group accounts. Groups accounts can be local or global.

Users log on with a particular account to gain access to the privileges and permissions associated with that account. User accounts contain the username, password, group memberships, **security identifier(SID)**, and any other information necessary for a user to establish a security profile. Windows NT provides two basic **built-in user accounts** which are necessary to use the computer.

Groups make it possible to control the access of several users who perform similar tasks on the computer. A group account contains a list of members, a SID for the group, and sometimes the names of other groups. Windows NT contains a number of **built-in groups** with pre-defined security policies, to simplify the task of protecting system resources.

See Also:

How Local and Global Groups Work

Account Management on a Domain

Windows NT Built-in User Accounts

The Administrator account is the account used to manage the system's overall setup. The user of this account has complete control of the system.

The Guest account is an account with no password, belonging to the least-privileged group. The user of this account has limited access to the computer's resources.

Windows NT Built-in Groups

Some built-in groups provide control on the basis of **the user's role:**

- **Administrators**
- **Power Users**
- **Users**
- **Guests**
- **Backup Operators**

Other built-in groups are based on **how the computer is being used:**

- **Interactive Users**
- **Network users**
- **Everyone**
- **Creator Owner**

How Local and Global Groups Work

A **global group** is not limited to protecting a single computer's resources. It can contain a number of user accounts from only one domain, but is able to protect resources on any computer that belongs to that domain or any other trusted domain. A domain's global groups are valid anywhere that the domain's user accounts are accepted.

A **local group** can be used to protect only the files and printers on the computer where the local group is defined, but can contain user accounts and global groups from any domain having a trusted domain relationship with the domain to which the computer belongs. A significant limitation of local groups is that they are effective only on the computer containing the resource to be protected--a user cannot use the same group to protect files on different computers.

By adding global groups to local groups on a Windows NT-based computer, you can assign special administrative privileges to and control access to files and printers by a particular class of users in a domain. **Example**

Example

Imagine that you want to give access to files on your computer to personnel managers from two separate domains. One domain contains a global group consisting of user accounts created for personnel managers in the Finance division, and the other contains user accounts for personnel managers in the Manufacturing division. You can give permission for access to personnel managers from both divisions by creating a local group on your computer, adding the two global groups to your local group, and then giving the appropriate file permissions to the local group.

Account Management on a Domain

Windows NT supports managing accounts on domains, so you can link a set of servers together in a logical group.

Within a domain, one server acts as the Primary Domain Controller (PDC), and holds the master user account database. All the other servers act as Backup Domain Controllers (BDCs), maintaining a copy of the PDC user account database. Although all servers within the domain function as logon servers, all new user accounts must be added to the PDC.

The advantage of this model is that one user account can log into any server on the domain. The limitation of this model is that one account is needed for each domain. If you have multiple domains (for example, development and engineering), you need multiple user accounts.

By establishing a trusted domain relationship, administrators can reduce the administration necessary to create security accounts on each server. Computers in one trusted domain can log on users from any other trusted domain. Users can connect to shared resources on all servers within the trusted domain. Even large networks with many domains can be set up so a user logs on once to connect with any computer on the network.

User Identification and Authentication

Before a user is allowed to do anything on a Windows NT system, the user must first log on to the system and be authenticated by entering a user name and password.

After successful authentication, the Windows NT security system tags the users shell process with a **security access token**. From this point forward, whenever the user attempts to access a protected object the security reference monitor will run an access validation routine against the users security access token. Any other process that the user creates will also be tagged with the users access token. Thus, the system can track any security-related events that the user initiates--another of the requirements for a Class C2 security rating.

Security Access Token

A security access token is a data structure that contains security-related information about a logged-on user. Contained within the access token are any rights that have been assigned to the user or any group of which that user is a member.

Security Auditing

Security can be set up to record where, when and how security-significant events (such as file access) take place in the enterprise.

By monitoring this type of information, you will be more able to create a security infrastructure that meets the needs of your organization. The security record is an "audit trail" that you can examine to determine how effectively your security setup is protecting your computer.

Security auditing is completely configurable--you decide what types of events you want to keep track of, how often, and who receives notification. There are three basic steps to setting up an auditing system:

1. **Deciding which events to audit**
2. **Configuring the security system**
3. **Monitoring the security log**

Deciding Which Events to Audit

Security auditing is a special purpose application of the event-logging service that records **system events** affecting the computer's security. You can examine the resulting event log to ascertain whether a user is violating security policy. Windows NT can record a range of event types, from system-wide events to an attempt by a particular user to read a specific file. Because the security log is of limited size, it is important to choose the events you want to audit carefully.

Minimum Security Requirements If your computer is reasonably secure physically (for example, if it's not located in a public place or connected to a large network) and if you are not concerned about monitoring your computer's authorized users, you can set up auditing to record only overt attempts to violate your computer's security.

Higher-Level Security Requirements In addition to setting up the minimum security requirements, other events can be monitored to provide a greater level of protection for your computer.

Information Recorded About Each System Event

- The **date** on which the event occurred.
- The **time** at which the event occurred.
- The **application** or operating system component that generated the event.
- The **type** of event that occurred (for example, success or failure at performing an audited action).
- The **category** of event that occurred (such as file system access or logon).
- A **numeric identifier** for the specific event.
- The **username** of the user who caused the event to occur.
- The **name of the computer** on which the event occurred.
- A **description** of the event.
- **"Raw" data** associated with the event, when appropriate.

Minimum Security Requirements

Failed attempts to log on. These usually result from usernames or passwords entered incorrectly by authorized users. However, repeated failed attempts within a short time period could be an indication of a "break-in" attempt.

Failed and successful attempts to change security policy. Successful attempts to change security policy at unusual times or attempts that violate your security standards should be monitored. Failed attempts might be caused by administrators who are unintentionally logged on to an account outside the Administrators group.

Failed and successful attempts to change certain file systems. Attempts to change program files that are part of the operating system can indicate the presence of a virus attempting to infect the system. Only administrators should be allowed to change files with extensions such as EXE, DLL, and DRV.

Higher-Level Security Requirements

Successful attempts to log. Determining who logs on and when can help you detect inappropriate use of the computer.

Successful and failed privileged actions. Auditing how a user employs accounts with special rights can help you enforce the implementation of your organization's security policy. It can also help you detect the possible effects of virus programs attempting to undermine your computer's security.

Attempts to gain access to certain files or printers. You can monitor whether a user is attempting to read or change sensitive files or use restricted printers.

Configuring the Security System

The event logging logging service acts on behalf of the operating system and applications to record information about particular events. The operating system uses this service to record security-related events in a special location on the disk called the security log.

Setting up auditing requires three steps:

1. With **Event Viewer,** set the maximum size of the security log.

2. With **User Manager,** specify the combinations of types and categories of events that you want to audit and tell Windows NT what to do when the security log is full.

3. With **File Manager,** specify the files and users for which you want to audit access.

Event Viewer

Set the maximum size of the security log to meet your needs--choose a larger size if you want to audit a large number of events, a smaller size if you're concerned about disk space. To change the size of the security log, use the Log Settings command in Event Viewer.

Choose the action that Windows NT is to take when the log approaches maximum size. It can overwrite certain event records as needed, overwrite event records that occurred prior to a specified number of days, or continue to write records to the log until it becomes full. Your choice will depend on the level of security you require and how often you check the security log.

User Manager

The user-account database contains setting regarding the security policy of a computer. It determines factors such as the minimum length of passwords and the rights assigned to each user. You can specify the categories (such as security policy changes or logons) and types (successful or failed) of events for each category to be audited.

To ensure that newer records are not lost when the audit log becomes full, enable the "Halt System when Security Event Log is Full" check box in the User Manager Audit Policy dialog box. If you enable this feature, you must check and clear the audit log frequently, otherwise the system can halt unexpectedly and unsaved application data can be lost.

File Manager

If your computer auditing policy includes keeping track of file-system access, you must specify the directories or files to be audited and the users whose access to those files is to be audited. This process, which is similar to setting permissions on a file, is performed using the Security Auditing command in the File Manager.

Monitoring the Security Log

Security auditing is useless unless the security log is examined at regular intervals by someone who knows how to interpret it and who is familiar with the requirements of computer security.

The frequency with which you check the security log depends on:

- **How important security is to you**
- **How often the computer is used and by how many people**
- **Whether the computer is set up for external connections**

In any case, you should ensure that the security log is checked often enough so that no event records go unexamined because they have been overwritten by newer entries and so that the event log does not become full.

How Important is Security to You?

If security is a high priority for you, you should treat the security log with the same concern that you show for your financial records. For maximum security, the security records of your computer should be examined by an independent auditor or designated administrator who can detect security violations.

How Often is the Computer Used and by How Many People?

The more users who regularly use your computer, the more difficult it is to monitor their actions directly and the more likely it is that one of them will be inclined to attempt a security breach.

Is the Computer Set Up for External Connections?

Your computer faces greater security exposure if it is accessible via modem, by a large network of users, or if your computer is physically set up to the general public or other unknown individuals. Watch carefully for failed attempts to gain access to files and frequently check the computer to be sure that no one is attempting to log on to it with an account that has special rights.

Memory Protection

When your application runs, it uses memory to store the information you are working on. When you close the application, you store this information in a file or directory subject to access controls you can define. However, the memory that the application used while running, which includes information from your file, has to be returned to the operating system so that it can be allocated to new applications. Windows NT protects the security of your files by automatically re-initializing this memory when it is returned, so that neither the system nor other applications can attain unauthorized access to your work.

Windows NT Seminars

Albany, NY

February, 24 1994

Omni Hotel Albany
Ten Eyck Plaza, State and Lodge Streets
518-462-6611

Arlington, VA

March, 7 1994

Marriott Crystal City
1999 Jefferson Davis Hwy
703-413-5500

Baton Rouge, LA

March, 1 1994

Holiday Inn Holidome
9940 Airline Hwy
504-924-7021

Boston, MA

February, 24 1994

The Copley Plaza, A Wyndham Hotel
138 St. James Avenue
617-267-5300

Charleston, SC

February, 1 1994

Charleston Marriott
4770 Marriott Drive
803-747-1900

Chicago, IL

March, 10 1994

The Westin Hotel Chicago
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312-943-7200

Cleveland, OH

February, 9 1994

Sheraton Cleveland City Centre
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216-771-7600

Columbia, SC

February, 3 1994

Ramada Townhouse Downtown Conf. Center
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803-771-8711

Columbus, OH

February, 7 1994

Hyatt on Capital Square
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614-228-1234

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Hilton Northfield
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Grand Rapids, MI

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187 Monroe NW /Pearl at Monroe
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February, 14 1994

Halekulani On the Beach at Waikiki
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808-923-2311

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February, 17 1994

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6101 W. Century Blvd.
310/642-1111

Memphis, TN

February, 3 1994

Radisson Hotel Memphis
185 Union Avenue
901-528-1800

Nashville, TN

February, 1 1994

Stouffer Nashville
611 Commerce St.
615-255-8400

New Orleans, LA

March, 3 1994

Hyatt Regency New Orleans
Poydras at Loyola Avenue
504-561-1234

New York, NY

February, 21 1994

New York Marriott Marquis
1535 Broadway
212-398-1900

Rochester, NY

February, 22 1994

Radisson Hotel at Rochester Plaza
70 State St
716-546-3450

Springfield, IL

March, 8 1994

Springfield Renaissance
701 East Adams Street
217-544-8800

Sequent

When one of the worlds leading UNIX® systems vendors decided to launch a line of Windows NT™-based servers, they also committed to using the new platform to help run their own business. The result is an integrated network of Windows™ and UNIX-based services that required minimal changes to the companys existing systems investments while providing a graphical workgroup platform for the future.

Sequent Solution Summary

Industry
Computer Manufacturing

Business Solution
Office Automation

Architecture
Windows-based local area networks integrated with worldwide UNIX network, including file, print, and e-mail services.

Products Used
Microsoft® Windows™ NT
Microsoft SQL Server for Windows NT
Microsoft Windows™ for Workgroups
Microsoft Office Professional
Microsoft Mail SMTP Gateway
LM Server (Syntax Corp.)
Novell® NetWare® for UNIX
Remote LAN Node (DCA)

Development Resources
Five internal developers, one project manager.

Development Time and Cost
Five months for initial rollout, $200,000 including hardware and software for 120 initial users and companywide infrastructure.

Benefit
Integrated Windows NT-based platform with existing UNIX environment with no interruption to operations; avoided costly hardware upgrades to printer network; enabled deployment of workgroup contact management and decision support applications.

Sequent - Solution Details

"The underlying philosophy in this effort was to build a platform that would give end users access to everything they have today in their UNIX environment, plus the added benefit of the Windows graphical environment."

"We now have a much more extensive environment with which to automate workgroups. People can now work faster, share information, and be more effective in their work."

Mark Anastas,
Senior Manager for Windows NT Systems, Sequent Computers

There are always numerous challenges to overcome in the workplace when a company decides to incorporate new information technology. But Sequent Computer Systems faced an especially difficult task in its recent adoption of the Microsoft Windows NT operating system into its business operations. The reasons were cultural as well as technological. Why? Since 1983, Sequent, based in Beaverton, Oregon, has focused exclusively on becoming one of the worlds leading vendors of UNIX-based database and application servers. The $350 million-plus (annual revenues) company develops and manufactures its own family of symmetric multiprocessing (SMP) computer systems. An SMP system links many processors in a single machine for greater computing power. Based on this product line, Sequent has built an impressive customer base for its systems, including major airlines, worldwide telecommunication businesses, financial services companies, and others.

Sequent pioneered the use of symmetric multiprocessing UNIX systems for commercial line-of-business applications in 1983. Almost ten years later, in late 1992, Sequent made the decision to expand its worldwide business to include the Windows platform.

With its experience in high performance servers and multi-processor systems, Sequent found that the Windows NT platform offered the best direction in which to expand its business. In early 1993, the company launched a line of multiprocessor machines running Windows NT, calling these the WinServer family. With this business decision to enter a new market--with a new technology--came the challenge of integrating a new computer environment into the companys daily business operations.

New Market Forces Integration
UNIX servers were not only Sequents core product, they also served as the companys primary business tools, used in everything from manufacturing to finance. Except for a few stand-alone PC and Macintosh users and several scattered local area networks running a UNIX-compatible version of Novell NetWare, PC applications and applications for Windows™ were foreign to most of the companys employees.

According to Mark Anastas, senior manager for Windows NT Systems at Sequent, it wasnt enough for Sequent to launch a new product line based on Windows NT. The companys 1,600-plus employees had to be able to use and benefit from this technology as well: "Its a real benefit to customers for the vendor whos providing a product to have

a deep understanding of how it will be used in a production environment," says Anastas. "Consequently, its always been an important part of Sequents culture to use the products we market." Anastas points out that Sequent was also looking for a competitive advantage from the PC technology for its own workers. "We realize that the Windows operating system is an excellent platform on which to build the client-server workgroup applications our workforce wanted. Our users wanted to empower themselves for greater personal productivity at their desktops and notebook computers, so Windows was a natural choice," explains Anastas.

With these goals in mind, the challenge remained--how could Sequent integrate PC-based Windows technology into a well-established business environment that was dominated by a host-and-terminal UNIX architecture and UNIX culture?

"Cookie-Cutter" Solution Integrates UNIX and Windows

"The underlying philosophy in this effort was to build a platform that would give end users access to everything they have today in their UNIX environment, plus give them the added benefits of the Windows graphical environment. In building this platform, we focused on four key areas: providing terminal access to the existing UNIX character-based applications; electronic mail; file and print sharing; and remote access," explains Anastas.

A team of six people--two from Sequents new Windows NT business unit and four UNIX technical staff from Sequents Information Systems department--devised and implemented a plan to bring Windows into Sequent.

According to Anastas, the team created an integrated package of services or a "subnetwork" that can be easily replicated and tied into the companys worldwide network at any Sequent location. This "cookie cutter" model allows for a smooth roll-out of Windows technology into different parts of the company. The roll-out could take place as fast as possible or gradually in order to accommodate different departments and individuals needs.

The subnetwork package is centered around one of Sequents own WinServer computers (which can be configured with from one to 30 Intel 486 processors) running the Windows NT Advanced Server operating system. This server is linked to 486-based desktop and portable PCs running Windows for Workgroups. The services provided to end users by the standard subnetwork configuration include terminal access to the existing UNIX character-based applications; access to Sequent Symmetry machines running Novell NetWare for UNIX (for links to Sequents existing Novell file and print servers), access to SQL Server for Windows NT running on the WinServer machine, access to file services running on the WinServer machine, a mail gateway to interconnect Microsoft Mail with Sequents existing SMTP mail network; a network-attached fax server; a color scanner; and a CD-ROM server. In addition, a dial-in modem server in the subnetwork package allows remote PCs, either home-based or portable, to access all of these services as if they were connected directly to the subnetwork in a particular Sequent office.

In addition to the Microsoft Mail and Schedule+ applications included with Windows for Workgroups, each user is also provided with the Microsoft Office family of programs for Windows.

This entire package of services, or any subset of it, can be easily replicated depending on a specific departments or workgroups needs.

Beginning in January 1993, the team set up the first subnetwork using 20 PCs at the Oregon headquarters. Five months later, by the launch of Windows NT in May of 1993, nearly 120 people were online with Windows-based workstations in five buildings at Sequents corporate campus, fully integrated with the existing UNIX services. And in the summer of 1993, the first Sequent field offices were coming online with their own Windows-based subnetworks.

Despite the relatively fast development, the creation of the subnetwork model and its integration with the UNIX systems was not without several significant challenges, according to Anastas. For example, Sequent did not want to lose their heavy investment in an existing UNIX-based electronic mail system and yet wanted to give people the option of using MS Mail with its graphical interface and ability to embed complex documents in messages. While the Microsoft Mail SMTP Gateway for UNIX provided the basic connectivity between the two systems, a problem arose because each system maintains its own global address book of user names. The UNIX system had over 5,000 existing mail "aliases" (shorthand names for groups of people) that were used every day. Also, there was an established internal procedure for creating and administering new aliases. The project team solved this challenge with a small custom program that kept the UNIX alias system intact by having it update the Microsoft Mail address book each night on the servers. Printer sharing posed another integration challenge. "We already had a large network of laser printers installed that was operating very well. Rather than recreate that system for connection to the WinServers or putting in additional LAN print servers, we chose to use a gateway to gain access to the UNIX printer network," says Anastas. The team decided on a third-party product called LM Server that runs on the existing UNIX systems and provides Microsoft network compatibility, giving every Windows-based PC access to Sequents existing worldwide network of printers.

New Workgroup Platform Preserves Investment

According to Anastas, the successful development of a Windows NT-based network platform delivers several key benefits to Sequent. "We now have a much more extensive environment with which to automate workgroups," says Anastas. "People can now work faster, share information, and be more effective in their work."

Anastas adds that the Windows platform, where applications take months to develop instead of the years of development for host systems, gives Sequent greater flexibility to respond quickly to rapidly changing market conditions. And Sequents customers also benefit, notes Anastas: "Having practical experience with the products for Windows will help us be more successful in supporting our customers as they deploy similar configurations."

While these benefits are important, Anastas points out that Sequents employees--and the companys budget--appreciate the direct benefits of the relatively smooth integration of the Windows and UNIX worlds. Because Sequent adopted a Windows-based computing platform while retaining its existing UNIX systems, its hardware cost savings were significant. For example, being able to use the existing printer network and cabling saved thousands of dollars, according to Anastas. In addition, business operations were not interrupted as users have complete access to their existing UNIX mail, file, and print systems either through integration with new Windows-based applications or through familiar character-based UNIX terminal sessions on their desktops running Windows.

"The main accomplishment of these initial efforts was to achieve that breakthrough where we now have a standard package that can be easily deployed and supported and is available to all groups in the company," notes Anastas. "Now departments can deploy applications for Windows in their workgroups and connect with the other services and users across the organization that need to interact on a daily basis."

Custom Applications Build for the Future

Anastas notes that Sequent is already developing new Windows-based applications to take advantage of the Windows platform as groups adopt it throughout the company. Two of these applications include a workgroup contact management system for Sequents 400-plus person worldwide sales force and a decision support tool for managers.

Both of these applications use client-server technology where the Windows for Workgroups-based client PCs access information stored in a SQL Server for Windows NT database, which is hosted on a WinServer running Windows NT.

"With the Windows infrastructure well begin to use new applications that we just havent had to date on the UNIX platform," explains Anastas. "To help make our business run more effectively we can quickly create information systems from building blocks like Microsofts Office Professional and Windows-based applications we build on our own."

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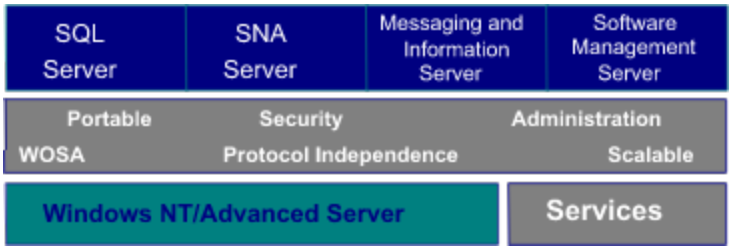
Future Microsoft Server Products

Aside from SQL Server for Windows NT and SNA Server for Windows NT. Microsoft plans to release two other Windows NT-based server products in 1994. For software management - the distribution and management of software and the inventory of hardware and software Microsoft is currently in Beta of a product currently code-named *Hermes*. As the cornerstone for Information management and a messaging infrastructure Microsoft will release an enterprise messaging and information server in 1994.



Microsoft Server Applications Strategy

More Information on Microsoft Hermes

More Information on Enterprise Messaging and Information Server

Future Microsoft Server Products - Hermes

In 1994, Microsoft will deliver an enterprise software management product designed to address the following issues:

Hardware and software inventory and reporting

Software distribution

Software configuration management

The software management and distribution system will run as a server application on Windows NT Advanced Server where it inherits such facilities as remote administration and performance statistics. It slated to deliver software packages to Windows, DOS and Windows NT clients.

For more information about Microsoft server products please contact your local Microsoft office.

Future Microsoft Server Products -Enterprise Information and Messaging Server

In 1994 Microsoft will introduce a server-based product that will specifically address the area of messaging and information management. It is designed to establish a client-server framework for integrated messaging and information sharing while simultaneously building the foundation for establishing an information infrastructure.

Like other Microsoft Client Server Applications, It will deliver the following benefits:

- **Powerful Client/Server architecture** designed to scale easily to small and large organizations
- **Tight integration with Windows NT** designed to maximize the powerful architecture in terms of scalability, management security and administration
- **Standards-based** to be compatible with existing infrastructure and excellent integration with external data and messaging sources.
- **Powerful Administration Model** will create a management structure for messaging and information dissemination that will improve productivity while significantly reducing overhead

Windows NT provides is an excellent platform for such an application since it provides basic services such as multithreading and multiprocessing support as well as an excellent remote administration and performance management.

A Guide to Performance and Scalability in Tightly-Coupled Multiprocessor Systems

Mark D. Campbell of NCR Corporation contributed to this subject

One of the most powerful and compelling components of the Microsoft® Windows NT™ operating system is its built-in support for symmetric multiprocessing systems. This section examines the benefits of symmetric multiprocessing from both a hardware and software perspective.

What Is Scalability?

Scalability is the ability to adjust an operating system to a broad range of hardware platforms.

It is a key attribute of any **computer system** because it determines the range of **price/performance** the system can achieve. Scalability increases the return on investment of a computer system by increasing its effective life. This increase in effective life is achieved because the capabilities of the computer system may be incrementally increased (at an incremental cost to the owner) as the needs of users of the computer system grow over time. Simply put, the owner is not forced to throw the existing computer system away--the capability of the computer system can be increased through a planned expansion path which is defined by the computer vendor.

Price/Performance

The price performance ratio for a computer system is a measure of the amount of work it is capable of completing in a given amount of time for a particular price.

Performance depends directly on the type of workload the computer is processing--whether multiple spreadsheets are being manipulated by different users or a single large database is being manipulated by multiple users. One primary influence on performance is the amount of sharing which is characteristic to the workload. In the case of multiple spreadsheets, there is very little sharing between users, while in the case of a single large database, there can be a great deal of sharing.

Price depends on the purchaser's preferred level of performance and prospects for future growth. Raw performance-related scalability can always be attained by over-buying the amount of performance needed for a given environment; for example, by buying a Cray to support a four-person business under the assumption that the business will grow to 4,000 users. However, most computer system purchasers would prefer to buy a less expensive system which is more appropriate for current needs and can grow with their business.

Computer System

A computer system is an entity which appears to a user as a single point of computing and repository services--for example, a compute engine and an associated set of secondary storage.

The number of cabinets or microprocessors making up a computer has nothing to do with the definition of a computer system. This is best explained through an example. A user who concurrently uses two workstations to perform unrelated tasks is using two computer systems. A user with one workstation connected to a server performing several tasks is using a single computer system. The fundamental difference between these two scenarios is not the number of cabinets or microprocessors involved (since each case involves a minimum of two) but the view of the computer system by the user.

Practical Use of Symmetric Multiprocessing

One of the best ways to produce faster applications with Windows NT is to use asynchronous I/O.

In operating environments that employ synchronous I/O, developers face a problem--when a program requests services from the operating system, it must idle until the operating system returns a value or performs a specific task. With Windows NT, the developer can employ threads to execute multiple tasks simultaneously. The asynchronous I/O model provides an environment where the program need not wait for one routine to finish before another begins. Depending on the nature of the application, it is possible to significantly increase productivity.

Windows NT truly differentiates itself in terms of improved performance when multithreading and asynchronous I/O are combined with symmetric multiprocessing. In a multiprocessor environment, multiple threads or multiple processes execute on separate processors. This can significantly increase the speed and power of applications that use threads extensively. RDBMS systems such as SQL Server are an excellent example. SQL Server deploys a new thread for each new user that enters the system. Aside from the fault tolerance of this approach (each thread runs protected from any other), multiple processors can service more system requests simultaneously. Thus in the SQL Server environment, the load of additional users can be distributed across multiple processors.

SQL Server Threading Under Windows NT

Tightly-Coupled Multiprocessor Hardware Basics

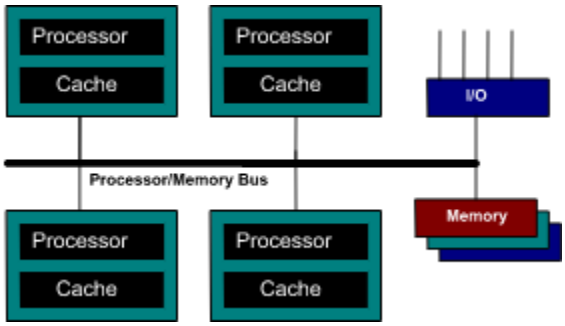
Many different computer system architectures have been developed to increase the scalability of computer systems. One of the most common is the tightly-coupled multiprocessor architecture. The fundamental characteristic of this architecture is that multiple processors can be added over time to increase the computer system's performance.

Graphical Representation of a Tightly-Coupled System

The primary components affecting scalability and overall system performance of the traditional tightly coupled multiprocessor system are the:

- **Processor/memory bus**
- **Processor/cache complex**
- **Memory subsystem and I/O subsystem**

Graphical Representation of a Tightly-Coupled System



Processor/Cache Complex

Tightly-coupled multiprocessor computer systems are designed to minimize the amount of traffic which occurs on the processor/memory bus. The caching subsystem is designed not only to allow the processor to quickly access repeatedly used data, but also to minimize the number of cache misses (and thereby maximize the number of cache hits) that occur when the processor needs to access secondary memory. For this reason, the type, overall size, line size, and associativity of this caching subsystem are critical. Associativity refers to the number of data entries available on a per-line basis in the cache. A 128K 2-way set associative cache has 256K available for data entries. A "direct-mapped cache" is a 1-way set associative cache--a cache in which there is one data entry per cache line.

Processor/Memory Bus

The processor/memory bus is a critical component in a correctly designed tightly-coupled multiprocessor system because it is the single point through which processors must go to access memory.

The design of a processor/memory bus must overcome one fundamental electrical problem: as the speed of the processor/memory bus and the number of processor/cache complexes attached to it increases, the capacitive loading on this bus correspondingly increases. This capacitive loading acts to slow the bits traveling between the processors, to the point where the bits no longer follow the correct protocol established for interprocessor communication. In addition, the length of the processor/memory bus must be minimized as the speed of the bus increases because the velocity of each bit is limited by the laws of physics.

To accommodate higher performance processors and/or a greater number of processors, the designers of a processor/memory bus tend to decrease the frequency at which the bus is clocked (the raw speed of the bus), and use **arbitration schemes** which allow greater effective throughput.

Common Arbitration Schemes

The three most common arbitration schemes are tenured, non-tenured (also called disconnect or split-transaction), and pipelined.

A **tenured bus scheme** is the simplest and has the least amount of overhead for a single transaction. The processor/cache complex strobes an address to the memory subsystem for which it wants corresponding data. The address strobe and subsequent data strobes occur sequentially, one after another, and during that time no other processor/cache complexes may access memory.

A **non-tenured bus scheme** is the most complex and has the greatest amount of overhead for a single transaction at equivalent bus speeds. A non-tenured bus yields the greatest effective throughput at equivalent bus speeds in systems requiring multiple concurrent transactions, when there is a great deal of difference between the processor and memory speeds. **How a Non-Tenured Bus Scheme Works**

A **pipelined bus scheme** is somewhere in the middle--while the address and data strobes are sequential, they can be pipelined so that the time spent between the address strobe and subsequent data strobes is made as efficient as possible.

How a Non-Tenured Bus Scheme Works

With a non-tenured bus scheme, the address and data strobes don't have to be sequential. Therefore other processor/cache complexes can also have cycles that access memory with the original requestor's cycles. At any given frequency, a non-tenured bus is more efficient than a tenured bus because the speed of the processor/memory complex is usually much greater than that of memory. As a result, the time between the address strobe and the data strobe (while the memory is preparing to send the requested data) can be quite long.

Memory Subsystem and I/O Subsystem

The memory subsystem is designed to quickly respond to requests by the processor/cache complex when a processor memory access can't be satisfied from the cache subsystem. The critical parameters in the design of the memory subsystem are worst case memory speed, interleaving, and line size.

The I/O subsystem must be designed to efficiently use the processor/memory bus and not starve the processors on large I/O transfers. The bandwidth of the I/O subsystem is very important for handling the requirements of large databases and imaging applications.

Microsoft SNA Server for Windows NT

The powerful nature of Windows NT makes it an excellent platform for any type of communication server. Microsoft recently released SNA Server, a tightly integrated set of utilities that facilitate flexible and reliable connectivity in your Windows NT, DOS, OS/2, MacIntosh, and IBM mainframe or minicomputer environment.

Deploying SNA Server as part of your distributed client-server system allows you to use **Windows NT Administration Tools** to control all of your SNA servers from a single location, maintaining C2-level security and centralized control. Users can log on once and have access to all of the SNA servers in the enterprise.

One of your biggest concerns is the stability and availability of your gateway--if the communications link goes down, mission-critical information and productivity is lost. SNA Server lets you choose the network protocol (NetBEUI, IPX/SPX, TCP/IP) that best suits your system requirements. All host communication is done at the server, which offers an open interface for writing drivers for a wide variety of **data-link protocols** to the host.

Active Backup and Automatic Routing

NetView Integration

Complete IBM SNA Connectivity

Third Party SNA Products for Windows NT

Integrating Windows NT into SNA Environments

Most corporate information is currently stored in SNA networks. It is imperative that client-server operating systems provide seamless and reliable access to all existing information. The Microsoft® Windows NT™ operating system can act as both client and gateway to the IBM® mainframe or minicomputer environment. When running as a client, Windows NT includes key connectivity components such as built-in Data Link Control (DLC) support. As a server, SNA Server is the gateway software that reliably links MS-DOS®, Windows™, Windows NT, Macintosh®, and OS/2® operating systems to your IBM host.

Windows NT as a Terminal Emulation Client to an SNA Network

Integrating Windows NT with DBMS on SNA Networks

Microsoft SNA Server for Windows NT

Third Party SNA Products for Windows NT

Windows NT as a Terminal Emulation Client to an SNA Network

A Windows NT workstation is an excellent platform for both client-server integration and simple terminal and printer emulation.

DLC and **TCP/IP** are included as two alternatives for connecting with IBM networks. DLC provides the protocol support necessary for integrating Windows NT into existing SNA networks. Adding SNA Server gives your Windows NT-based workstation full access to client-server protocols such as APPC or CPI-C. Alternatively, TCP/IP support for Windows NT allows you to use TN3270 and TN5250 to facilitate direct PC-to-host connections.

Third party SNA vendors offer a variety of related products that use the Windows NT communications protocols. You can connect via Coax, DLC(802.2), SDLC, X.25, Asynchronous, NetBIOS, IPX, TCP/IP or ISDN. The multitasking and power of a Windows NT platform allows you to run as many as 32 concurrent sessions on a single Windows NT-based machine, making it an excellent workstation for administrators.

Windows NT supports the DLC protocol primarily for use with network-attached printers and for communication to mainframes via SNA services. Network-attached printers such as the HP® III si use the DLC protocol because the received frames are very easy to take apart and because functionality can easily be coded onto ROM. SNA Server uses the DLC protocol for communicating with a mainframe. The downstream PU uses DLC to mimic a mainframe, thereby allowing all devices with full PU2-compliant software to communicate with the mainframe via the SNA services unit.

Integrating Windows NT with DBMS on SNA Networks

This section, when completed will discuss solutions from companies such as Micro Decisionware, XDB Systems IBI and Wall Data that facilitate seamless connectivity and integration with systems such as DB2, IMS and SQL/DS.

Among the topics discussed will be utilizing Windows NT in both a client host and client server environment where a DBA can use Windows NT to administer multiple heterogeneous database systems.

As more companies switch to TCP/IP transport as an enterprise protocol, TN3270 and TN5250 are becoming more popular for linking PCs to IBM hosts. Most vendors of 3270 and 5250 products now provide emulation products facilitating direct PC-to-host connections. If your host already has TCP/IP, native TCP/IP support and the inclusion of the stack itself makes this connectivity attractive.

Microsoft SNA Server for Windows NT

The powerful nature of Windows NT makes it an excellent platform for any type of communication server. Microsoft recently released SNA Server, a tightly integrated set of utilities that facilitate flexible and reliable connectivity in your Windows NT, MS-DOS, OS/2, Macintosh, and IBM mainframe or minicomputer environment.

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Active Backup and Automatic Routing

NetView Integration

Complete IBM SNA Connectivity

NetView Integration

SNA Server for Windows NT is designed to maximize administrative flexibility by tightly integrating with NetView®, notifying NetView of communications problems through automatic data-link alerts. Alerts can be sent to NetView from either a third party emulator or from the Windows NT Event Log. SNA Server also provides support for NetView RUNCMDs, which allows administrators to issue Windows NT commands from the NetView Console.

Active Backup and Automatic Routing

SNA Server's active back-up capabilities ensure that your session on the host will always be available. If your connection to the host via one server goes down, SNA Server automatically provides you an alternate session on another server. SNA Server for Windows NT is also designed to automatically route each session to optimize response time.

Complete IBM SNA Connectivity

SNA environments often support several concurrent protocols and different types of applications. SNA Server fully supports the Windows Open Services Architecture (WOSA) SNA APIs--a set of common programming interfaces for the Windows and Windows NT operating systems that facilitate the creation of new, more powerful applications while protecting your valuable legacy information. SNA Server supports APPC, CPI-C, CSV, and LUA APIs for advanced SNA applications. For users with modest host access requirements, SNA Server includes a simple, graphical 3270 for clients running Windows and Windows NT.

Four leading 3270 and 5250 terminal emulation vendors--Attachmate, DCA, Eicon Technology, and Wall Data--have announced support for SNA Server for Windows NT. Together, they represent over 70% of the market for connecting corporate desktops to IBM hosts.

Key Data-Link Protocols

SNA Server for Windows supports key data-link protocols, including NDIS-compliant token ring or ethernet adapters, SDLC over leased or switched telephone line connections, X.25 over public or private packet-switched connections, and DFT over Coax or twisted pair connections. From an SNA network perspective, the SNA server emulates PU 2.0 and PU 2.1, supports APPN networks as a LEN node, and provides DSPU support. SNA Server for Windows NT supports the LU 0, 1, 2, 3, and LU 6.2 protocols. A simple, single session 3270 applette is also provided for test purposes.

Windows NT Administration Tools

Windows NT **Performance Monitor** allows you to quickly and easily view and tune SNA Server performance characteristics, even from a remote Windows NT-based client machine. You can view SNA Server-specific information, such as data bytes transmitted or received, across a data link to the host.

SNA Server uses the Windows NT **Event Log** to store informational and error messages for full audit-tracking capability. Messages can be viewed either locally or across the network, simplifying administration. SNA Server logs messages such as startup/shutdown, session initiation, and error conditions, and allows you to send this information to the NetView Console if desired.

SNA Server uses the Windows NT **User Manager** to assign SNA resources. You can assign LUs or pools of LUs to individuals and to groups defined in the Windows NT user database. This ensures that resources are allocated only to users who are validated by the Windows NT operating system. Administrators manage just one set of user accounts.

Third Party SNA Products for Windows NT

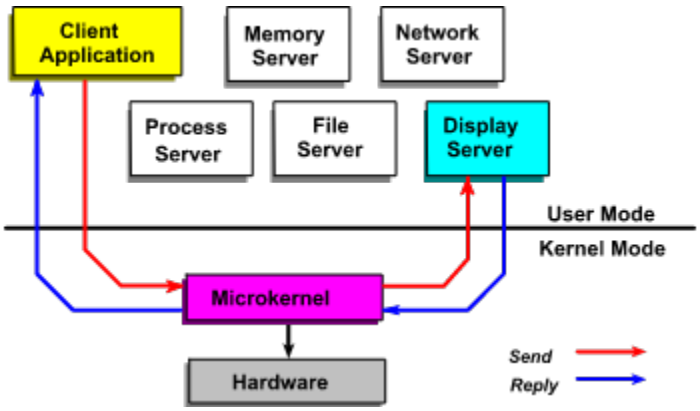
Andrew Corp

Attachmate Corp

DCA

Eicon Technology

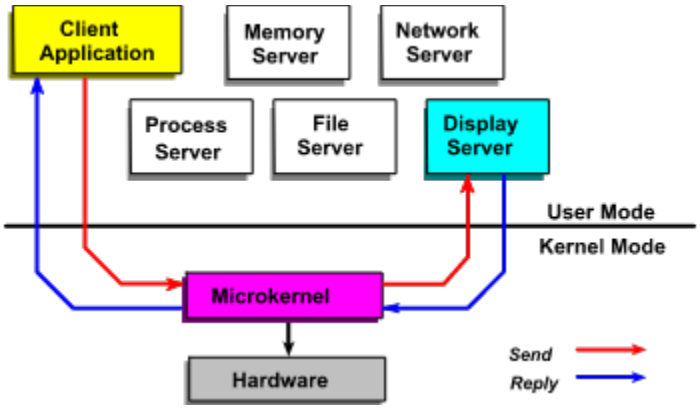
Wall Data



Andrew Corp: TranSend 400N

TranScend 400N is the first and only product to provide fast, simple file transfer between Windows NT and IBM's AS/400® line of computers. It is a software-only product that can operate over network or SDLC connections to the AS/400.

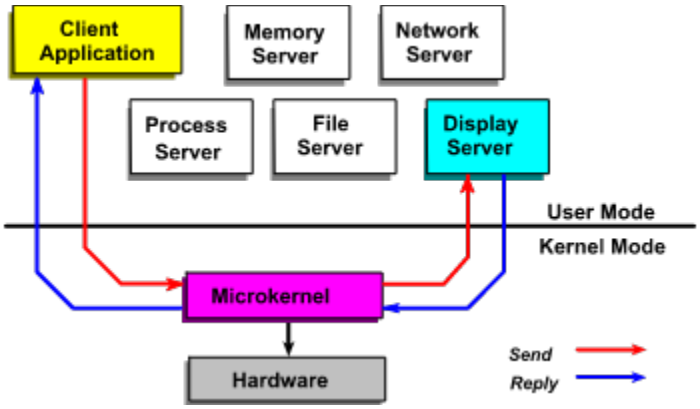
TranScend 400N is based on the Windows File Manager interface. This allows drag and drop file transfer, making it easy for any user of Windows to transfer a file to or from the AS/400. Pull-down menus allow rename and delete of AS/400 files as well as sending AS/400 commands. Products in development include a TCP/IP version of 5250 Elite, and a new high speed Windows-based gateway.



Attachmate Corp: EXTRA! for Windows NT

EXTRA! for Windows NT provides a complete set of 3270 connectivity options to take full advantage of Windows NT. This powerful software allows you to choose direct LAN, LAN gateway, Coax, and modem, via SDLC connections. It also supports industry standard file transfer protocols such as IBM Send/Receive (IND$FILE) and DISOSS PS/CICS, up to 26 host sessions, pull-down menus, dialog boxes, multiple windows, LU1 or LU3 printer emulation, and light pen or mouse pen support. EXTRA! for Windows NT offers a wealth of automation options including macros, DDE, and HLLAPI.

EXTRA! for Windows NT provides performance and reliability gains to users by providing a 3270 emulator tightly integrated into the Windows NT operating environment. Your investment in programs that use 3270 APIs for interaction with host applications is protected by providing consistent API implementations across 16-bit and 32-bit environments. Connectivity options allow integration into a wide range of data communications networks.



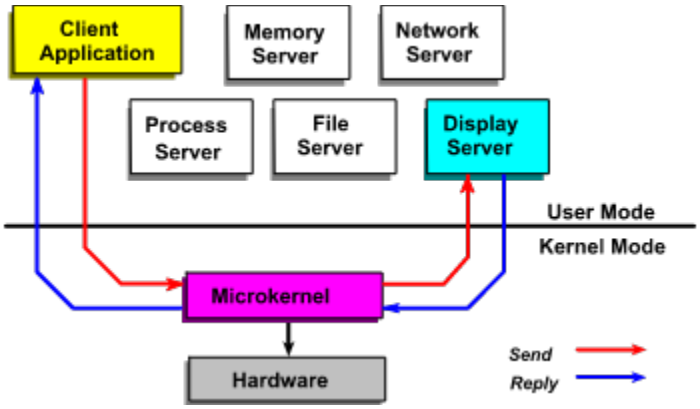
DCA: IRMA Workstation for Windows NT

IRMA™ WorkStation for Windows NT brings all the award-winning features of the IRMA WorkStation family to the Windows NT-based desktop. Because it was developed as a true 32-bit application, it takes advantage of Windows NT features such as symmetric multiprocessing, which can make your host communications faster and more responsive than ever. If you already use IRMA WorkStation for Windows, moving to IRMA WorkStation for Windows NT will be easy, with a soon-to-be released conversion program that will quickly migrate your configuration.

Features

IRMA WorkStation for Windows NT Features

- **Offers full-featured IBM 3270 display and printer emulation**
- **Supports 10 host sessions--Models 2, 3, 4, and 5**
- **Supports DFT, SDLC, 802.2, and X.25 host connections**
- **Acts as a client to Microsoft SNA Server for Windows NT**
- **Supports DCA® and IBM 3270 and token-ring communications adapters**
- **Supports APPC LU 6.2 and HLLAPI APIs**
- **Includes all the IRMA WorkStation productivity tools, including QuickInstall, QuickBar, QuickExec, QuickPad and QuickHit.**
- **For software developers, supports both the DCA Distributed Application Developer's and HLLAPI Software Developer's tool kits**



Eicon Technology: Access 3270 for Windows NT

Eicon Technology's Access 3270 for Windows NT is a full-featured IBM 3270 display and printer emulator for the Windows NT operating system. With Access 3270for Windows NT , users can take advantage of their favorite graphical user interface to reach IBM mainframe applications.

Access 3270 for Windows NT gives you a fully integrated workspace. The Multiple Document Interface (MDI) lets you open new Access sessions without opening new copies of Access for Windows NT, saving your system resources and stepping up response time.

Access 3270 for Windows NT can be combined with Access 5250 for Windows NT to allow concurrent midrange and mainframe sessions from the same desktop. This added connectivity makes it easy to share information and switch between 3270 and 5250 sessions.

Features

Access for Windows NT Features

- **Up to 32 concurrent host sessions**
- **Dynamic font resizing**
- **Full screen support**
- **Hotspots that allow PF keys to be activated by the mouse**
- **Macro record and playback**
- **Softkeys that can be defined to contain commonly-used keys, macros and commands**
- **Light pen emulation with mouse**
- **Host transparent printer driver**
- **Enable/disable menus and commands**
- **Host displayed color definition and remapping**
- **LAN file server installation**

Wall Data

RUMBA for the AS/400 (Windows NT Version)

RUMBA® for the AS/400 brings AS/400 applications to your PC, where you can work with them as easily as you do your favorite word processor, spreadsheet, or graphics package for Windows NT. Just point and click to access AS/400 applications, copy and paste information between PC and AS/400 applications, or work with more than one AS/400 application at a time.

RUMBA for the AS/400 makes it so easy, you'll forget you're connected to the host. QuickStep pads, HotMenus and HotSpots let you run AS/400 applications with a mouse, saving keystrokes and reducing errors. HotLinks allows you to create self-updating links between host data and Windows-based applications. A Windows-style point-and-click file transfer function simplifies AS/400 database and text file manipulations. Built-in support for IBM Text Assist lets you write and edit documents as usual on the AS/400. Intuitive menus, dialog boxes and on-line context-sensitive help guide you through all selections. RUMBA's Fast Path configuration feature makes installation painless. RUMBA for the AS/400 supports communications through DLC (802.2), Microsoft SNA Server for Windows NT, or TCP/IP (TN5250).

RUMBA for the Mainframe (Windows NT Version)

RUMBA for the Mainframe brings IBM host 3270 or APPC applications to your PC or RISC workstation where you can view and work with them just like your favorite applications for Windows. Just point and click to access multiple simultaneous host sessions, transfer files, copy and paste information between workstation and host applications, change colors or customize keyboards.

RUMBA for the Mainframe makes it so easy you'll forget that you are connected to the host. QuickStep macros automate long procedures with a single mouse click. HotLinks create self-updating links between host and Windows NT-based applications. HotSpots allow you to execute complex functions by pointing and clicking on screen text areas. An intelligent List Host Files feature provides fast and convenient file transfers. Simple menus, dialog boxes and instant context-sensitive on-line help guides you through all selections. Fast Path provides step-by-step assistance in initial configuration. RUMBA for the Mainframe supports communications through DLC (802.2), TCP/IP (TN3270), the Microsoft SNA Server for Windows NT, and DFT Coax. Developers and power users can integrate local workstation applications or develop custom graphical front ends with RUMBA Tools for DDE, EHLLAPI or the Microsoft Visual Basic® programming system.

SQL Server for Windows NT
A New Design Based on Proven Technology

Microsoft® SQL Server for Windows NT™ is a powerful, scalable relational database platform that makes managing distributed client-server applications easier. Part of the family of Microsoft client-server products, SQL Server can help you reengineer your line-of-business systems to take advantage of open, standards-based computing.

For Additional Information:

Scalability: Increase DBMS Performance with Multiprocessing

Multithreaded Design: Get the Most from Your RDBMS

Integration with Windows NT

Reliability and Availability

Open Interoperability and Compatibility

Scalability: Increase DBMS Performance with Multiprocessing

Perhaps the most exclusive feature within SQL Server for Windows NT is scalability. With single-processor systems like SQL Server for OS/2®, performance is limited to the fastest single-processor hardware system you can find. SQL Server for Windows NT uses the latest hardware technology, including powerful multiprocessing systems such as COMPAQ® SystemPro XL, AST® Manhattan, and NCR® 3450.

As your demand for transaction processing increases, single-processor systems like SQL Server under OS/2 become CPU-bound. Without symmetric multiprocessing, you have little alternative but to attack the problem using several single-processor servers--which is difficult unless your data is easy to partition. Using SQL Server for Windows NT with multiprocessing hardware raises the ceiling on your system's performance.

Multithreaded Design: Get the Most from Your RDBMS

SQL Server for Windows NT is designed to fully utilize the underlying hardware. As demands on your relational database management system grow, SQL Server scales with additional processing power to help you preserve your investment in software and your administrative costs, while getting the most from your hardware investment. The technology that underlies this flexibility is based on single-process architecture and native thread-level multiprocessing.

SQL Server for Windows NT maintains a single-process, multithreaded architecture that reduces system overhead and memory usage. One of the key design goals was to use native Windows NT facilities wherever possible. Instead of using multiple processes, SQL Server uses a single process with multiple operating system threads. Because all threads belong to the same process, a single address space is present, eliminating the need to coordinate processes through shared memory.

SQL Server for Windows NT allows preemptive operation and dynamic load-balancing across multiple CPUs by supporting multiprocessing at the thread level rather than the process level. On a non-threaded operating system, such as UNIX®, a typical SMP database server has multiple DBMS processes, each bound to a specific CPU. The processes communicate with each other using shared memory, which maintains the cache, locks, task queues, and user context information. The DBMS must include complex logic that takes on the role of operating system: scheduling user tasks, simulating threads, and coordinating multiple processes. When each process is tied to a specific CPU, dynamic load balancing is more difficult.

The Limitations of SQL Server Threading on OS/2

With OS/2, limits on the number of threads per process require SQL Server to simulate its own threads. SQL Server manages each simulated thread using its own nonpreemptive scheduler. (This is also how SQL Server works on nonthreaded operating systems such as UNIX or NetWare®.)

With OS/2, a single OS worker thread actually manages and services all simulated user threads--an extraordinary amount of work. It manages the network interface, listening for new connections and establishing them when detected. That task alone is intensive, but it also services all client requests. If 50 connections are using SQL Server simultaneously, one thread manages and services them all.

SQL Server for OS/2 employs a simple, nonpreemptive scheduling algorithm to "round robin" between the simulated client threads. Each client runs until either it blocks (by waiting for a resource such as a lock) or until a specified period of time has elapsed (the length of which is controlled by the "time slice" configuration parameter). If a client runs without being blocked for the entire time slice, the client is expected to yield and another client is serviced.

SQL Server Threading on Windows NT

SQL Server for Windows NT makes greater use of the native thread services of the operating system. Instead of one "worker thread," it uses many. To improve the efficiency of larger systems with hundreds of users, SQL Server uses separate threads for each network being supported, for handling database checkpoints, and establishes a pool of threads to handle all users.

The operating system schedules all threads preemptively and selects the most available CPU for each thread automatically. When a client issues a command, the network handler places the command on a queue, and the next available thread from the worker pool services it. If no worker thread is available, SQL Server creates a new thread dynamically, until reaching the maximum thread limit.

The maximum number of threads in the worker pool is configurable. Generally, the default value is the number of user connections. However, for very large numbers of users, overall throughput can be increased by setting the maximum worker threads to a lower value, reducing task switching within the system.

SQL Server gradually eliminates idle threads to improve memory utilization as the workload decreases. Under this scheme, a worker thread runs each user request to completion. If a given thread performs an operation that causes a page fault, only that thread and thus that client, is blocked.

Benefits of Native Multithreading

The benefits of a native multithreading approach are:

- **Reduced system complexity:** SQL Server need not duplicate operating system functionalities, such as scheduling, memory-allocation, and queuing.
- **Smoother, preemptive operation:** Both SQL Server and Windows NT schedule user tasks preemptively, providing for smoother operation and improved resource utilization.
- **Dynamic load balancing:** SQL Server's workload is dynamically and automatically balanced across multiple CPUs. For example, a thread that begins executing on CPU 1 may be switched to CPU 2 by the Windows NT operating system to achieve better system load balancing.
- **Greater robustness and reliability:** User tasks executing on separate threads are protected from one another and can be terminated gracefully by SQL Server in case of error. For example, it is possible to terminate a sleeping process and to isolate protection violations to a single thread rather than affecting the whole server.

Integration with Windows NT

SQL Server for Windows NT is a full 32-bit implementation using the Microsoft Win32® APIs and runs completely within the highly protected Win32 subsystem. SQL Server itself comes with an integrated set of management tools that make extensive use of the Microsoft Windows™ user interface to improve ease of use. SQL Server also integrates directly with Windows NT management facilities such as the Performance Monitor, allowing remote monitoring and troubleshooting of system performance.

For Additional Information:

Easy Installation and Migration

Service Control Management (SCM)

Event Log and Performance Monitor

Integrated Security

Service Control Management (SCM)

SQL Server runs as an integrated operating system service under the control of Windows NT.

Your administrator can start, stop, and pause SQL Server from the Windows NT Control Panel or from a SQL Server component called the SQL Service Manager. These operations can also be performed remotely, making centralized administration of multiple servers easier. The SQL Service Manager displays the current status of SQL Server (or SQL Monitor) even while minimized. The administrator can start many instances of the SQL Service Manager, each controlling a separate server, to get an instant visual reading of the status of each of the servers.

Pausing SQL Server: A new capability under Windows NT.

If paused, SQL Server will deny requests for new connections while continuing to process all current client requests. This is useful for performing an orderly shutdown of the system if you want to limit new connections while allowing existing clients to complete their work.

Easy Installation and Migration

SQL Server for Windows NT includes a graphical Setup program that simplifies installation and allows the setting of system configuration options in a more intuitive and dynamic manner.

The administrator can run Setup locally or over the network to install SQL Server on remote computers. The Setup program also functions as an automated migration tool for existing installations of SQL Server for OS/2, either version 1.1 or version 4.2. No structural changes are made to the database, so it is possible to alternate between Windows NT and OS/2 for a trial period, by simply rebooting the computer.

Event Log and Performance Monitor

SQL Server provides a single repository for warning, information, performance and error messages for the entire system.

Windows NT uses the Event Log to post messages about the system, the network, and security violations. Administrators can use the Event Viewer administration tool to view the Event Log of any servers on the network. The Event Viewer provides options to filter certain events, determine how long to retain logs and whether to overwrite them. The Event Viewer operates across the network, making it easy for a single administrator to monitor multiple SQL Servers simultaneously.

Administrators and database designers can quickly and easily view and tune server performance characteristics, even from a remote Windows NT-based computer. Many of these statistics are also available by using a new DBCC extension, DBCC SQLPERF. New statistics include information about the cache hit ratio, buffer usage, and I/O activity.

Integrated Security

SQL Server provides a single logon to both the network and database server for named pipes users.

With integrated security, access to SQL Server is controlled through privileges established for users and groups of Windows NT. The administrator does not have to maintain a separate set of logon accounts and passwords in SQL Server.

Integrated security in SQL Server provides administrators with:

- A single unified logon model for both network and database.
- Centralized control of access to multiple SQL Servers in a Windows NT domain.
- Centralized password management with password encryption, aging and minimum length restrictions.
- Auditing of database access attempts.
- Tools for managing multi-level security access privileges to SQL Server for network users and groups.

Reliability and Availability

SQL Server for Windows NT has been enhanced in a number of ways to improve reliability and availability, issues particularly important for production database platforms. SQL Server supports dynamic backup of databases and transaction logs while users are updating the database, providing the highest level of system availability.

A new capability with SQL Server is the backup of multiple databases and logs to the same tape. Combined with scheduled backup, it is now possible to perform fully unattended backups without operator intervention. SQL Server provides a tool for scanning tape headers if the DBMS is offline in a disaster recovery situation.

For Additional Information:

Log Threshold Management

Structured Exception Handling

Improved Error Handling

Structured Exception Handling

Ideally, a server should never crash, and SQL Server has always been highly reliable.

In all complex software environments, unforeseen errors can occur. In these cases the server may generate a protection violation (known as a "trap"). Under other protected operating systems, including OS/2, UNIX, and VMS®, if a client issues an obscure command that causes SQL Server to trap, the operating system will terminate the entire SQL Server process. This is an important feature of protected operating systems, since in an unprotected system the results are much worse--corruption of system integrity and, at least, the need to cold boot the computer.

Windows NT and SQL Server go one important step further. By using a feature of Windows NT called "structured exception handling," SQL Server can recover gracefully from protection violations by terminating only the thread of the client that issued the offending command. All other users continue safely and unaware. Structured exception handling provides superior reliability and ensures the highest availability of the system in mission-critical environments.

Log Threshold Management

It is now possible to monitor a SQL Server database log and set a threshold to automatically dump the log if it becomes too full or alert the administrator when log utilization reaches a certain point.

SQL Server makes this possible by exporting a new "log % full" statistic to the Windows NT Performance Monitor. The administrator can establish events, such as running a batch script to dump the log, that are automatically triggered whenever this statistic reaches a certain limit. This capability can substantially reduce the risk of downtime due to a full log.

Improved Error Handling

SQL Server now handles various common errors in a simpler manner.

For example, if a previous version of SQL Server was configured for 50 clients and a fifty-first tried to connect, that client would get a message stating that "SQL Server is unavailable," which the user would normally interpret as meaning "the DBMS is offline." Now a message states specifically that there are no additional configured connections available. Another example deals with recovery with a full master database log--previously SQL Server would not start if the transaction log was full--now it does. Network errors are better propagated to both the SQL Server and SQL Server clients. Many other error messages have also been improved.

Microsoft has developed a new **SQL Server Troubleshooting Guide** that is included with SQL Server. This book provides solutions for most common problems and is a valuable addition to the existing SQL Server documentation.

SQL Server Integrates Easily into Your Enterprise

One of the most compelling benefits of SQL Server is its ability to integrate into virtually any enterprise environment. All major networking protocols are supported so administrators can concentrate on delivering complete RDBMS solutions.

Because SQL Server is completely accessible through a variety of toolkits, custom application development is enhanced and delivery time for solutions is significantly reduced.

Finally, through built-in connectivity solutions such as SQL Bridge, users receive transparent access to UNIX RDBMS systems such as Sybase® and RDB.

For Additional Information:

Open Network Integration

Dynamic Protocol Support

Microsoft Open Data Services

Dynamic Protocol Support

SQL Server for Windows NT is capable of supporting clients communicating on multiple network protocols simultaneously without the need for add-on products like SQL Bridge.

Server-based net-libraries, implemented as DLLs, handle connections concurrently over multiple transports. Several net-libraries can be active at once, allowing SQL Server to "listen" on multiple connection types (such as sockets or named pipes) over multiple transports (such as NetBEUI, TCP/IP, or IPX/SPX).

In its initial release, SQL Server supports named pipes connections over either NetBEUI or TCP/IP transports for clients running Windows, Windows NT, MS-DOS®, and OS/2 operating systems. Named pipes connections are also supported over IPX/SPX for Windows NT clients using NWLink. In NetWare environments, clients running MS-DOS, Windows and OS/2 are supported over native IPX/SPX protocols and require no additional network software other than the Novell® redirector. SQL Server also simultaneously supports the TCP/IP sockets API for communication with Macintosh®, UNIX, or VMS clients running SYBASE Open Client software. SQL Server also supports native Banyan® VINES®/IP connections.

Microsoft Open Data Services

SQL Server is one of the few DBMS platforms to offer an open API for developing server-based gateway and connectivity applications.

Microsoft Open Data Services (ODS) is an event-driven API that provides a programmable gateway platform for server applications, that can access any data source. It uses the same multithreaded architecture as SQL Server for Windows NT. Customers and systems integrators can use ODS to develop custom database gateways, data-driven event alerters, external program triggers, request auditing, and more.

ODS-based applications can function as stand-alone gateways or data-access servers supporting connections from the same client platforms as SQL Server. They can also integrate with SQL Server directly through remote stored procedure calls. For the Windows NT platform, Open Data Services can be used for developing extended stored procedure DLLs.

Open Network Integration

SQL Server for Windows NT operates in all major network environments over native protocols.

SQL Server integrates directly with Novell NetWare, Microsoft LAN Manager, IBM LAN Server, and Microsoft Windows NT-based networks. It can also interoperate with SYBASE SQL Server clients and servers over TCP/IP-based networks. There are future plans to have it integrate directly with Banyan Vines. SQL Server for Windows NT supports native protocols such as IPX/SPX and VINES/IP without requiring special network software to be installed on each client.

Microsoft SQL Bridge

SQL Bridge provides transparent routing of SQL Server requests across different networks, transports, and operating system platforms

SQL Bridge can function as a gateway to SYBASE platforms when you prefer not to install host-based network protocols on each client. For example, SQL Bridge allows a client application on a NetWare LAN to access a Sybase server on UNIX over standard IPX/SPX protocols--SQL Bridge automatically routes the request over TCP/IP.
SQL Server for Windows NT also supports native TCP/IP sockets connections at the server, further increasing interoperability with Sybase environments.

SQL Server Toolkits

SQL Server supports direct call-level and embedded SQL application development in popular programming languages, including C, Visual C++™, Visual Basic®, and COBOL.

The **SQL Server Programmer's Toolkit** contains development libraries and tools for writing client applications using the native DB-Library interface, and for writing server applications and extended stored procedures using the Open Data Services interface.

Client applications can be written in C and C++ for MS-DOS, Microsoft Windows, Windows NT, and OS/2 with popular compilers from Microsoft and Borland. Applications can be developed with the Visual Basic™ Programming System for both MS-DOS and Windows. The Programmer's Toolkit also includes Microsoft Open Data Services development libraries for Windows NT.

Integrating Windows NT and UNIX

Although UNIX is a trademark of X/Open Ltd., there are many operating systems based on Unix technology that have common features, allowing them to interoperate. The Microsoft® Windows NT™ operating system can be integrated at several levels with many operating systems, including: Solaris, Open Desktop, HP-UX, Ultrix, Unixware and AIX. The three main integration issues are: interoperability, portability, and application support.

Windows NT Interoperates with UNIX

You can connect Windows NT with most UNIX-based operating systems by using standard features like **TCP/IP**, **SNMP**, **DCE/RPC**, **Windows Sockets**, **File Systems**, **X-Terminal**, and **SMTP**.

Windows NT standard utilities include: **arp**, **finger**, **ftp**, **ftpsvc**, **hostname**, **nbtstat**, **netstat**, **Packet INternet Groper (ping)**, **rcp**, **rexec**, **route**, **rsh**, **telnet**, **tftp**.

You can also enhance interoperability with products from several third parties. Many **additional utilities** are available.

TCP\IP

TCP/IP, a de facto standard for UNIX networking, is included in Windows NT to help you create heterogeneous networks.

Setting up Windows NT for networking is simple. Most network cards are automatically detected and configured, but you can intervene manually to make special adjustments if necessary. You can also configure multiple network cards to build a gateway machine. Configuring Windows NT for TCP/IP is also simple: after installation, you can set the IP address, subnet mask and broadcast parameters with a simple, **graphical dialog.**

Windows NT includes the most common TCP/IP utility: File Transfer Protocol (ftp and tftp). This familiar UNIX utility provides easy file transfer between Windows NT and UNIX hosts. With Windows NT, you can set up an anonymous ftp server as well as connecting to UNIX-based hosts.

For terminal access to a UNIX host, the familiar Windows terminal "applet" has been upgraded to provide Telnet capability. This marriage of the Windows user interface with UNIX connectivity helps ease the transition between systems.

ftp

offers file transfer services to remote systems supporting FTP (file transfer protocol). FTP supports a host of commands allowing bi-directional transfer of binary and ASCII files between systems. The FTP commands are explained in online help.

ftpsvc

The FTP Server service provides an FTP server for Windows NT. The FTP Server is not installed by default when installing Windows NT TCP/IP, due to security considerations described in the note later in this section. The FTP Server service is installed by using the Networks applet in Control Panel.

rexec

provides a simple mechanism to execute a process on a remote system supporting remote process execution over TCP/IP. **rexec** is identical to the functionality provided by **rsh**, with the addition of cleartext password authentication.

telnet

offers basic terminal emulation to remote systems supporting the Telnet protocol over TCP/IP. Telnet is implemented as a Windows NT service, which allows Telnet to be used by terminal emulation programs such as the Windows Terminal accessory. Telnet can be invoked from the command line by typing **telnet** (which starts the service) or **net start telnet** or by using the Services tool in Control Panel, followed by starting Windows Terminal and choosing the TELNET connector. (Other terminal emulation products can also support the TELNET port connector).

arp

allows a user to view and modify the ARP (address resolution protocol) table entries on the local system.

finger

allows a user to retrieve system information on remote systems supporting TCP/IP and a finger service.

hostname

returns the local workstation's hostname used for authentication by the **rcp**, **rexec**, and **rsh** TCP/IP utilities. This value defaults to the workstation's computername, but can be changed using the Networks applet in the Control Panel.

nbtstat
provides network statistics for NetBIOS over TCP/IP active and pending connections.

netstat

provides network statistics for all TCP/IP active and pending connections.

ping

provides a simple mechanism to determine whether a remote TCP/IP system is reachable. **ping** is generally used to determine whether a particular system is functioning properly in the TCP/IP network, for example, to determine whether it can see systems located on remote subnets.

route

manipulates network routing tables.

rcp

provides a simple mechanism to unidirectionally copy files between two systems. One or both systems can be remote. **rcp** provides rudimentary level security; the protocol passes both the username (on Windows NT, the locally logged-on user) and the hostname of the system for authentication. The remote system(s) generally must be configured to trust the **rcp** requests by configuring a file (in many cases, the **.rhosts** file in the user's local directory).

rsh

provides a simple mechanism to execute a process on a remote system supporting remote process execution over TCP/IP. **rsh** provides the same rudimentary level of security as **rcp**, but does not support redirection of STDIN (that is, only output from the remotely executed command is displayed; local keystrokes are not passed to the remote system).

tftp

provides a subset of FTP that uses the **UDP** protocol rather than TCP. TFTP allows the unidirectional transfer of files between the local and a remote system with no security provisions, relying on the world readability or writeability of the file(s) in question, on the remote system for access.

Additional Utilities

The Gopher Book 1.1: Kevin Gamiel's Gopher Book is a public domain 16-bit Windows application written in Asymetrix Toolbook. This application uses the Windows Sockets interface to allow users to explore the Internet with the mouse. *(kevin_gamiel@unc.edu).*

WinWais 2.2: WinWais is another 16-bit public domain Internet exploration tool. WinWais provides access to indexed databases across the Internet to help users find information by subject. Written in Visual Basic, C and Windows Sockets by Timothy Gauslin *(tgauslin@isdres.er.usgs.gov)*.

FTP Server: Windows NT and Windows NT Advanced Server come packaged with a 32-bit, multithreaded FTP service. This service allows Windows NT based systems to share files to with users on remote systems running TCP/IP (for example, UNIX®). Microsoft is now sponsoring an anonymous FTP server on the Internet using this software: *ftp.microsoft.com.*

Performance Monitor: Windows NT offers a powerful administration tool called the Performance Monitor. The Performance Monitor can be used to view a wide variety of statistics such as the standard MIB2 TCP/IP counters, CPU utilization, or the FTP server statistics. In addition, the Performance Monitor can alert an administrator if system problems arise.

eXcursion for Windows NT (preliminary): This is the preliminary 32-bit release of DEC's popular eXcursion software for Windows NT. This software allows users to run X Windows applications on remote systems and display them locally on the Windows NT system.

WinQVT/Net 3.65: This shareware utility provides FTP, Telnet, lpr, mail and NetNews access via Windows Sockets. This suite provides Windows-based terminal emulation with per-connection terminal preference settings. This package also offers an rcp server service. Written by QPC Software *(djph@troi.cc.rochester.edu).*

WinChat: Part of the Windows NT and Windows for Workgroups Accessory groups, this software allows users on any of these systems to have interactive conversations over the network in real time. Portions of WinChat conversations can be cut and pasted into other Windows-based applications.

Terminal (telnet): The terminal applet that comes with Windows NT is now Telnet-aware. By selecting TELNET in the Communications Settings dialog, the Terminal applet can be used to log into remote systems supporting the Telnet protocol. Written as a COM driver, the bundled Telnet support can be accessed by application developers as if it were a COM port.

Finger 3.1: Perhaps the first-ever Windows Sockets application, Lee Murach's public domain Windows-based finger application can be used to retrieve information about users on remote systems. This is a 16-bit Windows Sockets application. *(lee@nrc.com).*

HGopher 1.0 (beta): Martyn Hampson's Windows-based public domain Gopher application, written in C. This application takes advantage of the asynchronous Windows Sockets extensions to allow users to initiate simultaneous queries while simultaneously searching the Internet *(m.hampson@ic.ac.uk)*.

VanceMail! 1.03: a native 32-bit Windows NT SMTP (Simple Mail Transfer Protocol) mail client conforming to the Windows Sockets specification. VanceMail! can be used to exchange e-mail using the standard SMTP protocol. Written by Vance Gloster *(vance@inference.com)*.

PC Eudora 1.1a10: a Windows-based SMTP/POP3 (Post office Protocol v3) mail client written by Jeff Beckley *(beckley@qualcomm.com)* and Jeff Gehlhaar *(jbg@qualcomm.com)*. This 16-bit application allows users to exchange e-mail via the standard SMTP protocols.

Trumpet for Windows 1.0 (beta): a 16-bit Windows Sockets-compatible NNTP-based newsreader application. Written by Peter Tattam, Trumpet brings user-friendly access to Usenet services to users of Windows and Windows NT. *(peter@psychnet.psychol.utas.edu.au).*

Console-based utilities: In addition to the public domain and third party applications written to Windows Sockets, Windows NT also comes bundled with 13 basic 32-bit TCP/IP connectivity and diagnostic utilities. These include: ftp, tftp, netstat, arp, ping, finger, and others.

Simple Network Management Protocol - SNMP

The Simple Network Management Protocol (SNMP) is a part of the TCP/IP protocol suite. It was originally developed in the Internet community (RFC 1157) to monitor and troubleshoot routers and bridges. SNMP provides the ability to monitor and communicate status information between:

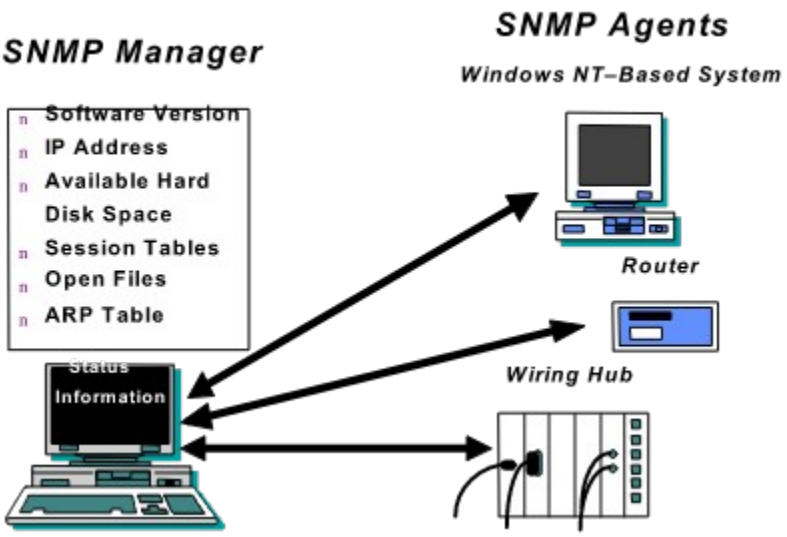
- Computers running Windows NT, Solaris, SCO, HP-UX etc.
- LAN Manager servers
- Routers or gateways
- Minicomputers or mainframe computers
- Terminal servers
- Wiring hubs

Under SNMP, certain network devices like routers, hubs and file servers act as

"agents" that gather information and store it in Management Information Bases (MIBs). The "management stations" can then access MIBs to provide you with information about the network's status. A SNMP agent can also alert the management station of critical events, such as running out of disk space.

Several vendors offer network management tools which use SNMP as the underlying protocol:

Hewlett Packard - OpenView
Cabletron - Spectrum
Lanera Corporation
NetManage, Inc.


SNMP Manager
Software Version
IP Address
Available Hard Disk Space
Session Tables
Open Files
ARP Table
Status Information
SNMP Agents
Windows NT–Based System
Router
Wiring Hub

Windows Sockets

The Windows Sockets specification defines a network programming interface for Microsoft Windows based on the "socket" paradigm popularized in the Berkeley Software Distribution (BSD), from the University of California at Berkeley. It encompasses both familiar Berkeley socket-style routines and a set of Windows-specific extensions designed to allow the programmer to take advantage of the message-driven nature of Windows.

The Windows Sockets Specification is intended to provide a single API, to which application developers can program and multiple network software vendors can conform. Additionally, with a particular version of Windows, it defines a binary interface (ABI) that allows an application written to the Windows Sockets API to work with a conformant protocol implementation from any network software vendor. Many of the TCP/IP utilities created by third party vendors use the Winsock API.

More information on Windows Sockets can be found at:

microdyne.com: /pub/winsock

vax.ftp.com: /pub/winsock

SunSite.UNC.EDU /pub/micro/pc-stuff/ms-windows/winsock

rhino.microsoft.comwinsock

Distributed Computing Environment - DCE

The Distributed Computing Environment (DCE) is the OSFs specification for distributed computing. While some significant UNIX vendors like Sun and Novell provide competing products, DCE has been adopted by many vendors of operating systems similar to UNIX. Windows NT interoperates with the DCE at the Remote Procedure Call (RPC) level. RPCs are a system-independent way for applications to expose their functions over a network. As such, RPC is a critical technology for client-server computing. Using the DCE/RPC, it is possible for Windows NT to provide client-server interoperability with systems as diverse as VAX/VMS, HP9000/HP-UX and Intel/Open Desktop.

Microsoft SQL Server is an example of RPC on Windows NT. This database server uses RPC to transmit performance information over the network so you can monitor your database performance from any Windows NT workstation.

File Systems

Windows NT provides internal support for FAT, HPFS (OS/2), and its own New Technology File System (NTFS). Additional file systems can be added as they become available because Windows NT is extensible. Also, many UNIX-based systems will be able to interoperate using the FAT system as a gateway. For users of traditional UNIX file systems like NFS, DFS or AFS, third party vendors provide solutions. These vendors are committed to supplying Windows NT connectivity with UNIX-based file systems.

Vendors Offering UNIX Compatibility Tools for NFS Clients and Servers

Beame & Whiteside
Products: NFS client and server
Main: (416) 765-0822

FTP Software, Inc.
Products: NFS client and server
Main: (800) 282-4387; (508) 685-4000
Direct Sales: (508) 685-3300
Fax: (508) 794-4477

NetManage
Product: Chameleon NFS32
* NFS client and server
Main: (408) 973-7171
Fax: (408) 257-6405

SunSelect
Product: PC NFS for Windows NT
* NFS client, no announced server support
Main: (800) 24SELECT; (508) 442-0000
Fax: (508) 250-5070

X-Terminal

X-Window/Motif is a graphical standard for UNIX-based operating systems. One of the benefits this system provides is remote graphical operation of a UNIX login session. Several independent companies provide X-Server software that allows Windows NT to act as an X-Terminal and run UNIX programs remotely.

Vendors Offering UNIX Compatibility Tools for X Windows Servers and Clients

Congruent Corporation
Product: NtNiX - X Client Support for Windows NT ($395 - Intel or MIPS)
* all standard X libraries, X-terminal support, X clients
* development tools: imake, GNU make, sed, cpp, gawk, ...
* Motif support
* multi-user Windows NT facility

Main: (212) 431-5100
Fax: (212) 219-1532
E-Mail: info@congruent.com

Digital Equipment Corp (DEC)
Products: eXcursion for Windows NT (X-Windows Server)
* call for other products and support for Windows NT

Main: (800) DEC-INFO xNT
Fax: (508) 486-2311

AGE Logic, Inc.
Products: Xoftware for Windows
* provides full 32-bit X11R5 server support

Main: (619) 455-8600
Fax: (619) 597-6030

Network Computing Devices, Inc. (PC-X Division)
Products: PC-Xware for Windows NT (X-Windows Server)
Main: (503) 641-2200
Direct Sales: (800) 793-7638
Fax: (503) 643-8642

Hummingbird Communications, Ltd.
Products: HCL-eXceed for Windows NT
Main: (416) 470-1203
Fax: (416) 470-1207

JSB Corp.
Product: Multiview/X
Main: (800) 359-3408; (408) 438-8300
Fax: (408) 438-8360

Messaging (SMTP)

Windows NT provides mail clients and servers that can interoperate with almost any other mail system. For UNIX mail interoperability, you can upgrade to the full Microsoft Mail client and use the gateway to SMTP.

UNIX Applications are Portable to Windows NT

Most UNIX applications are designed to be portable, so moving to Windows NT is usually quite simple. For instance, many developers have found that it is as easy to port from Solaris 1 to Windows NT as it is to port to HP-UX. Dozens of UNIX tools and applications have already been ported (Hamilton C-Shell and EMACS, for example).

Direct Porting Issues: Most character mode applications written in ANSI C will port without modification. Graphical applications will require modification to map X-Window calls to the equivalent calls in Win32.

The **NuTcracker Porting Kit** from DataFocus is a quick solution for running an application, particularly a graphical application, on Windows NT. This kit provides Win32 run-time libraries that emulate specific UNIX calls so that your program simply has to be re-compiled to run on Windows NT. **DataFocus Contact Information**

Many UNIX Compatibility Tools are available with Windows NT--some are included, and many more have been developed by independent vendors.
Unix Tools and Utilities
Unix Source Code Control Systems

Unix Tools and Utilities

Windows NT Product
Windows NT includes several UNIX utilities including TELNET, FTP, FTPD, and RSH.

Congruent Corporation
Products: Toolbuster - CD-ROM loaded with GNU Utilities for Windows NT ($199)
* GNU toolset, compilers. libraries, debuggers, editors, and utilities
* on-line documentation
* executables for Intel, Alpha, and MIPS
* RCS component

Main: (212) 431-5100
Fax: (212) 219-1532
E-Mail: info@congruent.com

Consensys Corporation
Products: Portage - SVR4 environment integrated into Windows NT
Main: (905) 940-2900
Sales: (800) 388-1896
Fax: (905) 940-2903

Mortice Kern Systems (MKS), Inc.
Products: MKS Toolkit for Windows NT
Main: (519) 884-2251
Direct Sales: (800) 265-2797
Fax: (519) 884-8861

Hippo Software
Products: HIPPIX ($79 - libraries; $79 - utilities; together - $109)
* provides a library that supports over 90% of the functions of the POSIX 1003.1 API working with the Win32 subsystem
* provides a suite of over 100 UNIX utilities including: SH, VI, AWK, GREP, MAKE, LEX, YACC, RCS, ...

E-Mail: CompuServe: 72360,2675; Internet: hippix-info@hippo.com

Hamilton Laboratories
Products: C Shell for Windows NT
Main: (508) 358-5715
Fax: (508) 358-1113

Software Innovations
*** All products available for Intel, MIPS, and Alpha.
Product: The Connectivity Kit for Windows NT ($149.95)
* TELNETD host service, FINGERD, UNIX talk daemon and client
* supports all of the Berkeley remote commands to Windows NT (RLOGIN, REXEC, RSH, RCP)
* serial port logon to Windows NT command line

Product: The LPR/LPD kit for Windows NT ($59.95)
* allows you to use all Windows NT hosted printers from a UNIX machine, and also all UNIX hosted printers from Windows NT and Windows for Workgroups which show up as regular Print Manager printers.

Product: Full feature NNTP news server for Windows NT ($125)
Product: Threaded News Reader for Windows NT ($39.95)
Product: Full SMTP/POP/UUCP/X.400 Gateway for Microsoft Mail for Windows NT (less than $400)
Product: SLIP and PPP kit for Windows NT (in beta - expected to ship in January '94)

Main: (800) 946-6688
Fax: (515) 232-7382
E-Mail: winnt@innov.com

Project Vincent Systems Support
Products: ftpd, misc utilities
E-Mail: martin@iastate.edu
Iowa State University Computation Center
Ames, Iowa 50011
Internet/CompuServe locations for current products:

* ftp.iastate.edu - pub/nt/(cpu-type)/ftpdserv.zip and other goodies
* ftp.cica.indiana.edu - pub/pc/win3/nt/iftpdsrv.zip and mftpdsrv.zip
* CompuServe forum MSWIN32 library 1 (New Uploads) - files iftpd.zip and mftpd.zip
* New releases will always show up on ftp.iastate.edu first.

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12450 Fair Lakes Circle
Suite 400
Fairfax, VA 22033
703-631-6770
703-818-1532

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E-Mail: winnt@innov.com

Project Vincent Systems Support
Products: ftpd, misc utilities
E-Mail: martin@iastate.edu
Iowa State University Computation Center
Ames, Iowa 50011
Internet/CompuServe locations for current products:
* ftp.iastate.edu - pub/nt/(cpu-type)/ftpdserv.zip and other goodies
* ftp.cica.indiana.edu - pub/pc/win3/nt/iftpdsrv.zip and mftpdsrv.zip
* CompuServe forum MSWIN32 library 1 (New Uploads) - files iftpd.zip and mftpd.zip
* New releases will always show up on ftp.iastate.edu first.

Unix Source Code Control Systems

Mortice Kern Systems (MKS), Inc.
Products: MKS Toolkit for Windows NT
Main: (519) 884-2251
Direct Sales: (800) 265-2797
Fax: (519) 884-8861

Congruent Corporation
Product: Toolbuster - CD-ROM loaded with GNU Utilities for Windows NT ($199)
* GNU toolset, compilers. libraries, debuggers, editors, and utilities
* on-line documentation
* executables for Intel, Alpha, and MIPS
* RCS component
Main: (212) 431-5100
Fax: (212) 219-1532
E-Mail: info@congruent.com

Hippo Software
Products: HIPPIX ($79 - libraries; $79 - utilities; together - $109)
* provides a library that supports over 90% of the functions of the POSIX 1003.1 API working with the Win32 subsystem
* provides a suite of over 100 UNIX utilities including: SH, VI, AWK, GREP, MAKE, LEX, YACC, RCS, ...
E-Mail: CompuServe: 72360,2675; Internet: hippix-info@hippo.com

Microsoft Windows API Support on UNIX

Bristol Technology
Product: Wind/U 1.3

* provides source code level support for MFC 2.0 and the Windows 16-bit API on UNIX Motif/X

Main: Jean Blackwell at (203) 438-6969
E-Mail: jean@bristol.com

Books About UNIX and Windows NT Interoperability

"Distributing Applications Across DCE and Windows NT"
by O'Reilly & Associates, Inc.
Main: (707) 829-0515
Fax: (707) 829-0104
E-Mail: order@ora.com

"Migrating to Windows NT"
by Randall C. Kennedy
Brady Publishing

Comparing Windows NT with UNIX

Why Should UNIX® Users Care About Windows NT?

Windows NT™ is a brand new operating system that brings power and portability to the Windows family. It has capabilities that make it ideal for high performance workstations and business servers that are currently UNIX based. If you use UNIX today, you now have a new choice of operating system that can serve your needs and may provide significant advantages. This section discusses Windows NT in terms of familiar UNIX concepts.

Comparing Windows NT with UNIX

Since UNIX is not a product but a brand name for a group of similar operating systems, it is difficult to make precise comparisons with Windows NT. However, it is a fair statement that UNIX based operating systems have more similarities with Windows NT than they have differences. Both are powerful, reliable and open. Both support "state of the art" hardware and applications. This comparison compares general UNIX features from the SVR4 base and identifies differences between common UNIX variants where appropriate.

General Features

Multi-user definition
Peer-to-Peer Capabilities
Multi-tasking
Multi-processing
Paged Virtual Memory
System limits
Reliability
Fault Tolerance
Architecture
Portability
Interoperability
File Systems

Multi-user definition

Both Windows NT and UNIX based systems are multi-user. However, they use very different approaches:

UNIX provides terminal-host multi-user capabilities. Several users can login to a remote UNIX computer with a dumb terminal and the remote computer will send and receive the character or graphical I/O needed during each session.

Windows NT provides client/server multi-user networking. This model assumes that all users have an intelligent machine, a PC or workstation, rather than a dumb terminal. Network bandwidth is conserved by avoiding exchange of graphical or character information. The client side applications provide good local performance for presentation and business logic while the server application is optimized for data handling, reliability and security.

A single Windows NT based system supports multiple accounts and multiple connections but only allows one login session. If you really want to use dumb terminals with Windows NT, that capability is being provided by independent vendors like Citrix.

Peer-to-Peer Capabilities

An important benefit of local area networks is the ability to share files and peripherals. While UNIX is functionally equivalent to Windows NT, file and print sharing is rarely controlled by users because the setup involves text files that are important for system operation.

In Windows NT, two user applications called File Manager and Print Manager, provide easy management and sharing of files and printers. You can control access to peripherals using Access Control Lists (ACLs) that set permissions for groups and individuals on your network. ACLs are easy to setup using graphical dialogs from File Manager and Print Manager.

Multi-tasking

Windows NT can multi-task just like UNIX. Specifically, Windows NT provides pre-emptive multi-tasking; a process can interrupt another process if it has higher priority. This allows the operating system to provide good interactive performance while giving significant processor time to background tasks.

Both systems allow you to set priorities of background tasks to give you the best compromise between interactive response and task completion times. In Windows NT, you can set a general policy for background tasks using the Control Panel and you can also assign a particular level to an application using the Start command from the command shell.

The major difference between the two systems is the granularity of multi-tasking. In UNIX, tasks are scheduled as "processes" that represent individual programs. Windows NT is more like OSF/1 where tasks are scheduled as "threads" (sometimes known as "lightweight processes"); a program can be composed of one or more threads. (there are multi-threaded versions of UNIX but no standard has yet emerged that is common in the UNIX world).

Multi-processing

Windows NT was designed to support SMP. This includes automatic thread scheduling that distributes threads across processors without any application modification. SVR4.2 includes multi-processing but many commercial implementations are not up to this revision yet. For example, Solaris 2 has proprietary SMP extensions since it is based on SVR4.0 source code. The result is that few UNIX applications actually use SMP and those that do have special implementations on each platform they support.

OSF/1 has standard SMP support and schedules at the thread level rather than the process level. However, OSF/1 is not widely used and the leadership of the OSF is in doubt because of other initiatives (COSE, X/Open 1170).

Paged Virtual Memory

The use of hard disk space to supplement physical memory is a standard UNIX feature that is also part of Windows NT. The Windows NT VM manager is part of the Windows NT executive that runs in kernel mode and can provide up to 2 GB of memory to each application.

System limits

Both Windows NT and UNIX are virtually limitless. Windows NT can access up to 4 GB of RAM and 2^64 bytes of local mass storage.

Reliability

Windows NT was designed to be an application server. Consequently, reliability is a key requirement. Reliability features that Windows NT shares with UNIX are:

Structured Exception Handling - provides a simple mechanism for developers to write exception handlers. This means that applications can behave predictably in response to problems like: floppy door open, printer not found or network error.

Protected Memory - isolates applications from each other and the system by providing completely independent memory resources. This prevents applications corrupting each others memory and leaves the system running in the event of an application crash.

As a UNIX user, you are used to very good reliability. You will find that Windows NT is completely different from any other Windows based product in this respect. While applications will always crash at times, it is virtually impossible to crash the system.

Fault Tolerance

An application server must be fault tolerant. Windows NT Advanced Server has several features that protect against hard disk failure, power failure and server failure. Standard fault tolerance features are:

Disk

Mirroring and Duplexing

Journalling file system - **NTFS** combines lazy write and commit techniques common in UNIX file systems with a transaction log to give very fast recovery in the event of system failure. Recovery to the "last known good state" is automatic when the system is rebooted.

RAID5 support

Power

Automatic recognition of **UPS** with system shutdown on power failure. **More information.**

Server

File Replication - mirrors data to multiple servers allowing real time recovery if one server fails.

Auxiliary Domain Controllers - Automatically backs up server information so that if the Primary Domain Controller fails, the network will continue to function using an alternative server.

Different UNIX variants may have some or all of these features. The area of system and network administration is, however, one of the main areas where different UNIX versions vary in their implementation as each vendor adds value to their own solution.

More information on fault tolerance in Windows NT.

Architecture

The micro-kernel architecture pioneered at Carniegie Mellon (Mach kernel - OSF/1), was very influential in the design of Windows NT. This architecture introduces a client server relationship between the operating system modules which is brokered by the kernel. Benefits are:

Simplification of the kernel while providing extensibility through additional modules.

Improved reliability because servers run in user mode. Therefore, if a server crashes, the operating system continues to run.

Suitability for distributed computing since servers can run on different processors or even on different machines.

This is an area where SVR4 lags behind Windows NT and OSF/1. Most UNIX implementations use a monolithic kernel. One example of how this affects users is in the addition of device drivers. A typical UNIX system requires the kernel to be re-linked each time a driver is added or re-configured. By contrast, the modularity of Windows NT allows drivers and services to be added without any modification to the Kernel.

Portability

Unlike other members of the Windows family of operating systems, Windows NT was designed to be portable to any hardware architecture. This is a feature that is familiar to UNIX users because of the historic origins of UNIX as a widely distributed source code base. Unfortunately, the free distribution of UNIX source code has also been a weakness of UNIX because it has been modified differently by each commercial UNIX vendor to add special value to their implementation. Consequently, minor incompatibilities still exist between different implementations of UNIX.

Microsoft has also shared the source code of Windows NT but in a much more controlled way to ensure that complete compatibility is maintained. Consequently, Windows NT based applications are very easy to port between Intel, Alpha, MIPS, PowerPC and any other architectures that Windows NT supports in the future. The same is not true for UNIX. Even porting from one version to the next can be painful. Solaris 2 is a good example of how an upgrade is not at all straightforward either for application developers or system administrators.

Interoperability

Although UNIX based operating systems interoperate very well with each other, they often have limited interoperability with other systems like PCs and Macintoshes. For example, the IPX and AppleTalk protocols that are widely used on PCs and Macs are seldom provided with UNIX so additional software and configuration is usually needed to interoperate with these platforms.

Windows NT Advanced Server provides extensive interoperability with many platforms through standard protocols:

TCP/IP, IPX, AppleTalk, DLC, NetBEUI.

Windows NT has many features that allow it to interoperate with UNIX based networks:

Share files and information	LAN Manager for UNIX Server Message Block standard (X-Open) FTP server included with Windows NT NFS for Windows NT available from third parties
Access UNIX applications	Telnet included with Windows NT X servers available from third parties
Networking and Distributed Computing	TCP/IP protocol and utilities SNMP standard in Windows NT Windows Sockets (compatible with Berkeley Sockets) DCE compatible RPC

More information:

Shared Resources
OSFs Distributed Computing Environment
Integrating Windows NT with UNIX

Shared Resources

Like UNIX, Windows NT treats resources as named objects that are available to anyone with the appropriate privileges. This model is easier for developers and users who can regard printers, plotters, modems and other peripherals as files and access them accordingly.

OSFs Distributed Computing Environment

Although some UNIXes offer competing distributed computing features, DCE has generated considerable momentum in the open systems community. Consequently, Microsoft chose to adopt the Remote Procedure Call standard as a mechanism to enable distributed, client server applications on a network.

Other DCE services like naming, time and security will be included in future releases of Windows NT.

File Systems

Windows NT has installable file systems very much like UNIX. It comes with FAT, HPFS and NTFS and third party vendors will supply others.

The new NTFS file system is immediately familiar for UNIX users. It has enhanced security (certifiable to C2), long filenames and automatic recovery after system failure. Here is a summary of NTFS limits and capabilities:

Filenames	255 Unicode (2 byte) characters
File Size	2^64 bytes
Partition Size	2^64 bytes
Path Length	no limit
Directory Sorting	B-tree
Security	built in to C2 level

The User's Perspective

If you have any experience with Microsoft Windows, Windows NT will be immediately familiar. The user interface is essentially the same but with extensions to support the advanced features of Windows NT. In fact, Windows NT is a combination of the powerful features of UNIX and the familiar user interface of Windows.

Logging on

Just like UNIX, Windows NT has user accounts on each machine and you have to logon to a particular account to gain access to that machine. An important difference between the two systems is that, while UNIX allows multiple login sessions on a single machine, Windows NT only allows one.

Another difference is that you cannot log on to Windows NT remotely (the equivalent of a Telnet session). This does not mean that you cannot access another Windows NT machine, simply that you cannot log on as a user. You can still use files and peripherals on the remote machine and also use distributed applications like Performance Monitor to communicate with it.

Security

In UNIX you are identified as soon as you logon by a user id and group ids (UID, GID) according to the groups you belong to. This information can then be used by the system to verify your access privileges both locally and across the network. Windows NT uses a similar system in which a Windows NT based server issues you a security ID (SID) that can then be used by any other Windows NT based machine on the network to verify your privileges. In this way you only have to logon to the network once to gain access to any connected host that you have privileges for.

Other security features that you can use in Windows NT:

Lock your workstation - this keeps you logged in but prevents others from using your machine while you are away from your desk.

Password protected screen saver - if you are away for longer than anticipated, the screen saver will activate and can only be disabled by your password.

Graphical User Interface

To provide UNIX users with a graphical user interface, various graphical software is available. The most popular GUIs for UNIX are SunSoft's OpenLook and MIT/OSFs X-Window/Motif. The look and feel of these systems, particularly X-Window/Motif, is similar to the Windows GUI used in Windows NT. Indeed, the OSF licensed some elements of Windows from Microsoft. If you use UNIX via one of the graphical shells, you will find Windows NT very easy to adapt to.

One difference between UNIX and Windows NT is the variation between applications in their use of the GUI. Under UNIX, most applications have their own distinctive look. Conversely, under Windows NT, most applications conform to the Windows style guide. Consequently, you will find more consistency between common functions under Windows NT than you get under UNIX. For example: the order of menus, help key, load, save, clipboard. Windows based applications are usually easier to learn because of this consistency.

Filing Systems

The new NTFS filing system that comes with Windows NT is far more sophisticated than the FAT system of MS-DOS and Windows. Probably the most significant improvement for UNIX users is the long filename capability (255 characters). As an interoperability feature, case information is now stored in filenames and while this is not used natively in Windows NT, sub-systems like POSIX and other services can observe character case differences.

The user interface for filing in Windows NT is the **File Manager** which will be familiar if you have used Windows™ for Workgroups (or Windows). It differs from most UNIX graphical file managers that use the desktop metaphor of documents and folders. In reality, your preference depends largely on taste and both systems provide equivalent capabilities.

One disadvantage of NTFS is that it is currently only available for Windows NT. There are standard ways to exchange files with UNIX systems (FTP, Telnet) built into Windows NT, but if you want a distributed file system that is compatible with UNIX, you must get this from a third party supplier. NFS for NT is being supplied by several independent software vendors.

List of UNIX compatibility vendors

Customizing Your Environment

In UNIX, the system environment is controlled by a collection of text files that either control how a system component is configured or run as scripts to automatically perform various functions. This is a flexible approach that gives you very precise control over your environment. However, it is also difficult to keep track of so many files and mistakes are easy to make. The most common answer to this problem is NIS (formerly yellow pages) which conveniently lets the administrator centralize the multitude of text files.

In Windows NT, the environment configuration is controlled by a database called the Registry. This replaces all the .ini files that are used in Windows and Windows for Workgroups. The advantage of having a single repository of configuration information is that it is far easier to manage. The Registry can be modified manually using the **Registry Editor** or by programs like **Control Panel**. In fact, any application can store its default settings in the Registry. Also, you can backup the Registry easily to guarantee the safety of your environment. It is even possible to store your environment settings in a remote location and access them from several different Windows NT workstations. In this way, you get a consistent environment regardless of which workstation you use.

Command Shells

Command shells are a familiar interface with UNIX for most users. The Bourne, C and Korn shells are the most popular but many others exist. Realistically, if you are an expert UNIX user, this will be the most significant difference between Windows NT and UNIX. Windows NT is a graphically driven system and consequently, makes very little use of scripts. There is a command shell based on MS-DOS but this offers only a fraction of the capability of a typical UNIX scripting language.

To help make the transition from UNIX to Windows NT easier, third parties are offering Windows NT versions of both the C and Korn shells.

List of UNIX compatibility vendors

Remote Access

Although UNIX is widely associated with TCP/IP, it is essentially protocol independent. Consequently, remote access is easy to setup using an asynchronous protocol like SLIP or the more modern PPP. Similarly, Windows NT is protocol independent and includes RAS using Asynchronous BEUI. This allows any Windows or Windows NT machine to connect asynchronously. Future versions of Windows NT will include additional asynchronous protocols such as SLIP and PPP.

Choice of Hardware

An interesting difference between Windows NT and UNIX is that most UNIX based operating systems are supplied by hardware manufacturers (SCO is a notable exception). Because of this, you often choose your hardware platform rather than the OS you want to run. With Windows NT, you can reverse this choice since it is available for several different **hardware platforms**. In this way you can always choose the best hardware for your needs while getting seamless compatibility with legacy systems.

Compatibility with MS-DOS and Windows

Although UNIX is powerful and mature operating system, it has failed to gain significant market share in office automation and personal productivity tools. Most desktop UNIX users are using CAD/CAM, CAE, GIS or other technical and scientific applications. For many users, the daily work of writing, planning and presenting is done using PC or Macintosh applications. This has created a need for two desktop computers on each desk which is clearly wasteful.

The UNIX suppliers answer to this problem is to offer MS-DOS and Windows emulation tools like WABI and SoftWindows. In some cases, these can be very effective. SoftWindows uses libraries licensed from Microsoft so compatibility is assured. However, tools like WABI can offer no guarantee of compatibility. In both cases, performance is a potential problem since however efficient the emulator is, it must use processor time to translate the environment.

Windows NT provides MS-DOS and Windows compatibility through a sub-system that is part of the operating system. Almost any well written application can use this sub-system in what is known as a "virtual DOS machine" (VDM). Realistically, there are some applications that will not run because they include non-standard use of the system. For example, writing directly to hardware or patching the operating system are both prohibited in Windows NT since they would compromise the reliability of the system. Performance of MS-DOS and Windows based applications under Windows NT is certainly slower than under their native environment on the same hardware but this is because of the extra capabilities and improved security of the system.

Application Availability

Windows NT is a new operating system so inevitably there are fewer 32 bit Windows NT based applications available than on UNIX. However, this is changing fast. There are over 200 32 bit applications available today and this is increasing at a rate of over 3 per day. Interestingly enough, about 25% of Windows NT based applications are ported from UNIX.

32 bit applications for Windows NT

The POSIX sub-system

Some UNIX applications can run unchanged on Windows NT using the POSIX sub-system. This is a 1003.1 implementation certified to FIPS 151.2 standards. Realistically, this is very basic compatibility with UNIX and you can only expect to run character mode programs that are completely POSIX compliant. The POSIX sub-system was built into Windows NT to ease migration between the two systems rather than a long term intention for Windows NT to run UNIX applications.

X-Terminal Support

A useful feature of the X-Window system in UNIX is that the display (X-Server) can be remote from the application. This is commonly used as a way of distributing applications on a UNIX network. Unfortunately, this approach uses a lot of network bandwidth by distributing graphics calls from the client to the server. Windows NT was designed for true client server applications that minimize network traffic by keeping graphic manipulation on the client and only exchanging critical data between sides. For this reason, there is no native support for X-Window in Windows NT.

For users who have X-Window applications on UNIX and want to display them on Windows NT, there are X-Terminal emulators from several third party vendors.

Suppliers of X-Window software for Windows NT

System Management

System administration is a major part of the cost of ownership of a computer system. Making system administration easier was therefore a major design goal for Windows NT.

The most important difference between UNIX and Windows NT for system administrators is that UNIX is fundamentally a character mode system while Windows NT is a graphical one. In UNIX, everything can be controlled by simple text files and you can automate your work using powerful scripting languages. In Windows NT, almost all administration parameters are stored in a central database, the Registry, and most of your work is done using graphical dialogs that update parameters in the Registry.

The simplicity of the graphical approach can be unsettling at first and give the impression that Windows NT is somehow less flexible or powerful than UNIX. This is not true. The graphical approach is simply a different (more modern) approach that provides an intuitive way to interact with a complex system.

User Administration
Remote Administration
Security
Network Management
E-Mail

User Administration

Early UNIX variants relied on text files to store user information. This has the disadvantage of being insecure and difficult to synchronize across multiple machines. Consequently, tools like NIS have evolved to help the system administrator. Windows NT provides an equivalent capability based on the Registry database mentioned above. The main difference between NIS and the registry is that NIS uses a flat file to store its profiles while the Registry is a true database. This means that you have a hierarchy in the data store and you can set privileges for different system parameters. Also, the Registry exists both on local machines and on servers. As the administrator, you can choose how much information is stored locally and how much is stored centrally. For example, you may want very strict control over a users environment. This can be done by setting up a mandatory user profile in the registry that limits environmental changes that the user can make. This is also convenient for the user because their profile is used regardless of which workstation they connect from.

More on user administration in Windows NT

Remote Administration

A commonly used feature of UNIX is the capability to login remotely. You can connect to any machine and perform administrative tasks remotely. Since remote login is not possible with Windows NT, this might seem like a serious disadvantage when compared with UNIX. In fact, you can use any of the Windows NT administration tools remotely since they are all enabled with RPC capabilities.

Examples of things that you can do without leaving your desk.

Security

UNIX variants and Windows NT have very similar security features. Most UNIX based systems are certifiable to the US Governments C2 level. Windows NT is also designed to meet these specifications. Individual users and groups of users can be assigned privileges to run certain commands, access certain peripherals and see certain files or directories.

Windows NT and UNIX both allow individual files to be controlled for read, write and execute and for ownership to be defined in the file system. This is extended by the file metaphor which allows devices as well as files to be restricted.

One important difference between the two systems is that Windows NT security is entirely based on the privileges of the user while UNIX allows programs to change their security level using the setuid command. The UNIX approach has the advantage of convenience for developers but raises the possibility of a user (or hacker) gaining access to information that they are not entitled to. Windows NT does provide an "impersonation" capability that allows server applications to act on behalf of their clients at the appropriate security level but this is still controlled by the security level of the client user. There is also no equivalent of the su command in Windows NT. You have to logout and then log back in to change your user status. Again, this is to provide security that is increasingly important as more people gain access to networks.

Two other Windows NT security features that are particularly useful for system administrators are the Lock Workstation command and password protected screen savers. Both features prevent others using the workstation until it is unlocked by the user who is logged in.

Network Management

The standard network management protocol used in TCP/IP networks is SNMP (Simple Network Management Protocol). SNMP is similar in concept to IBM's NetView and ISO's CMIP. One of Microsoft's design goal was to make Windows NT manageable in enterprise management systems. To accomplish this, Microsoft focused on de facto standards, SNMP and NetView. Windows NT has an extendible agent Management Information Base (MIB) interface with a DLL API optimized for the Windows NT environment. This API hides the complexity of SNMP from the programmer. A Messenger API is provided that serves as a high-level, easy-to-use SNMP API. Windows NT supports both MIB1 (RFC 1156), LAN Manager MIB II and LAN Manager Alerts-II. Microsoft has committed to support other MIBs as they become standard, and the company also intends to track work being done in SNMP security.

Third parties can extend Microsoft's core SNMP product through the documented agent extension DLL API. Microsoft will also support Desktop Management Task Force's (DMTF) Desktop Management Interface (DMI). This is independent of any management-tool and will support the ability of any management tool (e.g. HP Open View, UB Net Director etc.) to manage any DMI compliant desktop component (e.g. FAX boards, printers) in the Windows machine. To summarize: Windows NT has built-in SNMP services, which enable the integration of Windows NT based servers and desktops with standards-based management platforms.

E-Mail

Windows NT is supplied with a proprietary mail system that is suitable as a workgroup mail system for a homogeneous network (Windows, Windows for Workgroups and Windows NT). This can be upgraded to the full Microsoft Mail system which can be equipped with mail gateways to many different systems. Of primary interest to UNIX users are SMTP and X.400, both of which are available with Microsoft Mail.

In many migration strategies, you will need to preserve existing directory or naming services from your mail system. This is not directly addressed in Windows NT but many corporate development groups have successfully written directory translators between systems.

Customer Case Study: Sequent

Questions and Answers

What is your compatibility with DCE?
When are you going to support SLIP or PPP?
Which common UNIX utilities are available for Windows NT?
How do the hardware requirements of Windows NT compare with UNIX?
How do I reach Microsoft on Internet?
What is Microsoft's position on Open Systems?
Does Windows NT support Streams and Sockets?
How does Windows NT support X.400 and X.500?

What is your compatibility with DCE?

Windows NT 3.1 includes RPC that is compatible with DCE. This is not a complete implementation of the DCE/RPC but it is fully interoperable with DCE/RPC and Windows NT has been demonstrated interoperating with RPC running under VMS as an example of the potential for heterogeneous connectivity.

In future releases of Windows NT, support for DCE will be strengthened to include name services and kerberos security.

When are you going to support SLIP or PPP?

SLIP and PPP will be supported in the next release of Windows NT. This is planned for release in mid-1994.

Which common UNIX utilities are available for Windows NT?

Many common UNIX utilities are available for Windows NT. These include GNU tools like EMACs and command shells like the Hamilton C Shell.

Standard TCP/IP utilities included in Windows NT: **arp**, **finger**, **ftp**, **ftpsvc**, **hostname**, **nbtstat**, **netstat**, **Packet INternet Groper (ping)**, **rcp**, **rexec**, **route**, **rsh**, **telnet**, **tftp**.

Link to UNIX tools list

How do the hardware requirements of Windows NT compare with UNIX?

Windows NT and UNIX have very similar hardware requirements. Because both systems are powerful and secure, they need more than average resources. Also, their portability means that the system cannot be specially "tuned" for a single architecture. A typical Windows NT workstation needs a minimum of 16 Mb RAM and 100 Mb of free disk space.

How do I reach Microsoft on Internet?

ftp.microsoft.com

What is Microsoft's position on Open Systems?

Microsoft is committed to helping customers realize the benefits of Open Systems. Our family of Windows operating systems and products provides a consistent and compatible set of platforms for our customers to build on. Through our Open Process program, we openly distribute and discuss our preliminary specifications for APIs. With our Windows Open Services Architecture (WOSA), we are leading the industry towards a common framework for application interoperability. We participate in most industry standards organizations. And, with Windows NT, we offer a portable operating system specifically designed with interoperability, portability, and manageability in mind.

"X/Open has, in the past, asked [Microsoft] for specifications, and we've never been refused to date. They've always been cooperative in open systems, when anyone has asked, despite what anyone has said in the press."

- Mike Lambert, Technical Vice President - X/Open Ltd. in Open Systems Today (January 10, 1994).

Does Windows NT support Streams and Sockets?

Streams is an architecture introduced with Unix System V, Release 3.2, that provides flexible and layered communication paths between processes (programs) and device drivers. Sockets are an inter process communications facility, originally part of the Berkeley Unix.

Windows NT supports Windows Sockets interface based on Berkeley Unix with Windows specific extensions. Windows NT, through the transport device interface (TDI) provides a common transport interface for Windows Sockets and NetBIOS libraries to offer transparent access to NetBEUI, XNS, TCP/IP and DECnet transports. Windows Sockets on Windows NT provides a System V STREAMS-compatible environment for protocol stacks through a kernel DLL. STREAMS-based stacks are implemented as loadable drivers; therefore, other transports may be furnished by third parties.

How does Windows NT support X.400 and X.500?

X.400 is an international standard which enables disparate electronic mail systems to exchange messages. Although each e-mail system may operate internally with its own, proprietary set of protocols, the X.400 protocol acts as a translating software making communication between the e-mail systems possible. Microsoft is committed to support X.400 in its mail products. Native 1988 X.400 support will be provided in the future. MS Mail 3.0 has a gateway to support sending and receiving mail from X.400 mail systems.

An X.500 compliant directory service will be provided in the future.

The Microsoft Windows Family of Products

Key Features of Windows NT

Windows NT features a number of powerful components designed to solve problems other operating system are unable to adequately address. This subject examines a range of topics that address specific enterprise computing issues such as networking, security and fault tolerance.

Windows NT Administration

Windows NT Fault Tolerant Components

Windows NT Networking

Windows NT Remote Access Services

Windows NT Services for The Macintosh

Windows NT Security

Symmetric Multi-Processing

Key Microsoft System Technologies

Aside from a common user interface and a common programming model, Microsoft Systems product share several key technologies including the use of Object Linking and Embedding (OLE) for application integration and the creation of objects, and the Windows Open System Architecture (WOSA) for a common interface to external data sources. These technologies help ensure application compatibility and shorten the development process.

An Overview of Client Server Computing

The Windows Open Services Architecture

An Overview of Windows Objects

Other Sources of Information

Reference Books for Windows NT

Microsoft Press Reference Books

On-Line Services

Evaluating Windows NT

Windows NT Evaluation Criteria

Windows NT Case Studies

AT&T Inbound Services

Baxter Healthcare Corporation

Chevron Canada

Freightliner Corporation

National Fuel Gas Supply Corporation

Nationwide Building Society

National League for Health Care

Paragon Trade Brands

Reuters

Sequent

Other Microsoft Products To Consider

SQL Server for Windows NT

SNA Server for Windows NT

Service Providers for Windows NT

There are over 300 service providers who provide training, development and support for Windows NT. When completed, information about how to contact your nearest provider will follow in this section.

The Windows NT Evaluation Guide

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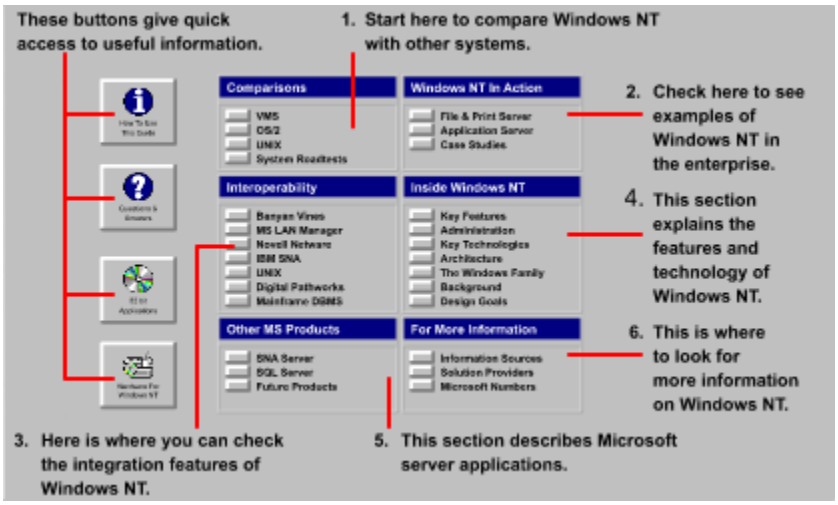
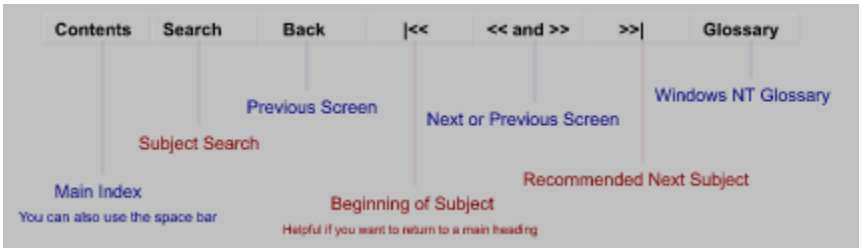


More Help on Using this Guide

Quick Tool Bar Reference



Development Tools from Microsoft

Here are two examples of powerful development environments from Microsoft:

Microsoft Fortran PowerStation

Microsoft Visual C++

Microsoft Ships Visual C++, Professional Edition Version 1.5

REDMOND, Wash. – Dec. 14, 1993 – Microsoft Corporation announced today it has shipped version 1.5 of the Microsoft® Visual C++™ development system for the Microsoft Windows™ operating system. It is the fourth major release of a Visual C++ product from Microsoft in 1993, preceded by Visual C++ 1.0 in February, Visual C++, 32-bit Edition in August, and a localized Japanese version in November. Throughout the year, Microsoft has received recognition from the industry applauding the excellence of its Visual C++ products. With Visual C++, Professional Edition version 1.5, Microsoft continues to build upon the popular and critical success of Visual C++, Professional Edition version 1.0 and the full line of Visual C++ products.

Visual C++ 1.5 contains major enhancements to Microsoft Foundation Classes (MFC) 2.5, including new wizards, making it easy to master both the power of Object Linking and Embedding (OLE) 2.0 and the database access flexibility of Open Database Connectivity (ODBC). Visual C++ 1.5 now also has the ability to run under the Microsoft Windows NT™ operating system in addition to Windows 3.1. Visual C++ 1.5 includes the OLE software development kit (SDK) and key components from the ODBC SDK in addition to all the features of Visual C++, Professional Edition version 1.0.

"Microsoft is completely committed to the professional C++ developer," said Denis Gilbert, general manager, Visual C++ division at Microsoft. "The shipment of Microsoft Visual C++ 1.5 further demonstrates this commitment. We've been listening to our developers and responding to their needs with relevant updates to our products; Visual C++ 1.5 is the fourth product in the line shipped this year. We're especially pleased with our customers' and the industry's reception of our products. We look forward to continuing the tradition of producing high-quality products in response to our customers needs in the coming year."

Visual C++ Customers Applaud New Visual C++ 1.5 Features
Visual C++ Products Recognized for Excellence and Innovation
Microsoft Foundation Class Library Becomes Widely Used C++ API for Windows
Visual C++ 1.5 With MFC 2.5 Supports Latest Technologies

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Visual C++ Customers Applaud New Visual C++ 1.5 Features

Paul King, software consultant at Xerox Corporation, says the following about the enhancements in Visual C++ version 1.5: "Microsoft Visual C++ 1.5 will allow developers of MFC applications to add OLE 2.0 support to existing applications in a matter of hours. Creating OLE 2.0 applications from scratch using the MFC 2.5 class libraries is a piece of cake. The tutorials included will help take the mystery out of OLE 2.0. This tool is a necessity for any serious OLE 2.0 or ODBC development."

"The Microsoft Visual C++ development group has obviously listened to what users had to say about version 1.0," said Mary Kirtland, senior software engineer, NIRSystems, Inc. "The new wizards are great. With MFC, we will be able to OLE-enable our application. MFC 2.5 also makes it easy to access existing databases using ODBC."

"A new programmer with no previous experience with OLE or MFC was able to add OLE 2.0 server functionality to an MFC application in less than two days," said Steve Proteau, senior software engineer, research and development at Dynapro Systems Inc. "What impresses me most about MFC 2.5 is that it does a great job of hiding the intricacies of OLE 2.0, but does not get in the way of serious OLE programmers."

Visual C++ Products Recognized for Excellence and Innovation

Microsoft Visual C++ products have been recognized for excellence and innovation by the industry as well and received the following awards in 1993:

- Choice Award, Programming Tool, *COMPUTE*
- Reader's Choice, Best C++ Compiler, *Data Based Advisor*
- Grand Winner, Innovation of the Year: Software Category, *EDN*
- Readers' Choice Award, Windows Development Tools, *.EXE Magazine*
- MVP Award, System Software-Application Development Tools, *PC/Computing*
- Technical Excellence Finalist, Development Tools, *PC Magazine*
- Winner, Star Tech Product of the Year awards, *Windows Tech Journal*
- Winner, Development Tools Category, *Ziff-Davis Europe*

"Visual C++ is an elegant development environment that comes with a host of superb programming tools," reported *COMPUTE* magazine. "Visual C++ really is next-generation programming."

"Visual C++ has transformed Windows-based programming from a tedious, error-prone process to a productive, fast and repeatable process," reported *Windows Tech Journal.* "Indeed, we believe the Visual C++ feature set makes so much sense that before long every C++ will include copycat features."

Microsoft Foundation Class Library Becomes Widely Used C++ API for Windows

Since its release as part of the Microsoft C/C++ development system version 7.0 in April 1992, the Microsoft Foundation Class Library has quickly become a popular tool for
Windows-based programming. This position has been further strengthened through its licensing by a number of other development tool vendors. Companies licensing the MFC Library include Blue Sky Software, Metaware Incorporated, Symantec Corporation and most recently WATCOM International Corporation.

MFC provides developers with a set of reusable, high-level C++ components that provide a completely portable interface for applications for the Microsoft Windows and Windows NT operating systems. Through various versions of MFC, Microsoft has consistently delivered upward compatibility and portability of its class library, thus protecting the investment that developers have made in developing with the class library.

Visual C++ 1.5 With MFC 2.5 Supports Latest Technologies

The MFC 2.5 database support consists of data access classes providing a high-level C++ application programming interface (API) for accessing databases through an ODBC driver. These database classes will allow developers to easily retrieve and browse data, display it on the screen as a form, change the data, and write it back into the database. New wizards enable developers to easily attach to any ODBC data source and bind user interface elements to data without requiring any coding.

The Visual C++ 1.5 package includes ODBC drivers for the Microsoft Access® database management system; dBASE®; the FoxPro® database management system; and Paradox®, Btrieve®, Microsoft Excel, SQL Server, and Oracle® databases. These drivers can be redistributed at no charge with applications developed with the MFC 2.5 database classes. Visual C++ 1.5 is also compatible with all other third-party ODBC-compliant drivers (such as Watcom™ SQL for Windows) and database formats.

MFC 2.5 classes for OLE 2.0 build on the document view architecture provided in MFC 2.0 to add full support of OLE 2.0. The new OLE 2.0 classes provide an extensive encapsulation of the OLE 2.0 API, combined with comprehensive OLE 2.0 implementations amounting to approximately 20,000 lines of tight MFC C++ code. Using Visual C++ 1.5 with MFC 2.5, developers can easily create powerful OLE 2.0-based applications with container and/or server capabilities that have full support for Visual Editing and Drag and Drop. MFC 2.5 offers support for OLE Automation for exposing member functions and data members of C++ classes to other applications.

Windows NT Compared to OpenVMS

by David Solomon of Solomon Software Technologies

On the whole, Windows NT provides a comparable 32-bit operating system environment to OpenVMS for building high-performance, mission critical server applications and desktop client applications. Windows NT is in its first release, whereas OpenVMS has had 15 years of development, so of course it doesn't provide everything. This section presents a comparison of the two systems.

Diskless Workstation Support
Robust Command Language (DCL)
More Open Standards Support
Logical Names
Record Management Services (RMS)
Commercial Strength SORT
Disk Quotas
Crash Dumps
Standalone Backup and Restore

Fully 32-bit OS

Windows NT, like OpenVMS, is a fully 32-bit operating system. Each user application has its own protected address space and can address up to 2GB of virtual memory at a time.

Scalable from Desktop to Data Center

Windows NT runs on your desktop as well as on data center/mainframe class machines. In fact, it has a greater range of scalability than OpenVMS because of the variety of hardware platforms it supports--from Intel 386 systems on the low end up to multiprocessor RISC machines on the high end.

True Preemptive Multitasking

Like OpenVMS (but unlike Windows 3.1), Windows NT can concurrently execute multiple processes. Its priority-driven, preemptive round-robin scheduler is very similar to that of OpenVMS. In fact, priority numbering is the same: 0-15 is normal, 16-31 is realtime. One important difference is that whereas OpenVMS schedules processes, Windows NT schedules threads.

Runs on Alpha AXP

The fact that Windows NT and OpenVMS are both supported on Digital's Alpha AXP platform means long-term investment protection for the OpenVMS customer base. Although the initial Alpha AXP systems supported by OpenVMS do not (and probably never will) run Windows NT, Digital has made it clear that future Alpha systems will support both operating systems.

This means that OpenVMS customers will be able to move their OpenVMS environment to the high-performance Alpha AXP platform today (preserving all their software investment) and have the option to someday in the future move to Windows NT while preserving the hardware investment--no small advantage!

Rich OS API

On the whole, the Win32 system service interface on Windows NT provides a comparable set of programming features to the OpenVMS system services. Both systems have their unique features, but on the whole, they both provide a rich set of base operating system services.

Integrated Networking

As with OpenVMS, networking was not an afterthought for Windows NT. Networking was designed in from the start. In fact, the networking architect for Windows NT (Dave Thompson) came from Digital with a DECnet background.

Robust Program Development Environment

OpenVMS and Windows NT are both great development environments that support a wide variety of software development tools. However, if you look at where the new and exciting development tools are coming out, it is not OpenVMS any more--it is Windows.

C2-level System Security

In short, Windows NT provides comparable system security support to OpenVMS. Like OpenVMS, Windows NT was designed to meet the U.S. Government requirements for trusted computer systems at the C2 level. This means that Windows NT supports discretionary access control and security auditing on all shareable system objects (such as files, directories, print queues, etc.).

Open Systems Standards Support

Although the key interface for Windows NT is the same GUI as Microsoft Windows (not an open standard), the system does come with support for two key open standards: the POSIX.1 operating system interface standard and the OSF DCE Remote Procedure Call (RPC). Other open standards are or will be available from third party vendors, including X-11 servers, X-11 client and Motif toolkits, and eventually the full OSF DCE environment as well.

Portability Across Machine Architectures

One of the key advantages of Windows NT is that it was designed to run on a wide variety of hardware platforms, including Intel and RISC. This means that as new hardware architectures emerge in the industry, Windows NT will be in a position to take advantage of them. Your software investment will be transferable to these new technologies and you won't be locked into any single vendor for hardware solutions.

By contrast, OpenVMS was designed originally to run on one hardware architecture: Digital's proprietary VAX platform. Although it has since been ported to the Alpha AXP platform, OpenVMS is by no means generally portable as is true with Windows NT.

To date, Windows NT runs on the Intel x86, MIPS R4xxx, and the Digital Alpha AXP platforms. Expect to see Windows NT available on all the important industry PC and RISC platforms.

Greater Range of Scalability

If you look at the range of systems on which Windows NT can or will run, you will see that it has a greater range than OpenVMS, especially on the low end (and with Win32s that extends down even further).

True Multithreaded Process Support

Windows NT supports multithreaded applications at the kernel level, whereas OpenVMS supports them at user level--Windows NT schedules threads whereas OpenVMS schedules processes. This means that a multithreaded application on Windows NT will scale better on a symmetric multiprocessing platform because the system can schedule multiple threads within a single process to run concurrently on multiple processors. Because the OpenVMS scheduler does not know about multiple threads, a multithreaded application running on an OpenVMS SMP system will not be able to take full advantage of the multiple CPUs.

Also, since each thread on Windows NT has its own security profile (on OpenVMS it is an attribute of the process), it is much easier to build multiuser/multithreaded server applications.

Multiple Operating System Personalities

One of the differences between Windows NT and OpenVMS is that Windows NT was designed to support multiple operating system environments (or personalities). This was realized by having a core executive that provides all the basic operating system services needed to implement a variant of advanced, 32-bit programming interfaces. The advantage here is that Windows NT will be in a better position than OpenVMS to respond as the industry evolves and programming interfaces change.

Support for 16-bit MS-DOS and Windows Applications

Without a doubt, the widest array of choices in applications software today are 16-bit MS-DOS and Windows applications. Windows NT can run the majority of these applications without change, and without any additional hardware or software accessories.

Of course, there is some overhead involved in emulating the 16-bit environment. Some applications run slower, some run faster. If your main purpose is running 16-bit applications, then Windows NT is probably not for you.

Graphical System Management Tools

The Windows NT system management tools are all Windows applications, and thus provide a friendly, easy to use interface that in many cases is self-explanatory. Since many OpenVMS system managers are used to character cell interfaces, this may take some time to get used to, but the productivity and usability gains will be well worth it.

Networking

Peer-to-peer networking is built in, so you don't have to buy a separate network license to connect systems in a network, like you have to with OpenVMS. Each Windows NT system comes with client and server networking out of the box.

The Windows NT Advanced Server package goes far beyond the networking capabilities of OpenVMS, especially with its centralized management of an enterprise-wide network and single network log-on capability that eases access to network resources.

Unicode Support

Unicode is a new 16-bit character set standard put together by a consortium of companies (including Digital and Microsoft). It defines a representation for all the world's important character sets, including both European and Asian (Japanese, Chinese, etc.) characters.

Windows NT supports Unicode through and through because all text strings inside Windows NT are 16-bit Unicode strings (whereas on OpenVMS, strings are 8-bit ANSI strings). This means Windows NT is capable of being a truly international platform and providing the base for your applications to be sold to the global marketplace.

Fast I/O and File System

The Windows NT I/O system and file system provide several evolutionary advances over the same components in OpenVMS. First, the system has a global system-wide write-back data cache shared by all file systems. OpenVMS V6.0 just recently acquired a write-through cache. Write-back data caches allow modifications to be cached in memory instead of written directly to disk, thus boosting I/O performance.

The new NT File System (NTFS) improves I/O throughput because of the application of transaction logging techniques to buffer I/Os in memory and allow deferred updating of file system volume structure data.

Unified System Configuration Database

Windows NT has a single, unified configuration database (called the Registry) where both the operating system itself and layered products can store per-user and system-wide configuration information in a structured and consistent fashion.

This eliminates the multiplicity of differently formatted system-wide and per-user database files such as SYSUAF.DAT, RIGHTSLIST.DAT, the network databases, SYSGEN parameters, DECW$*.DAT files, etc.

The Windows NT Registry simplifies life for the system manager, since there is only one place to look for all system configuration information.

Cluster Support

Certainly OpenVMSclusters are a unique advantage for OpenVMS--you cannot match the availability and load balancing capabilities of OpenVMSclusters with multiple Windows NT server systems.

Generalized Resource/Lock Manager

Because there is no concept of a cluster, there is no need for a distributed lock manager. However, even on a single node system, Windows NT does not have anything comparable to the generalized resource/lock manager of OpenVMS, with its multiplicity of lock modes and hierarchical resource structure.

Only simple mutual exclusion (the equivalent of an OpenVMS exclusive lock) is available on Windows NT. If you need anything more complex, you have to write your own (which is what most database vendors on Windows NT had to do).

Software Licensing Facility

There is no current equivalent to the OpenVMS LMF utility and callable routines. However, a Windows software licensing API (called LSAPI) has been designed and products are under development. The LSAPI specification is available from a number of sources, including the Microsoft Developer Network CD-ROM.

Commercial Strength Batch System

There is no robust, commercial strength batch system on Windows NT. There is a simple equivalent of the DCL SUBMIT command called "at" that allows you to schedule a command script or program to execute at a future time.

Diskless Workstation Support

There is no diskless boot support at least in the first release. Windows NT requires a local hard drive for the operating system to load.

Robust Command Language (DCL)

The command shell provided with Windows NT has as its command syntax something similar to MS-DOS 5. For an OpenVMS DCL user, this is by no means sufficient as a command language.

Although there are several third party Unix shells available for Windows NT, nobody to date has produced a DCL implementation. However, the two companies that offer DCLs on Unix (Accelr8 and Sector 7) are considering porting to Windows NT. They are interested in hearing your requirements--for Sector 7, call Jon Power at 512-451-3961 and for Accelr8, call Robert Hickler at 800-582-8898.

More Open Standards Support

OpenVMS supports more open standard interfaces such as POSIX.2, POSIX.4, POSIX.4a, XPG3, more components of the OSF DCE, etc. Of course, this depends on your definition of what an open system is--the Windows platform has an installed base of millions and with the advent of Windows NT is available on multiple hardware platforms. So while OpenVMS may have more standards that you can "check the box" for, the action is happening on the Windows platform. Also, the Win32 API, although owned by Microsoft, did have independent review and input by key ISVs during its development process.

Logical Names

Logical names are not available on Windows NT. Implementing them on Windows NT would be straightforward in theory, but they are just not part of the first release. Environment variables provide a subset of the features provided by logical names, but require specific application support.

Record Management Services (RMS)

There is no RMS, so if you need indexed file support you have to buy a third party library. The Win32 I/O system services are similar to Unix in that they only provide simple byte stream I/O (e.g. read 10 bytes, write 20 bytes). There is no concept of "records" at the Win32 interface level.

Commercial Strength SORT

The Windows NT SORT utility is the same as that of MS-DOS 5, which provides only limited file and record selection capabilities. OpenVMS customers that require advanced file sorting on Windows NT will have to purchase a third party product, such as a database.

Disk Quotas

Disk quotas are certainly an important commercial feature missing from Windows NT. Microsoft has said that disk quotas will be provided in a future release.

Crash Dumps

Windows NT has no mechanism to save the system state in a file in the case of a system crash. When Windows NT crashes it displays basic crash information on the local VGA display (similar to what is output on the console when OpenVMS crashes). So how is a Windows NT system crash debugged? The crash must be reproduced on the special debug version of Windows NT that ships as part of the Device Driver Kit.

Standalone Backup and Restore

To perform a backup or restore you must in fact be running Windows NT. There is no equivalent to the OpenVMS standalone backup package.

Why is Windows NT of Special Interest to OpenVMS customers?

There are a number of reasons why Windows NT should be of particular interest to OpenVMS customers as a potential long-term replacement platform:

- The chief architect of Windows NT, David Cutler, was the project leader for OpenVMS Version 1 at Digital. In addition, many of the key developers on Windows NT came from Digital with a strong OpenVMS background, so it is no surprise that Windows NT shares many cultural similarities with OpenVMS. In fact, OpenVMS programmers and system managers have an advantage in coming up to speed on Windows NT because they already know many of the concepts and terms in Windows NT that are all "new concepts" to the PC world.

- Windows NT runs on **Digital Alpha AXP**

- Windows NT runs the major **DOS and Windows 16-bit applications**

- Microsoft Windows is the choice platform for new applications and development tools in today's PC marketplace.

Base Operating System Description in OpenVMS Terms

Multi-user Capabilities

Networking

Memory Management

Processes and Threads

Synchronization

I/O System

File Systems

Interprocess Communication

Windows NT Registry

Exception Handling

Win32 Services

Multi-user Capabilities

Although Windows NT does not come with the traditional dumb-terminal style of multi-user support present in OpenVMS (though this will be provided by a third party as described below), it is definitely not a single user system either. Windows NT can be used as a multi-user system in several ways.

It is a multi-user system in the sense that a single Windows NT based workstation can be shared effectively by multiple persons *serially* (one at a time). Each user can have their own username, password, and personal user profile, and can protect their files so that they are not accessible to anyone who has access to the system.

With the Windows NT Advanced Server product, accounts and user profiles can be defined once for a domain (or even the enterprise), thus allowing a user to log into any PC in the domain and still get their individual customized user profile loaded automatically. If trust relationships are defined, a user can even log in from a PC in a remote domain, e.g. while visiting an out of town office.

However, the real support for multiple users is as a non-interactive server system running in a client/server fashion. There are a number of ways Windows NT based servers can effectively serve multiple remote client users:

1. As a file or print server (built into Windows NT)
2. As a database server, for example running a SQL Server product
3. As an application server running a Win32 server program built on one of the variety of client/server mechanisms built into Windows NT, such as Named Pipes, Winsockets, or RPC.
4. As an application server running X or Motif applications using third party X client tool kits (such as will be available from Digital, Hummingbird Communications, and Congruent).

Note that a multithreaded Win32 application can simultaneously serve multiple different remote client users using the built-in security impersonation APIs (see ImpersonateNamedPipeClient, RpcImpersonateClient, and ImpersonateDDEClientWindow). Using these APIs, threads within a process can run under security access tokens that are different from that of the locally logged on user.

What is not supported in the Windows NT-based product, is the ability to have multiple *interactive* users on the system logged in at one time, such as multiple dumb terminals connected by asynchronous lines or remote users setting host into the system (like OpenVMS SET HOST). However, this capability is under development by a third party in Florida called Citrix Systems (for more information call 305-755-0559). Though this is not the style of computing envisioned for Windows NT by Microsoft, it is comforting for OpenVMS users to know that it will be available as an option for Windows NT.

Networking

As with OpenVMS, networking was included in the Windows NT system from the start and not added on as an afterthought. In fact, the key architect for networking under Windows NT (Dave Thompson) came from Digital with a strong DECnet background. This is reflected in the networking design of Windows NT.

Basic Windows NT Networking
Client and server networking is built-in, so you don't have to buy a separate network license to connect systems in a network, like you have to with OpenVMS. When you take Windows NT out of the box, you have the ability to link together a set of user PCs, share print and disk resources, and run server applications like those using the RPC. Several network transports come with Windows NT: Netbeui for LAN Manager networks, TCP/IP for Unix connectivity, IPX/SPX for NetWare connectivity, and DLC for mainframe and network printer access.

Though the software licensing for Pathworks forbids this, it is possible to connect a Windows NT based client workstation to an OpenVMS server system that is running Pathworks and has the TCP/IP support option, without any additional software on the Windows NT based system.

But the real connectivity solution between Windows NT and OpenVMS systems is Pathworks for Windows NT, which provides DECnet transport support as well as other DECnet interoperability tools.

Centralized Management with the Windows NT Advanced Server
The Windows NT Advanced Server provides a number of networking advances not currently possible with OpenVMS. One is the ability to define usernames and groups globally for an entire network (as opposed to OpenVMS, which requires that each system or cluster have its own authorization database).

This is accomplished by the addition of a new security concept: the domain. A domain consists of one or more Windows NT Advanced Server based systems and any number of Windows NT based workstations. It functions like a single system in that user accounts and groups can be defined once for the domain. Users can log into any Windows NT based workstation in the domain under their account and get their customized user profile (screen settings, privileges, etc.). This is similar to cluster-wide accounts on a VMScluster.

But the Windows NT Advanced Server goes a step beyond VMSclusters when it comes to network access, because it also allows accounts to be defined once for the entire network. This is accomplished through "trust relationships". Trust relationships are defined between domains in a network--in some ways, they are similar to wild card DECnet proxies. They do not have to be bi-directional (e.g. domain A can trust domain B, but not vice-versa). Once a trust relationship is defined by the system manager, users in the trusted domain can access network resources (files & directories, printers, and server applications) without having to perform any kind of authentication.

Processes and Threads

There are a few differences in the process environment between Windows NT and OpenVMS:

- There is no process/subprocess relationship between Win32 processes as there are on OpenVMS. Processes created with CreateProcess are like OpenVMS detached processes--. if the creating process exits, the created process remains.

- Processes have no names, only an i.d. The process i.d. is the same as OpenVMS in that it is a unique identifier for the process on the system. Run the Pview utility to see the list of processes and their i.d.'s.

OpenVMS->Win32 Process System Service Equivalents

Multithreaded Process Support
The Win32 API has direct support for building multithreaded applications. These include the basic primitives for creating and manipulating threads (CreateThread, ExitThread, TerminateThread, SuspendThread, ResumeThread, etc.) as well as services to synchronize access to data within a process virtual address space by multiple threads (EnterCriticalSection, LeaveCriticalSection).

While multithreaded applications were always possible on VMS (and are made easier by the new DECthreads run-time library), Windows NT has better support for multithreaded applications because it knows about threads at the kernel level. What this means is that Windows NT schedules threads, whereas OpenVMS schedules processes. Where this makes a difference is on a SMP (symmetric multiprocessing) machine because Windows NT can schedule multiple runnable threads within a single process to run concurrently on multiple CPUs. Since the OpenVMS scheduler doesn't know about threads, a multithreaded application on OpenVMS running on an SMP machine cannot take full advantage of the multiple CPUs.

Scheduling Priorities
Threads on Windows NT have a similar priority range as processes on OpenVMS: 0-15 is normal, 16-31 is real time. However, the way you set priorities from the application program point of view is different. Instead of specifying numeric values, you specify relative values within a range of 5:

- THREAD_PRIORITY_HIGHEST
- THREAD_PRIORITY_ABOVE_NORMAL
- THREAD_PRIORITY_NORMAL
- THREAD_PRIORITY_BELOW_NORMAL
- THREAD_PRIORITY_LOWEST

The numeric value with which these correspond depends on the "process priority class", which can be one of four settings:

- IDLE_PRIORITY_CLASS
- NORMAL_PRIORITY_CLASS
- HIGH_PRIORITY_CLASS
- REALTIME_PRIORITY_CLASS

Note that it does not require privileges to increase a thread's priority level within the relative range of five levels described above, but it does require privileges to increase a process' priority class (since that can have a major impact on system performance).

Detecting Process Termination
The CreateProcess system service does not have a parameter like the OpenVMS termination mailbox. However, you can accomplish the same thing by waiting on the handle to the new process created with either **WaitForSingleObject** or **WaitForMultipleObject**. When the process exits, the wait is satisfied, thus notifying you that the process has gone away.

OpenVMS->Win32 Process System Service Equivalents

$ADJSTK	No equivalent.
$CANEXH	No direct equivalent (see $DCLEXH).
$CANWAK	No direct equivalent. KillTimer works, but you must have the timer handles returned by SetTimer.
$CMEXEC	Not applicable.
$CMKRNL	Not applicable.
$CREPRC	CreateProcess.
$DCLCMH	Not applicable.
$DCLEXH	No direct equivalent. For Windows applications (vs. console applications), the WM_DESTROY message on the main window indicates the process is going away. For DLLs, a separate mechanism exists to get notification on process exit (DLL_PROCESS_DETACH call to LibMain).
$DELPRC	TerminateProcess (or TerminateThread for a thread). Warning: like OpenVMS, this call may leave things in an inconsistent state (DLLs are not notified).
$EXIT	ExitProcess (or ExitThread for a thread).
$FORCEX	OpenProcess to get a process handle and use CreateRemoteThread to cause an ExitProcess to execute in the context of the target process.
$GETJPI[w]	Several alternatives, depending on information required. For wild card process information, see $PROCESS_SCAN. To get information on processes other than your own requires an open handle to the target process. Some process information services accept a process handle. For those that do not (e.g. GetUserName), use CreateRemoteThread to execute the function in the target process. Some process information not available via direct Win32 calls is included in the debug process and thread startup messages sent to a debugger (see DEBUG_EVENT structure). You can attach yourself to a process as a debugger and receive these messages with the DebugActiveProcess call.
$HIBER	WaitForSingleObject (wait on an event object; another process must then use SetEvent to wake you up). For Windows applications, WaitMessage can also be used.
$PROCESS_SCAN	Not documented (Windows NT internal routines exist). Information also available from registry - see PERF.ZIP from Compuserve, MSWIN32, Lib 6.
$RESUME	No direct equivalent. ResumeThread will resume a specific thread.

$SCHDWK	In the main process thread, do a SetTimer (specifying an action routine to run) followed by a SuspendThread. Have the action routine resume the thread with ResumeThread. If the timer is not to be repeated (e.g. a one-shot), cancel it in the action routine with KillTimer. To perform this on a process other than your own, use OpenProcess and CreateRemoteThread to perform the above in the context of the target process.
$SETEXV	No equivalent - Win32 structured exception handling is completely frame based; OpenVMS provides both frame-based and vector-based.
$SETPRA	No equivalent. Note that the UPS (Uninterruptible Power Supply) control panel application may allow the specification of a process to run on power recovery.
$SETPRI	SetThreadPriority, SetPriorityClass.
$SETPRN	Not applicable (Win32 processes have no names).
$SETRWM	No equivalent.
$SETSFM	No equivalent. Note: SetErrorMode controls how hard file I/O errors are handled.
$SETSTK	No equivalent (stack size specified at thread creation).
$SUSPND	No direct equivalent. SuspendThread will suspend a specific thread.
$WAKE	SetEvent (set event that the hiberating process is waiting on). See $HIBER.

Memory Management

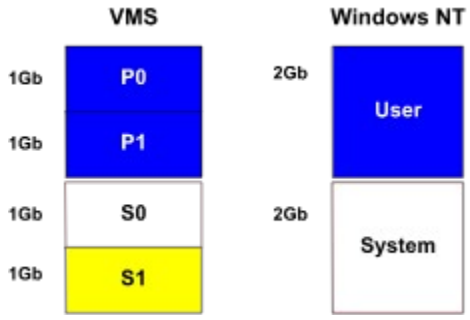
The Windows NT memory management services will be familiar to anyone who knows OpenVMS. The architect for the Windows NT memory management (Lou Perrazoli) was another of the several key people on the Windows NT team with a strong OpenVMS background, so it is no surprise that many of the terms are the same--such as balance set and working set, paged and nonpaged pool, and shared memory.

OpenVMS->Win32 Memory Management Service Equivalents

One difference is that there is no working maximum setting--the system decides how big to let working sets grow and when to shrink them depending on demands for system physical memory. Also, Windows NT does not implement swapping (but this may be added in a future release). Instead, an inactive process will have its working set reduced over time so as not to consume much physical memory.

Virtual Address Space Layout

The virtual address layout is similar to OpenVMS in that user applications have 2 Gb:



There is no P0-P1 split because with multithreaded applications each thread has its own stack (vs. the typical single stack in an OpenVMS application), so stack space is simply reserved when a thread is created.

Shared Memory

Shared memory fundamentally has the same support and the same capabilities as OpenVMS global sections but they are called file mapping objects. For more information, see the CreateFileMapping and MapViewOfFile system services.

One interesting difference is that Windows NT implements an algorithm called copy-on-write which has a performance advantage over OpenVMS. In most cases when you map a piece of shared memory into an OpenVMS process and it has dirty (read/write) data, a per-process copy is made at that time. Windows NT uses the approach of deferring the copy until you actually go to modify it, because if you never modify dirty data, it is in essence read only.

OpenVMS->Win32 Memory Management Service Equivalents

$ADJWSL	No equivalent (no working set maximum in Windows NT)
$CRETVA	VirtualAlloc (lpAddress,size,MEM_COMMIT,prot)
$CRMPSC	CreateFileMapping + MapViewOfFile. For page-file sections, specify -1 as the file handle; for disk-file sections, must first open the file (in exclusive mode).
$DELTVA	VirtualFree(Addr,0,MEM_RELEASE). To unmap a section, use UnmapViewOfFile and CloseHandle on file mapping object. If you created the section, do a CloseHandle on the file handle.
$DGBLSC	Not applicable (section automatically deleted after last accessor)
$EXPREG	VirtualAlloc (lpAddress=0,size,MEM_COMMIT,prot)
$LCKPAG	No equivalent (cannot lock pages into physical memory)
$LKWSET	VirtualLock
$MGBLSC	OpenFileMapping + MapViewOfFile (or MapViewOfFileEx)
$PURGWS	No equivalent (no working set maximum in Windows NT)
$SETPRT	VirtualProtect
$SETSWM	No equivalent (no swapping in Windows NT; working sets are shrunk)
$ULKPAG	No equivalent (cannot lock pages into physical memory)
$ULWSET	VirtualUnlock
$UPDSEC[w]	FlushViewOfFile

Synchronization

Windows NT does not have a generalized resource lock manager like the OpenVMS lock manager $ENQ/$DEQ services. Instead, four basic synchronization primitives are provided, upon which one could build more sophisticated locking mechanisms:

1. **Mutexes** (like OpenVMS exclusive locks)
2. **Semaphores** (like a mutex with a count--more than one thread can lock the resource)
3. **Event** (a superset of OpenVMS event flags)
4. **Critical Sections** (like an OpenVMS exclusive lock but accessible only to threads within a process)

The first three are usable by threads across one or more processes (the last one is usable only within a single process). These three objects can optionally have a name (like an OpenVMS resource) so that they can be referenced by multiple processes.

I/O System

The Windows NT I/O system has many similarities to the OpenVMS I/O system, and one reason for that is that the Windows NT I/O Architect (Darryl Havens) came to Microsoft with a very strong background in OpenVMS internals. For example, it supports fully asynchronous I/O.

One of the things that sets the Windows NT I/O system apart from OpenVMS is the common system-wide data buffer cache shared by all file systems.

The device driver interface on Windows NT is very similar to that of OpenVMS, but device drivers are written in C and the support routines are designed to allow portable device drivers. If you follow the Microsoft rules for writing portable device drivers you should be able to recompile and relink on another hardware platform or on another hardware architecture.

However, to build device drivers you must purchase the Win32 Device Driver Development Kit (DDK) which is bundled with the Win32 Software Development Kit. This CD-ROM includes the documentation and tools needed to build Windows NT device drivers. The cost for the SDK/DDK bundle is $199.

File Systems

Windows NT supports three disk based file systems:

- **FAT** (for DOS compatibility)
- **HPFS** (for OS/2 compatibility)
- **NTFS** (the new native Windows NT File System)

NTFS is the file system of most interest to OpenVMS customers since it provides a superset of the OpenVMS file system features.

Common System-Wide Data Buffer Cache
Windows NT I/O has a common, system-wide global data cache that goes beyond the new OpenVMS I/O disk cache introduced with OpenVMS Version 6.0. It is a write-back cache vs. the OpenVMS write-through cache. This means that when you write a buffer to disk, the system can cache that write in memory. The new OpenVMS cache provides write-through caching, which means I/O operations are always written through to the disk (though a copy is cached for future read operations).

Of course, you can disable this caching on a per-file open basis (by specifying the FILE_FLAG_WRITE_THROUGH flag on the CreateFile call).

Note that OpenVMS does have a write-back data cache but only on a per-process level (the RMS "deferred write" option), not on a system-wide basis like the Windows NT cache.

NTFS vs. the OpenVMS File System
The new Windows NT File System is similar to the OpenVMS ODS-2 file system in that it supports volume sets, disk striping, long file names (though longer than OpenVMS), access control lists, and security auditing. It is missing two key OpenVMS file system features: disk quotas (promised for a future release) and file version numbers (not likely ever to appear in Windows NT).

NTFS provides, however, a number of advantages over the OpenVMS file system, such as:

- **Huge file size**: all file offsets are in 64-bit quantities, which means a potential file addressing size of 18 million gigabytes (note: Digital recently announced plans to add this capability to the OpenVMS file system in the future)

- **Transaction or log-based file system update mechanism**: this technology (recently introduced on OSF/1 with the new Polycenter Advanced File System) provides a dramatic increase in file system throughput compared to OpenVMS, without losing the quick crash restart recovery provided by the OpenVMS file system

- **Longer and mixed-case file names**: file names can be mixed case and

up to 256 Unicode characters in length.

- **Better internationalization support**: because file names are stored as 16-bit Unicode strings (vs. OpenVMS which stores file names as 8-bit strings), you can have file names with Asian character set values that do not get lost when moving volumes from one system to another

- **Multiple data streams**: a file can have named "sub files" that are stored with the file but separately accessible on file open.

Interprocess Communication

Windows NT was designed to support sophisticated client/server applications in a networked environment. Therefore a number of different interprocess communication (IPC) mechanisms are provided:

- Windows messages
- Named Pipes
- Mailslots
- Winsockets
- Remote Procedure Call (RPC)
- Network DDE
- OLE 2.0

Local IPC
The primary local IPC mechanism on OpenVMS is mailboxes. Depending on how you are using OpenVMS mailboxes, there may or may not be a direct equivalent on Windows NT, however the same fundamental services can be implemented on Windows NT. The OpenVMS Lock Manager can also be used as an IPC mechanism (using the lock value block). There is no equivalent to this on Windows NT.

However, Windows NT provides a way for individual threads to post messages to other threads that own windows (the PostThreadMessage service). This is a way to pass a very small amount of information between threads (like the OpenVMS lock manager lock value blocks), but requires the use of a windows message loop.

Network IPC
For networked applications, OpenVMS provides DECnet task-to-task communication. This will be provided in a future release of Pathworks for Windows NT

For applications that must interoperate between OpenVMS and Windows NT based systems, use the Remote Procedure Call or Winsockets. Or, consider the Digital ObjectWorks (previously known as ACA Services) layered product that runs on both OpenVMS and Windows NT.

For building homogeneous Windows NT based networked applications, look carefully at Named Pipes (in addition to the RPC), as they provide powerful features for multithreaded server applications, such as easy client security impersonation. Named Pipes are similar to mailboxes in that they provide a simple way to exchange bytes between processes, but unlike mailboxes they work over a network.

Equivalent of OpenVMS Mailboxes
In terms of the equivalent of OpenVMS mailboxes, depending on how you are using mailboxes, there may be or may not be a built-in equivalent. However you can accomplish any style of OpenVMS mailbox usage on Windows NT:

- If you are using the many writers to many readers style, where the mailboxes are the first in/first out messages queue, there is no direct equivalent in the Win32 API. However, this would be straightforward to implement using shared memory (called File Mapping Objects) and a mutex to control insert/removal of messages from a queue.

- If you have the style where you have one process talking to another process and not talking to anybody else, that can be accomplished with named or unnamed (anonymous) pipes.

- If you have the style where you have many people writing to a mailbox but only one process reading from the mailbox, that can be done with Win32 Mailslots.

Windows NT Registry

The Windows NT Registry is a unified database where both Windows NT itself as well as layered products can store system-wide and per-user configuration and profile information in a structured and secure fashion. The system service interface to the registry is documented and there are guidelines as to where layered software products should store product-specific information in the registry.

The Registry cleans up what has become a mess over time on OpenVMS--the proliferation of different product-specific system and per-user configuration data files each with a different format. Examples include SYSUAF.DAT, RIGHTSLIST.DAT, the network database files, SYSGEN parameters, and the multitude of DECW$xxx user profile files in SYS$LOGIN. With Windows NT, there is now one place for both the operating system and third party software products to store such information in a consistent and structured fashion.

A key feature of the registry is that it is network-accessible. This is why Windows NT based systems can be managed remotely. Because Windows NT stores all of its configuration information in the registry; the various system management utilities on Windows NT can connect to a remote system's registry and perform the management functions remotely. This is key because you cannot SET HOST into a Windows NT based system (like on OpenVMS), so to perform remote system management on Windows NT, a system manager will run the specific utility locally on his/her Windows NT based system, and perhaps connect to a remote system's registry.

Finally, note that the Registry is not just an on-disk non-volatile database--it also contains a volatile section that represents the running system's current state (such as currently loaded device drivers, performance counters, etc.). Again, because of the Registry's network accessibility, system managers can view dynamic system state and performance information of remote Windows NT based systems.

Exception Handling

The Win32 Structured Exception Handling mechanism provides basically the same functionality as the OpenVMS condition handling facility: the ability to declare condition handlers in each stack frame that gain control when software or hardware exceptions occur. Like OpenVMS, Win32 can either re-signal the exception, unwind the stack, or continue execution at the point the exception occurred. Software exceptions are also supported (the equivalent of LIB$SIGNAL).

However, the way the programmer-declared exception handlers work is different--instead of calling system services, you must use special (non-standard) language extensions that are processed by the compiler and in turn generated into special code that tells the Win32 exception handling mechanism where your handlers are. Therefore, each compiler vendor must add special support for the facility. For example, the Microsoft C/C++ compiler has been extended to add keywords to support Win32 exception handling such as TRY, EXCEPT, and FINALLY. But, it is still like OpenVMS in that the mechanism is language-independent (implemented by the system).

Win32 Services

Like OpenVMS, Windows NT supports the execution of multiple detached processes running under different usernames. Whereas on OpenVMS you might start such server applications in your system startup file, on Windows NT this must be done by defining a Win32 application as a "service" via the Win32 CreateService() function. For each service, you can specify the image to run, the username to run it under, whether or not the service should be started automatically at system boot time, and whether the service should run in its own process or if it can share a multithreaded process with other services. Once started and initialized, services are notified by Win32 when client requests arrive. For further details, see the see the Win32 API help file under "Services Overview"--there are about 20 routines related to the creation, management, and execution of Win32 services.

User's View

The primary user interface to Windows NT is the Micosoft Windows graphical environment. There is a bundled command shell that provides a character cell environment, but the command syntax is basically the same as the MS-DOS V5 command interface, which, of course, is a much less sophisticated command shell than DCL. If you know Unix, there are several third-party Unix shells available.

Logging In

Graphical User Interface

Program Manager

Changing Your Password

File Naming

DCL for Windows NT

Windows NT Command Prompt

System Information

Logging In

To get the login banner, you have to type CONTROL/ALT/DELETE. This is like hitting RETURN on OpenVMS to get the username prompt or like the optional OpenVMS secure attention sequence (BREAK key) that a system manager can require to prevent trojan horse applications from simulating the login prompt.

Note one additional field besides username and password: "From:". This is a very powerful feature provided by Windows NT Advanced Server that allows a user to log in from any Windows NT based workstation in the network, referencing his or her account defined on another remote system. This user feature is currently not possible with OpenVMS. Once you log in, you come right into the Windows NT Program Manager--you don't type WIN at the DOS prompt as with Windows 3.1.

Graphical User Interface

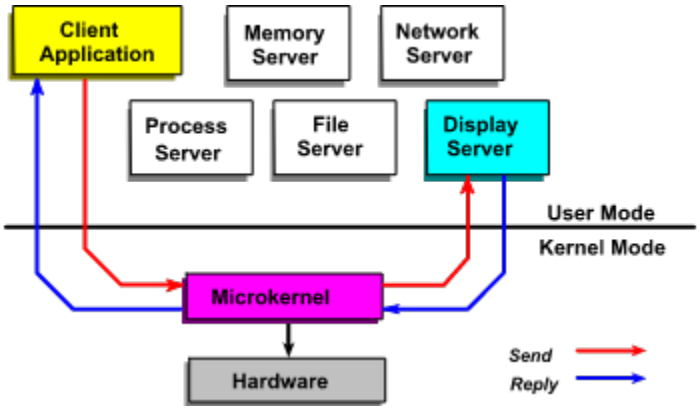
If you are already familiar with the Microsoft Windows graphical user environment then using Windows NT will be a snap, because the user interface is a superset of what is provided in Windows 3.1 In fact, unless you look closely and try a few things, you may not even be able to tell the difference between Windows 3.1 and Windows NT at the basic user interface level (of course, Windows NT provides a number of user interface enhancements over Windows 3.1, such as true multitasking).

If you are not familiar with Microsoft Windows, but have used a graphical user interface before (such as DECwindows Motif on OpenVMS), it won't be much trouble to become familiar with the Windows environment.

If you are a traditional OpenVMS character cell DCL user, and this is your first experience with a graphical user environment, you're in for a treat. Of course, it will take some getting used to, but the productivity gains and usability improvements will be worth the time investment (confession: even though I like the graphical environment, I find myself still doing many things from the command prompt--old habits die hard).

Program Manager

Once you log in, you come right into the Windows NT program manager--you don't type WIN at the DOS prompt as with Windows 3.1. The Program Manager is like the DCL "$" prompt--from here, you launch applications by either double clicking on an icon or manually entering the filename to run by using the File->Run menu option.



There is a nice interactive user tutorial (look for the icon above) which will take you through the basic features of the key bundled applications.

Windows NT Command Prompt

The Windows NT command shell provides a character cell interface to many (but not all) of the Windows NT utilities and system functions.

System managers take note: with the exception of Backup and some Network Management commands, the bulk of Windows NT system management functionality is provided only through Windows graphical applications.

Running Programs and Creating Processes

To run a program, simply type in the name of the .EXE--there is no RUN command like in DCL. Note that you can run any type of .EXE from the command prompt, whether it be a 16-bit DOS program, a 32-bit graphical application or character cell application, or a POSIX program.

The equivalent of DCL SPAWN would be to either open a new command prompt window or type the START command. However, unlike DCL SPAWN, if you exit the "parent" window the "child" process remains running, because Win32 processes do not have a parent/child relationship as with OpenVMS processes and subprocesses.

Batch Jobs

The equivalent of the DCL SUBMIT command is the Windows NT "at" command. It allows a user to schedule a program or command script to run at a future time (or repeatedly on a certain date or time). To cancel a pending job (like DELETE/ENTRY), type AT NNN/DELETE. The syntax is: **at [\\nodename] time [/every:date[,...] | /next:date[,...] "command"**

NOTE: the Schedule service must be started to use the AT command (services are like detached processes started at system startup time). To control service startup options, use the Control Panel application and click on the Services icon.

For more information, see the Windows NT command reference help file or type HELP AT from the command prompt.

File Manipulation Commands

The following is a chart of the basic DCL file manipulation commands and their equivalent from the Windows NT command prompt:

VMS DCL	Windows NT command prompt
DIR	dir
CREATE/DIRECTORY	md
TYPE	type
COPY	copy
COPY	[dir1...]*.* [dir2...]*.* xcopy \dir1 \dir2 /s/e
RENAME	ren (note: cannot rename directory files)
DELETE	del
DELETE xxx.dir	rd xxx
EDIT	Editors that come with Windows NT: 1. edit (simple text editor from MSDOS) 2. Notepad (Windows app) 3. Write (Windows app)
EDIT/EDT	SEDT (shareware) - write to: Anker Berg-Sonne 8 Middlemost Way Stow, MA 01775 USA
EDIT/TPU	nu/TPU from A Soft - (603) 666-6699
SEARCH	findstr
DIFF	fc
CREATE xxx	COPY CON: xxx
APPEND x y	COPY y+x
PRINT	print

Directory Navigation

VMS DCL	Windows NT
SHOW DEFAULT	cd
SET DEFAULT disk:[xxx.yyy]	1. cd disk: 2. cd \xxx\yyy

Control Character Equivalents

VMS DCL	Windows NT
CTRL/C	same
CTRL/S, CTRL/Q	same
CTRL/O	same
CTRL/U	CTRL+HOME (or ESC to clear entire line)
CTRL/Y	no equivalent
CTRL/T	no equivalent
CTRL/X	no equivalent
CTRL/E	END key
CTRL/H, Backspace, F12	HOME key
CTRL/A or F14 (toggle insert/overstrike)	INS key

Command Line Editing

VMS DCL	Windows NT
uparrow/downarrow	same
CTRL/B	uparrow
RECALL/ALL	F7 (function key)
RECALL n	F9 (function key)
RECALL/ERASE	ALT+F7

Getting Help

There are two choices for help:

- Type HELP <command> from the command prompt (like the DCL HELP command)
- Launch the graphical **Windows NT command help** from the Program Manager, seen below.

For a complete list of commands, either type HELP from the command prompt or click on the "Command Reference Help" topic in the main Windows NT help menu below:

If you know MS-DOS and want to see a quick summary of how the Windows NT command shell differs from the MS-DOS 5 command syntax, see the topic "What's New or Different from MS-DOS?", available under the Command Reference Help topic above.

File Naming

Windows NT itself does not impose what file names and device names look like--that decision is left to each individual environment subsystem. Win32 exposes file and device names using the MS-DOS naming syntax. File names are of the form: **disk:\directory\directory2\...\name.ext[:stream]**

For FAT formatted partitions, file names are limited to 8 character names and 3 character extensions. For NTFS partitions, file names can be up to 255 characters (including the name and extension) and can consist of any Unicode character. Note the Windows NT command prompt is limited to the characters available in the OEM code page you installed when you set up Windows NT.

Unlike OpenVMS which as a consistent device naming scheme, Win32 device names vary depending on device type:

Disks (including network drives)	a:, b:, c:, d:, e:, ...
Tape devices	TAPEn:
Printers	LPTn:
NL:	NUL
SYS$INPUT	CON:

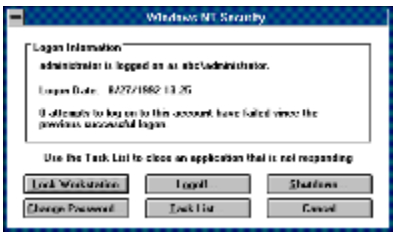
There is no equivalent to OpenVMS logical names (yet), though it would straightforward to add that to Windows NT in the future.

System Information

The equivalent of SHOW SYSTEM is the output from the graphical **Pview** (Process Viewer) utility. Note that this utility is on the Windows NT kit in the \SUPTOOLS directory, however it is not installed by default (it is, however, installed as a part of the Win32 Software Development Kit). Here is a sample screen snapshot from Pview showing the processes on the system. As you select each process, Pview shows the threads within that process. Clicking on the Memory Details button displays information similar to a DCL SHOW PROCESS/ALL command.

Changing Your Password

The equivalent of the DCL SET PASSWORD command is to type CONTROL+ALT+DELETE while logged in and select the "Change Password" button from the following dialog box:



DCL for Windows NT

Although there is not currently a commercially available DCL product for Windows NT, the two companies that today provide DCL emulation products on Unix are evaluating porting these to Windows NT. For more information or to let them know your requirements contact:

- **Accelr8:** Robert Hickler - 800-582-8898
- **Sector 7:** Jon Power - 512-451-3961

Programmer's View

Win32 System Service Interface

One of the style differences between OpenVMS and Windows NT is that there are just lots more system services. Instead of having fewer services with item codes and function codes like on OpenVMS, Windows NT has many separate services to perform each operation. In addition, Windows NT uses data structures as input/output arguments as opposed to item lists or parameters. So, there are some calls that use data structures to pass input arguments as well as return extended information upon completion.

As far as getting up to speed, the overviews in the Win32 Programmers Reference Volume 2 (also in the on-line help) provide a good description of each of the various classes of Win32 services. These chapters are like the Introduction to OpenVMS System Routines manual which also has a chapter for each class of OpenVMS system services.

Program Development Environment

The basics are similar: you still compile, you still link, you still debug. But unlike OpenVMS, the base development tools (e.g. Linker, Librarian, Message Compiler, etc.) are not bundled with the system but instead typically come with the compiler you choose.

Most of the key languages used on OpenVMS, such as Fortran, C, Cobol, Ada, and Pascal, are or will be available on Windows NT. The one language for which there is no real equivalent coming is VAX BASIC.

What OpenVMS programmers will likely find exciting are the integrated, graphical development environments available for the Windows environment, such as Microsoft Visual C++, Borland C++, Visual Basic, and Microfocus Cobol. Also, there are many new programming tools coming out on the Windows platform--just pick up a copy of any Windows programming magazine and flip through the ads to get a flavor of what is available.

Debugging Features

One useful development feature not available in OpenVMS, is the ability to get into the debugger on an unhandled or unexpected exception. For example, if you run an application that signals an exception and there is no condition handler that traps it, a dialog box comes up asking you whether you want to exit the image or enter the debugger. Note that this works even on images you run without the debugger. On OpenVMS of course you would get the exception reported but the image would immediately exit and you would be back at the DCL prompt, unable to get into the debugger.

If you don't want this dialog box to come up to your users, you can have a top level condition handler that could trap unhandled exceptions and display your own message box that might say "fatal internal software error, please call so-and-so phone number to

report the problem" and then exit.

User Interface Issues

There are basically three choices for building graphical applications for Windows NT:

1. Write them to the native Win32 graphical user interface
2. Build them on a third party X/Motif toolkit
3. Use a third party cross-platform GUI library.

Clearly, building on the Win32 API is the strategic interface for Windows NT and provides the best level of integration with other Windows applications. But some OpenVMS customers want to write single source code across both OpenVMS and Windows NT. Although there are many cross platform GUI toolkits, only three claim to support OpenVMS and Windows NT, and thus could be a choice for writing portable graphical programs across the two platforms:

1. Open Interface (by Neuron Data)
2. XVT (by XVT Software)
3. Galaxy (by Visix Software)

System Manager's View

Most of the OpenVMS system management utilities have direct parallels on Windows NT. What the OpenVMS system manager will probably find most different, is that the utilities are almost all graphical Windows applications, as opposed to the traditional character cell interfaces found on OpenVMS.

The key management utilities include:

- **User Manager** - user authorization and security policy management
- **Disk Administrator** - disk partition management, volume sets, stripe sets, mirror sets
- **Event Viewer** - examine system event and security audit logs
- **Performance Monitor** - look at hundreds of system counters (in real time, logged to a file, or define pop-up alerts based on counter values)
- **Backup** - comparable to OpenVMS backup and restore
- **Registry Editor**

However, a number of management functions are found in the **Control Panel** application as well.

For a mapping of the OpenVMS system management utilities to their equivalents on Windows NT , see **OpenVMS->Windows NT Management Utilities Mapping Table.**

Differences Worth Noting

Registry Editor

The Registry Editor allows you to examine and/or modify values in the Windows NT Registry database. There is no icon to run this utility by default because the goal is that you should not have to run this directly--instead, any information stored in the Registry should have a utility that provides a nice graphical user interface to both examine and change its contents. However, as could be expected with a first release, there are cases where you need to go into the Registry directly, so you may need to run this. Simply using it to browse through the information contained is useful in terms of getting familiar with the information that Windows NT stores there.

Disk Administrator/Manager

This is used to create and delete partitions, volume sets, and RAID0 stripe sets. If you have the Windows NT Advanced Server you get an extended version of this utility called Disk Manager that allows the creation of shadow sets (called Mirrors) and RAID5 stripe sets.

User Manager

This utility is used to add and delete usernames and groups and modify system security policies. It is the equivalent of the VMS AUTHORIZE, SET/SHOW ACCOUNTING, and SET/SHOW AUDIT commands, all in one.

One of the things that is nice about the User Manager is that you have the ability to delegate user administration. You can empower an individual to create and delete accounts within his or her group, but not to affect accounts in other groups, whereas on OpenVMS you require full privileges to get to the authorization file.

Event Viewer

This is used to look at the system event log, security audit log, and application event log. It is the equivalent of the VMS ANALYZE/ERROR and ANALYZE/AUDIT commands. Besides supporting a graphical display of event log records that you can filter based on time, event time, node name, etc., you can also export event logs to files suitable for external processing.

Backup

This is a graphical version of what is pretty much comparable to OpenVMS Backup and Restore. It supports incremental, full, and differential backup. It also supports multiple savesets per tape like OpenVMS. File selection is done by pointing and clicking on directory or individual file selections. Windows NT Backup is one of the few management utilities that does have a command line interface so that you can write backup command scripts. See the **ntbackup** command for more details.

Performance Monitor

The Performance Monitor application allows you to examine over 100 per-process and system-wide counters on your local system as well as remote systems. Many of the counters have names you will readily identify, like page faults, pagefile usage, disk I/O counters, etc.

There are three modes of operation:

1. Display counters graphically in real time.
2. Log counter values to a file for later processing.
3. Alert the system manager if certain counters go above or below a preset value.

Differences Worth Noting

No SET HOST: Since Windows NT does not support SET HOST into another Windows NT based system, OpenVMS system managers in a network might wonder how they would accomplish their tasks. The answer is that the majority of the management utilities allow you to connect to a remote Windows NT based system and operate on it remotely. For example, with the Windows NT Advanced Server, the User Manager for Domains allows you to connect to a remote Windows NT based system (with proper authorization of course) and add and delete usernames on that remote system. Another example is Print Manager, which also allows you to connect to a remote system and perform remote print queue administration. This is even true of the Pview utility and Performance Monitor applications, which means you can look at process information and monitor counters as well on remote systems in your network.

No SYSTARTUP.COM: There is no SYSTARTUP.COM file that is run upon system startup. Instead, the things that you would normally do in an OpenVMS startup file are defined in various Control Panel options. Examples of this include: services to start at boot time, devices to configure, etc.

System Disk Structure: Windows NT does not have the highly structured system disk layout as with OpenVMS ([SYSMGR], [SYSEXE], [SYSHLP], etc.). Most of the Windows NT system files are in one big subdirectory, \system32 (though there are a few subdirectories underneath that).

VMS identifiers = Windows NT groups: Groups on Windows NT are like identifiers on OpenVMS. Files and directories can reference group names in their access control list just like ACLs on OpenVMS files and directories might reference identifier names. Instead of granting identifiers to a username as you would on OpenVMS, you simply make a username a member of a group (usernames can be members of many groups just like a single identifier can be granted to many usernames on OpenVMS).

ACL Processing Differences: On Windows NT, Access Control Lists (ACLs) are read through until all desired accesses are granted (or an attempted access is denied). On OpenVMS an ACL is read until the first match on the username or identifier.

OpenVMS->Windows NT Management Utilities Mapping Table

SYSMAN	Not applicable since no support for clusters. Note that with the Windows NT Advanced Server you can perform centralized management of the entire network.
AUTHORIZE	User Manager or User Manager for Domains
SET/SHOW ACCOUNTING	User Manager - Policies->Audit menu
SET/SHOW AUDIT	User Manager - Policies->Audit menu
ACCOUNTING	Event Viewer (reading security audit log)
ANALYZE/AUDIT	Event Viewer (reading security audit log)
ANALYZE/ERROR	Event Viewer (reading system event log)
SYSGEN CREATE PAGEFILE	Control Panel->System applet
NCP	Control Panel->Networks, Services, Server applets
INITIALIZE/QUEUE	Print Manager
BACKUP	Backup Utility (also has a command line interface for writing command scripts. See NTBACKUP command)
INITIALIZE <disk volume>	FORMAT command
MOUNT	Disk Administrator
ANALYZE/DISK	CHKDSK command
INSTALL	There is no support for installing images with privileges. Note that shareable images on Windows NT are automatically shared, so there is no need for installing shareable images as with OpenVMS.
MONITOR	Performance Monitor
SYSGEN & AUTOGEN	None - Windows NT has virtually no changeable system parameters
LMF	No equivalent

About the Author

David Solomon is president of Solomon Software Technologies, a Windows NT, Win32, and C++ training firm. He created the popular "Windows NT Technical Description in OpenVMS Terms" seminar, now delivered to over 900 persons worldwide. Microsoft has recognized his work by awarding him the Microsoft Support Most Valuable Professional (MVP) award for 1993. Formerly a Consulting Software Engineer at Digital Equipment Corporation, David worked for over 9 years as a project leader and developer in the OpenVMS operating system development group.

In addition to his seminar work, David authors the monthly Windows NT Tactics column for *Digital News & Review* and has contributed Windows NT articles to a number of other publications. He speaks regularly at developer conferences such as WinDev, Software Development, and DECUS. David was the Program Chair for two recent national Windows NT developer conferences.

For more information on seminars and training, contact:

Solomon Software Technologies
20 Hunters Lane
Nashua, New Hampshire 03063-2245, USA
Tel: 603-595-9059
FAX: 603-595-9005
Email: 71561.3603@compuserve.com

The Windows Family of Operating Systems

The Microsoft® Windows™ family of operating systems is a unique suite of graphical platforms designed to increase productivity in diverse hardware environments. Whether you are using pen-based systems, intelligent fax machines, notebook PCs, or symmetric mulitprocessing servers, there is a version of Windows to optimize your system. Microsoft has designed the Windows family of operating systems to allow Windows-based applications to migrate easily between them. Windows Open Services Architecure (WOSA), enables every family member to provide back-end services such as messaging, network services and database access.

Microsoft At Work
Microsoft Windows 3.1
Microsoft Windows for Workgroups 3.11
Chicago
Microsoft Windows NT 3.1
Microsoft Windows NT Advanced Server
Cairo

Microsoft At Work

Microsoft At Work is a set of software building blocks that reside in both office machines and PC products, making it easier for them to work together.

The first Microsoft At Work devices will be available in 1994, developer kits are already available.

Microsoft At Work-based products include:

- desktop and network connected printers
- digital copiers (both monochrome and color)
- telephones and voice messaging systems
- fax machines and PC fax products
- handheld systems
- hybrid combinations of the above (Multifunction Devices)

Adding Microsoft At Work software to your office systems will:

- make them easier to use, either as standalone or together, and provide simpler access to more powerful features
- allow seamless integration of office machines so they can "talk to one another"
- dramatically improve ability to navigate and modify digital information in various forms

Microsoft Windows 3.1

The Windows 3.1 operating system enhances MS-DOS to make your PCs easier to use, while enabling you to maximize the use of your existing MS-DOS-based applications.

Windows 3.1 is designed for standalone desktop PCs, including laptops and pen-based PCs. It will run on a 286 system, and is optimized for today's mainstream 386sx machine with 4 MB of RAM. Thousands of applications have been created for the Windows environment, and Windows 3.1 automatically sets up most of these applications for MS-DOS. It runs MS-DOS applications as fast as MS-DOS, and has close integration with MS-DOS 6 and PIF files.

Microsoft Windows 3.1 is easy to install, learn, and use. It includes an Express Install feature that will automatically load and determine the correct Windows settings on your PC in minutes. You can access on-line help from anywhere in Windows, and can learn basic Windows concepts from a comprehensive, built-in, computer-based Tutorial.

Windows 3.1 is also a powerful, dependable, operating system. It is an efficient memory manager, leaving more memory available for greater application performance. Windows 3.1 has improved printing speed, faster scrolling of MS-DOS and Windows applications, and an Application Reboot capability which lets you stop one application while keeping Windows and other applications running.

Microsoft Windows for Workgroups 3.11

If you use Windows and your PC is networked. You Need Windows for Workgroups. Windows for Workgroups 3.11 adds integrated networking functions to the familiar Windows operating system, simplifying the process of connecting individual personal computers, servers, and printers.

Windows for Workgroups 3.11 features all of the benefits of Windows: the graphical interface, the memory management and multitasking, and the WYSIWYG output, as well as all of the software you need to start a cost-effective network.

Windows for Workgroups 3.11 provides networking that is easy to set up, use, and maintain. It includes built-in file- and print-sharing capabilities to make it easier for groups of people to share information and resources. It includes electronic mail so users can immediately begin exchanging messages, and organizations can develop messaging-enabled workgroup applications. Windows for Workgroups 3.11 also comes with group scheduling.

If you require remote access to your network server or you want to access your personal machine from home, Windows for Workgroups 3.11 provides everything you need(except the modem)to connect to Windows NT servers or Windows for Workgroups 3.11 servers. Users access all services remotely as they do from their desk. Setup and logon are so easy even the most novice user can reap the benefits of remote access service.

Whether you have an existing network or need room to grow, Windows for Workgroups 3.11 integrates with server-based systems, such as Windows NT Advanced Server and Novell® NetWare™, making it a sound addition to your operating environment.

Chicago

Slated for release in the second half of 1994, Chicago will combine the basic functions found in MS-DOS 6, Windows 3.1, Windows for Workgroups 3.11, and Win32, into one well-integrated, complete operating system.

To provide a standard way of organizing information, the Chicago shell will have an enhanced and easy-to-use interface, including consolidated program and file managers with a refined printer interface. Chicago will deliver a more robust and powerful 32-bit platform for Windows-based applications, and smooth, preemptive multitasking will be inherent in the system. In addition, Chicago will be a great network client for both Windows NT and Novell networks, and an excellent peer server.

A Remote Network Access product is being designed to make it easier to access Chicago, Windows NT, and Novell LANs and desktop PCs. File Synchronization will be a key part of this product, to enable users to keep their data in sync across multiple PCs.

Chicago will provide full compatibility for MS-DOS-based applications and device drivers, as well as 16-bit Windows-based applications and device drivers. Chicago is targeted to run well on machines with an Intel 386sx processor or better, and 4MB or more of RAM.

Microsoft Windows NT 3.1

Windows NT is the high-end member of the Windows family of operatings systems. It facilitates high-end business solutions while maintaining compatibility with personal productivity applications on the same desktop.

Windows NT is a superset of Windows 3.1 and Windows for Workgroups. It has the familiar Windows user interface, integrated networking, and workgroup productivity tools. Windows NT provides:

- **Compatibility** with applications for Windows, MS-DOS, OS/2 1.x, and POSIX
- **Support** for new 32-bit applications (via the Win32 and Win32s APIs)
- Unlimited **integrated networking** including TCP/IP and DCE RPC
- Built-in **workgroup mail and scheduling** applications
- Integrated **security** designed to meet U.S Government C2 requirements
- **Support for Intel (x86) and RISC** (MIPS, Alpha and Clipper) processors
- **Support for symmetric multiple processors**
- Single-user version of **Remote Access Service** for remote support
- **Easy installation**, with automatic migration of existing Windows 3.1 information

Microsoft Windows NT Advanced Server

Windows NT Advanced Server is the most powerful server operating system for client-server computing. It is an effective platform for client-server applications, database servers, communication servers, and file and print servers.

The open network design of Windows NT Advanced Server makes it easy to integrate into existing networks based on LAN Manager, Novell NetWare, Banyan® Vines™, and UNIX®, without disturbing existing operations.

Windows NT Advanced Server is the business-critical server of the Windows family of operating systems. Based on the Windows NT operating system, Windows NT Advanced Server provides a single network logon, centralized management, and advanced fault-tolerance. It includes multi-user remote access service (RAS) and Macintosh® connectivity.

As the top member of the Windows family, Windows NT Advanced Server offers the benefits of the common Windows user interface, applications for Windows, and the Windows programmatic interface, on one powerful, reliable, and open operating system.

Cairo

Cairo is the next major release of Windows NT. It combines an OLE 2.0-based, object-oriented infrastructure with a distributed file system to provide users with seamless and easy access to dispersed resources.

To help users access information easily, Cairo features an improved Windows user interface that encourages direct manipulation of documents, folders, and network resources without the impediment of special-purpose managers like Program Manager or File Manager. From the desktop, users can search for and access the information they need regardless of its location. Documents can be opened and viewed, regardless of application or information source.

Building on the powerful foundation of Windows NT, Cairo provides an even more powerful infrastructure to solve many of today's distributed operating system problems. Cairo's interface is dynamically extensibile, because its object-oriented infrastructure allows new objects to provide their own browsing, searching, and displaying interfaces. Cairo integrates information-management components so administrators can centrally organize, manage, and maintain network information. Cairo will dramatically increase the efficiency with which users consume, process, and manipulate information.

list by product >>

Close Popup

32 Bit Applications for Windows NT

A

Abraxas Software, Inc. CodeCheck for Windows NT
Abraxas Software, Inc. PCYACC for Windows NT
Absoft Corp. Absoft FORTRAN 77 for Windows NT
AccessWare InfoPath
AccessWare PeerPath, ShadowPath, ViewOperator
AccessWare ViewMaster
Adra Systems, Inc. CADRA-III
Advanced Systems Concepts, Inc. CaMERA
AGE Logic, Inc. XoftWare(TM)/32 for Windows NT
Altair Computing, Inc. SuspensionGen
Altamira Software Corp. Composer
AMT Corporation DEMOquick
Ansoft Corporation Maxwell Field Simulators
Arbor Software Essbase
Arity Corporation Arity/Prolog32
Autodesk AutoCAD Strategic Developer Release (SDR) for Windows NTAutoCAD Strategic Developer Release (SDR) for Windows NT
Autologic, Inc. APS-FAX
Autologic, Inc. APS-SoftPIP for Windows NT

B

Base Technology Liana Professional Developer
BGW Computers UUtil
Black Forest Software SimPlexus
Blackwell Software Idealist for Windows NT
Blossom Software Corporation Ibrow
Blue Sky Software Magic Fields for Windows NT
Blue Sky Software RoboHELP 2.0
Blue Sky Software WindowsMAKER Professional 5.0 for Windows NT

C

clySmic Software Drag 'n' Drop Utilities
CMA, Inc. Claim Analyzer I
Combs International, Inc. Wfrm
Compass Point Software application::ctor

Congruent Corporation NtNiX
Congruent Corporation Tool Buster (GNU Tools for Windows NT)
Conner Software Backup Exec for Windows NT
Control Data Systems, Inc. ARIA*BackupPlus
Control Data Systems, Inc. VistaCOM for Windows
Control Data Systems, Inc. VistaKIT Client/Server Toolkit
Coromandel Industries, Inc. ObjecTrieve for Windows NT

D

DeScribe, Inc. DeScribe Word Processor for Windows NT
Digital Equipment Corporation DEC C++ for Windows NT
Digital Equipment Corporation eXcursion for Windows NT
Digital Equipment Corporation PATHWORKS for Windows NT
Digital Equipment Corporation PATHWORKS for Windows NT Programmer's Kit
Digital Equipment Corporation PrintServer Software for Windows NT (tm) Systems, Version 4.2
DIGITALK, Inc. PARTS Workbench for Windows NT
DIGITALK, Inc. Smalltalk/V for Windows NT
Dyad Software M++
Dyad Software M++ FEM
Dyad Software M++ LSM
Dyad Software M++ ODE
Dyad Software M++ OPTIM
Dyad Software M++ QUAD
Dyad Software M++ SUM
Dyad Software M++ TEST
Dyad Software M++ VIS

E

Eaglesoft Corporation EagleEye
Eaglesoft Corporation QR/Control
Edinburgh Petroleum Services Ltd FloSystem
Edinburgh Petroleum Services Ltd PanSystem
EditPro Corporation EditPro for Windows NT
Eicon Technology Corporation WAN Services for Windows NT
Eicon Technology Corporation X.25 Network-Level Developer's Toolkit for Windows NT
Elan Computer Group, Inc. Elan License Manager
Elite Technology Jupiter
Ex Machina, Inc Notify! Network
Ex Machina, Inc Notify! Personal
Executive Software, Inc. FILE ALERT Disk File Corruption Detector

F

Felsina Software A-Talk(R) for Windows NT
Fourth Wave Technologies, Inc. WinBEEP
Fourth Wave Technologies, Inc. WinBEEP SDK
Frontier Technologies Corporation Super-TCP for Windows NT 3.0

FutureSoft Engineering, Inc. DynaComm/Elite For Windows NT

G

GrayTech Software, Inc. CAD X11
GrayTech Software, Inc. CAD X11/Lite
GUILD Products, Inc. GUILD Development System for Windows NT
GUILD Products, Inc. GUILD Prototyper for Windows NT

H

Hamilton Laboratories Hamilton C shell
Hippo Software Inc. HIPPIX
Hummingbird Communications, Ltd. eXceed for Windows NT
Hummingbird Communications, Ltd. eXceed X Development Kit for Windows NT
Hyperception, Inc. Hypersignal RT3 for Windows NT

I

I/O Software, Inc. PharmStar
I/O Software, Inc. Stereolusion
I/O Software, Inc. VitaD
Image-In, Inc. IMAGE-IN Power Pack
Impact Software Almanac for Windows NT
Impact Software Icon Manager
Inclination Software, Inc. SpeedEdit for Windows NT
Industrial Systems, Inc. CIM/21
Inference Corporation ART*Enterprise for Windows NT
Inference Corporation CBR Express for Windows NT
Informix INFORMIX-SE
Inmark Development Corp. zApp for Windows NT
Intergraph ACEPlus Designer
Intergraph CogoWorks
Intergraph MicroStation
Intergraph Modular GIS Environment (MGE)
Intersolv, Inc. PVCS Configuration Builder
Intersolv, Inc. PVCS Developers Toolkit
Intersolv, Inc. PVCS Version Manager
Ithaca Software HOOPS A.I.R.
Ithaca Software HOOPS Graphics Development System
Ithaca Software HOOPS I.M.

J

J.A. Woollam Co. WVASE
JetForm Corporation JetForm Server for Windows NT
Johnson Properties JPSMath
JP Software, Inc. 4DOS for Windows NT
JPN Associates EIFFELCASE for Windows NT
JPN Associates ISE EIFFEL 3 for Windows NT

K

KEA Systems Ltd. KEAterm 340 for Windows NT

KEA Systems Ltd. KEAterm 420 for Windows NT
Kenan Technologies Acumate ES
Knowledge Garden Inc. KnowledgePro for Windows NT
KnowledgeWare, Inc. AccessWare
Kofax Image Products, Inc. Kofax Image Processing Platform (KIPP) for Windows NT

L

LBMS, Inc. Process Engineer
LBMS, Inc. Systems Engineer

M

Mach 2 Systems, Inc. Error and Message Logging Facility
Mark V Systems, Ltd. MethodMaker
Mark V Systems, Ltd. ObjectMaker
Mark V Systems, Ltd. ProcessMaker
MathSoft, Inc. Mathcad for Windows
mbp Software and Systems Technology, Inc. Visual COBOL for Windows NT
McGill University TCP 3270 for Windows NT
Media Vision Pellucid OpenGL SDK for Windows NT
Mercury Interactive TestRunner for Windows NT
Mercury Interactive WinRunner for Windows NT
Metro Link, Inc. Metro-X/NT Development
Microcom, Inc. LANlord for Windows NT
MicroEdge Inc. SlickEdit
MicroProcessor Engineering Ltd PowerForth/386 for Windows NT
MicroQuill Software Performance Tracer
MicroQuill Software SegMentor
MicroQuill Software SmartHeap
Microsoft Corporation Microsoft FORTRAN Powerstation for Windows NT
Microsoft Corporation Microsoft Macro Assembler Professional Development System (MASM) version 6.11
Microsoft Corporation Microsoft SNA Server for Windows NT
Microsoft Corporation Microsoft SQL Server for Windows NT
Microsoft Corporation Microsoft Visual C++ for Windows and Windows NT
Microsoft Corporation Microsoft Win32 Software Development Kit (SDK)
Microsoft Corporation Microsoft Windows NT Advanced Server upgrade for LAN Manager
MKS Inc. MKS Toolkit
Mozart Systems Corporation MOZART

N

National Instruments LabVIEW for Windows NT
National Instruments NI-488.2M for Windows NT
National Instruments NI-DAQ
National Instruments NI-VXI
NetManage Chameleon32 Version 3.11
Neuron Data C/S Elements

Neuron Data Neuron Data Open Interface
Neuron Data NEXPERT OBJECT
Neuron Data OPEN INTERFACE ELEMENTS
Neuron Data SMART ELEMENTS
NUKO Information Systems Message Port/NT 1.0
NUS (a Halliburton Co.) PRONET for Windows NT

O

Objectivity, Inc. Objectivity/DB
OHB Software Inc. BarMaster Retailer
OHB Software Inc. BarMaster Windows
OHB Software Inc. GraphixMaster
One Tree Software SourceSafe
Oracle Corp. ORACLE 7 Server for Windows NT

P

P & J's Software Background Noise
Pacific CommWare TurboCom for Windows NT
Parametric Technologies Corporation Pro/ENGINEER
Passport Communications RJE for Windows NT(TM)
Passport Communications SYSOUT Express(TM)
PDS Engineering WinSCSI-NT
PEACOCK SYSTEMS, INC. CBTREE for Windows NT
Persistent Data Systems IDB Introductory Package
Persistent Data Systems IDB Object Database
Personal MicroCosms Astronomy Lab for Windows NT
Phar Lap Software QuickStart for Windows NT
Premia Corporation Codewright for Windows NT
ProtoView Development Corp. DataTable Spreadsheet Control
ProtoView Development Corp. ProtoGen+
ProtoView Development Corp. SQLView

Q

Q.E.D. Software, Inc Eagle Integrated Development Environment

R

Raindrop Software Corporation Software Engineer
Realtime Performance, Inc. RPCluster for Windows NT
Realtime Performance, Inc. RPCore for Windows NT
Rhode Island Soft Systems, Inc. WinPak Screen Saver Collections
RIX Softworks, Inc WinRIX
Ross Systems, Inc. Renaissance CS Financial Series

S

SAS Institute The SAS System under Windows NT, Release 6.09
Scientific Endeavors Corp. GraphiC for Windows NT
Scopus Technology, Inc. ProTEAM for Windows NT
Silicon Valley Software SVS x86/FORTRAN-77 for Windows NT
Silicon Valley Software SVS x86/Pascal for Windows NT

SL Corporation SL-GMS
Softool Corporation CCC/Manager
Software Excellence By Design Inc. Zip Manager for Windows NT
SQL Business Systems Inc. SQLStor
Square D Company System Manager and EXPlorer Software
Stirling Technologies, Inc. InstallSHIELD

T

The ASK Group, Inc. ASK Embedded SQL for C for Microsoft Windows NT
The ASK Group, Inc. ASK INGRES Networking for Microsoft Windows NT
The MathWizards MathViews
Tower Technology Corporation TowerEiffel for Windows NT
Trillennium Corporation XPLib v2.0
Trimco WIN-Track Imaging System
Trinzic AionDS

V

Visix Software, Inc Galaxy Application Environment
Visual Numerics, Inc. PV-WAVE Advantage
Visual Solutions VisSim
VITAL CRISP
Vox-L Inc. A Lateiner Dataspace Company Vox-L Workstation

W

WATCOM International Corp. WATCOM C/C++32
WATCOM International Corp. WATCOM FORTRAN 77 32
Welcom Software Technology Texim Project
Wilson WindowWare Inc. File Commander
Wilson WindowWare Inc. WinEdit
WinSoft Instant Prototyper
WinSoft Instant Windows
Wolfram Research, Inc. Mathematica for Windows NT
Wonderware Software Development Corp. DDE Servers
Wonderware Software Development Corp. NetDDE
Wyvern Technologies Camelot

X

XVT Software, Inc. XVT Portability Toolkit
XVT Software, Inc. XVT-Design 2.0

list by company >>

Close Popup

32 Bit Applications for Windows NT

A

A-Talk(R) for Windows NT
Absoft FORTRAN 77 for Windows NT
AccessWare
ACEPlus Designer
Acumate ES
AionDS
Almanac for Windows NT
application::ctor
APS-FAX
APS-SoftPIP for Windows NT
ARIA*BackupPlus
Arity/Prolog32
ART*Enterprise for Windows NT
ASK Embedded SQL for C for Microsoft Windows NT
ASK INGRES Networking for Microsoft Windows NT
Astronomy Lab for Windows NT
AutoCAD Strategic Developer Release (SDR) for Windows NTAutoCAD Strategic Developer Release (SDR) for Windows NT

B

Background Noise
Backup Exec for Windows NT
BarMaster Retailer
BarMaster Windows

C

C/S Elements
CAD X11/Lite
CAD X11
CADRA-III
Camelot
CaMERA
CBR Express for Windows NT
CBTREE for Windows NT
CCC/Manager

Chameleon32 Version 3.11
CIM/21
Claim Analyzer I
CodeCheck for Windows NT
Codewright for Windows NT
CogoWorks
Composer
CRISP

D

DataTable Spreadsheet Control
DDE Servers
DEC C++ for Windows NT
DEMOquick
DeScribe Word Processor for Windows NT
4DOS for Windows NT
Drag 'n' Drop Utilities
DynaComm/Elite For Windows NT

E

Eagle Integrated Development Environment
EagleEye
EditPro for Windows NT
EIFFELCASE for Windows NT
Elan License Manager
Error and Message Logging Facility
Essbase
eXceed for Windows NT
eXceed X Development Kit for Windows NT
eXcursion for Windows NT

F

FILE ALERT Disk File Corruption Detector
File Commander
FloSystem

G

Galaxy Application Environment
GraphiC for Windows NT
GraphixMaster
GUILD Development System for Windows NT
GUILD Prototyper for Windows NT

H

Hamilton C shell
HIPPIX
HOOPS A.I.R.
HOOPS Graphics Development System
HOOPS I.M.

Hypersignal RT3 for Windows NT

I

Ibrow
Icon Manager
IDB Introductory Package
IDB Object Database
Idealist for Windows NT
IMAGE-IN Power Pack
InfoPath
INFORMIX-SE
InstallSHIELD
Instant Prototyper
Instant Windows
ISE EIFFEL 3 for Windows NT

J

JetForm Server for Windows NT
JPSMath
Jupiter

K

KEAterm 340 for Windows NT
KEAterm 420 for Windows NT
KnowledgePro for Windows NT
Kofax Image Processing Platform (KIPP) for Windows NT

L

LabVIEW for Windows NT
LANlord for Windows NT
Liana Professional Developer

M

M++ FEM
M++ LSM
M++ ODE
M++ OPTIM
M++ QUAD
M++ SUM
M++ TEST
M++ VIS
M++
Magic Fields for Windows NT
Mathcad for Windows
Mathematica for Windows NT
MathViews
Maxwell Field Simulators
Message Port/NT 1.0
MethodMaker

Metro-X/NT Development
Microsoft FORTRAN Powerstation for Windows NT
Microsoft Macro Assembler Professional Development System (MASM) version 6.11
Microsoft SNA Server for Windows NT
Microsoft SQL Server for Windows NT
Microsoft Visual C++ for Windows and Windows NT
Microsoft Win32 Software Development Kit (SDK)
Microsoft Windows NT Advanced Server upgrade for LAN Manager
MicroStation
MKS Toolkit
Modular GIS Environment (MGE)
MOZART

N

NetDDE
Neuron Data Open Interface
NEXPERT OBJECT
NI-488.2M for Windows NT
NI-DAQ
NI-VXI
Notify! Network
Notify! Personal
NtNiX

O

Objectivity/DB
ObjectMaker
ObjecTrieve for Windows NT
OPEN INTERFACE ELEMENTS
ORACLE 7 Server for Windows NT

P

PanSystem
PARTS Workbench for Windows NT
PATHWORKS for Windows NT Programmer's Kit
PATHWORKS for Windows NT
PCYACC for Windows NT
PeerPath, ShadowPath, ViewOperator
Pellucid OpenGL SDK for Windows NT
Performance Tracer
PharmStar
PowerForth/386 for Windows NT
PrintServer Software for Windows NT (tm) Systems, Version 4.2
Pro/ENGINEER
Process Engineer
ProcessMaker
PRONET for Windows NT
ProTEAM for Windows NT

ProtoGen+
PV-WAVE Advantage
PVCS Configuration Builder
PVCS Developers Toolkit
PVCS Version Manager

Q

QR/Control
QuickStart for Windows NT

R

Renaissance CS Financial Series
RJE for Windows NT(TM)
RoboHELP 2.0
RPCluster for Windows NT
RPCore for Windows NT

S

SegMentor
SimPlexus
SL-GMS
SlickEdit
Smalltalk/V for Windows NT
SMART ELEMENTS
SmartHeap
Software Engineer
SourceSafe
SpeedEdit for Windows NT
SQLStor
SQLView
Stereolusion
Super-TCP for Windows NT 3.0
SuspensionGen
SVS x86/FORTRAN-77 for Windows NT
SVS x86/Pascal for Windows NT
SYSOUT Express(TM)
System Manager and EXPlorer Software
Systems Engineer

T

TCP 3270 for Windows NT
TestRunner for Windows NT
Texim Project
The SAS System under Windows NT, Release 6.09
Tool Buster (GNU Tools for Windows NT)
TowerEiffel for Windows NT
TurboCom for Windows NT

U

UUtil

V

ViewMaster
VisSim
VistaCOM for Windows
VistaKIT Client/Server Toolkit
Visual COBOL for Windows NT
VitaD
Vox-L Workstation

W

WAN Services for Windows NT
WATCOM C/C++32
WATCOM FORTRAN 77 32
Wfrm
WIN-Track Imaging System
WinBEEP SDK
WinBEEP
WindowsMAKER Professional 5.0 for Windows NT
WinEdit
WinPak Screen Saver Collections
WinRIX
WinRunner for Windows NT
WinSCSI-NT
WVASE

X

X.25 Network-Level Developer's Toolkit for Windows NT
XoftWare(TM)/32 for Windows NT
XPLib v2.0
XVT Portability Toolkit
XVT-Design 2.0

Abraxas Software, Inc.

zApp for Windows NT
Zip Manager for Windows NT

5530 SW Kelly Avenue
Portland, OR 97201
USA

CodeCheck for Windows NT

Contact: Patrick Conley
Phone: (503) 244-5253
FAX: (503) 244-8375

Retail Price: $995.00
RISC Version Available: Yes.

Source Code Manager.

CodeCheck Version 4.0 is a programmable tool for managing all C and C++ source code on a file or project basis. CodeCheck is input compatible with all variants of K&R, ANSI C and C++. CodeCheck is designed to solve all of your Portability, Maintainability, Complexity, Reusability, Quality Assurance, Style Analysis, Library/Class Management, Code Review, Software Metric, Standards Adherance, and Corporate Compliance Problems.

Abraxas Software, Inc.

5530 SW Kelly Avenue
Portland, OR 97201
USA

PCYACC for Windows NT

Contact: Patrick Conley
Phone: (503) 244-5253
FAX: (503) 244-8375

Retail Price: $995.00
RISC Version Available: Yes.

Language Development Toolkit.

PCYACC Version 4.0 is a complete language development environment that generates ANSI C source code from input Language Description Grammars for building Assemblers, Compilers, Interpreters, Browsers, Page Description Languages, Language Translators, Syntax Directed Editors, Language Validators, Natural Language Processors, Expert System Shells, and Query Languages.

Absoft Corp.

2781 Bond Street
Rochester Hills, MI 48309
USA

Absoft FORTRAN 77 for Windows NT

Contact: Wood Lotz
Phone: (313) 853-0050
FAX: (313) 853-0108

Retail Price: $695.00
RISC Version Available: Yes.

32-bit globally optimizing VAX/VMS compatible FORTRAN 77 compiler for Windows NT development.

Absoft FORTRAN 77 for Windows NT is a full 32 bit ANSI X3.9-1978, MIL-STD 1753, SAA CPI FORTRAN compliant compiler. Compatibility options facilitate porting to Windows NT from mainframes, RISC workstations, and Microsoft FORTRAN or developing native Windows NT applications. Most VAX/VMS extensions are supported including STRUCTURE and RECORD, all VAX intrinsic functions, plus Cray/Sun-style POINTER. Either Intel or Weitek FPU hardware is required. The compiler is compatible with the Microsoft Windows NT SDK tools, link compatible with Microsoft C/C++ for Windows NT, and includes a Windows interface. Source compatible with other Absoft FORTRAN 77 PC and workstation compilers.

AccessWare

2190 North Loop WestSuite 301
Houston, TX 77018
USA

InfoPath

Contact: Ralph White
Phone: (713) 682-8649
FAX: (713) 682-8066

Retail Price: $3,445.00 - $7,400.00
RISC Version Available: Call.

InfoPath automatically exports relational database records from AccessPoint.

InfoPath builds an interface between Informix or other popular relational database applications and AccessPoint runtime databases, from programmable logic controllers PLC or I/O devices.

AccessWare

2190 North Loop WestSuite 301
Houston, TX 77018
USA

PeerPath, ShadowPath, ViewOperator

Contact: Ralph White
Phone: (713) 682-8649
FAX: (713) 682-8066

Retail Price: P: $995.00, S: $2,995.00, V: $595.00

RISC Version Available: Call.

PeerPath provides a client server for master, sub-master or peer AccessPoint.

PeerPath and ShadowPath enable multiple AccessPoint database installations to run as client servers. The applications can be a master, slave, or peer configuration. The client server ViewOperator also allows remote console operation with messaging on change.

AccessWare

2190 North Loop WestSuite 301
Houston, TX 77018
USA

ViewMaster

Contact: Ralph White
Phone: (713) 682-8649
FAX: (713) 682-8066

Retail Price: $1,895.00 - $5,400.00
RISC Version Available: Call.

ViewMaster allows system integrators to develop advanced AccessPoint controls.

ViewMaster advanced developers toolkits allow standalone application configuration, development and testing . Advanced toolkits for programming interfaces are easily developed to AccessPoint. ViewMaster configured AccessPoint runtime with programmable logic controllers PLC or I/O devices allows automatic control.

Adra Systems, Inc.

59 Technology Drive
Lowell, MA 01851
USA

CADRA-III

Contact: Mike Robinson
Phone: (508) 937-3700
FAX: (508) 453-2462

Retail Price: $3,995.00 - $5,995.00
RISC Version Available: Yes.

CADRA-III is a design drafting system optimized for the production of complex, multi-view drawings.

CADRA-III is a 2-1/2D - 3D design drafting system optimized for the production of complex, multi-view drawings. Up to 64 independently scalable views per drawing may be created, each with a local origin. View geometry may be scaled independently of text and dimensions to preserve clarity. CADRA-III features a highly intuitive on-screen user interface, one that is learned quickly enabling users to be far more productive than with other CAD systems. FlexDesign(TM), CADRA-III's parametric component, enables users to apply dimension-driven and variational constraint techniques to CADRA geometry, or geometry imported from other CAD systems. Geometric constraints (such as tangencies), dimensional constraints, and equations may be defined and used in the creation of families of parts, or in the testing of new design ideas. Translators, both direct and indirect, are fully supported by CADRA-III. ADT, our bi-directional translator for CADAM (TM) databases is widely recognized as the most complete and accurate, allowing users to migrate successfully from resource-hungry mainframe environments. On personal computers, ADT runs seamlessly - fully within CADRA and without requiring terminal-mode operations. Adra also offers CDT, a bi- directional translator for Computervision CADDS databases; a direct CATIA (TM) translator for those mainframe and workstation databases, and DXF and IGES translators.

Advanced Systems Concepts, Inc.

2200 Defense HighwaySuite 203
Crofton, MD 21114
USA

CaMERA

Contact: Dr. H. H. Sayani
Phone: (410) 721-4433
FAX: (410) 721-1167

Retail Price: $6,000.00
RISC Version Available: Yes.

CASE Repository, Semantic dbms and Modeling Tool.

CaMERA is a semantic database tool that can serve as a repository and an integrating CASE tool. It enables you to gather information about your system in terms that you choose. CaMERA can be used across the development life cycle; as your view of the system changes in subsequent phases, your terms can be extended. CaMERA permits expression of your problem and provides a means to reflect your information for examination, and to analyze your information against selected criteria. CaMERA can also help incorporate information from its database into documentation that conforms to a variety of standards. It has been used as a repository in CASE tools, a translator between various tools to integrate diverse systems, as a modeling tool for schema harmonization and a rapid prototyper.

AGE Logic, Inc.

9985 Pacific Heights Blvd.
San Diego, CA 92121
USA

XoftWare(TM)/32 for Windows NT

Contact: Inside Sales
Phone: (619) 455-8600
FAX: (619) 597-6030

Retail Price: $495.00
RISC Version Available: Yes.

PC X Server Software for Microsoft Windows NT.

XoftWare/32 for Windows NT is AGE's full 32-bit PC X server solution for the Microsoft Windows NT operating system. Available for both Intel and MIPS platforms, XoftWare/32 for Windows NT enables Windows NT users to concurrently access and display Microsoft Windows, Windows NT and network-based UNIX applications on the same PC. In addition to providing 32-bit performance, XoftWare/32 for Windows NT is fully X11R5 compliant and includes many features that make X easier to use. A sophisticated network file manager utility provides a convenient Windows-based method of copying, deleting and printing both local and UNIX window managers, automatic host login, concurrent application start-up, support for true color and a UNIX Print Re-route Utility. Trace, AGE's new X protocol monitoring system, is also included as well as support for Windows NT's native TCP/IP networking service.

Altair Computing, Inc.

3150 Livernois AveSuite 270
Troy, MI 48083
USA

SuspensionGen

Contact: Customer Service
Phone: (313) 680-1670
FAX: (313) 680-8815

Retail Price: Call
RISC Version Available: Call.

Suspension kinematics analysis tool.

SuspensionGen is a parametric suspension kinematics analysis tool with a built in solver. It is designed for fast, effective suspension analysis.Suspensions include:*MacPherson - front and rear *Short Long Arm - front and rear *Five Link - front and rear *Twin I-beam - front *Quadra Link - rear *Hotchkiss - rear *Solid axle with four links - rear Steering linkages: rack and pinion, parallelogram, Haltenberger. Features: Instant calculation of static design parameters; Interactive 3D graphics for viewing and animating the model; Interactive plotting of analysis results; Automatic calculation of over 30 kinematic design parameters; Toe alignment utility; Metric to English conversion; and writes IGES format files. Also available on UNIX workstations with X. Free evaluation period.

Altamira Software Corp.

150 Shoreline HighwaySuite B27
Mill Valley, CA 94941
USA

Composer

Contact: Customer Service
Phone: (415) 332-5801
FAX: (415) 332-5804

Retail Price: $795.00
RISC Version Available: Yes.

Object oriented image composition & manipulation.

Altamira Composer is the revolutionary new image composition and manipulation application that brings the flexibility of object-based drawing to image editing. Unlike other imaging applications, with Altamira Composer, images are never "pasted down." You have total freedom to change, move, or edit the images in your composition at any time. Altamira Composer turns an image into an image object. Instead of time-consuming selecting and masking, image objects are automatically created when you bring elements into your composition. These objects "float" transparently in a dynamic alpha stack. They can be painted, trimmed, scaled, rotated, given transparency, moved up or down in the stack or otherwise manipulated without any image degradation. Altamira Composer also includes hundreds of innovative new anti-aliased tools and effects.

AMT Corporation

183 Guggins Street
Boxboro, MA 01719
USA

DEMOquick

Contact: Richard McMahon
Phone: (508) 263-3030
FAX: (508) 263-2265

Retail Price: $495.00
RISC Version Available: Call.

Create realistic demos of Windows applications...FAST !

DEMOquick is a powerful Authoring System which creates an exact stand-alone simulation of a Windows application. The developer then adds pop-up information windows, custom graphics, and interaction along with optional voice segments. Demos prepared with DEMOquick guide the user step-by-step through a realistic simulation of the application with messages and voice to describe each operation. At any point, the user may select from a list of topics and go directly to the demonstration of the chosen feature. Demo development is as simple as running the real application once. DEMOquick captures each keyboard and mouse interaction, along with all screen activity. The developer then plays the demo simulation back, adding pop-up information windows, graphics, and interaction at appropriate points. The finished demos are easily distributed on floppy disk and do not require the real application. There are no run-time fees for distribution of the finished demos. The completed demos may also be converted to full interactive training tutorials using the CBIquick system, also available from AMT.

Ansoft Corporation

4 Station SquareSuite 660
Pittsburgh, PA 15219
USA

Maxwell Field Simulators

Contact: Mark Ravenstahl
Phone: (412) 261-3200
FAX: (412) 471-9427

Retail Price: $3,400.00 - $9,000.00
RISC Version Available: Call.

Maxwell Field Simulators.

Maxwell Field Simulators let design engineers building motors, transformers, relays and other electrical equipment simulate product performance quickly and accurately - saving time, money and market share. Maxwell 2D Field Simulator is a dedicated simulator.

Arbor Software

3211 Scott Blvd.
Santa Clara, CA 95054
USA

Essbase

Contact: Kirk Cruikshank
Phone: (408) 727-5800
FAX: (408) 727-7140

Retail Price: Call.
RISC Version Available: Call.

Multidimensional Analysis System.

Essbase provides workgroup access to consolidated, corporate data from your spreadsheet for dynamic multidimensional analysis and reporting.Essbase provides: - Workgroup access to shared data.- Consolidation of large-scale corporate data.- Seamless access, requiring no query language directly from your spreadsheet.- Multidimensional analysis and reporting.- An API for development of applications in Visual Basic or C. Financial, Marketing, and Sales professionals use Essbase to analyze and consolidate large-scale multidimensional data. The spreadsheet interface (Excel, 1-2-3) means there is no new interface or query language to learn. Data can be viewed at any level of detail from any perspective with a simple click of the mouse. Since data is retrieved directly into the spreadsheet, the user is able to perform reporting and analysis without re-keying data. Shared data access from the Windows NT server ensures that workgroup productivity and data integrity are maximized.

Arity Corporation

30 Domino Drive
Concord, MA 01742
USA

Arity/Prolog32

Contact: Meredith Bartlett
Phone: (508) 371-1243
FAX: (508) 371-1487

Retail Price: $2,450.00
RISC Version Available: Call.

Sophisticated 32-bit Prolog development system for Windows NT.

Arity/Prolog32 is a complete, powerful, and flexible development system for building sophisticated applications running under Windows NT. This Prolog has been highly extended including a 4Gb virtual database with sequential, hashed, and B-tree indexing. An embedded 'C' compiler is provided, enabling direct interface between Prolog and C or C++. Arity/Prolog32 code can be interpreted, or compiled into an object form to be linked into an EXE or DLL. Applications built using Arity/Prolog32 can be deployed without an additional runtime charge.

Autodesk

2320 Marinship Way
Sausalito, CA 94965
USA

AutoCAD Strategic Developer Release (SDR) for Windows NTAutoCAD Strategic Developer Release (SDR) for Windows NT

Contact: Inside Sales
Phone: (800) 964-6432
FAX: (415) 331-8093

Retail Price: Call
RISC Version Available: Call.

AutoCAD is a general purpose design, drafting, and modeling software program that runs on a wide selection of desktop computers and workstations.

AutoCAD's open architecture, embedded high-level programming language, and C programming interface contribute to its unique versatility as a CAD standard for many disciplines, as does its provisions for writing customized drivers for peripheral devices. AutoCAD's flexible user interface includes such features as easy-to-use pull down menus, dialogue boxes, and icon menus that help customers take advantage of a host of dynamic features, including 2D and 3D modeling capabilities and integrated color rendering.

Autologic, Inc.

1050 Rancho Conejo Blvd
Thousand Oaks, CA 91320-1794
USA

APS-FAX

Contact: Al Brunner
Phone: (805) 498-9611
FAX: (805) 498-1167

Retail Price: $65,000.00 per site
RISC Version Available: Yes.

APS-FAX is an advanced remote high-resolution imaging system running under Windows NT.

APS-FAX is a high-resolution facsimile system which provides for the remote imaging of high-quality line art, text and halftone graphics. Full size newspaper sheets are transmitted from a single sending site over high-speed phone lines such as T1 or ISDN to one or more remote sites for imaging. An APS-FAX configuration consists of one APS-FAX Sending Site unit and one or more APS-FAX Imaging Site units. A maximum of 31 Imaging Sites can be supported from a single Sending Site.

Autologic, Inc.

1050 Rancho Conejo Blvd
Thousand Oaks, CA 91320-1794
USA

APS-SoftPIP for Windows NT

Contact: Al Brunner
Phone: (805) 498-9611
FAX: (805) 498-1167

Retail Price: $14,000.00
RISC Version Available: Yes.

High Performance, Low Cost PostScript Page Production System.

Operation of the APS-SoftPIP is performed on a dedicated EISA CPU, and can run unattended for maximum efficiency. PostScript files are sent from the PC; the job is interpreted and rasterized. At customer option, rasterized pages can be output directly to the imager or queued to memory or disk using throughput accelerator. The rasterized data can be output to any Autologic laser printer or imager on film, paper or plate material. Imager selection is easy to configure from the application program via 'page set-up' and 'chooser'. Throughput acceleration which allows simultaneous input, RIPing and imaging of files boosts page production. Features include Adobe compatible PostScript Level 2 and support of color laser imagers with resolutions up to 4000 x 4000 dpi. Screening options include various dot shapes plus Harlequin Precision Screens (HPS). Support of popular network protocols include etherTalk II and TCP/IP/FTP for input. Thirty-five LaserWriter fonts are provided. Other fonts and font libraries are available.

Base Technology

1543 Pine Street
Boulder, CO 80302
USA

Liana Professional Developer

Contact: Jack Krupansky
Phone: (303) 440-4558
FAX: (303) 444-4186

Retail Price: $695.00
RISC Version Available: Call.

Liana gives you Object-Oriented Programming without the hassle.

Liana is a new, C-like, interpretive object-oriented programming language and class library designed specifically for Microsoft Windows. Syntax is very similar to C and C++, but simplified and extended to be more flexible and as friendly as BASIC. A very high-level class library has over 100 classes for data management and Windows objects with easy-to-use support for DDE, DLLs, and MDI. Supports user-defined classes with inheritance. Manual has tutorial with over 70 sample programs. Great for prototyping and casual programming. Can be used as a standalone tool or as a companion tool for C and C++ programmers.

BGW Computers

5238 Holiday Rd
Minnetonka, MN 55345
USA

UUtil

Contact: Ben Witso
Phone: (612) 934-3986
FAX: (612) 934-3685

Retail Price: $49.95
RISC Version Available: Call.

UUtil gives you powerful UNIX-like commands in Windows NT.

The UUtil package includes the most common UNIX shell commands and programming utilities in Windows NT Single Command Shell executable form. Also included are a set of batch commands that mimic the UNIX commands using Windows NT Single Command Shell commands, giving you UNIX functionality with small disk space requirements. The second release of UUtil will add a Windows interface to the commands, in addition to the command line versions.

Black Forest Software

3555 Conecrest Lane
Colorado Springs, CO 80908
USA

SimPlexus

Contact: Ron VanHuss
Phone: (719) 488-0650
FAX: --

Retail Price: Introductory price $50
RISC Version Available: Call.

Simple, easy-to-use simulation and modeling tool.

This is a discrete event simulation and modeling tool for estimating the performance and capacity of computer systems. It is useful for rapid prototyping of system and component design elements, and for conducting experiments which vary the load and configuration of the system under study. Little or no previous knowledge of simulation or simulation languages is required, since the interface is designed to be entirely graphical. Building blocks include workstation nodes, host nodes, traffic generators (source nodes), executable images (processes, tasks, virtual machines), real time graphical outputs in the form of plots, and many more. It is not designed to be a replacement for a simulation language, but is flexible in that it is hierarchical and can model a system-of-systems. Load can be modeled using one of several stochastic processes, or from scripted scenarios. Resources include LANs, printers, CPUs, disks, and memory. Results can be displayed in real time windowed text or can be printed from text file output.

Blackwell Software

BSP LtdOsney Mead
Oxford, OX2 OEL
UK

Idealist for Windows NT

Contact: Peter Kibby
Phone: 44 (0) 865 791738
FAX: 44 (0) 865 791738

Retail Price: Call
RISC Version Available: Yes.

Idealist - the information manager Idealist is the only FULL-TEXT database manager for Windows, Windows NT, MS-DOS and the Macintosh.

A full-text database differs in three key ways from the flat-file/relational type: fields are variable in length (not preset); records may vary in type (multiple record types per file); every term in the database is indexed (every item is an instantaneous search term).In an Idealist database you have the flexibility to store ALL the information, not just the parts that fit. An Idealist database can find you any record by anything it contains - in milliseconds. Idealist is the database for making information accessible.In the USA and Canada Idealist is available from: EUROP2OOO, Inc 1272 Coolidge Avenue San Jose, CA 95125 Contact: Bernard F King Tel/fax: (408) 295-6821 Toll free: (800) 634-5155 Compuserve: 70272,766

Blossom Software Corporation

One Kendall SquareBuilding 600, Suite 185
Cambridge, MA 02139
USA

Ibrow

Contact: Inside Sales
Phone: (617) 738-1516
FAX: (617) 566-4936

Retail Price: $49.95 (binary)$179.95 (source)

RISC Version Available: Call.

A lightning-fast, Windows NT-based, programmer's editor featuring direct links into online help files.

Ibrow incorporates advanced features like: single-click access to on-line help, program objects, and header files; built-in multi-directory grep; multiple concurrent search/replace dialogs; mega undo/redo; integrated program launching; wicked-fast cut and paste; per-window fonts and tabs; configurable accelerators and menus; and fast editing of large files.Ibrow is avialable in binary and source. It is written in C using message crackers and a hierarchy of window classes including a cached text-editor class. The code compiles under Win32 and Win16. Source includes the monograph Programming Windows with Class.

Blue Sky Software

7486 La Jolla Blvd.Suite 3
La Jolla, CA 92037
USA

Magic Fields for Windows NT

Contact: Inside Sales
Phone: (800) 677-4WIN
FAX: (619) 459-6366

Retail Price: $495.00 (no royalties or runtime fees)

RISC Version Available: Yes.

Data Validation Controls for Windows NT.

Instead of writing code to do your input checking, simply point and click to add pre-defined or custom defined data entry fields to your Windows NT application. You can also visually specify typefaces, fonts, borders and colors and add a 3-D NeXT look to the fields. The grayed 3-D effect can also be applied to any dialog box and to any other elements inside it. Magic Fields consists of a large collection of objects that perform data field validation. The collection includes: numeric, text, alphanumeric, data, $, international currency, phone number, zip code, social security number, password and other templates, pictures, and objects. In addition, custom objects can be defined. Magic Fields also offers full support for international date/currency formats. Magic Fields may be used with any standard Windows dialog editor, such as Microsoft or Borland dialog editors or WindowsMAKER Professional.

Blue Sky Software

7486 La Jolla Blvd.Suite 3
La Jolla, CA 92037
USA

RoboHELP 2.0

Contact: Inside Sales
Phone: (800) 677-4WIN
FAX: (619) 459-6366

Retail Price: $499.00 (no royalties)
RISC Version Available: Yes.

The Premier Help Authoring Tool for Windows and Windows NT.

RoboHELP allows you to design, test and generate comprehensive, context sensitive, hypertext help systems for Windows NT. RoboHELP also offers full automatic document to help system conversion - if you have an existing document, you can turn it into a help system with a few clicks of your mouse. You can also turn your help system into printable documentation. RoboHELP reduces the time it takes to create a help system by up to 95%. RoboHELP guides you through the necessary steps - you just fill in the actual help text. You can spend your time concentrating on the contents of your help system, not the peculiarities of the source code format for the Windows Help Compiler. RoboHELP takes care of the complexities of setting context strings, keywords, browse sequences, and hypertext links as well as cross references, topics, bitmap hot links, graphics, and more. A fully integrated tool, RoboHELP generates all the source files required by the compiler (H, HPJ, and RTF files), takes care of running the help compiler, and will even test run your help system. Supports all the powerful features of the Windows 3.1 Help Engine, such as macros, secondary windows, and multiple hotspot graphics. Allows you to update and maintain existing help systems by importing existing help source files (even projects not originally created with RoboHELP), utilizing all pre-existing links and keywords.

Blue Sky Software

7486 La Jolla Blvd.Suite 3
La Jolla, CA 92037
USA

WindowsMAKER Professional 5.0 for Windows NT

Contact: Inside Sales
Phone: (800) 677-4WIN
FAX: (619) 459-6366

Retail Price: $995.00 (no royalties or runtime fees)

RISC Version Available: Yes.

Professional Visual Prototyper and C/C++ Code Generator for Windows NT.

WindowsMAKER Professional is an award winning Prototyper and C/C++ code generator that allows you to visually design, test and generate Windows and Windows NT applications the fast way. This is the professional development tool for Windows NT. From the tool palette, select, place & add functionality to menus, toolbars, icons, bitmaps, dialog boxes, and other graphical objects that comprise a Windows application. Visual prototyper and an embedded dialog editor give you fast prototyping and the ability to preview your application and make changes on the fly. Switch-It Code Generation Modules for ANSI C, MFC and OWL allow for cross platform development. Generates portable code (shared source code for 16 and 32 bit apps). TrueCode Technology ensures that your user code is preserved during code regeneration. Generates expert level, fully commented source code and production files. No royalties or runtime fees.

clySmic Software

PO Box 2421Empire State Plaza
Albany, NY 12220
USA

Drag 'n' Drop Utilities

Contact: Ralph Smith
Phone: (518) 438-5548
FAX: --

Retail Price: $24.95
RISC Version Available: Call.

Drag 'n' Drop Utilities for Windows NT.

The clySmic Drag n Drop Utilities for Windows NT provide utilities for your 32-bit desktop, including: Paper Drop - drag .BMP files and drop to change the wallpaper; Recycler - deletes unwanted files; EXE Type - drag 'n' drop an EXE file to find out whether its a Windows NT, OS/2, Win16 or MS-DOS executable; SIN - System Information; General Drop - turn any command-line program into a drag 'n' drop program; Exit Windws NT - quick system exit or shutdown; two kinds of clocks; and a File Manager extension complete with toolbar buttons.

CMA, Inc.

1341 Ocean Ave.Suite 531
Santa Monica, CA 90401
USA

Claim Analyzer I

Contact: Robert Porter
Phone: (310) 393-2727
FAX: (310) 393-8980

Retail Price: Call
RISC Version Available: Call.

For Analysis of Claims & Assets from on-line information.

A complete analysis tool for parsing information from on-line sources into database structures and providing analysis of all relevant interelationships. Provides tools for working with and interrelating all types of on-line source information (assset locators, corporate records, real property records, UCC and litigation records). A tool to produce complete reports of claims and assets research by incorporating the analytical skills of one the top asset research firms in the country into the software to parse and organize all researched data, either from in-house or on-line sources.

Combs International, Inc.

886 Belmont Avenue, Suite 3
North Haldeon, NJ 07508-2564
USA

Wfrm

Contact: Bob Combs
Phone: (201) 427-9292
FAX: (201) 427-3428

Retail Price: $395.00
RISC Version Available: Call.

Screen form window utility.

Wfrm (pronounced: W form) is an easy to use screen utility that creates custom Microsoft Windows data entry forms from simple edit files. Programmers can create window data entry applications in hours instead of days. Wfrm routines execute all the Window subroutines so that the programmer doesn't need to know how to program in Windows to be able to create appealing screens. The Wfrm library supports Microsoft C/C++ and other high level programming languages. The screen is defined by a simple text file created by an editor. The file defines the screen in a WYSIWYG layout, with field attributes and name labels in additional sections. The screen attributes control colors, selections lists, button actions, etc. to make screens more meaningful. The Wfrm subroutine library consists of simple screen management routines to display the form, read or write files, await user action, display messages, and alter certain field attributes. The routines perform all the Microsoft Windows actions (hidden from the Wfrm programmer) making windows programming direct, simple, and much faster.

Compass Point Software

332A Hungerford Dr.
Rockville, MD 20850
USA

application::ctor

Contact: Jason Flatt
Phone: (800) 359-2867 or (301) 738-9109
FAX: (301) 738-9134

Retail Price: $395.00
RISC Version Available: Yes.

A C++ rapid application development tool.

Application::ctor is a visual programming tool that simplifies and accelerates the development of applications. The product consists of three parts: an application editor that allows you to visually design and edit the components of your application's user-interface, such as windows, menus, and dialog boxes; a powerful C++ source code browser (with pre-compile browsing); and a class library consisting of more than 100 classes that simplify and extend the functionality found in the SDK. The application editor provides a direct connection to the source code browser, allowing you to connect user-interface messages and events to member functions in your code or to built-in prototype functionality. Rather than generating pages of C++ code, application::ctor generates resource data to store information about the user-interface. This data is read at run-time by the class library to manage your user-interface for you. The only code you manage is the code you write. The product incorporates many features that allow it to be used by teams of developers. By splitting the user-interface into several smaller sub-projects, several developers can design and develop user-interface components simultaneously. Because the product generates far less source code than competing products, the application source code will integrate better with version control systems. Other features include custom control support, forms layout technology (gravity and attachment), and full MDI support.

Congruent Corporation

110 Greene Street
New York, NY 10012
USA

NtNiX

Contact: Arthur Kreitman
Phone: (212) 431-5100
FAX: (212) 219-1532

Retail Price: $395.00
RISC Version Available: Yes.

X Window Client Support for Windows NT.

NtNix enables X client applications to be hosted on Windows NT platforms. It includes: complete X11R5 development libraries(Xlib, Xt, Xaw) and OSF Motif (Xm, mwm, Mrm and UIL). Also provided is the complete "standard" X client application set including: xterm; the font server; and xdm. TCP/IP applications such as tftpd, bootp, telnetd, rsh, and rexec are included for the special support needs of X terminals.

Congruent Corporation

110 Greene Street
New York, NY 10012
USA

Tool Buster (GNU Tools for Windows NT)

Contact: Arthur Kreitman
Phone: (212) 431-5100
FAX: (212) 219-1532

Retail Price: $199.00
RISC Version Available: Yes.

ToolBuster makes the full GNU UNIX toolkit available to Windows NTdevelopers.

It includes all the tools needed for program development including: the emacs editor; version control (rcs and cvs); the gcc c/c++ compiler; backup utilities (tar and cpio); and almost 100 other utilities. ToolBuster includes complete source code for all utilities and includes executables for the Intel, DEC Alpha AXP and MIPS R4X00 versions of Windows NT. As with all GNU software, you are free to make unlimited copies of all programs.

Conner Software

36 Skyline Drive
Lake Mary, FL 32746
USA

Backup Exec for Windows NT

Contact: Conner Express
Phone: (800) 4 NT BK UP
FAX: (407) 263-3665

Retail Price: Call
RISC Version Available: Yes.

Full-featured 32-bit application for Windows NT.

Backup Exec for Windows NT, developed by the same company that provided the backup utility included with Microsoft Windows NT, is the first full-featured Win32 backup product for Microsoft Windows NT offering users and network administrators an easy-to-use, comprehensive solution for backing up and restoring data on Windows NT workstations and servers. Backup Exec for Windows NT provides complete support for backing up and restoring all Windows NT supported file systems and security, including FAT, HPFS and NTFS volumes. Backup Exec supports all the popular SCSI controllers and tape drives.

Control Data Systems, Inc.

9315 Largo Drive WestSuite 250
Landover, MD 20785-4755
USA

*ARIA*BackupPlus*

Contact: Customer Service
Phone: (301) 808-4281
FAX: (301) 808-4288

Retail Price: Call
RISC Version Available: Call.

Automated workstation backup.

ARIA*BackupPlus provides an automatic, unattended backup of hetergeneous UNIX workstations and PCs on a TCP/IP network. Backups are automatic based on schedules defined by the system administrator. Restores can be originated by users without operator assistance. HP, SUN, SGI, and MIPS systems are supported as backup servers. PC clients are available for DOS and Windows PCs. PC clients are supported with FTP Software's PC/TCP Kernel or WINSOCK DLL. UNIX clients support Apollo, DEC, HP, MIPS, IBM, SGI, and SUN. Data can be backed up to a variety of devices including disk, tape stacking devices, optical disk, cartridge tape jukebox, or silo. BackupPlus is further complimented by Volume Manager and Migration Manager to provide large scale storage management solution required by both departmental users and large computing enterprises.

Control Data Systems, Inc.

9315 Largo Drive WestSuite 250
Landover, MD 20785-4755
USA

VistaCOM for Windows

Contact: Customer Service
Phone: (301) 808-4281
FAX: (301) 808-4288

Retail Price: Call.
RISC Version Available: Call.

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Communications and terminal emulation in Windows environment.

Control Data Systems, Inc.

9315 Largo Drive WestSuite 250
Landover, MD 20785-4755
USA

VistaKIT Client/Server Toolkit

Contact: Customer Service
Phone: (301) 808-4281
FAX: (301) 808-4288

Retail Price: Call
RISC Version Available: Call.

.

VistaKIT is a suite of libraries and utility programs that provide the tools necessary to link client front-ends to local or remote data bases. Client applications can be built using XVT, SQLwindows, Powerbuilder, Microsoft C, Visual Basic, or any design tool capable of making C function calls. Applications access data using SQL statements, while VistaKIT performs reliable message exchange between the client and the database. VistaKIT provides a SQL interface to local dBASE files on the PC. Options support both DOS and Microsoft Windows environments. Optional drivers are available to access remote ORACLE, INFORMIX, dBASE files, or remote sequential files.

Coromandel Industries, Inc.

70-15 Austin StreetThird Floor
Forest Hills, NY 11375
USA

ObjecTrieve for Windows NT

Contact: Customer Service
Phone: (800) 535-3267
FAX: (718) 793-9710

Retail Price: $699.00
RISC Version Available: Call.

Transaction based ISAM data manager for Windows NT with support for BLOBs.

ObjecTrieve for Windows NT is an ISAM data manager based on the X/OPEN standard. It is also available under DOS, UNIX and SUN OS. ObjecTrieve for Windows NT supports multiple variable length fields, user defined keys, multi-part indexes, automatic index updates and nested transactions. In addition, it can store and retrieve Binary Large OBjects, popularly known as BLOBs. This allows you to build applications that manipulate large binary data such as documents, bit-maps, sound and video.ObjecTrieve can be used to build industrial strength transaction based database applications for both conventional data handling and multi-media.

DeScribe, Inc.

4234 N. Freeway Blvd.Suite 500
Sacramento, CA 95834
USA

DeScribe Word Processor for Windows NT

Contact: Monica Tugaeff
Phone: (800) 448-1586 or (916) 646-1111
FAX: (916) 923-3447

Retail Price: $349.00 (introductory pricing).

RISC Version Available: Yes.

The first 32-bit, multithreaded word processor available for Microsoft Windows NT!

DeScribe, the company that brought you the first 32-bit word processor for OS/2 2.0, is again setting the pace with DeScribe 4.0 for Microsoft Windows NT, a native 32-bit application. With the ability to multitask and multithread, DeScribe can perform several different tasks simultaneously, and allows you to continue working in an application while another operation is underway. The extensive custom toolbox and document-processing features combine with DeScribe's powerful text and graphics capabilities to make DeScribe 4.0 the product of choice.DeScribe has shipping versions for Windows 3.1, Windows for Workgroups, Windows NT and OS/2.Describe for MIPS-based Windows NT workstations will be demonstrated at Fall COMDEX. The DEC Alpha AXP version will be ready shortly after Fall COMDEX.

Digital Equipment Corporation

30 Porter Road
Littleton, MA 10460
US

DEC C++ for Windows NT

Contact: Susan Auburg
Phone: (206) 865-8541
FAX: (206) 865-8890

Retail Price: Call.
RISC Version Available: Yes.

DEC C++ for Windows NT.

DEC C++ for Windows NT is a port of DEC C++ for DEC OSF/1, OpenVMS, and ULTRIX Version 1.2. It includes native, optimizing C++ and ANSI-compliant C compilers, C++ and C source-level debugger, class libraries, MFC, windows-based user interface, the SDK, and other assorted tools. The Alpha AXP and Intel Windows NT platforms are both supported.

Digital Equipment Corporation

30 Porter Road
Littleton, MA 10460
US

eXcursion for Windows NT

Contact: Susan Auburg
Phone: (206) 865-8541
FAX: (206) 865-8890

Retail Price: Call.
RISC Version Available: Yes.

Heightens productivity by merging Windows NT and X applications -- on A SINGLE DESKTOP!

eXcursion is a PC-based software application that allows simultaneous access to both host-based X applications (on DEC, Sun, HP, IBM, etc.) and local Windows NT applciations -- simplifying the migration to Windows NT on the desktop! The X Window application is displayed alongside your native Windows applications, responding to the same Windows "point-and-click" input conventions.

Digital Equipment Corporation

146 Main Street
Maynard, MA 01754-2571
USA

PATHWORKS for Windows NT

Contact: DECdirect .
Phone: (800) 344-4825
FAX: (508) 493-8780

Retail Price: Call.
RISC Version Available: Yes.

Integrate Windows NT with corporate information environments!

Digital extends its PATHWORKS family to include Windows NT systems into corporate information environments. PATHWORKS products incorporate and unify other network operating systems, including Microsoft's LAN Manager, into an integrated environment.

Digital Equipment Corporation

146 Main Street
Maynard, MA 01754-2571
USA

PATHWORKS for Windows NT Programmer's Kit

Contact: DECdirect .
Phone: (800) 344-4825
FAX: (508) 493-8780

Retail Price: Call.
RISC Version Available: Yes.

Incorporate DECnet support into Windows NT applications.

Digital extends its PATHWORKS family to include both Windows NT based clients and servers on Intel, MIPS, and Alpha AXP platforms. PATHWORKS products incorporate and unify other network operating systems, including Microsoft's LAN Manager, into an integrated environment. Features include file, print and application services utilizing DECnet, TCP/IP and NetBEUI transports and Ethernet, Token Ring, and FDDI topologies.The PATHWORKS for Windows NT Programmer's Kit contains libraries, include files and online documentation to support access to DECnet through Winsock and PATHWORKS socket API's. The Windows NT Software Developer Kit is a prerequisite.

Digital Equipment Corporation

151 Taylor St.4 Technology Park Drive
Westford, MA 01886
US

PrintServer Software for Windows NT (tm) Systems, Version 4.2

Contact: Abe Litman
Phone: (508) 497-7817
FAX: (508) 635-8724

Retail Price: $98.00 site license
RISC Version Available: Yes.

The most powerful Network Printing solution! Period!

Imagine being able to print from your Windows NT system to the most powerful, feature-rich network printers that exist. PrintServer Software for Windows NT allows Windows NT systems to share Digital's PrintServer Printers with HP-UX Systems, SunOs Systems, SCO Unix Systems, Novell Netware Systems, IBM AIX Systems, VMS Systems, Ultrix and OSF/1 Systems. There are no distance limitations; the printer can be down the hall, or on another continent entirely! PrintServer Printers are affordable, powerful tools.This is DIRECT printing; there is no intermediary spooling system. ALL users regardless of platform print DIRECTLY to the printer. This "one on one" relationship provides: -Access to industrial-strength printing. Duty cycles of up to 200,000 pages per month per PrintServer printer! -Real-time notification of ALL printer events, WHEN THEY happen, on your Windows NT system's Event Viewer. -EVERY Windows NT System on your network can print DIRECTLY to a shared PrintServer Printer, reducing the load on your servers! -REAL tray selection that works! Input AND Output, including Digital's 10 and 20 bin output "mailbox", with optional locks! -Job banner pages that allow for quick job identification, even COLORED banner page selection. The banner page also has job statistics that you cannot get in ANY OTHER WAY. -Seamless compatibility with ALL Print Manager features.Best of all, since this software product was designed for YOUR Windows NT Printing needs, ALL of your Windows NT compatible applications will be able to print with NO modifications!

DIGITALK, Inc.

9841 Airport BoulevardSuite 600
Los Angeles, CA 90099-5250
USA

PARTS Workbench for Windows NT

Contact: Customer Service
Phone: (800) 922-8255 or (310) 645-1082
FAX: (310) 645-1306

Retail Price: Call
RISC Version Available: Call.

PARTS Workbench is a revolutionary client/server integration tool.

PARTS Workbench(TM) allows very rapid application development through easy assembly and reuse of prefabricated application components. PARTS(TM), an acronym for Parts Assembly and Reuse Tool Set, is the first Client/Server Technology Integration Tool. The PARTS Workbench is the framework for this technology. It makes the assembly and re-use of software components from different technologies a distinct and easier process than creating the components. These components can be written in Smalltalk/V, C or other languages. The PARTS Workbench consists of a catalog of over 60 prebuilt components, both visual and non-visual, and a workbench window. Applications are created with these simple steps: - drag parts from the catalog into the workbench - specify part interaction by visually wiring parts together. The purchase price includes both the right to distribute unlimited runtime applications and the right to deliver components based on this technology.

DIGITALK, Inc.

9841 Airport BoulevardSuite 600
Los Angeles, CA 90099-5250
USA

Smalltalk/V for Windows NT

Contact: Customer Service
Phone: (800) 922-8255 or (310) 645-1082
FAX: (310) 645-1306

Retail Price: Call
RISC Version Available: Call.

Digitalk's 32-bit version of its pure object-oriented development environment for Windows NT.

Smalltalk/V for Windows NT is a complete set of tools compatible with Windows NT for developing 32-bit graphical, portable applications in one box. You can program easier and faster with a high-level interface to operating system functionality. Smalltalk/V also includes tools for developing applications incrementally, reducing development time by eliminating the compile-link-run loop used in non object-oriented languages. Other features include: automatic memory management, tools for organizing and browsing source code, an integrated debugger with single-stepping capability, object inspectors, a pluggable object library builder, full support for OLE 2.0, DLLs, Dynamic Data Exchange, National Language/Double Byte Character Set, Help Manager and MDI. You can distribute the resulting applications royalty-free. Digitalk Professional Services provides consulting and training for all Digitalk products as well as object-oriented design and analysis.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $595.00; $990.00 with source code.

RISC Version Available: Yes.

The Complete Math Library for C++.

M++ is a complete math library and array language which allows the user to dramatically reduce program development time and program maintenance costs.M++ includes complete LINPACK linear system classes, complete EISPACK eigenvector/eigenvalue classes, and a full set of multidimensional signal processing methods (FFTs, convolutions, correlations, coherence, power, and FIR and IIR filters). M++ allows operations on a full set of data types ranging from Bit to both complex double and complex float. Math functions provided include real and complex trigonometric and hyperbolic functions, real and complex Bessel functions, Legrendre polynomials, Householder rotations, etc.M++ provides a full array language with complete outer operations, array manipulations, etc., enabling the solution of the most difficult advanced scientific problems. Both persistent and virtual arrays are allowed. Advanced mathematical modlules for Optimization, finite Element Modeling, etc., are available.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ FEM

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00; $490.00 with source code.

RISC Version Available: Yes.

M++ Finite Element Module (FEM).

FEM (Finite Element Model) provides the user the necessary tools for piecewise approximation solutions of boundary problems and can be used equally well for static problems or dynamic problems. FEM provides member functions for defining the body and structural characteristics, a frontal solver with automatic frontwidth minimization routines, and eigenvalue extraction functions for the dynamic data analysis.FEM requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ LSM

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Least Squares Module (LSM)

M++ LSM computes linear and non-linear least squares estimates and associated statistics. Generalized least squares models with vector and matrix weights and multiple dependent variables can be fit. Residuals, covariance matrices, R-squared statistics and goodness of fit statistics can be computed. Most standard nonlinear fitting algorithms are provided in this easy to use class library.LSM requries M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ ODE

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Ordinary Differential Equations Module (ODE).

M++ ODE provides a set of classes and methods for computing numerical solutions to Ordinary Differential Equations with inital value constraints for both stiff and non-stiff problems. ODE provides the user a wide selection of both fixed step methods and adaptive step methods based on local error estimates.ODE requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ OPTIM

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Optimization Module (OPTIM).

M++ OPTIM provides for the general unconstrained optimization of arbitrary functions. The user has control over the descent algorithms with the ability to switch descent algorithms at appropriate points. Descent algorithms include steepest descent, Broyer-Fletcher-Goldfarb-Shanno's, Davidon-Fletcher-Powell's, and others. Step length methods include Brent, golden, and cubic.OPTIM requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ QUAD

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Numerical Integration Module (QUAD).

M++ QUAD provides an easy to use object oriented interface to one and two dimensional numerical intergration problems. Based upon the well known QUADPACK package, QUAD allows for functional limits in two-dimensional integrals, giving complete control of the 15 adaptive and non-adaptive quadrature rules available. The class design makes it easy to solve most quadrature problems quickly and easily.QUAD requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ SUM

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Statistical Utility Module (SUM).

M++ SUM contains a basic set of scalar and array functions. It includes functions for univariate and bivariate normal (Gaussian) cdfs, the chi-squared cdf, Student's cdf, and the Snedcor's F cdf as well as the incomplete beta integrals. Also included are functions for computing a covariance matrix from data. These functions can operate on real and complex arrays.SUM requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ TEST

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Test Module (TEST).

M++ TEST contains methods for testing numberic software using M++ arrays and includes a complete set of test programs for M++. Test programs distributed with other M++ modules also require the TEST module. These test programs are used to check for proper operation of M++ under different compiler options. Test types included are checksum tests, equality tests, and assertion tests.TEST requires M++.

Dyad Software

515 116th Avenue NESuite 120
Bellevue, WA 98004
USA

M++ VIS

Contact: Customer Support
Phone: (800) 366-1573 or (206) 637-9426
FAX: (206) 637-9428

Retail Price: $245.00 with source code.
RISC Version Available: Yes.

M++ Visualization Module (VIS).

VIS provides a complete plotting package with capability for both program controlled and interactive plotting. This module works for a wide variety of terminals for MS-DOS, Windows, UNIX and Windows NT. The module provides a complete set of member functions to allow the user to specify plot format (lines, steps, points, etc.), plot type (2D, 3D, countours, polar etc.), and plot parameters (color, titles, line lables, axis lables, axis tics, etc.).VIS requires M++.

Eaglesoft Corporation

810 Third AvenueSuite 208
Seattle, WA 98104
USA

EagleEye

Contact: Doug Ray
Phone: (206) 682-4830
FAX: (206) 682-4789

Retail Price: Call
RISC Version Available: Call.

Complete Warehouse Location Management with Bar Codes and RF.

EagleEye is a full-service, real-time warehouse location management system. It makes maximum use of bar code technology and portable data terminals with bar code scanners linked to a Windows NT host by RF for real-time transaction control and paper-free operation. All phases of warehouse activity are provided, including Receiving, Putaway, Relocation, Picking, Shipping, Palletization, Kitting, Full Inventory, and Cycle Counts. Extensive transaction sharing with other mainframe systems and software packages is supported, using a number of industry standard communications technologies. EagleEye also supports EDI transactions with other companies, or for materials tracking in a single company.

Eaglesoft Corporation

810 Third AvenueSuite 208
Seattle, WA 98104
USA

QR/Control

Contact: Customer Service
Phone: (206) 682-4830
FAX: (206) 682-4789

Retail Price: Call
RISC Version Available: Call.

Comprehensive EDI-based Quick Response Support and Control.

QR/Control is designed specifically to support the collection and tracking of demand and supply transactions between two or more companies acting as customers and suppliers. It is especially well suited for trading partners who wish to cooperatively implement Quick Response order and supply concepts. The specific sequential steps in the QR/Control business process are defined as follows. 1. Collect demand at point of sale.2. Organize demand transactions in a database.3. Communicate orders from customers to suppliers.4. Confirm supplier receipt and acceptance of orders.5. Expedite product delivery from supplier to customer.6. Automate customer receiving.

Edinburgh Petroleum Services Ltd

Research ParkRiccarton
Edinburgh, Scotland EH14 4AP
Scotland

FloSystem

Contact: Ken Nicolson
Phone: (UK) 031 449 4536
FAX: (UK) 031 449 5123

Retail Price: Call
RISC Version Available: Call.

FloSystem - Oil and gas production optimization.

FloSystem consists of two programs designed to optimize production from hydrocarbon resources. WellFlo models individual well performance including electric submersible pumps, gas lift systems, reservoir inflow and choke performance. This allows identification of the key operating parameters of the well and predicts expected performance improvements on adjustment of these parameters. FieldFlo allows the linking of wells together and the modelling of complete field performance. This allows the existing production configuration to be modelled and then the system to be optimized to maximize oil production or revenue generated.

Edinburgh Petroleum Services Ltd

Research ParkRiccarton
Edinburgh, Scotland EH14 4AP
Scotland

PanSystem

Contact: Ken Nicolson
Phone: (UK) 031 449 4536
FAX: (UK) 031 449 5123

Retail Price: Call
RISC Version Available: Call.

PanSystem - Well test Analysis.

PanSystem is the most successful well test analysis software package in the world. Used by thousands of engineers over the last eight years, the program has been redesigned and implemented as a Windows 3.X and Windows NT products. The system allows the user to quickly and effectively read in data from multiple pressure gauges, edit and prepare the data and then perform the complete range of traditional analysis techniques as well as state of the art simulation. In fact the program is a multi-well multi-layer analytical simulator as well as an easy to use analysis tool for well test evaluation.

EditPro Corporation

PO Box 927161
San Diego, CA 92192-7161
USA

EditPro for Windows NT

Contact: Dean Weber
Phone: (619) 549-8081
FAX: (619) 546-8765

Retail Price: $269.00
RISC Version Available: Call.

EditPro Professional Programmer's Editor.

Powerful full featured editor supports all major compilers, allows for fast error tracking and background compiles.Supports unlimited file sizes, unlimited undo, C macro language for easy extensions to the editor. Customize the menus, tool bars, and keyboard mappings. Fast color coding support of keywords, strings, and comments for C/C++ and Pascal languages. Spell checker with 100K word dictionary and user dictionary. Powerful Regular Expression search, replace, and file grep.Other features include word wrap, insert/overstrike modes, column/line/snake blocking modes, auto-save and auto-backup, BRIEF/WordStar/CUA emulation, CTags, and SDK support.

Eicon Technology Corporation

2196 - 32nd Avenue (Lachine)
Montreal, Quebec H8T 3H7
Canada

WAN Services for Windows NT

Contact: Dina Gibbons
Phone: (514) 631-2592
FAX: (514) 631-3092

Retail Price: $595.00
RISC Version Available: Call.

WAN Services for Windows NT is specifically tailored to provide wide area networking services to the Windows NT environment and is designed to complement products offered by Microsoft.

WAN Services for Windows NT integrates seamlessly with the host communications environment, augmenting it with WAN communications services complementary to the Microsoft product line. The wide area services provided include full-featured, robust and high capacity implementations of X.PAD, SNADIS and X.25 support. These communications facilities are all optimized for the EiconCard family of high speed intelligent communications adapters. The product provides wide area support for all of Microsoft's communications programs in a single integrated package. Whether users are looking to add WAN support to the Microsoft Remote Access Server (RAS), Microsoft e-mail applications or SNA Server for Windows NT, the solution is Eicon Technology's WAN Services for Windows NT.

Eicon Technology Corporation

2196 - 32nd Avenue (Lachine)
Montreal, Quebec H8T 3H7
Canada

X.25 Network-Level Developer's Toolkit for Windows NT

Contact: Dina Gibbons
Phone: (514) 631-2592
FAX: (514) 631-3092

Retail Price: $1,000.00
RISC Version Available: Call.

The X.25 Network-level Developer's Toolkit for Windows NT is a powerful communications tool.

The X.25 Network-Level Developer's Toolkit for Windows NT is a powerful communications tool that allows developers to design custom solutions with the aid of an extensive C function library. The X.25 Network-Level Developer's Toolkit for Windows NT contains a library of C functions that provide a high-level interface to the X.25 data stream. Developers have complete control of all parameters for X.25 communications without low-level coding. The toolkit allows management of up to 254 concurrent virtual circuits and completely insulates applications form all protocol processing. Full access to X.25 User Facilities allows different facilities to be set for each individual virtual circuit. user-defined window and packet sixes mean communications processing can be tailored for optimum performance.

Elan Computer Group, Inc.

888 Villa Street3rd Floor
Mountain View, CA 94041
USA

Elan License Manager

Contact: Bob Taylor
Phone: (800) 536-3526 or (415) 964-2200
FAX: (415) 964-8588

Retail Price: $7,500.00 per year
RISC Version Available: Call.

Software License Manager for Windows & Windows NT.

Elan License Manager is a software toolkit that controls multi-user access to software applications in a network or multi-user environment. It's principal functions are:o To allow only the number of licensed users access to an application concurrently.o To incorporate a flexible expiration date into software for creating evaluation copies.o To implement a form of copy protection, such that the controlled application will only operate on a licensed network or licensed CPU.o To provide the ability to individually license components of an application.Elan License Manager is an all-software solution to software licensingand is ideal for virtually any software application.

Elite Technology

12348 Rose Street
Artesia, CA 90701
USA

Jupiter

Contact: George Hwang
Phone: (310) 924-0028
FAX: --

Retail Price: $595.00
RISC Version Available: Call.

32-bit object-oriented desktop publishing application.

Jupiter version 1.5 integrates the power of graphics and word processing to achieve the ultimate desktop publishing tasks. Jupiter provides full-featured graphics to create, resize, rotate, skew, and reshape both graphics and text objects. Jupiter supports powerful word processing capabilities such as arbitrary change of typeface and formatting. Jupiter offers versatile text layout with maximum flexibility. Jupiter handles multiple text flows for the application of mass media publications. Jupiter implements both horizontal and vertical writings to support Far East languages.

Ex Machina, Inc

45 East 89th St.Suite 39-A
New York, NY 10128-1232
USA

Notify! Network

Contact: Customer Service
Phone: (800) 238-4738 or (718) 965-0309
FAX: (718) 832-5465

Retail Price: $349.00
RISC Version Available: Call.

The Wireless Message Center for Windows.

Don't be tied to your desk in the office, or tied to the phone when you're away. With Notify! your PC can deliver time sensitive, important information right into your pocket, on the road, in a meeting, at home or at the coffee machine. Working with an inexpensive full-text alphanumeric pager available from local or nationwide paging carriers, Notify! turns your PC into a complete wireless message center. Paging Features Send Tone, Numeric and Alphanumeric pages; Send messages to individuals or groups; Use pre-stored Quick Messages for common texts; Send complete text files from disk; Automatically split long messages into blocks; Background operation; Complete logging of status and message traffic; Protocols Telocator Alphanumeric Protocol (TAP) IXO protocol Numeric DTMF SkyPage DTMF Mobilcomm Nationwide DTMF Inter-Application Communications; Full DDE Support; MAPI support for Microsoft Mail Message forwarding of incoming mail. Notify! Network works with all printers and networks supported by Windows NT.

Ex Machina, Inc

45 East 89th St.Suite 39-A
New York, NY 10128-1232
USA

Notify! Personal

Contact: Customer Service
Phone: (800) 238-4738 or (718) 965-0309
FAX: (718) 832-5465

Retail Price: $149.00
RISC Version Available: Call.

The Wireless Message Center for Windows.

Don't be tied to your desk in the office, or tied to the phone when you're away. With Notify! your PC can deliver time sensitive, important information right into your pocket, on the road, in a meeting, at home or at the coffee machine. Working with an inexpensive full-text alphanumeric pager available from local or nationwide paging carriers, Notify! turns your PC into a complete wireless message center. Paging Features Send Tone, Numeric and Alphanumeric pages; Send messages to individuals or groups; Use pre-stored Quick Messages for common texts; Send complete text files from disk; Automatically split long messages into blocks; Background operation; Complete logging of status and message traffic; Protocols Telocator Alphanumeric Protocol (TAP) IXO protocol Numeric DTMF SkyPage DTMF Mobilcomm Nationwide DTMF Inter-Application Communications; Full DDE Support; MAPI support for Microsoft Mail Message forwarding of incoming mail.

Executive Software, Inc.

701 N. Brand Blvd.6th Floor
Glendale, CA 91203-1242
USA

FILE ALERT Disk File Corruption Detector

Contact: Tony Rockcliff
Phone: (818) 547-2050
FAX: (818) 545-9241

Retail Price: $99.00
RISC Version Available: Yes.

FILE ALERT is a totally automatic data corruption detection system for Windows NT.

Using the Set It and Forget It(TM) feature found in all Executive Software products, FILE ALERT continually scans the disk while the user works on other tasks, and detects any unintended change in file contents. Upon such detection, FILE ALERT immediately alerts the user or system manager to the data corruption with full particulars. FILE ALERT goes far beyond mere virus checking in that it detects data corruption from any source, such as operating system errors, power surges, aging hardware, etc.

Felsina Software

4440 Finley AvenueSuite 108
Los Angeles, CA 90027
USA

A-Talk(R) for Windows NT

Contact: Marco Papa
Phone: (213) 669-1497
FAX: (213) 669-1893

Retail Price: $99.95
RISC Version Available: Call.

A-Talk is a comprehensive telecommunications package for the Windows NT, Windows 3.1 and Windows for Workgroups operating systems. A-Talk supports Microsoft Mail, cc:Mail, Network DDE, Drag and Drop, Tecktronix 4014 emulation and speech.

A-Talk is designed not only for the beginner but also for the power user who wants to set up Network DDE hot links to access and share information such as stock quotes. A-Talk is the only telecommunications product for Windows NT that provides seamless access through the E-Mail Connection(TM) to the advanced messaging features of Microsoft Mail, cc:Mail and Lotus Notes. A-Talk provides a powerful script language with learn mode, an interactive script editor, and superior terminal emulations that include VT100 and Tektronix 4010/4014. A-Talk supports nine file transfer protocols, the clipboard, the DDE Management Library, TrueType fonts, Common Dialogs, Drag and Drop, a history buffer, split windows, and an unlimited phone directory with queue dialing and journal functions. A-Talk provides full support of many modem types with auto-dial, auto-redial, auto-answer and hang up. A-Talk includes a feature which allows you to customize the program for any modem. With Drag and Drop support, you can send text files, set communications parameters and execute scripts by dragging files from the File Manager and dropping them into A-Talk.

Fourth Wave Technologies, Inc.

560 Kirts Blvd. Suite 105
Troy, MI 48084
USA

WinBEEP

Contact: Customer Service
Phone: (313) 362-2288
FAX: (313) 262-2295

Retail Price: Call
RISC Version Available: Yes.

WinBEEP A Complete Wireless Messaging System for Windows NT.

WinBEEP is a Windows NT based application that lets users send wireless messages (sentences and paragraphs of important information) to pocket-sized full-text pagers. WinBEEP offers immediate, unobtrusive, effective delivery of detailed text messsages to people who are regularly on the move. It also enables organizations to improve business operations by having instant access communication links with outside entities important to their success. Messages reach mobile workers instantly regardless of their location, with minimal chance of error, and without interrupting important meetings and tasks in progress. Pagers and paging devices hold as much as 6K (four pages) of data and up to 40 messages. Many departments, including sales, purchasing, and customer support require quick access to customers, vendors, service providers and other outside entities. By installing WinBEEP and providing these key contacts with pagers, organizations will have 24-hour global communication systems that increase and operating efficiency of everyone involved. WinBEEP gives users a bridge to future wireless communication solutions. Other features include the ability to create a central activities log, send individual or group messages, attach sender ID information, create predefined messages and attach other software files to pager messages. WinBEEP is built on Fourth Wave Technologies, Inc.'s WinBEEP SDK and WAPI (Wireless Application Programming Interface).

Fourth Wave Technologies, Inc.

560 Kirts Blvd. Suite 105
Troy, MI 48084
USA

WinBEEP SDK

Contact: Customer Service
Phone: (313) 362-2288
FAX: (313) 262-2295

Retail Price: Call
RISC Version Available: Yes.

WinBEEP SDK: A Complete Wireless Messaging Development Kit for Windows NT.

The WinBEEP SDK allows developers to 'PAGE-ENABLE' their application using the WinBEEP paging transport engine and WAPI (Wireless Application Programming Interface). This development kit will allow applications to communicate directly out the communications port to the paging service or to the WinBEEP Server. The system supports VIM and MAPI messages. The system comes with utilities and simple calls with embedded dialog boxes for administration of paging services and paging addresses as well as Microosft Visual Basic and 'C' examples for using the SDK. The SDK supports paging distribution lists, priorities and logging of pages. It also supports the NASI and INT14 shared modem communication standards. The WinBEEP Server is a wireless paging server for networks. This server is an active message store for outbound alphanumeric paging that can be used by multiple clients in a IPX, NETBIOS,TCP/IP or Windows For Workgroup environment Future wireless transports to be added include Two Way Wireless and inboud paging. Clients for the WinBEEP Server include WinBEEP Standalone or any applications written with WinBEEP SDK or any applications that communicates via DDE to WinBEEP or Network DDE to the server.

Frontier Technologies Corporation

10201 North Port Washington Road
Mequon, WI 53092
USA

Super-TCP for Windows NT 3.0

Contact: Kevin McManus
Phone: (414) 241-4555 ext. 217
FAX: (414) 241-7084

Retail Price: $495.00
RISC Version Available: Call.

Comprehensive Suite of TCP/IP & NFS Networking Applications.

**VT320 & tn3270 Terminal Emulation with multiple sessions, session printing and logging, keyboard mapping, font selection, color selection, scripting, international and graphic character sets. *Client/Server File Transfer with simultaneous display of local and remote file systems and intuitive file folder directory. *Electronic Mail with MIME binary file attachments allowing users to send and view mail messages with attached graphics, spreadsheets, sound, and video! Supports industry-standard SMTP and POP 2 & 3 protocols. *NNTP News Reader provides access to the thousands of news and information databases available on the Internet News System *NFS Client/Server provides fast, transparent, shared access via the Network File System (NFS). *TALK enables users to converse interactively across the network. *Remote Protocols for use in UNIX environments-rexec, rsh, and rcp. *LPR Print Client allows users to share valuable printing resources *PING tests network connectivity and assists in problem detection.

FutureSoft Engineering, Inc.

12012 Wickchester LaneSuite 600
Houston, TX 77079
USA

DynaComm/Elite For Windows NT

Contact: Customer Service
Phone: (800) 989-8908
FAX: (713) 496-1090

Retail Price: Call
RISC Version Available: Yes.

DynaComm/Elite is a full featured emulator for Windows and Windows NT.

DynaComm/Elite is a full featured 3270 emulator for Windows and Windows NT. DynaComm/Elite supports IBM 3278, Models 2-5 (LU type 2); IBM 3287 DSC printer (LU type 3); printing to disk base and extended field attributes; and up to five 3270 terminal sessions.

GrayTech Software, Inc.

2172 Menomini
Wheaton, IL 60187
USA

CAD X11

Contact: Inside Sales
Phone: (708) 682-4030
FAX: (708) 682-0047

Retail Price: Introductory pricing starts at $1,995.00

RISC Version Available: Yes.

3-D modeling, design, and drafting system for Windows NT and UNIX.

CAD X11 is a workstation independent, true 32-bit Mechanical CAD system ideally suited for design and manufacturing applications. A built-in floating network license allows users to choose from PCs and workstations running Windows NT, DOS 5.0/Windows 3.1, and UNIX operating systems.Standard features of CAD X11 include 3-D wireframe and surface modelling, rendering (hidden line removal, Gouraud shading, and more), dynamic rotations, multiple views, data verification, and geometric analysis. Also standard are the custom IGES interface, macros, 2-D and 3-D drafting with ANSI, ISO, BSI, DIN, and JIS dimensioning, geometric tolerancing, bill of materials, crosshatching, layering, macros, undo/redo, dragging, rubberbanding, user-defineable 'hot' buttons, Gerber and CGM interfaces, and on-line help. Output methods include pen and electrostatic plotters, PostScript printers, HP LaserJet printers, and Encapsulated PostScript. Options are available for User Programming in C or Fortran, and custom interfaces to Framemaker, Interleaf, Patran, and other software packages. Introductory pricing begins at $1995 for CAD X11, offering the most powerful, feature-rich MCAD solution for today's economically minded engineers and drafters working on the forefront of technology. GrayTech's products are backed by an established reputation for easy to learn and use software and exceptional customer support.

GrayTech Software, Inc.

2172 Menomini
Wheaton, IL 60187
USA

CAD X11/Lite

Contact: Inside Sales
Phone: (708) 682-4030
FAX: (708) 682-0047

Retail Price: $995.00
RISC Version Available: Yes.

2-D and 3-D design and drafting system for Windows NT and UNIX.

CAD X11/Lite is a workstation independent, true 32-bit Mechanical CAD system ideally suited for design and manufacturing applications. A built-in floating network license allows users to choose from PCs running Windows NT, DOS 5.0/Windows 3.1, and UNIX operating systems.Standard features of CAD X11/Lite include simple and complex geometry creation, 3-D wireframe modelling, multiple views, dynamic rotations, 2-D and 3-D drafting with ANSI, ISO, BSI, DIN, and JIS dimensioning, ordinate dimensions, geometric tolerancing, ANSI/ISO crosshatching, macros, undo/redo, dragging, rubberbanding, data verification, geometric analysis, layering, custom IGES and DXF interfaces, user-definable 'hot' buttons, and on-line help.Output methods include pen and electostatic plotters, PostScript printers, HP LaserJet printers, and Encapsulated PostScript. GrayTech provides device drivers free of charge. Introductory pricing is $695 for this powerful lite version of GrayTech's CAD X11 software, offering the most feature-rich MCAD solution for today's economically minded engineers and drafters working on the forefront of technology. First in its field, CAD X11./Lite includes excellent drafting functions, mature built-in IGES and DXF interfaces, and the same built-in floating network license available with the full CAD X11. product. All of GrayTech's products are backed by an established reputation for easy to learn and use software and exceptional customer support.

GUILD Products, Inc.

1710 South Amphlett2nd Floor, Suite 203
San Mateo, CA 94402
USA

GUILD Development System for Windows NT

Contact: Toby Mosby
Phone: (800) 995-5452
FAX: (415) 349-4908

Retail Price: $895.00
RISC Version Available: Yes.

GUILD is the leading User Interface Management System AVAILABLE TODAY!

GUILD uses a visual programming approach, enabling developers to create most of their GUI using point-and-click. The product also includes a high level, fully-portable API and provides access to C and C++ for extended GUI and application features. Because GUILD keeps the application code separate from the user interface, you can easily construct GUI front-ends for existing C applications and even modify the GUI after it is compiled.The NT version of GUILD includes support for Microsoft Foundation Classes (MFC), 30 days free technical support and more. Support for modeling, plotting and popular PC databases is also available.

GUILD Products, Inc.

1710 South Amphlett2nd Floor, Suite 203
San Mateo, CA 94402
USA

GUILD Prototyper for Windows NT

Contact: Toby Mosby
Phone: (800) 995-5452
FAX: (415) 349-4908

Retail Price: $195.00
RISC Version Available: Yes.

Build your GUI prototypes for Windows NT, Windows 3.1, Macintosh and OS/2.

The GUILD Prototyper uses visual programming to enable rapid development of GUI application prototypes. Attach properties and variables to screen objects to define the objects' default attributes. Then attach complete event specifications; the objects will respond to user- and developer-initiated events. The GUILD Prototyper automates many actions (timers, messagebox, sendmessage , . . .) and all are specified by point-and-click.The GUILD Prototyper includes the GUILD database, application templates and much more. Get started with the GUILD Prototyper NOW and upgrade to the GUILD Development. System when you are ready to create your final application.

Hamilton Laboratories

13 Old Farm Road
Wayland, MA 01778-3117
USA

Hamilton C shell

Contact: Doug Hamilton
Phone: (508) 358-5715
FAX: (508) 358-1113

Retail Price: $350.00 ($395.00 International)

RISC Version Available: Yes.

World's most powerful tools for Windows NT!

Hamilton C shell recreates the original UNIX C shell and utilities, adding numerous enhancements. Over 130 commands, utilities and built-in functions including alias, cat, chmod, cls, cp, cut, diff, dirs, dskread, dskwrite, du, eval, fgrep, grep, hashstat, head, history, kill, markexe, more, mv, popd, printf, ps, pushd, rm, sed, sleep, split, strings, tabs, tail, tar, tee, time, touch, tr, uniq, vol, wc, whereis and xd. Designed from scratch. Carefully follows all Windows NT conventions. Fanatical quality.Hamilton C shell comes with a 260 page manual split evenly between tutorial and reference material.Features include: history, full-screen command line editing, filename and command completion, user-defined and built-in procedures, aliases, expressions, local variables, command substitution, wildcarding with indefinite directories. Outstanding scripting capabilities. Unlimited command line size. Extensively multi-threaded.Users familar with UNIX become instantly productive on Windows NT. Runs existing UNIX command scripts with little or no porting effort. Even users with no UNIX background find the powerful tools in this product allow complex operations to be performed or automated with ease. Users typically report savings of an hour/day.

Hippo Software Inc.

448 E. 400 StreetSuite 303
Salt lake City, UT 84111
USA

HIPPIX

Contact: P.K. Stoll
Phone: (801) 644-4776
FAX: (801) 531-1302

Retail Price: $109.00
RISC Version Available: Call.

Development tools that bridge the gap between Windows NT.

HIPPIX provides a library that supports over 95% of the functions of the POSIX 1003.1 API. Unlike the POSIX implementation that comes with Windows NT, the HIPPIX library functions can be used with calls to the Win32 subsystem. Also available is a suite of over 100 UNIX utilities, including sh, vi, awk, grep, man, make, lex, yacc, and the RCS revision control system. The HIPPIX utilities simplify the software development process, while the HIPPIX library allows software developers to write applications that are source code compatible with POSIX compliant UNIX systems.

Hummingbird Communications, Ltd.

2900 John StreetUnit 4
Markham, Ontario L3R 5G3
Canada

eXceed for Windows NT

Contact: Customer Service
Phone: (416) 470-1203
FAX: (416) 470-1207

Retail Price: $645.00 (single user); $2,740.00 (5 users)

RISC Version Available: Call.

An X server for PCs running Microsoft Windows NT.

This high performance 32-bit PC X server has been developed to run on PC's using the Microsoft Windows NT operating system. It provides a high degree of integration between Windows NT and UNIX offering end-users concurrent access to X Window clients and applications for Windows NT. eXceed is X11 release 5 fully compliant and includes all the common X features found in the Hummingbird family of PC X server products.

Hummingbird Communications, Ltd.

2900 John StreetUnit 4
Markham, Ontario L3R 5G3
Canada

eXceed X Development Kit for Windows NT

Contact: Customer Service
Phone: (416) 470-1203
FAX: (416) 470-1207

Retail Price: $695.00
RISC Version Available: Call.

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The XDK provides the following facilities to developers: - Create and run X Window clients on Windows NT rather than a remote host - Run local X Window clients on Windows NT with output displayed on remote UNIX hosts or X servers - Port X applications to PC's from UNIX. Includes all requiste X11R5 development components.

Hyperception, Inc.

9550 SkillmanLB 125
Dallas, TX 75243
Dallas

Hypersignal RT3 for Windows NT

Contact: David Crowell
Phone: (214) 343-8525
FAX: (214) 343-2457

Retail Price: $2,995.00
RISC Version Available: Call.

Hypersignal RT3 for Windows NT.

This software package allows engineers and scientists to acquire, create, and analyze signals using a variety of Mathematical and Digital Signal Processing tools. Included in this package are graphical analysis for studying the time and frequency domain representations of waveforms, a filter design package for designing digital filters, code generators for generating filter code for a variety of digital signal processors, real-time spectrum analyzer, real-time digital oscilloscopes, and real-time data acquisition digital recorder. In addition, the package also includes Hypersignal for Windows NT Block Diagram for higher-level simulation of algorithms and system modeling.

I/O Software, Inc.

10970 Arrow RouteSuite 202
Rancho Cucamonga, CA 91730
USA

PharmStar

Contact: William Saito
Phone: (800) 800-7970 or (909) 483-5700
FAX: (909) 483-5710

Retail Price: Call.
RISC Version Available: Call.

A Complete stability testing database, management and analysis softwarepackage.

The first program of its kind, PharmStar is written with an easy to learn and use Microsoft Windows user interface. A complete solution, PharmStar features: - Protocol initiation - Test scheduling - Data search, retreival, verification/validation - Statistical and graphical data analysis - Flexible report generation - Network supportPharmStar organizes your stability testing program like never before, reducing data entry and analysis time drastically. PharmStar manages your stability information and generates reports for reference and submission. A solution to all your stability problems, PharmStar is developed and tested by a team of pharmaceutical scientists and computer system professionals according to information released by the Computer System Validation Committee (CSVC) of the Pharmaceutical Manufacturers Association.

I/O Software, Inc.

10970 Arrow RouteSuite 202
Rancho Cucamonga, CA 91730
USA

Stereolusion

Contact: Tas Dienes
Phone: (800) 800-7970 or (909) 483-5700
FAX: (909) 483-5710

Retail Price: $59.00
RISC Version Available: Call.

A 3-D illusion creation software.

Stereolusion is a Windows and Windows NT-based program which creates Random Dot Stereograms (RDS) from images imported as GIF, TIFF, PCX, BMP or JPEG files. Output images appear as random dot patterns, but when viewed correctly, a 3-D image becomes visible. Depth information is extracted from the shading of the original image. Interesting and artistic designs can be created and viewed or printed on color and laser printers. Practical applications include general advertising, calendars, product brochures, and posters.

I/O Software, Inc.

10970 Arrow RouteSuite 202
Rancho Cucamonga, CA 91730
USA

VitaD

Contact: William Saito
Phone: (800) 800-7970 or (909) 483-5700
FAX: (909) 483-5710

Retail Price: Call.
RISC Version Available: Call.

A computer database program for cataloging Vitamin D analogs.

VitaD is a sophisticated database program for biochemists in the field of Vitamin D research. This database can store an unlimited amount of analog records. All records can be searched on the basis of chemical structure, catalog number, pharmaceutical code, chemical name, descriptions, etc. Data entry of chemical structures and substituents are accomplished through a menu of commonly used functional groups. VitaD can also display/print three dimensional perspectives of the different vitamin D analog structures. VitaD takes full advantage of the Windows NT graphical user interface to make using the program very easy. Developed in cooperation with the University of California.

Image-In, Inc.

406 East 79th Street
Minneapolis, MN 55420
USA

IMAGE-IN Power Pack

Contact: Customer Service
Phone: (800) 345-3540 or (612) 888-3633
FAX: (612) 888-3665

Retail Price: $795.00
RISC Version Available: Call.

24-bit Photo Image Retouching.

Now your color photographs and art images can be scanned, retouched, manipulated and separated right on the desktop with IMAGE-IN Power Pack. This powerful pre-press software for Windows NT is the most advanced true-color 24-Bit image processing system available for the Windows NT platform.

Impact Software

12140 Central AveSuite 133
Chino, CA 91710
USA

Almanac for Windows NT

Contact: Len Gray
Phone: (909) 590-8522
FAX: (909) 590-2202

Retail Price: $79.95
RISC Version Available: Call.

Almanac for Windows NT.

Almanac is a powerful calendar/scheduler for Windows NT. A straight-forward user interface based on a traditional calendar provides easy access to a wide array of holidays and recurring events. Separate windows for the daily schedule, notes, and to-do list can be positioned and sized to your preference. Many extras include digital watch, sunrise/set times, moon phases, Jewish calendar mode, an iconic clock, and full print support (including color).

Impact Software

12140 Central AveSuite 133
Chino, CA 91710
USA

Icon Manager

Contact: Leonard Grey
Phone: (909) 590-8522
FAX: (909) 590-2202

Retail Price: $24.95
RISC Version Available: Call.

Icon Manager for Windows NT.

Icon Manager provides a comprehensive feature set of icon management functions. Use it to extract icons out of any data or program Requires Windows NT, sound card optional.

Inclination Software, Inc.

P.O. Box 8668
Incline Village, NV 89452-8668
USA

SpeedEdit for Windows NT

Contact: Sandra Bradford
Phone: (702) 831-5595
FAX: (702) 831-4979

Retail Price: $295.00
RISC Version Available: Call.

Professional Text Editor.

SpeedEdit is a powerful text editor for Windows, Windows NT, Unix and X-Windows and runs on PCs, IBM-RS6000s, SUN, HP and Sequent systems. This family of products provides common editing on all platforms, powerful keyboard macros, macro language. Over 200 built-in functions, selectable MDI or multiple top level windows, up to 64 open windows, a reconfigurable tool bar, complete keyboard remapping, user configurable menus, and powerful use of color to tag reserved words, comments, modified lines and more. Supports all languages, C, Fortran, COBOL, Assembler, Pascal... and compilers from just about any manufacturer. Free demo available.

Industrial Systems, Inc.

18720 142nd. Avenue NE
Woodinville, WA 98072
USA

CIM/21

Contact: Customer Service
Phone: (206) 481-6325
FAX: (206) 481-0506

Retail Price: Call
RISC Version Available: Call.

Open Access to Process Information.

CIM/21 is an integrated software package capable of both supervisory control and process information management and is based on many years of practical experience, the latest industry standard technology and a clear mission to increase productivity and quality in process operations. The supervisory control components of CIM/21 directly improve process operations by allowing advanced control strategies to be implemented across unit, cell and plant levels. CIM/21 provides the real-time link between high level production management systems and process control. Recipe management, Statistical Process Control (SPC) and real-time process modeling are all features of CIM/21. Implementing CIM/21 can directly increase your profitability by providing every department open access. Connectivity to the desktop is a fundamental feature of CIM/21. Currently CIM/21 supports OLE, NetDDE, and ODBC connections to UNIX based process data servers. Future releases (1994) will support additional core functionality on NT platforms. This high degree of connectivity is possible because CIM/21 employs a true client-server architecture based on industry standards for operating system, communications, databases and display (UNIX, TCP/IP, SQL and X). CIM/21 is not constrained by proprietary hardware or software. The CIM/21 client-server architecture is optimized to take full advantage of the new generation of high-performance, low-cost RISC processors. There are no artificial boundaries between information so you have a complete picture of your operations for maximum benefit. With complete support and development facilities in the US and Europe, CIM/21 is the choice of both domestic and international process manufacturers. CIM/21 is the right architecture, the right technology and the right solution for the 90's and into the 21st century.

Inference Corporation

550 N. Continental Blvd
El Segundo, CA 90245-5052
USA

*ART*Enterprise for Windows NT*

Contact: John Knightly
Phone: (310) 322-0200
FAX: (310) 322-3242

Retail Price: Call company
RISC Version Available: Call.

The Integrated Development Tool for Corporate Computing (TM).

ART*Enterprise is a software application development tool that provides all of the features necessary to prototype, develop and deploy graphical, object-oriented applications in the client/server environment. Offering the greatest flexibility, ART*Enterprise allows developers to build enterprise-wide applications from any of three starting points: the object model; data base; or graphical user interface (GUI). Once the first component is complete, the other two are created automatically by ART*Enterprise's built-in application generators. This approach offers a point-and-click means to building applications that are fully object-oriented and leverage the productivity gains permitted by multiple inheritance, object-oriented data modelling and software reuse. ART*Enterprise features an event-driven, open architecture, allowing creation of applications that link multiple heterogeneous data bases, integrate with other tools and languages, and are fully portable across Windows, Windows NT, Macintosh, OS/2, UNIX and MVS. ART*Enterprise also provides a built-in class library of reusable GUI and multimedia objects, as well as rules and case based retrieval of unstructured information, permitting development of strategic applications. Its high productivity development environment features incremental compilation, debugging and the ART*Enterprise Repository Manager(TM) which facilitates storage of work-in-progress and multi-developer use.

Inference Corporation

550 N. Continental Blvd
El Segundo, CA 90245-5052
USA

CBR Express for Windows NT

Contact: Customer Service
Phone: (800) 322-9923 or (310)-322-0200
FAX: (310) 322-3242

Retail Price: $595.00 - $9,995.00
RISC Version Available: Call.

Application Development Shell for: Help Desk Automation, Knowledge Publishing, and Information Access.

Inference's CBR Express for Windows NT is an exciting tool recognized as the latest in knowledge-based systems technology. Case Based Reasoning is a powerful method for providing users access to consistent answers from unstructured information based on an organization's "cases" or learned experience. CBR Express uses natural language input to create, store, and retrieve cases that represent an organization's knowledge assets such as corporate policies or rules, case histories, problem resolutions, or any other type of discrete objects that need to be stored and retrieved quickly. CBR Express benefits users by allowing even new hires to become more productive sooner with easy access to on-line answers to questions. Inference also markets a high-speed, read-only runtime product, CasePoint, which delivers an organization's information to its end-users or customers.

Informix

4100 Bohannon Drive
Menlo Park, CA 94025
USA

INFORMIX-SE

Contact: Customer Service
Phone: (800) 331-1763 or (415) 926-6300
FAX: (415) 926-6593

Retail Price: Call.
RISC Version Available: Call.

INFORMIX-SE Relational Database Server.

INFORMIX-SE is a high-powered, fully relational database management system based on the ANSI-SQL access language standard. SE provides robust facilities for storage and retrieval of business-critical data, and is the no-worry choice for mid-range installations. Not requiring a database administrator, INFORMIX-SE is well suited for environments where cost is a critical success factor. Standard SQL statements can be used to SELECT, INSERT, UPDATE, and DELETE information in the database through companion language compiler tools such as INFORMIX-4GL, INFORMIX-ESQL/C, INFORMIX-HyperScript Tools, end-user tools such as INFORMIX- ViewPoint, plus a wide selection of popular third-party client tools. INFORMIX-SE is also available on a wide range of systems platforms to provide ultimate portablity and connectivity across a wide range of environments.

Inmark Development Corp.

2065 Landings Drive
Mountain View, CA 94043
USA

zApp for Windows NT

Contact: Sales .
Phone: (800) 3-INMARK
FAX: (415) 691-9099

Retail Price: $495.00
RISC Version Available: Yes.

Portable C++ Application Framework.

zApp for Windows NT is a Portable C++ Application Framework designed to simplify Windows NT development by encapsulating Windows API within 200 optimized, easy to use C++ classes. With single source code compatibility, zApp provides you with portability between Windows, Windows NT, DOS, OS/2 and is planned for Unix X/Motif. Classes include Windows, Dialogs, Controls, Menus, Fonts, Bitmaps, Forms, MDI, Printing, Window Positioning and Memory Management.

Intergraph

1 Madison Industrial Park
Huntsville, AL 35984-0001
USA

ACEPlus Designer

Contact: Charles Paglicco
Phone: (205) 730-2000
FAX: (205) 730-8344

Retail Price: $7,000.00
RISC Version Available: Call.

ACEPlus Designer Electronics Schematic Capture.

ACEPlus Designer is Intergraph's electronic design automation (EDA) schematic software for Windows NT systems. This schematic tool drives and is integrated with a broad array of Intergraph and third-party software products that together address CAE/CAD/CAM electronic design automation needs. EDA applications are also available in DOS/Windows and UNIX versions on Intergraph and Sun workstations and network servers. ACEPlus Designer is the companion product to ACE Plus PC Design Entry, available on PCs with Windows/DOS, and ACE Plus Design Entry System, available on both Intergraph and Sun workstations and their UNIX operating systems. A design is portable among these schematic tool alternatives. Schematic entry is both easy to learn and use with ACEPlus Designer. Editing is as simple as pointing, pressing a button or function key, or making a selection from pull-down, context-sensitive pop-up, and icon-based menus. ACEPlus designer has an optimized database structure to provide improved system performance. Response time is instantaneous for pan and zoom, even on large schematics, for example. ACEPlus Designer was developed for outstanding performance in the Windows NT environment. On-line help is available to guide the new and infrequent user in the edit mode. Macro command files and keyboard entry can be used to accelerate the design process for the experienced user. ACEPlus Designer can be used for mixed or multiple level designs, with phases of a design beginning either top-down or bottom-up or anywhere in between. And, to assist in the design of error free systems ACEPlus Designer includes a built-in schematic rules checker. ACEPlus Designer has available a large library of symbols covering standard digital, analog, and mixed a/d devices, PLDs, FPGAs, and ASICs provided by Intergraph, third parties, and device vendors. Tools are available to create symbols as needed. ACEPlus Designer design databases are 100% compatible with workstation-based schematics. Common data can be shared within a network. Designers can move effortlessly between environments and access EDA tools available as needed for detailed design analysis, verification, simulation, test, layout, or interface to manufacturing. Database access is available as is support of the industry standards for data transfers, such as EDIF for netlists and schematics. Windows NT and ACEPlus Designer can be quickly put to work on the most demanding designs with high confidence in the quality of the design results. Intergraph Background Information: Intergraph Corporation products include a broad range of complementary workstations and network servers, as well as complete

applications- specific systems for computer-aided engineering, design, manufacturing and publishing, plus numerous other earth science applications. A member of the Fortune 500, Intergraph is the world's largest producer of interactive computer graphics systems. Sales Contact number is 1-800-345-4856.

Intergraph

1 Madison Industrial Park
Huntsville, AL 35984-0001
USA

CogoWorks

Contact: Customer Service
Phone: (800) 345-4856 or (205)-730-2000
FAX: (205) 730-2108

Retail Price: $2,000.00
RISC Version Available: Call.

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CogoWorks is the coordinate geometry (COGO) module of Intergraph's MasterWorks suite of applications for architecture, engineering, and construction. CogoWorks provides tools to easily design streets, intersections, cul-de-sacs, and subdivisions. CogoWorks' features include: input, output, and audit trail file processing; customized commands for lot, easement, right-of-way, and setback layouts; street, street-intersection, and cul-de-sac design capabilities, and easy-to-use annotation and reporting capabilities. CogoWorks is fully compatible with RoadWorks and SiteWorks, Intergraph's roadway engineering and site design applications. Intergraph Corporation products include a broad range of complementary workstations and network servers, as well as complete application-specific systems for computer-aided engineering, design, manufacturing and publishing, plus numerous earth science applications. A member of the Fortune 500, Intergraph is the world's largest producer of interactive computer graphics systems.

Intergraph

1 Madison Industrial Park
Huntsville, AL 35984-0001
USA

MicroStation

Contact: Customer Service
Phone: (800) 345-4856 or (205)-730-2000
FAX: (205) 730-2108

Retail Price: $3,450.00
RISC Version Available: Call.

Solutions for the Technical Desktop.

MicroStation is a CAD software package from Intergraph Corporation. It has a rich set of design tools with many advanced productivity features. MicroStation provides complete 2D drafting capabilities, including fully associative dimensioning and hatching, and dimension-driven design. It includes a variety of 3D modeling functions including wireframe, primitive surfaces, and freeform NURBS surfaces. The user can view the model in multiple viewports, including perspective, as well as rendering with multiple light sources, surface textures, and shadow-casting. MicroStation includes utilities to read and write dxf, AutoCAD .dwg, IGES, and CGM files as standard features. MicroStation for Windows NT is fully compliant with the Windows look and feel and sets the standard for CAD programs on Windows. It takes full advantage of the Windows environment, including Cut & Paste, DDE, and OLE. It supports hot links to relational databases for storage of non-graphic attribute data. In addition to Windows NT and Windows 3.1, MicroStation is available for DOS, Intergraph workstations, SUN and HP700 under UNIX, and Apple Macintosh. All versions are fully interoperable, including binary compatible graphic design files. Intergraph Corporation products include a broad range of complementary workstations and network servers, as well as complete application-specific systems for computer-aided engineering, design, manufacturing and publishing, plus numerous earth science applications. A member of the Fortune 500, Intergraph is the world's largest producer of interactive computer graphics systems.

Intergraph

1 Madison Industrial Park
Huntsville, AL 35984-0001
USA

Modular GIS Environment (MGE)

Contact: Customer Service
Phone: (800) 345-4856 or (205)-730-2000
FAX: (205) 730-2108

Retail Price: Call.
RISC Version Available: Call.

MGE provides complete GIS andmapping capabilities.

The Modular GIS Environment (MGE) is a modular solution for capturing, analyzing, and presenting geographic information in applications such as infrastructure and land management, environmental site remediation, transportation modeling, petroleum exploration, and many more. The MGE family consists of a variety of sophisticated, easy-to-use tools that address all of the Geo-Sciences. The system allows specialized modules to be configured with the nucleus product capabilities to create a customized, truly flexible geographic information system. Intergraph Corporation products include a broad range of complementary workstations and network servers, as well as complete application-specific systems for computer-aided engineering, design, manufacturing, and publishing, plus numerous earth science applications. A member of the Fortune 500, Intergraph is the world's largest producer of interactive computer graphics systems.

Intersolv, Inc.

3200 Tower Oaks Blvd.
Rockville, MD 20852
USA

PVCS Configuration Builder

Contact: Customer Service
Phone: (800)-547-PVCS or (301) 230-3200
FAX: (301) 231-7813

Retail Price: $199.00
RISC Version Available: Yes.

Software Configuration Management for Heterogeneous LAN-Based Development.

Functional Description: PVCS Configuration Builder automates the task of constructing a software system. PVCS Configuration Builder shares information with PVCS Version Manager, including all the files, modules, and libraries that comprise a system, which compiler to use for each module, and how to set switches. Footprinting lets users maintain a detailed history of their code by recording information with each compile. This allows conditional processing based on footprinting information and assists with problem tracking.Unique Characteristics: * NMAKE and UNIX MAKE compatible.* Full integration with PVCS Version Manager.* Footprinting of object modules and executables.* Build scripts can be compiled into standalone .EXE's.* Operates on Windows NT, Windows, DOS, OS/2 and UNIX.

Intersolv, Inc.

3200 Tower Oaks Blvd.
Rockville, MD 20852
USA

PVCS Developers Toolkit

Contact: Customer Service
Phone: (800)-547-PVCS or (301) 230-3200
FAX: (301) 231-7813

Retail Price: $499.00
RISC Version Available: Yes.

Software Configuration Management for Heterogeneous LAN-Based Development.

The new PVCS Developer's Toolkit is an application program interface (API) for the software configuration management services of INTERSOLV's PVCS Series. Using the toolkit API, you can integrate the revision control, version control, and build control services of PVCS Version Manager and PVCS Configuration Builder directly into your own software applications. Developer's Toolkit is designed to help you start fast and stay productive: * Sample programs provide a quick start.* Dynamic link libraries (DLLs), linkable libraries, and C header files offer easy access to PVCS services.* Over 30 functions can be called from DLLs or linked routines; each function returns expressive error and result values to your applications.* Functions include file locking, file promotion, merging, and archiving.* Adapts to your environment for immediate productivity; developers can connect full PVCS functionality to any programming interface you use.

Intersolv, Inc.

3200 Tower Oaks Blvd.
Rockville, MD 20852
USA

PVCS Version Manager

Contact: Customer Service
Phone: (800)-547-PVCS or (301) 230-3200
FAX: (301) 231-7813

Retail Price: $499.00
RISC Version Available: Call.

Software Configuration Management for Heterogeneous LAN-Based Development.

Functional Description: PVCS Version Manager is a software configuration management tool that lets you control all of your development objects, including binary files, graphics, and documentation. It controls revisions of individual modules and versions of complex applications. It includes unlimited branching capabilities for parallel development, file locking features to prevent conflicting updates, and extensive reporting facilities. Unique Characteristics: Developers can define and enforce custom promotion structures for each project; supports all development objects, including binary files; supports LAN-based development teams in Windows NT as well as Windows, MS-DOS, many UNIX environments, and OS/2; provides a single file format for all operating systems; supports NLS and Double Byte Character Set (DBCS).

Ithaca Software

1301 Marina Village Pkwy
Alameda, CA 94501
USA

HOOPS A.I.R.

Contact: Customer Service
Phone: (510) 523-5900
FAX: (510) 523-2880

Retail Price: Call
RISC Version Available: Yes.

HOOPS A.I.R.brings the highest quality photorealistic rendering to HOOPS applications.

A.I.R. (Advanced Interactive Rendering) is an add-on module that combines radiosity, ray tracing and scan line rendering methods to produce interactive photorealistic rendering. Based on Hewlett-Packard's ARTCore technology, A.I.R. provides unsurpassed levels of realism. Ray tracing provides transparency, translucency, specular reflection, as well as texture, bump and environment mapping. Radiosity provides fine diffuse shading and allows users to 'fly through' and interactively edit photorealistic scenes. A.I.R. shares HOOPS' unique strengths; portability across all major platforms, ease of declarative programming, and high speed performance. A.I.R. is optimized for Windows NT and Win32 application development and will support Win32s.

Ithaca Software

1301 Marina Village Pkwy
Alameda, CA 94501
USA

HOOPS Graphics Development System

Contact: Customer Service
Phone: (510) 523-5900
FAX: (510) 523-2880

Retail Price: Call
RISC Version Available: Yes.

HOOPS simplifies the creation of interactive and portable 2D and 3D graphics.applications.

HOOPS Graphics Development System is a high-level graphics API used by many of the world's largest software developers, including Autodesk and Computervision. HOOPS' declarative interface reduces development time by five to ten times compared to conventional graphics systems. HOOPS provides a single interface to all major platforms, window managers and graphics devices that lets programmers develop high-performance applications and port them across PCs and workstations without modification. HOOPS includes a hierarchical database, intelligent rendering engine, and an integrated input event manager. HOOPS is optimized for Windows NT and Win32 application development and will support Win32s.Also available in Kanji.

Ithaca Software

1301 Marina Village Pkwy
Alameda, CA 94501
USA

HOOPS I.M.

Contact: Customer Service
Phone: (510) 523-5900
FAX: (510) 523-2880

Retail Price: Call
RISC Version Available: Yes.

HOOPS I.M. extends user control and flexibility by integrating display and immediate mode graphics techniques.

I.M. (Intermediate Mode) is an add-on module that lets users define and represent their own graphical objects and rendering methods. User-defined primitives can be stored in the HOOPS database or directly rendered using portable HOOPS drawing routines. I.M. enhances users' design flexibility and allows for rapid display of large datasets or time-varying data. Like HOOPS, applications that use I.M. are 100% source code compatible across major platforms and take full advantage of advanced graphics display hardware, accelerators and hard copy devices. I.M. is optimized for Windows NT and Win32 application development and will support Win32s.

J.A. Woollam Co.

650 J. StreetSuite 39
Lincoln, NE 68508
USA

WVASE

Contact: Inside Sales
Phone: (402) 477-7501
FAX: (402) 477-8214

Retail Price: $10,000.00
RISC Version Available: Call.

WVASE: Software for the analysis of optical data.

The WVASE program provides a comprehensive tool for the analysis of experimental optical data, including Variable Angle Spectroscopic Ellipsometric data, reflection and transmission (R&T) data, neutron reflection data, etc. A model-based approach is used to analyze the data. The model, which is constructed interactively in the Windows environment, can consist of a multilayer material stack of arbitrary complexity. Fit parameters, such as layer thicknesses, optical constants, etc., are defined, and then a non-linear regression algorithm is used to 'fit' the model generated optical data to the experimental optical data. The Win32s version of the program is 1.5 - 5 times faster than the 16-bit version of the code. The same software is also used to control the J.A. Woollam Co. ellipsometer hardware. The tight integration of the hardware with the data analysis software can provide the user with real-time analysis of the experimentally acquired ellipsometric data, i.e., actual film thicknesses and compositions can be determined while the material is being deposited. The J.A. Woollam Co. ellipsometer hardware/WVASE analysis software combination is targeted for materials research, insitutional deposition monitoring, and quality control applications.

JetForm Corporation

800 South Street, suite 305
Waltham, MA 02154
US

JetForm Server for Windows NT

Contact: Customer Service
Phone: (800) 538-3676
FAX: (613) 594-8886

Retail Price: $1,195.00 for 20 clients, $2,495.00 for unlimited until 11/30/93

RISC Version Available: Call.

The Ultimate Client/Server Forms Processing Solution.

JetForm Server is a client/server forms processing product that automates the entire process of dat JetForm Server forms database library allows for the substituting or updating of forms on a network .

Johnson Properties

PO Box 404230 S. Webster
Omro, WI 54963
USA

JPSMath

Contact: Matthew Johnson
Phone: (414) 685-5523
FAX: (414) 685-5523

Retail Price: $99.00
RISC Version Available: Call.

A 32-bit Math/Science package.

JPS Math is an exciting new Math/Science package from Johnson Properties. It features a calculator simulator based on a popular programmable, hand-held graphics calculator.

JP Software, Inc.

PO Box 1470
East Arlington, MA 02174
USA

4DOS for Windows NT

Contact: Customer Service
Phone: (800) 368-8777
FAX: (617) 646-0904

Retail Price: $79.00
RISC Version Available: Call.

New version of JP Software's award-winning 4DOS command processor, tailored specifically for Windows NT and offering a wide range of command-line capabilities. Substantially enhances usefulness and productivity of the command line.

4DOS for Windows NT is a complete, compatible replacement for the default Windows NT command processor (CMD.EXE), offering unparalleled power and flexibility at the command prompt and in batch files. It enhances most Windows NT commands, and adds over 80 new commands, variables, and functions to aid everyone from novice users to experienced batch programmers. Features include command-line editing, command history and recall, user-defined aliases for common commands, and file descriptions up to 120 characters long for FAT, NTFS, and HPFS files. 4DOS for Windows NT is fully compatible with CMD.EXE and with 4DOS, JP Software's award-winning command processor for MS-DOS.

JPN Associates

5848 Acacia CircleSuite A120
El Paso, TX 79912
USA

EIFFELCASE for Windows NT

Contact: Chacko Kurian
Phone: (915) 584-3020
FAX: (915) 584-2160

Retail Price: Call
RISC Version Available: Call.

Analysis and design workbench for ISE EIFFEL 3 for Windows NT.

EIFFELCASE for Windows NT is the Analysis and Design workbench for ISE EIFFEL 3 for Windows NT. It covers the full lifecycle of software modeling, design and user-developer communication.It assists in preparing, documenting and tracking identified object oriented system elements and their relationships from preliminary specifications to the programming phase. Based on the Better Object Notation (BON), EIFFELCASE provides clear notation and a set of methodological guidelines for analysis & design in the EIFFEL spirit of precision, scalability and clarity. BON supports structure AND semantics. It also enables textual and graphical elements to be stored and manipulated.

JPN Associates

5848 Acacia CircleSuite A120
El Paso, TX 79912
USA

ISE EIFFEL 3 for Windows NT

Contact: Chacko Kurian
Phone: (915) 584-3020
FAX: (915) 584-2160

Retail Price: Call.
RISC Version Available: Call.

Purely Object Oriented toolset and development environment.

ISE EIFFEL 3 for Windows NT is a second generation OBJECT ORIENTED development environment and toolset to build large scale commercial application systems.It consists of integrated components and libraries, based on the EIFFEL object oriented language, enabling a seamless approach to robust software development. The toolset consists of: EIFFEL BENCH - a programmers workbench EIFFEL BUILD - an interactive application & GUI builder.EIFFEL VISION - a Graphics library for windowing.EIFFEL STORE - a class library for interfaces with OODBMS and RDBMS.EIFFEL BASE - basic EIFFEL libraries of well tested, re-usable components. EIFFEL LEX - a library for lexical analysis.

KEA Systems Ltd.

3738 N. Fraser WayUnit 101
Burnaby , British Columbia V5J 5G1
Canada

KEAterm 340 for Windows NT

Contact: Carlo Rossetti
Phone: (800) 663-8702 or (604) 431-0727
FAX: (604) 431-0818

Retail Price: $445.00
RISC Version Available: Call.

PC-to-Host Connectivity.

KEAterm VT340 emulation for Windows NT is a powerful link to VAX and UNIX host applications. Users can maintain access to host applications while enjoying Windows NT's many advantages: optimized performance, increased responsiveness, security, portability, scalability, and reliability. The on-screen display of ReGIS, Tektronix and sixel graphics will be able to be copied and pasted between other Windows NT-based applications as they become available. KEAterm 340 is part of the KEAterm product family which includes VT420 and VT340 emulation for Microsoft Windows and Windows NT. Users can run multiple host and PC applications, and transfer files and data using simple dialog boxes and pull-down menus. KEAterm products feature multiple sessions, multiple pages, coupling and downloadable fonts. KEAterm also supports Dynamica Data Exchange (DDE) and has many extensions inlcuding ISO language support and file transfer. Advanced features include: macro language; phone directory; and user-definable, on-screen buttons and dialog boxes.

KEA Systems Ltd.

3738 N. Fraser WayUnit 101
Burnaby , British Columbia V5J 5G1
Canada

KEAterm 420 for Windows NT

Contact: Carlo Rossetti
Phone: (800) 663-8702 or (604) 431-0727
FAX: (604) 431-0818

Retail Price: $295.00
RISC Version Available: Call.

PC-to-Host Connectivity.

KEAterm VT420 emulation for Windows NT is a powerful link to VAX and UNIX host applications. Users can maintain access to host applications while enjoying Windows NT's many advantages: optimized performance, increased responsiveness, security, portability, scalability, and reliability. KEAterm 420 is part of the KEAterm product family which includes VT420 and VT340 emulation for Microsoft Windows and Windows NT. Users can run multiple host and PC applications, and transfer files and data using simple dialog boxes and pull-down menus. KEAterm products feature multiple sessions, multiple pages, coupling and downloadable fonts. KEAterm also supports Dynamica Data Exchange (DDE) and has many extensions inlcuding ISO language support and file transfer. Advanced features include: macro language; phone directory; and user-definable, on-screen buttons and dialog boxes.

Kenan Technologies

One Main Street5th Floor
Cambridge, MA 02142
USA

Acumate ES

Contact: Joseph Frio
Phone: (800) 775-3626 or (617) 225-2200
FAX: (617) 225-2220

Retail Price: Call
RISC Version Available: Yes.

ACUMATE turns corporate data into information.

ACUMATE is the solution for any data integration and analysis problem, providing true Executive Information System (EIS) and Decision Support System (DSS) capabilities. Lack of data isn't a problem anymore. The challenge is unlocking the information trapped in that data, analysing it, and quickly using it to increase your company's competitive advantage. Because the information needed to answer complex business questions is often difficult to extract from traditional two-dimensional data representations, your decision makers may not be getting the information they need from your relational databases. ACUMATE is a powerful environment for slicing and dicing data along any number of dimensions. ACUMATE can easily integrate large quantities of data from different data sources in different environments. Users can then drill down, roll up, and rotate through different views of the data, for quick, clear answers to critical business questions.

Knowledge Garden Inc.

Stony Brook Technology Center12 Technology Drive, Suite 8
Setauket, NY 11733
USA

KnowledgePro for Windows NT

Contact: Brian Pioreck
Phone: (516) 246-5400
FAX: (516) 246-5452

Retail Price: $795.00
RISC Version Available: Yes.

High-level OOP development with Expert Systems.

KnowledgePro for Windows (KPWin) is a high-level, objected-oriented environment for developing fast, runtime free Windows applications. Chosen by PC Magazine as Best of 1990, KPWin uniquely integrates visual design tools, a full-featured OOP language, hypertext, multimedia and expert systems capabilities into one easy to use tool. Unlike a high-level language that's too slow and limiting, or a low-level language that's too hard to use, KPWin strikes a balance of functionality, performance and ease-of-use. KPWin supports DDE as both client and server and permits DLL access at the C pointer level. Toolkits for adding Database, SQL and Math capability are available.

KnowledgeWare, Inc.

3340 Peachtree Rd., NESuite 1100
Atlanta, GA 30326-9826
USA

AccessWare

Contact: Customer Service
Phone: (800) 444-8575 or (404) 231-8575
FAX: (404) 364-0883

Retail Price: $2,195.00 - $4,995.00
RISC Version Available: Call.

AccessPoint process control software provides function with flexible capacity.

AccessPoint is a supervisory process and manufacturing runtime monitor and control software. Easy to configure with graphical realtime displays and historical database and alarm records from programmable logic controllers and other I/O devices. DDE-Path and control actions enables advanced automation.

Kofax Image Products, Inc.

3 Jenner Street
Irvine, CA 92718
USA

Kofax Image Processing Platform (KIPP) for Windows NT

Contact: Brian Finnegan
Phone: (714) 727-1733
FAX: (714) 727-3144

Retail Price: $1,495.00
RISC Version Available: Call.

Kofax Image Processing Platform (KIPP).

The Kofax Image Processing Platform (KIPP) is a comprehensive set of hardware and software that serves as a platform for the development of PC-based document imaging systems. KIPP consists of software development tools and hardware image processing engines for image caputre, retrieval, manipulation and printing as well as peripheral control.

LBMS, Inc.

1800 West Loop SouthSuite 1800
Houston, TX 77027
USA

Process Engineer

Contact: Peter Combe
Phone: (713) 623-0414
FAX: (713) 623-4955

Retail Price: Call
RISC Version Available: Yes.

Process Management solutions for Windows NT.

Process Engineer provides methodology automation, project planning and estimating using an SEI-based architecture. Process Engineer is targeted at organizations implementing methodology and TQM with automated delivery. The Process Manager's component creates and maintains processes in the LAN-based multi-user library. Project managers use the Project Manager's component to retrieve processes and build project plans. These plans can be estimated, and exported to scheduling tools like Microsoft Project for Windows NT.

LBMS, Inc.

1800 West Loop SouthSuite 1800
Houston, TX 77027
USA

Systems Engineer

Contact: Peter Combe
Phone: (713) 623-0414
FAX: (713) 623-4955

Retail Price: Call.
RISC Version Available: Yes.

.

Systems Engineer (SE) is a comprehensive set of open, integrated client/server CASE tools that address the full software lifecycle -- from planning and design to code generation, re-engineering and maintenance. SE runs under Microsoft Windows NT to provide ease-of-use in workgroup development environments as well as for individual users. All SE products share a common LAN-based repository that allows seamless integration between SE tools. SE products support industry standards and interoperate seamlessly with products from other leading application development software vendors. Applications designed with SE can be generated and deployed on both client/server and host/terminal architectures.

Mach 2 Systems, Inc.

5125 North 16th StreetSuite C138
Phoenix, AZ 85016
USA

Error and Message Logging Facility

Contact: Josette van Stiphout
Phone: (602) 266-7656
FAX: (602) 266-5808

Retail Price: $295.00
RISC Version Available: Call.

Fully featured error and message logging system for Windows 3.1 and Windows NT.

Enhance your application with a professional, full featured error and message loggin facility where logging of information is extremely useful during application development of Windows NT 32-bit applications. Only a single function call is required to log a message to both screen and disk. Full specification of each message layout and contents including date and time stamp, make of the application, line number in the source code file and source filename in which the error occurred.

Mark V Systems, Ltd.

16400 Ventura BlvdSuite 303
Encino, CA 91436-2123
USA

MethodMaker

Contact: Mo Bjornestad
Phone: (818) 995-7671
FAX: (818) 995-4267

Retail Price: $10,000.00
RISC Version Available: Call.

MethodMaker(R) is an advanced meta tool for creating CASEtool support for new methods.

MethodMaker(R) is a rule-driven repository-based meta tool for graphically creating and maintaining CASEtool support for software engineering and process modeling methods and notations.

Mark V Systems, Ltd.

16400 Ventura BlvdSuite 303
Encino, CA 91436-2123
USA

ObjectMaker

Contact: Mo Bjornestad
Phone: (818) 995-7671
FAX: (818) 995-4267

Retail Price: $3,000.00 - $5,000.00
RISC Version Available: Yes.

Integrated object-oriented CASE.

ObjectMaker is a new generation Meta CASE tool which offers developers broad, off-the-shelf support for more than 25 Object-Oriented and Traditional methods, multi-language Code Generation, Reverse Engineering, and the ability to use the Tool Development Kit to construct a user specific Custom tool. Methods supported as published include ADARTS, BAILIN, BERARD, BOOCH, BUHR, CHEN, COAD-YOURDON, COLBERT, CONSTANTINE, DEMARCO, FIRESMITH, GANE-SARSON, HAREL, HATLEY-PIRBHAI, PAGE-JONES, RUMBAUGH, SHLAER-MELLOR, etc.

Mark V Systems, Ltd.

16400 Ventura BlvdSuite 303
Encino, CA 91436-2123
USA

ProcessMaker

Contact: Mo Bjornestad
Phone: (818) 995-7671
FAX: (818) 995-4267

Retail Price: $3,000-5,000
RISC Version Available: Yes.

ProcessMaker(R) supports more than 15 notations for enterprise, workflow, decision support, and process modeling.

ProcessMaker(R) supports decision and process modeling for enterprise, workflow and software engineering. Additional notations, extended concepts, templates, semantics and relationships can be implemented using MethodMaker(R).

MathSoft, Inc.

201 Broadway
Cambridge, WA 02139
USA

Mathcad for Windows

Contact: Customer Service
Phone: (800) 628-4223 or (617) 577-1017
FAX: (617) 577-8829

Retail Price: $495.00
RISC Version Available: Yes.

Do more math faster, easier and more accurately!

New Mathcad 4.0 makes your life easier with quick power to do a wide range of technical calculations. Add graphs, math and explanatory text anywhere on the page. Enter your calculations and you're done-Mathcad does the work for you. Print your results in real math notation. Mathcad's unique 'live document interface' gives you the 'what-if' power of a spreadsheet with the WYSIWYG and graphical power of a word processor. Mathcad 4.0 has unique new SmartMath, our new programmed-in rules processor. SmartMath does the early-state decision making and calculations, freeing up your time to do the creative problem-solving, fun work. If a formula isn't in the form you need, for example, SmartMath simplifies your equation using the powerful built-in Maple symbolic processor to solve any equation symbolically. To save more time, Mathcad's Electronic Handbooks give you hundreds of formulas, facts and explanations you can cut and paste right into your work. Electronic Handbooks are available for a variety of disciplines and are based on the well-known handbooks you've been using for years. Mathcad 4.0 Features: Operators. Includes a variety of operators to perform iterated sums and products, take definite integrals and derivativew of nearly any mathematical operation: square root, factorial, absolute value. Graphs. Click on the Graph button and fill in the blanks for precise graphs in most shapes, sizes, varieties.2D-3D plots. Includes a variety of 2D & 3D plots: log-log, semi-log, plot trace options, surface, and new polar and contour plots. DDE and OLE Client Support. 'Live Link' Mathcad numbers with word processing documents and spreadsheets. Units. Automatically convert different units in a formula, or convert results to any desired unit system. Vectors & Matricies. Includes all the operators you need: multiplication, determinants, eigenvalues and eigenvectors.

mbp Software and Systems Technology, Inc.

1131 Harbor Bay ParkwaySuite 260
Alameda, CA 94501
USA

Visual COBOL for Windows NT

Contact: Micheal Hicks
Phone: (800) 231-6342
FAX: --

Retail Price: $2,495.00
RISC Version Available: Yes.

Visual COBOL for Windows NT includes, a powerful GUI screen design system, direct interface to Windows printer routines and fonts, and multi-user support, in order to develop powerful, native code, Windows NT applications.

Visual COBOL is an optimized high level ANSI-85 native code COBOL compiler and is fully compliant with the X/Open portability gude and IBM SAA. Many language extensions are included to enhance application program development, including a high level of compatibility with IBM VS COBOL II. It is a fully featured production environement that includes an integrated set of programming tools to develop, compile, debug, and test COBOL applications for use in PC, Open Systems, Client/Server, Cross Development, or Downsizing situatiuons.

McGill University

805 Sherbrooke Street WestRoom 200
Montreal, Quebec
Canada

TCP 3270 for Windows NT

Contact: Pierre Goyette
Phone: (514) 398-7354
FAX: (514) 398-6876

Retail Price: $500.00 educational
$900.00 corporate site license.

RISC Version Available: Call.

TCP3270 is a high-performace 3270 emulator for Windows NT.

TCP3270 for Windows NT is a full featured 3270 emulator. It uses NT's built-in Winsock support for advanced TCP/IP connectivity. The workstation program offers a number of unique features including multiple sessions, extended data streams, Entry Assist, drag-and-drop text editing, definable hotspots, tool bars, button bars, and support for ALA for use with NOTIS. TCP3270 uses true-type font technology to support any screen size of your choice including screens containing ALA characters and diacritics. TCP3270 supports all languages by allowing you to modify the EBCDIC/ASCII translate tables.

Media Vision

3185 Laurelview Court
Freemont, CA 94538
USA

Pellucid OpenGL SDK for Windows NT

Contact: Herb Kuta
Phone: (408) 987-0315
FAX: (408) 986-8378

Retail Price: $995.00
RISC Version Available: Yes.

3D Application Development Environment under Windows NT NOW!

Originally developed by Silicon Graphics, OpenGL is the industry's leading graphics library for 3D application development. Designed for realtime 3D rendering and object manipulation, OpenGL has been adopted by leading vendors including Silicon Graphics, IBM. Intergraph, Digital Equipment Corporation, and Microsoft. To be incorporated into a subsequent release of Windows NT by Microsoft, OpenGL will enable high performance 3D graphics under the worlds' most advanced desktop operating environment. The Media Vision OpenGL SDK for Windows NT enables ISVs and institutional developers to develop and test OpenGL-based, 3D applications under Windows NT in advance of the release of OpenGL by Microsoft. Compliant with the OpenGL Graphics Library Specification published by Silicon Graphics and Addison-Wesley as well as the Microsoft WGL specification for the OpenGL to Windows NT interface, Media Vision's OpenGL SDK provides 3D application developers with the tools necessary to develop, test, and ship real time 3D applications in both Intel and RISC-based environments.SDK Contents: - Pellucid OpenGL for Windows NT DLL and Header Files. - Addison Wesley OpenGL Reference Manual - On-line help via standard Windows help - Release Notes and Guide for Usage with Windows NT - Sample Programs and DemonstrationsDistributor and OEM pricing available.

Mercury Interactive

3333 Octavius Drive
Santa Clara, CA 95054
USA

TestRunner for Windows NT

Contact: Moshe Egert
Phone: (408) 987-0100
FAX: (408) 982-0149

Retail Price: Call
RISC Version Available: Yes.

TestRunner for Windows NT is a completely non-intrusive software verification and validation tool designed to help automate the process of testing and ensure software quality in Windows NT-based applications.

TestRunner for Windows NT, an advanced, universal language multi-platform solution, consists of a PC loaded with Mercury's testing program and database and special digital processing hardware that acquires screen, keystroke, and mouse data. TestRunner for Windows NT automatically enters required input, monitors results, compares actual with expected results and records relevant errors. TestRunner for Windows NT is uniquely Output Synchronized (driven by a patented digital signal processing vision system), guaranteeing successful test execution. TestRunner for Windows NT supports testing of all Microsoft Windows NT- based applications regardless of development language or GUI builder.

Mercury Interactive

3333 Octavius Drive
Santa Clara, CA 95054
USA

WinRunner for Windows NT

Contact: Scott Bradley
Phone: (408) 987-0100
FAX: (408) 982-0149

Retail Price: Call
RISC Version Available: Yes.

WinRunner is an advanced software testing tool designed to help automate the process of testing and ensure software quality in Windows NT-based applications.

Utilized throughout all phases of the development life-cycle, WinRunner for Windows NT supports interactive test creation through programming and/or recording (context-sensitive recording automatically interprets user operations based on context, such as selecting an item from a menu; analog recording records exact keyboard and mouse movements). WinRunner for Windows NT assures automatic verification using Output Synchronization (independent of window position or size, or time delay), text recognition, report generation, and error review. WinRunner for Windows NT supports testing of all Microsoft Windows NT-based applications regardless of development language or GUI builder.

Metro Link, Inc.

2213 W. McNab Road
Pompano Beach, FL 33069
USA

Metro-X/NT Development

Contact: Garry Paxinos
Phone: (305) 970-7353 ext. 402
FAX: (305) 970-7351

Retail Price: $299.00
RISC Version Available: Call.

Metro-X/NT : X11.5 Window System for Windows NT.

Metro-X/NT si a complete, highly optimized implemetation of Version 11 Release 5 of the X Window System from M.I.T. The Metro-X Devlopment System includes OSF/Motif 1.2, as well as all the standard MIT toolkits and libraries. When it comes to reliability, Metro-X is time tested and proven in the most demanding of environments such as process control, factory automation, medical imaging, battlefield command and control, aviation cabin management systems, nuclear fail safe systems and scientific modeling environments. Metro-X is current to the latest patches supplied by the X Consortium, and updates will be made available whenever new patches are released. Combined with it's increased speed and it's extensive array of graphics card support, the Metro-X server environment provides users with the latest is X Window functionality. Metro-X is also available for ISC, AT&T, SCO, ODT, all SVR4's, UnixWare, Venix, LynxOS, QNX, SunOS, Solaris 2.x and CTRX (Harris).

Microcom, Inc.

1 Executive Blvd, suite 4
Yonkers, NY 10701
US

LANlord for Windows NT

Contact: Muki Murthy
Phone: (914) 377-2704
FAX: (914) 968-7100

Retail Price: $2,499.00 per 50 users
RISC Version Available: Call.

LANlord: Desktop Management, from the Workgroup to the Enterprise.

LANlord is an integrated desktop management software system that enables network managers to centrally monitor, control and configure remote PC hardware and software, including Microsoft Windows and Windows NT, in realtime. It combines the multiple applications required to manage networked DOS and Windows PCs, and provide user support, into a single package whose features can be accessed through a common Windows-based graphical user interface. LANlord includes the following applications: Automatic Inventory: Provides network mangagers with centarlized control of network PC assets. Remote PC hardare & software is automatically discovered. Remote Control: Allows companies to reduce on-site personnel requirements and provide cost effective user support Network & PC Monitoring: Allows companies to manage PCs pro-actively by identifying potential problems before they occur. Software Metering: Assists in researching and reporting on MS-DOS and Windows-based application usage and ensure compliance with software licensing agreements and improve software purchasing decisions. Virus Detection & Repair: Provides centralized detection and treatment of more than 1300 PC viruses. Reporting & Data Export: Provides network managers with expanded flexibility in developing reports and presentations, through support for standard export formats and pre-formatted reporting options.

MicroEdge Inc.

P.O. Box 18038
Raleigh, NC 27619-8038
USA

SlickEdit

Contact: Inside Sales
Phone: (800) 934-EDIT or (919) 790-1691
FAX: (919) 831-5586

Retail Price: $195.00
RISC Version Available: Yes.

SlickEdit has been shipping for Windows NT since May of 1991. Order today and find out why Dave Cutler, architect and director of Windows NT development, says "SlickEdit is the only editor I use."

SlickEdit v2.3 for Windows NT is a feature rich, easy to use programmer's editor that includes a powerful macro language and a programmable file manager. Features include mouse support, hypertext help (entire manual on-line), undo/redo to 32,000 steps, incredible procedure tagging, compiler error message processing, syntax expansion and indenting, CUA marking, multiple windows, multiple clipboards, Microsoft C 6 & 7 browse support, and more! Simultaneously edits Macintosh, UNIX, and DOS ASCII format files. SlickEdit is completely configurable and has comprehensive Brief 3.1 and Emacs emulation (not just key reassignments). Watch for Visual SlickEdit for Windows NT and Windows 3.1 coming this December! Also available for DOS, OS/2, and many UNIX platforms. Full 30-day guarantee.

MicroProcessor Engineering Ltd

133 Hill LaneShirley
Southampton, SO1 5AF
UK

PowerForth/386 for Windows NT

Contact: Roy Goddard
Phone: (44) 703 631441
FAX: (44) 703 339691

Retail Price: Call.
RISC Version Available: Call.

MPE PowerForth/386 for Widows NT.

PowerForth/386 for Windows NT is a 32-bit Forth development environment for Windows NT and Win32s applications. It allows users to interactively test and produce Windows applications. All standard Windows functions of Windows, dialog boxes, menus, graphics, etc. are supported, with the benefit of interactive debugging for rapid development. This system provides a full development system, and does not require tools other than Windows NTitself.

MicroQuill Software

4900 25th AVE. NE #206
Seattle, WA 98105
USA

Performance Tracer

Contact: Inside Sales
Phone: (206) 525-8218
FAX: (206) 525-8309

Retail Price: $495.00
RISC Version Available: Call.

Application wide call-tree profiler. Picks up absolutely every call in a single pass. Reports include call-tree history, function times and frequencies and more. Great for coverage analysis.

Performance Tracer traces C/C++ EXEs, DLLs, and multi-threaded programs. It is the only profiler available that traces an entire application at once, regardless of size, and captures every call including those through pointers and call-backs. Reports include: A complete call tree history showing every function, including those called through messages, pointers, or call-backs.Every function called by, or calling, a given function.The execution time of every instance of each function, including minimum, maximum, total, and average times.Frequencies for each function.All functions not exercised.All function calls that could have occurred but did not.Data also available in ASCII format for custom analysis.

MicroQuill Software

4900 25th AVE. NE #206
Seattle, WA 98105
USA

SegMentor

Contact: Inside Sales
Phone: (206) 525-8218
FAX: (206) 525-8309

Retail Price: $2,795.00
RISC Version Available: Call.

SegMentor optimizes the allocation of functions to code pages so that disk swapping is minimized. Increases performance 2-10x in tight memory conditions.

SegMentor traces the function calling activity of the application to build a database of every function call and how frequently it occurs. This database is then run through simulated annealing algorithms to compute an optimal solution that groups those functions calling each other most often into the same page. Finally, SegMentor automatically integrates the final optimized map back into the executable, without changing the source. The application winds up with dramatically fewer cross-page function calls. SegMentor can accommodate very large (5MB+ exe) and multi-threaded C and C++ applications. Works with most vendor's C/C++ compilers. Many commercial software vendors are users of this product.

MicroQuill Software

4900 25th AVE. NE #206
Seattle, WA 98105
USA

SmartHeap

Contact: Inside Sales
Phone: (206) 525-8218
FAX: (206) 525-8309

Retail Price: $695.00
RISC Version Available: Call.

Fast, optimum memory management library with comprehensive error detection and debugging.

SmartHeap(tm) V. 2.0 is a malloc (and operator new) which is faster in physical memory, and scales well to very large heap sizes, even when allocations exceed currently free physical memory. Benchmarks show SmartHeap is 3-100X faster. Plus, SmartHeap does not sacrifice space or incur unnecessary fragmentation in exchange for speed. In addition to malloc, SmartHeap has numerous fixed-size and handle-based allocators, supports multiple pools to improve locality and further eliminate fragmentation, and includes a debugging mode with exhaustive heap error detection. SmartHeap links into your app in minutes, and includes a 300+ page manual. Used by a "who's who" of commercial software vendors. Guaranteed faster, more reliable, and to have more exhaustive heap error detection than ANY memory manager you are using -- or your money back. No royalties. Source Available.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft FORTRAN Powerstation for Windows NT

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: Call.
RISC Version Available: Call.

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Microsoft FORTRAN PowerStation 32 for Windows NT is a powerful 32-bit FORTRAN development system that harnesses the power of Windows NT and enables you to use Intel-based PCs to solve large, complex problems that previously required a mainframe, minicomputer or Unix workstation. It offers you unparalleled price/performance because you get comparable performance at a much lower cost. It enables you to protect and enhance your investment in existing FORTRAN code because you can port your applications to PCs from other hardware platforms with little or no modification.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft Macro Assembler Professional Development System (MASM) version 6.11

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: $249.00
RISC Version Available: Call.

Provides developers with a complete solution for optimizing protected-mode applications for Windows NT, Windows 3.1 and 16- and 32-bit MS-DOS operating systems.

This newest version of MASM features hosting on Windows NT, support for Pentium and Windows NT-compatible utilities including Cross-Reference (CREF) and C-header-file to MASM-include file (H2INC). Applications for Windows NT developed with MASM 6.11 can now be assembled, linked and debugged completely within the Windows NT environment. In addition, assembly code created in MASM 6.0 or 6.1 does not require modification for compatibility with MASM 6.11.When used in conjunction with the appropriate Software Development Kit (either Windows 3.1 or Windows NT, depending on which environment is being targeted) or with Visual C++, MICROSOFT MASM 6.11 lets developers build highly optimized applications for Windows or Windows NT. MASM 6.11 also includes a full set of development tools -- an editor, compiler, linker, debugger and browser -- for writing, compiling and debugging assembly-language programs. Tools can be used separately or within the MICROSOFT Programmer's WorkBench integrated environment. MASM 6.11 ships with Programmer's WorkBench version 2.1 which includes an editing environment, a browser, and an extensive online help facility.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft SNA Server for Windows NT

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: Call.
RISC Version Available: Yes.

Microsoft® SNA Server for Windows NT combines client-server architecture with the power and productivity of Windows NTTM to deliver advanced connectivity between LANs and SNA networks.

Microsoft SNA Server for Windows NT makes enterprise-wide connectivity easy and economical. SNA Server offers PC users reliable and secure access to IBM® host computing with the familiar user interface of desktop PCs and the flexibility of modern LAN systems.By employing advanced client-server architecture to distribute the communications processing, SNA Server maximizes the power of your host computers and desktop PCs. Each PC uses standard LAN protocols to connect to one or more servers. The servers then provide shared links to host computers using SNA protocols which carry the bulk of the communications workload, thus reducing the storage and processing requirements on desktop PCs. SNA Server offers advanced tools for easy system setup, and centralized graphical administration, regardless of the desktop PC operating system, LAN operating system, and SNA host connection or host type.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft SQL Server for Windows NT

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: Starts at $995.00
RISC Version Available: Yes.

Client-Server Database Management System for Windows NT.

Take advantage of distributed client-server technology with Microsoft SQL Server for the Windows NT operating system. It's the high-end database platform that delivers line-of-business solutions on today's corporate networks -- all within a powerful, reliable and open client-server architecture that builds on your computing investment.High performance design: Access up to 2 gigabytes of memory and multiple terabytes of disk storage through a powerful 32-bit architecture.Scalable Symmetric Server Architecture: Assure a high degree of scalability across single-processor or multiprocessor hardware by balancing user tasks dynamically across processors.System management: Install, configure, and administer SQL Server for Windows NT with minimal effort, locally or remotely, using the graphical tools.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft Visual C++ for Windows and Windows NT

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: $599.00
RISC Version Available: Call.

Development System for Windows and Windows NT.

The Microsoft Visual C++ development system, 32-bit Edition, brings the power and productivity of Visual C++ to Windows NT. You get a reusable, high-level class library with source code, a visual environment, integrated debugging tools, "wizards" to assist you with fundamental tasks, and more -- all working in unison to shorten your development process.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft Win32 Software Development Kit (SDK)

Contact: Inside Sales
Phone: (800) 426-9400
FAX: (206) 635-6100, Dept. 1117

Retail Price: Call.
RISC Version Available: Yes.

Tools for Writing 32-Bit Applications for Windows.

The Microsoft Win32 Software Development Kit (SDK) offers the tools and information you need to develop powerful, 32-bit applications and drivers for the popular Microsoft Windows family of operating systems.The Win32 API offers a widened, 32-bit implementation of the Windows operating system 3.1 API, maiking it easy to move existing applciations for Windows 3.1 to Win32.Create powerful applications using features fo the Win32 API, including a 32-bit flat memory model, memory protection, multithreading, preemptive multitasking, synchronization objects, Bezier curves, paths, Remote Procedure Calls (RPC), Windows Sockets, Network DDE, and structured exception handling.Access the complete API references, driver interface references, and tools documentation in Window Help format on CD-ROM.

Microsoft Corporation

One Microsoft Way
Redmond, WA 98052-6399
US

Microsoft Windows NT Advanced Server upgrade for LAN Manager

Contact: Microsoft Sales
Phone: (800) 227-4679
FAX: (206) 635-6100, Dept. 1117

Retail Price: $595.00
RISC Version Available: Yes.

The Windows NT Advanced Server upgrade includes Windows NT Advanced Server and a set of automated, easy-to-use tools, with online Help and extensive documentation for pre-upgrade planning. A graphical user interface that runs on both the LAN Manager and Windows NT Advanced Server intuitively walks users through the upgrade process. Users can also create batch files for customized work. The upgrade will enable users to upgrade from LAN Manager version 2.0c and higher servers.The upgrade will allow for the reliable transfer of user accounts and associated permissions, restoration of the LAN Manager environment (including Scheduled Commands, UPS, Shared Directories, Network Connections, Network Services), back-up data to tape or another network server, reliable file-system conversion, upgrade Services for Macintosh*, seamless implementation of single network logon, and the ability to generate a log of all changes to validate the upgrade for completeness.Customers can choose to perform an "in-place" upgrade on the same machine or a "clone" upgrade to another Windows NT Advanced Server-compatible x86, Pentium™, R4000® and R4400, or Alpha AXP™ machine.The upgrade is available for a suggested retail price of $595 to all users of LAN Manager for OS/2*, LAN Manager for UNIX* Systems, IBM* LAN Server, 3Com* 3+Open* or 3+Share*. The automated tools, included with the upgrade, have been designed to upgrade Microsoft LAN Manager for OS/2 servers to Windows NT Advanced Servers. The upgrade can be obtained through retail outlets, resellers, Microsoft Solution Providers and from original equipment manufacturers (OEMs). For more information, please call (800) 227-4679.

MKS Inc.

35 King St. North
Waterloo, ON N2J 2W9
Canada

MKS Toolkit

Contact: Chuck Lownie
Phone: (519) 884-2251
FAX: (519) 884-8861

Retail Price: $299.00
RISC Version Available: Yes.

Essential development tools for programmers.

MKS Toolkit is a complete set of the most powerful UNIX utilities available for Windows NT. MKS Software construction tools include: Make, awk, an awk compiler, and new Windows icons for Toolkit commands such as SH, VI, AWK, FIND, GREP, and MAN. The MKS Kornshell provides many time saving features such as command aliasing, command recall and control structures. MKS Vi is a complete implementation of the popular and powerful Vi full-screen editor.MKS Toolkit also offers raw device support for data interchange with any diskette written on a DOS system or 386 UNIX system, variable install for loading all or only part of MKS Toolkit, and complete on-line reference documentation.

Mozart Systems Corporation

1350 Bayshore HighwaySuite 630
Burlingame, CA 94010
USA

MOZART

Contact: Andrew Lev
Phone: (415) 340-1588 ext. 222
FAX: (415) 340-1648

Retail Price: $6,000.00
RISC Version Available: Call.

MOZART(TM) is a set of advanced Progressive Application Renovation(TM) development tools that facilitate the transition from host-based applications to client/server.

Mozart Systems' Progressive Application Renovation(TM) is designed to enable companies to modernize host applications with a powerful graphical interface. With Progressive Application Renovation and its primary tool, Mozart(TM), companies can achieve many of the key advantages of client/server computing immediately -- with their existing platform technology. Moreover, the Progressive Application Renovation approach leaves open all major options for future platforms and architectures. Also, it significantly reduces ongoing maintenance costs. Using MOZART's advanced functionality, developers have modified applications in a fraction of the time required in different environments. MOZART is a true multi-platform: all applications developed with MOZART run transparently without modification under Windows, DOS, OS/2 and Windows NT. The systems also includes SQL support for major relational database management systems, including ORACLE, Microsoft SQL Server and OS/2 DB Manager.

National Instruments

6504 Bridge Point Parkway
Austin, TX 78730-5039
USA

LabVIEW for Windows NT

Contact: Inside Sales
Phone: (512) 794-0100
FAX: (512) 794-5357

Retail Price: $2,995.00
RISC Version Available: Call.

General-purpose graphical programming tool with graphical user interface tools.

With LabVIEW for Windows NT, engineers and scientists build software modules called virtual instruments (VIs) instead of writing cryptic text-based programs. LabVIEW features a library of ready-to-use controls, graphs, and strip charts for quickly and easily building custom user interfaces and control panels. With LabVIEW, users build block diagrams as the executable programs in applications such as process monitoring and control, laboratory automation, and automated testing. The LabVIEW Data Acquisition VI Library conrols the company's PC plug-in data acquisition, DSP, and signal conditioning hardware. LabVIEW also has libraries for controlling over 115 RS-232, GPIB, and VXI instruments.

National Instruments

6504 Bridge Point Parkway
Austin, TX 78730-5039
USA

NI-488.2M for Windows NT

Contact: Inside Sales
Phone: (512) 794-0100
FAX: (512) 794-5357

Retail Price: Call
RISC Version Available: Call.

High-performance IEEE 488.2 driver software.

NI-488.2M for Windows NT includes the industry-standard set of NI-488 functions and a set of routines that duplicate the IEEE 488.2-specified sequences and protocols. New driver features include 'Smart I/O', that automatically selects the most effecient data transfer method (either DMA or Programmed I/O) depending on the transfer size. NI-488.2M for Windows NT includes a language interface library for the Windows NT version of the Microsoft C compiler. For other languages, a dynamic-link library (DLL) provides a set of direct entry points that you can access through any application that can access 32-bit DLLs. The NI-488.2M software package includes configuration and debugging utilities, as well as a completely new documentation set.

National Instruments

6504 Bridge Point Parkway
Austin, TX 78730-5039
USA

NI-DAQ

Contact: Inside Sales
Phone: (512) 794-0100
FAX: (512) 794-5357

Retail Price: Call.
RISC Version Available: Call.

High-performance data acquisition software.

NI-DAQ is a high-performance DLL with functions for analog, digital, and timing I/O and stream-to-disk acquisition and waveform generation. It employs double-buffering techniques for acquiring large amounts of data, so users can update a waveform buffer while a second buffer is being generated. Users can also take advantage of multiple functions and boards simultaneously.

National Instruments

6504 Bridge Point Parkway
Austin, TX 78730-5039
USA

NI-VXI

Contact: Inside Sales
Phone: (512) 794-0100
FAX: (512) 794-5357

Retail Price: Call.
RISC Version Available: Call.

High-performance VXIbus interface software.

NI-VXI for Windows NT is a software package that simplifies programming VXI with C or LabVIEW. NI-VXI features intuitive graphical tools for interacting with and learning about VXI, and comprehensive high-performance routines for programming VXI using the C programming language or LabVIEW software system. NI-VXI includes a Resource Manager, an interactive VXI Resource Editor, a comprehensive library of software routines for VXI programming, and a VXI Interactive Control program for interacting with and learning about the VXIbus. NI-VXI includes support for multiple-mainframe configurations. Programs developed with NI-VXI for Windows NT are compatible with NI-VXI programs for many other controller platforms.

NetManage

20823 Stevens Creek Blvd Suite 100
Cupertino, CA 95014
USA

Chameleon32 Version 3.11

Contact: Customer Service
Phone: (408) 973-7171
FAX: (408) 257-6405

Retail Price: $495.00
RISC Version Available: Yes.

TCP/IP Applications for Windows NT.

Chameleon32 is the first TCP/IP applications package running on Windows NT. The combination of Chameleon32 and Windows NT is an outstanding TCP/IP client/server networking solution. Chameleon32 combines the power of Windows NT with the ease of use of the Windows user interface for TCP/IP networking. Chameleon32 provides an extensive set of TCP/IP applications. These include Telnet terminal emulation (VT100, VT220, TN3270), FTP, Mail, TFTP, Ping, Domain Name Service, Finger and Whois. All applications provide a point and click user interface and allow cut and paste between windows. Chameleon32 lets users transfer files between Windows NT-based PCs and UNIX based systems using the FTP transfer protocol. Users can also log into either UNIX systems or IBM mainframes with their Windows NT-based PC. Chameleon32 is written to the Windows Sockets API, the new standard for TCP/IP sockets for Windows and Windows NT.

Neuron Data

156 University Avenue
Palo Alto, CA 94301
USA

C/S Elements

Contact: Customer Service
Phone: (800) 876-4900 or (415) 321-4488
FAX: (415) 321-9648

Retail Price: Call.
RISC Version Available: Yes.

C/S ELEMENTS adds Data Access technology to Neuron Data's OPEN INTERFACE product.

C/S ELEMENTS provides transparent access to any flat-file or relational database system, enabling developers to mix and match data from Oracle, Sybase and Mcirosoft ODBC-compatible databases. Developers can build that capability seamlessly and easily by pointing and clicking on the database they choose.

Neuron Data

156 University Avenue
Palo Alto, CA 94301
USA

Neuron Data Open Interface

Contact: Customer Service
Phone: (800) 876-4900 or (415) 321-4488
FAX: (415) 321-9648

Retail Price: Call
RISC Version Available: Call.

Portable Graphic User Interface Development Tool.

Neuron Data Open Interface is an object-oriented software development tool for building graphical user interfaces (GUIs) which are portable across the industry standard windowing environments, including: Microsoft Windows and Windows NT, Motif, Open Look, Presentation Manager and the Macintosh. Open Interface improves the economics of software development with the most portable and extensible development environment available. The architecutre features a superset of widgets or controls (such as tables, text edit, menus, browser and buttons) contained in the native toolkits. Developers combine these pre-built widgets through the Open Editor. Open Editor is a WYSIWYG interface builder that allows a developer to build a GUI front end that is easily portable across all standard platforms without rewriting code. Open Interface also allows advanced developers to design custom widgets that are portable to all windowing environments.

Neuron Data

156 University Avenue
Palo Alto, CA 94301
USA

NEXPERT OBJECT

Contact: Customer Service
Phone: (800) 876-4900 or (415) 321-4488
FAX: (415) 321-9648

Retail Price: Call.
RISC Version Available: Call.

NEXPERT OBJECT is the leading rule and object-based development tool.

NEXPERT OBJECT is a rule-and-object-based development tool written in C that runs on over 40 platforms including Motif, OpenLook, Microsoft Windows and Windows NT, Macintosh, OS/2, VAX/Alpha, IBM mainframes, and VT00 and DOS character terminals. Derived from cognitive and computer science, its features include integrated forward and backward chaining, automatic goal generation, pattern-matching, dynamic creation of objects, classes, properties, multiple and user-defined inheritance, and non-monotonic reasoning. NEXPERT's open, event-driven architecture permits intergration within existing systems and direct access to standard spreadsheets, relational databases, and other conventional software.

Neuron Data

156 University Avenue
Palo Alto, CA 94301
USA

OPEN INTERFACE ELEMENTS

Contact: Customer Service
Phone: (800) 876-4900 or (415) 321-4488
FAX: (415) 321-9648

Retail Price: Call.
RISC Version Available: Call.

OPEN INTERFACE ELEMENTS is the leading GUI development tool.

Developers can design any type of graphical interface application for over 40 platforms, including Motif and OpenLook, Microsoft windows and Windows NT, Apple Macintosh, OS/2 Presentation Manager, VAX/Alpha, as well as VT100 and DOS character terminals. OPEN INTERFACE gives developers more flexibility, power, and extensibility with new widgets, a script language, and C++ support and allows developers to reduce development effort by as much as 50 percent.

Neuron Data

156 University Avenue
Palo Alto, CA 94301
USA

SMART ELEMENTS

Contact: Customer Service
Phone: (800) 876-4900 or (415) 321-4488
FAX: (415) 321-9648

Retail Price: Call.
RISC Version Available: Yes.

SMART ELEMENTS provides a development environment unmatched in portability, ease of use, scalability and extensibility.

SMART ELEMENTS is a client/server cross-platform development tool integrating three extensible, powerful elements: - The object- and rule-oriented element is based on NEXPERTOBJECT: a high level language graphical knowledge-bse development tool capable of capturing and efficiently representing complex application logic and business rules. - The easy-to-use GUI design element is based on OPEN INTERFACE ELEMENTS: a point-and-click tool for code-less GUI design. - The dynamically compiled Script language element provides communication links between the GUI objects and the underlying application objects for event-driven architectures.All elements can easily be tied into existing data and applications. Applications are portable across over 40 platforms without recompilation.SMART ELEMENTS provides a development environment unmatched in portability, ease of use, scalability and extensibility.

NUKO Information Systems

1609A S. Main St.
Milpitas, CA 95035
USA

Message Port/NT 1.0

Contact: Bob Schiender
Phone: (800) 995-2166 or (408) 262-2225
FAX: (408) 262-2261

Retail Price: $699 for 10 users, $999 for 20 users

RISC Version Available: Yes.

Multiport fax and modem pooling server software based on Windows NT.

Message Port/NT lets Windows and DOS users access any modem attached to the message port Windows NT server as if the modems were directly connected to the local serial ports. Any user can send fax messages directly from either Windows or DOS applications and receive fax messages directly to their computer. Incoming fax messages can be routed immediatly using any email such as Microsoft Mail, CC:Mail or MHS Mail. User may view the incoming fax message directly on the computer.

NUS (a Halliburton Co.)

2650 McCormick DriveSuite 300, Two Prestige Place
Clearwater, FL 34619
USA

PRONET for Windows NT

Contact: Dan Wisniewski
Phone: (800) 522-2121 or (813) 797-7841
FAX: (813) 797-8341

Retail Price: Call.
RISC Version Available: Call.

PRONET for Windows Document Management System.

PRONET is the software solution designed to provide document management and control on a local area network (LAN). This means that all the information necessary to write or revise a document, including a complete history of previously approved document revisions, is controlled by PRONET and is accessible to all users. Document references to regulations, specifications, related documents, drawings and forms are easily reviewed. And, most importantly, all system users share document standards and use the same formats and document configurations. PRONET's document control system offers: Increased productivity by reducing time required to find and/or create files. Increased information sharing and communication within your oganization On-line controlled access to the latest document revision. PRONET integrates with Word for Windows, WordPerfect for Windows and most other Windows- and Windows NT-based packages.

Objectivity, Inc.

800 El Camino Real
Menlo Park, CA 94024
USA

Objectivity/DB

Contact: Inside Sales
Phone: (415) 688-8000
FAX: (415) 325-0939

Retail Price: Call.
RISC Version Available: Call.

Object Database Management Systems (ODBMS) for C/C++.

Objectivity is the leading developer of ODBMS for C and C++. More software applications use Objectivity/DB today than any other commercial ODBMS. Objectivity offers leading capabilities for sharing information throughout a distributed environment. Applications share transparent access through a single logical view of objects across multiple schemas, databases and machines. Objectivity/DB provides the highest possible performance through on-demand object processing and a fully distributed architecture. This high performance is scalable as amounts of information and numbers of users increase. Objectivity/DB is a proven production-quality ODBMS with full referential integrity, a type-safe interface, on-line backup and restore and a large suite of tools that are integrated with many popular third-party application development environments.

OHB Software Inc.

5005 Newport Drive
Rolling Meadows, IL 60008
USA

BarMaster Retailer

Contact: S.D. Bailey
Phone: (708) 590-1095
FAX: (708) 590-1097

Retail Price: $799.00
RISC Version Available: Call.

Shipping Container Bar Code system.

BarMaster Retailer allows vendors who sell to all major US retailers to create Bar Code shipping labels with ease. All label formats are encoded right into the program. No design, or conformance worries, we have done it all for you. Just install it, and go. The product even includes a database of all shipping points for each retailer. Add, Change, or Delete shipping points at will. Just select a retailer, label format, destination, and PO info, and the software does the rest. The package works with any postscript or postscript compatible printer.

OHB Software Inc.

5005 Newport Drive
Rolling Meadows, IL 60008
USA

BarMaster Windows

Contact: S.D. Bailey
Phone: (708) 590-1095
FAX: (708) 590-1097

Retail Price: $499.95
RISC Version Available: Yes.

Bar Codes on Windows and Windows NT.

BarMaster Windows allows any user to print any of 16 bar code symbologies effortlessly. BarMaster Windows support PostNet, Code 39, 128, UPC, EAN, 2 of 5, and many more commonly used bar codes. Print bar codes from any program, any time, anywhere in a document, with no hassle. Requires Windows 3.1, Windows for Workgroups, or Windows NT, and any Laser, Dot Matrix, or Postscript Printer.

OHB Software Inc.

5005 Newport Drive
Rolling Meadows, IL 60008
USA

GraphixMaster

Contact: S.D. Bailey
Phone: (708) 590-1095
FAX: (708) 590-1097

Retail Price: $499.95
RISC Version Available: Yes.

Converts DOS graphics to Windows, and Windows NT.

GCS allows a programmer to write graphic software once to run under DOS, Windows, Windows NT, and OS/2. Using the GCS toolkit a programmer only needs to recompile, and link for the target platform. The package includes DOS libraries, Windows, Windows NT, and OS/2 DLL's.

One Tree Software

PO Box 11639
Raleigh, NC 27604
USA

SourceSafe

Contact: Ken Felder
Phone: (919) 821-2300
FAX: (919) 821-5222

Retail Price: $395.00 one user; $1,595.00 two users; $2,745.00 ten users; $4,745.00 twenty users
RISC Version Available: Yes.

SourceSafe coordinates multiple developers on a network--and tracks the histories of code files and entire projects--under Windows NT, Windows 3.1, and DOS.

SourceSafe, the project-oriented version control system, offers five principal benefits to your development process.1. Developer Coordination. SourceSafe prevents several developers, working together on a project, from accidentally overwriting each other's changes.2. History Tracking. SourceSafe records each change you make to every file. So if you change a file ten times, SourceSafe stores all ten versions--in less disk space than two would normally take.3. Hierarchical Projects. To the normal functions of version control, SourceSafe adds a developer-specific project management layer; tracking modular code (one file used in multiple projects), and maintaining full project histories as well as file histories.4. Ease of Use. SourceSafe's interface, modelled on the Windows file manager, offers one-point system control with a fast learning curve under Windows, DOS, and Windows NT.5. Ease of Maintenance. SourceSafe installs in under ten minutes, and requires almost no administration or maintenance.And best of all, SourceSafe is the ONLY version control system with complete systems for Windows NT, Windows 3.1, and MS-DOS environments!

Oracle Corp.

500 Oracle Parkway
Redwood Shores, CA 94065
San Mateo

ORACLE 7 Server for Windows NT

Contact: Customer Service
Phone: (800) ORACLE-1 or (415) 506-7000
FAX: (415) 506-7200

Retail Price: Call.
RISC Version Available: Call.

ORACLE 7 Server for Windows NT.

ORACLE 7 Server for Windows NT uses the latest version of the ORACLE RDBMS, which provides state-of-the art technology and unmatched performance for client-server operations. Among the advanced features that ORACLE7 Server for Windows NT introduces are a multithreaded server and shared SQL. Combined, these features reduce resource usage and enhance ORACLE's ability to support more users with fewer resources. ORACLE 7 Server for Windows NT also provides advanced distributed database capabilities that make access to remote databases transparent to the user. Thus, ORACLE 7 Server for Windows NT eliminates the need for the costly custom-programming formerly needed to execute transaction updates among distributed databases. In addition, ORACLE 7 Server for Windows NT supports transparent asynchronous table replication (snapshots). It can also function as a two-phase commit coordinator for non-ORACLE database systems and as a participant in two-phase commits coordinated by external services. ORACLE 7 Server for Windows NT also provides extensive and robust new functionality in the areas of server enforced integrity, query optimization, and security management.

P & J's Software

14150 NE 20thBox 277
Bellevue, WA 98007
USA

Background Noise

Contact: Paul McLaughlin
Phone: (206) 881-8251
FAX: (206) 869-0252

Retail Price: $9.95
RISC Version Available: Call.

Central application to play WAV ,MIDI files and CD audio.

Background Noise is a Win32 application that lets you play WAV, MIDI files and CD audio. Play the files yourself, or create a list of sound files for Background Noise to play while you work in other applications. Play the list sequencially, or create a programmable order or play them in random order (much like CD player). Background Noise is shareware, so you can try it before you buy it.

Pacific CommWare

180 Beacon Hill Lane
Ashland, WA 97520
USA

TurboCom for Windows NT

Contact: Stuart Brainerd
Phone: (503) 482-2744
FAX: (503) 482-2627

Retail Price: Call.
RISC Version Available: Call.

High Speed Async Serial Communications.

TurboCom highspeed serial port drivers for Windows NT and Async serial port board with support for speeds up to 460.8 Kbaud. RS-232, RS-422, and RS-485 Protocols.

Parametric Technologies Corporation

128 Technology Drive
Waltham, MA 02154
USA

Pro/ENGINEER

Contact: John Hudson
Phone: (617) 894-7111
FAX: (617) 891-1069

Retail Price: Call.
RISC Version Available: Yes.

Pro/ENGINEER is the only mechanical design automation tool that integrates the entire design-through-manufacturing process.

The Pro/ENGINEER product family provides a new generation of mechanical design automation software tools based on a unique parametric, feature-driven solid modeling technology. These advanced tools naturally and intuitively assist the engineering team in productively completing a full range of design-through-manufacturing tasks. Pro/ENGINEER's single data structure ensures design integrity by capturing changes made in any stage of the process and automatically updating the model and all engineering deliverables. Pro/ENGINEER is hardware-independent, and is available today on every leading workstation platform.

Passport Communications

1101 S. Capital of Texas HwySuite 250-F
Austin, TX 78746
USA

RJE for Windows NT(TM)

Contact: Richard Ohren
Phone: (512) 328-9830
FAX: (512) 328-4773

Retail Price: $24.95
RISC Version Available: Call.

Passport Communications... providing micro-to-mainframe connectivity solutions since 1984.

Win 3770(TM) is a full function 3770 RJE Workstation for Microsoft SNA Server. It supports up to eight 3770 (LU Type 1) host sessions. These sessions each support multiple input (reader) and multiple output (punch and printer) devices. A full function RJE console is also provided to send commands to the host. Full SCS compression and transparency are supported to reduce the transmission time for print jobs. Win 3770 is fully configured and monitored using the standard administration functions supplied by SNA Services.

Passport Communications

1101 S. Capital of Texas HwySuite 250-F
Austin, TX 78746
USA

SYSOUT Express(TM)

Contact: Richard Ohren
Phone: (512) 328-9830
FAX: (512) 328-4773

Retail Price: $49.95
RISC Version Available: Call.

Passport Communications... providing micro-to-mainframe connectivity solutions since 1984.

SYSOUT Express(TM) allows a high speed bus and tag printer to be attached to a Windows NT(TM) workstation. Printer drivers are also available which install and operate as standard Windows printer drivers. They are compatible with any Windows 3.x compliant application. Printers supported include: Xerox(R) production printers (4650, 4850, 4135, etc.).

PDS Engineering

401 W. MainSuite 303
Norman, OK 73070
USA

WinSCSI-NT

Contact: Roger Ryan
Phone: (405) 329-2223
FAX: (405) 329-7373

Retail Price: $125.00
RISC Version Available: Call.

SCSI users! Interrogate, display, and modify SCSI device configuration.

WinSCSI-NT is a system maintenance tool which will interrogate and display SCSI target information including mode page information, inquiry data, and defect data. Also, the SCSI device mode pages can be modified, if desired. This feature can be disabled. The ability to retrieve and modify device data is subject to the target device SCSI compliance. This version is specific for the Microsoft Windows NT operating system.

PEACOCK SYSTEMS, INC.

2922 Pennsylvania Ave SE
Washington DC, 20020
USA

CBTREE for Windows NT

Contact: Inside Sales
Phone: (202) 575-8185
FAX: (202) 575-8186

Retail Price: $149.00
RISC Version Available: Yes.

Windows NT needs a B+Tree too!

CBTREE for Windows NT adds powerful B+Tree and ISAM file handling capabilities into your Win32 applications. The CBTREE DLL is finely tuned for the Windows NT 32-bit operating environment allowing your applications to search and update files quickly and easily. It provides random and sequential access to records by key value. You can use CBTREE for special purpose file indexing as needed, or use CBTREE to manage your entire database. Our full function B+Tree ISAM access method is already in use by several thousand C programmers and stands out because it is so easy to use and yet, it provides efficient and powerful data retrieval operations for your applications.

Persistent Data Systems

75 W. Chapel Ridge Rd.
Pittsburgh, PA 15238-9925
USA

IDB Introductory Package

Contact: Inside Sales
Phone: (412) 963-1843
FAX: (412) 963-1846

Retail Price: $99.00
RISC Version Available: Call.

Programmer's introduction to the IDB Object Database.

The IDB Introductory Package shows how to build a complete application using the IDB Object Database: how to use the IDB Browser, how to specify IDB data using the IDL definition language, and how to program object behavior in C using the IDB API. It includes a working application running under the IDB Browser, a 130 page tutorial, and source for the database schema and object operations. The tutorial assumes a knowledge of C but does not require prior experience with object-oriented systems.

Persistent Data Systems

75 W. Chapel Ridge Rd.
Pittsburgh, PA 15238-9925
USA

IDB Object Database

Contact: Inside Sales
Phone: (412) 963-1843
FAX: (412) 963-1846

Retail Price: $1500.00
RISC Version Available: Call.

High-performance distributed object database.

IDB allows developers to define and manipulate objects of arbitrary size and complexity. The IDB run-time system supports polymorphism, dynamic binding, quick-fit storage allocation, garbage collection, long and nested transactions, versioning, dynamic linking, and exception handling. IDB applications may run standalone or distributed, and may be configured with or without an interactive display manager and browser. Both applications and data are portable across the full range of supported platforms.

Personal MicroCosms

8547 E. Arapahoe RoadSuite J147
Greenwood Village, CO 80112
USA

Astronomy Lab for Windows NT

Contact: Eric Bergman-Terrell
Phone: (303) 753-3268
FAX: --

Retail Price: $17.50
RISC Version Available: Call.

Astronomy graphing, prediction and simulation program

Astronomy Lab is an astronomy program for Microsoft Windows NT. Astronomy Lab produces 7 movies that simulate a host of astronomical phenomena, 15 graphs that illustrate many fundamental concepts of astronomy, and 14 printed reports that contain predictions of the most important astronomical events. All movies, graphs, and reports are customized for the user's time zone and location.

Phar Lap Software

60 Aberdeen Ave.
Cambridge, MA 02138
USA

QuickStart for Windows NT

Contact: Maria Vetrano
Phone: (617) 661-1510
FAX: (617) 876-2972

Retail Price: Call.
RISC Version Available: Call.

QuickStart for Windows NT.

QuickStart enables developers to build 32-bit Win32s and Windows NT applications under DOS or Windows 3.1. QuickStart runs Microsoft's NT tools under DOS or the Windows 3.1 DOS box, so developers can create and run Win32s applications under Windows, rather than repeatedly rebooting between NT for developing and Windows for testing. Because QuickStart runs in the familiar DOS environment, programmers can run NT tools in conjunction with their favorite DOS editors, utilities, source control systems and network software. QuickStart is available from Phar Lap and is free for a limited time.

Premia Corporation

1075 NW Murray BlvdSuite 268
Portland, OR 97229
USA

Codewright for Windows NT

Contact: Sales .
Phone: (800) 547-9902
FAX: (503) 641-6001

Retail Price: $249.00
RISC Version Available: Call.

Editor of Choice for Professional Programmers.

Codewright adds power to your editing and adds glue to your Windows NT environment. Codewright is an industrial strength editor. It handles files and lines of unlimited length. You get Column Blocks, Bookmarks, Regular Expression searches, UNIX file compatibility, and support for popular languages, just for starters. Codewright for Windows NT is a native Win32 application, so compiling starts faster, complex searches finish sooner. In fact, just about everything in this editor goes faster than you've ever seen a GUI editor go. Run a separate copy of Codewright for each of your projects under Windows NT. Switching projects is a snap, anytime. Let Codewright launch your compiler, make utility or debugger for you. Capture output, process errors, search for files and scan files for strings -- your tools are as close as the Tool Ribbon. Extend Codewright by creating a Dynamic Link Library (DLL) with any Windows NT-compatible language. Sample DLL code makes it easy. Codewright gives you convenient access to your version control system. It can also prevent other users from modifying the files you are editing. Built-in differencing and merging helps you handle multiple revisions of a file or files. For quotes, reprints, and feature lists call us now. We can arrange for you to try Codewright without risk. Then you can tell us how Codewright brings Windows NT programming together for you.

ProtoView Development Corp.

353 Georges Road
Dayton, OH 08810
USA

DataTable Spreadsheet Control

Contact: Inside Sales
Phone: (800) 231-8588 or (908) 329-8588
FAX: (908) 329-8624

Retail Price: data table:$249.00 source code:$495.00

RISC Version Available: Call.

DataTable Spreadsheet Control Add A Spreadsheet To Your Windows/Win32 Applications.

DataTable is a sophisticated Windows spreadsheet control that will give your application the look and feel of a professional spreadsheet. Interactively set it up in any standard dialog editor. With its 80 messages and 30 notification codes you can control every aspect of its behavior. Order the source and learn how to write sophisticated windows controls.

ProtoView Development Corp.

353 Georges Road
Dayton, OH 08810
USA

ProtoGen+

Contact: Inside Sales
Phone: (800) 231-8588 or (908) 329-8588
FAX: (908) 329-8624

Retail Price: $395.00
RISC Version Available: Call.

ProtoGen - Quickly generate code in C/C++ for Windows/Win32 Get the Visual Development Edge!

Visual programming with ProtoGen dramatically cuts the time it takes to learn Windows/Win32 programming and to develop Windows applications. With ProtoGen, you can visually design user interface elements and then generate the source code for the framework of your application. With ProtoGen's regeneration technology all of the code you add to the framework is preserved - even if you change the interface - drastically reducing maintence time. Four in One - Made specifically to generate ANSI C code, MFC C++, OWL C++, and Pascal with Objects.

ProtoView Development Corp.

353 Georges Road
Dayton, OH 08810
USA

SQLView

Contact: Inside Sales
Phone: (800) 231-8588 or (908) 329-8588
FAX: (908) 329-8624

Retail Price: $395.00
RISC Version Available: Call.

SQLView Client Server Development/Database Access.

SQLView is a rapid application development language for client server systems. With SQLView, production quality systems can be built under Windows/Win32 with database access, transaction processing and data security. Using OOP techniques and visual editors, developers build robust, maintainable, client/server applications with advanced GUI components, access to multiple database platforms, transaction security and project life-cycle management. SQLView offers a practical, effective, production environment for accomplishing down-sizing and right-sizing of corporate systems.

Q.E.D. Software, Inc.

275 Saratoga Ave.Suite 160
Santa Clara, CA 95050
USA

Eagle Integrated Development Environment

Contact: Bob Evans
Phone: (408) 995-0270
FAX: (408) 261-9632

Retail Price: $389.00 - Introduction $249.00

RISC Version Available: Call.

A Windows-hosted Integrated Development Environment for C, C++ and FORTRAN.

Eagle is a multi-language Integrated Development Environment featuring a powerful programmer's editor, language parsers, cross referencing and graphical browsers for functions and data. and interfaces to popular compilers, source code control systems and metrics packages. The editor supports syntax coloring, filtering on strings or variables, and navigation to and from the graphical browsers. The cross reference and browsing systems support multiple languages simultaneously. Users can extend the system with new functionality or for new languages by writing call-compatible DLLs. A complete data interface library is available for producing custom code documentation or for reverse engineering applications. Eagle currently supports C and FORTRAN with C++ availability July 1993.Eagle is available for both Windows 3.1 and Windows NT.

Raindrop Software Corporation

833 E. Arapaho RoadSuite 104
Richardson, TX 75081
USA

Software Engineer

Contact: Inside Sales
Phone: (214) 234-2611
FAX: (214) 234-2674

Retail Price: $349.95
RISC Version Available: Call.

Lisp Programming Language.

Software Engineer is a complete LISP/CLOS development environment for Windows NT. Included is a small and efficient LISP kernel, a text editor, a dialog box editor, an icon editor and an executable binder. Software Engineer produces stand alone executable files (no royalties or run time libraries required). Full support for Dynamic Data Exchange (client and server) and client support for Object Linking and Embedding . Standard interface to the Windows API allows you to create robust Windows programs. There is no need to purchase the Microsoft SDK. Software Engineer includes comprehensive documentation, sample programs and on-line help. Contact Raindrop Software for upgrade, site license and academic pricing information. Software Engineer is available on Microsoft Windows NT for Intel, MIPS and DEC Alpha processors.

Realtime Performance, Inc.

349 Cobalt Way
Sunnyvale, CA 94086
USA

RPCluster for Windows NT

Contact: Yoav Agmon
Phone: (408) 245-6537
FAX: (408) 245-6547

Retail Price: Call
RISC Version Available: Yes.

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RPCluster is a complete family of software products for controlling all types of clustered (or distributed) systems utilized in automated manufacturing. RPCluster consists of a Cluster Tool Controller (RPCTC), a Transport and Cassette Module Controller (RPTMC) and a Process Module Controller (RPPMC). Each can operate as a stand-alone product or as a part of a complete cluster tool system. Each product includes a complete set of MESC communications services for semiconductor manufacturing equipment plus a functional application upon which to base the specific implementation. Implemented and compliant with current semiconductor industry standards such as SECS-I/II and MESC, RPCluster can also be used for non-MESC distributed control applications.

Realtime Performance, Inc.

349 Cobalt Way
Sunnyvale, CA 94086
USA

RPCore for Windows NT

Contact: Yoav Agmon
Phone: (408) 245-6537
FAX: (408) 245-6547

Retail Price: Call
RISC Version Available: Yes.

Equipment and instrumentation control tools and services.

RPCore for Windows NT is a core suite of facilities for the development of equipment control applications. It supports supervisory, embedded and process controls, data I/O and logging, and basic control mechanisms such as Finite State Machines and Petri Nets. Used as the foundation for real-time human interface and equipment control applications, RPCore is written in ANSI C and integrates easily into the Windows NT 32-bit development environment. RPCore modules run as separate processes, making them ideally suited for demanding equipment control environments where real-time, reliability, power, flexibiily, cost, and time of software development and maintenance are of prime importance. Because it is based on 386 and 486 PC hardware platfoms in conjunction with the fully distributed architecture provided by Windows NT, RPCore allows an optimal configuration for any performance requirements. RPCore provides seemless integration with the communication facilities of Windows NT, making it an excellent basis for distributed control applications. RPCore managers provide the fundamental control facilities, such as alarms, recipes, I/O, communications, access control, datalogging, scheduling, and lot control. Various means of interprocess communications are provided which are consistent with the Windows NT evironment, such as RPC's and DDE. This provides the flexibility to use other Windows NT- compatible products and tools along with RPCore.

Rhode Island Soft Systems, Inc.

P.O. Box 748
Woonsocket, RI 02895-0784
USA

WinPak Screen Saver Collections

Contact: Eric Robichaud
Phone: (401) 658-4632
FAX: (401) 658-4632

Retail Price: $19.95 for quantity
RISC Version Available: Call.

WinPak Screen Saver Collections.

Each WinPak Collection consists of six high-quality, entertaining screen saver modules designed to be installed on a system running Windows NT. Also included in each WinPak are four unique, custom TrueType fonts, and two collections of 100 icons each. Our screen saver modules are added to the list of screen savers that are recognized by Windows NT. Each package contains the screen saver modules, fonts, and icons in addition to a convenient and easy to use installation utility, and complete documentation to get you going. Special discounts are provided to customers who wish to purchase several or all of the WinPak Volumes. Volume discounts, Site Licenses and Corporate Licenses are available as well. Experience our animation!

RIX Softworks, Inc.

18023 Sky Park CircleSuite J
Irvine, CA 92714
USA

WinRIX

Contact: Inside Sales
Phone: (714) 476-8266
FAX: (714) 476-8486

Retail Price: $395.00
RISC Version Available: Call.

WinRIX Image Editor for Multimedia.

WinRIX is the premier choice of image editing products for Multimedia for Windows NT. RIX is well known as the most innovative image editing package under DOS. WinRIX can: - Scan using Twain.- Capture Still video images from live video through MCI.- Retouch images with cutting pasting, painting, airbrushing, cloning, erasing and filling. - Image edit with size transforming and scaling, changing color depth filtering, sharpening, changing contrast, brightness. - Add text with anti-aliasing (needed for video titling).- Save in any popular format, including the RIX highquality compression format and ColoRIX formats. - Screen capture. - Load WMF vector drawings and rasterize them with smoothed edges. WinRIX is the best all-around image editor for multimedia presentations.

Ross Systems, Inc.

555 Twin Dolphin DriveSuite 600
Redwood City, CA 94065
USA

Renaissance CS Financial Series

Contact: Customer Service
Phone: (404) 851-1872, ext. 2400
FAX: (415) 592-9364

Retail Price: Call.
RISC Version Available: Call.

Renaissance CS Financial Series.

The Renaissance CS Financial Series is a tightly integrated set of financial accounting products for the open systems environment and designed for client/server processing. Designed to be used in a worldwide environment, the products have multi-currency facilities, are ready for multi-language implementations, and have the functions that multi-national companies need such as alternative forms of payment and local tax handling. The Renaissance CS Financial Series is built with GEMBASE, Ross Systems' open fourth generation language (4GL). GEMBASE closely follows open systems standards to give customers a wide variety of platform and database choices. The client component of the Renaissance CS Financial Series is delivered in the native look and feel of Windows 3.x, Macintosh, and Motif desktop environments. The graphical user interface contains buttons, scroll bars, multi-window capabilities, pull-down menus, tool bars, and mouse control. Key components of the Renaissance CS Financial Series include: General Ledger, Accounts Payable, Accounts Receivable, Purchase Order, Fixed Assets, Currency Management, Cost Allocations, Project Accounting, and Encumbrance.

SAS Institute

100 SAS Campus Dr.
Cary, NC 27513-2414
USA

The SAS System under Windows NT, Release 6.09

Contact: Software Sales Department
Phone: (919) 677-8000 x7000
FAX: (919) 677-8123

Retail Price: Call
RISC Version Available: Call.

The SAS System for enterprise-wide information delivery.

The SAS System for Windows NT provides an integrated, single solution for a wide range of applications for your desktop environment, as well as distributed environments throughout the organization.The SAS System is designed around four key areas of application generation and development: universal data access, data management, data analysis, and presentation of data. Some of the applications addressable by the SAS System include EIS, report writing, project management, forecasting, quality improvement, and simple or advanced data analysis.This functionality is accessible through a wide range of highly interactive, pre-existing application front-ends, and through object-oriented application development tools for creating customized front-ends.Applications developed by the SAS System can provide connectivity to platforms throughout the enterprise for client/server computing, and are completely compatibility across a wide range of hardware environments while taking full advantage of the robust computing environment of Windows NT.

Scientific Endeavors Corp.

508 North Kentucky Street
Kingston , TN 37763
USA

GraphiC for Windows NT

Contact: Customer Service
Phone: (800) 998-1571
FAX: (615) 376-1571

Retail Price: $495.00
RISC Version Available: Yes.

Publication quality scientific graphics for Windows NT.

GraphiC is a library of C routines that allow the scientist to display information with the maximum impact. High resolution output may be converted to CGM, PIC, GEM, HPGL, TIFF, WMF and BMP formats for importing into desktop publishing packages. The Windows NT version like the Windows version requires no Windows programming since the software creates and manages its own window and resources. All the source code needed to customize the GraphiC window and resources is provided. GraphiC for Windows makes full use of the clipboard to import data or to export bitmaps or Windows metafiles. Licensed for pers onal use only. Sells for $495.

Scopus Technology, Inc.

1900 Powell Street, suite 900
Emeryville, CA 94608
US

ProTEAM for Windows NT

Contact: Aaron Omid
Phone: (510) 428-0500
FAX: (510) 428-1027

Retail Price: Call.
RISC Version Available: Call.

ProTEAM - Suite of Customer Information Management Tools.

Scopus' ProTEAM is a comprehensive set of information tracking and management systems specifically designed to help automate a business' operations. ProTEAM is the culmination of working with leading-edge companies who needed a breakthrough system for improving product quality and customer satisfaction. The result is a tightly integrated groupware system that allows an organization to integrate information from Engineering, Quality Assurance, Customer Support, Order Entry, Sales and Marketing. ProTEAM is easily configured to meet unique business requirements. Each application can be tailored to capture the information flow and business rules that work best for the organization.

Silicon Valley Software

PO Box 2279
Orinda, CA 94563
USA

SVS x86/FORTRAN-77 for Windows NT

Contact: Tony Parkhill
Phone: (510) 283-9540
FAX: (510) 283-9270

Retail Price: $660.00
RISC Version Available: Call.

Exceptional 32-bit FORTRAN development system combines with Win32, Win32s and Windows NT delivering unprecedented programming power for the creation and execution of native 32-bit FORTRAN-77 Windows NT applications.

SVS X86/FORTRAN-77 for Windows NT version 2.8.2 implements the entire "full" language, as per the 1978 ANSI specification, with numerous extensions. SVS X86/FORTRAN complies with ANSI X3.91 - 1978 and Mil-STD-1753. The system includes a complete source level symbolic debugger capable of debugging combined language executables. SVS X86/FORTRAN-77 for Windows NT is commonly used as an effective porting tool, featuring extensions such as Double Precision Complex data types, value parameter passing, improved bit field operations and ENCODE/DECODE. SVS X86 FORTRAN-77 for Windows NT is specifically tailored and optimized for Microsoft Windows NT systems and Win32/Win32s applications development. System includes SVS FORWIN GUI library for effective Win32 interfaces and compatibility from SVS FORTRAN without code changes.

Silicon Valley Software

PO Box 2279
Orinda, CA 94563
USA

SVS x86/Pascal for Windows NT

Contact: Tony Parkhill
Phone: (510) 283-9540
FAX: (510) 283-9270

Retail Price: $660.00
RISC Version Available: Call.

Exceptional 32-bit Pascal development system combines with Win32, Win3s and Windows NT delivering unprecedented programming power for the creation and execution of native 32-bit Pascal applications for Windows NT.

SVS X86/Pascal for Windows NT is a certified, full implementation of the ANSI/IEEE 70 X3.97-1983 standard and is ISO compliant. The system includes a complete source level symbolic debugger capable of debugging combined language executables. SVS X86/Pascal contains a robust set of extensions which include features for interfaction to subroutines written in C and FORTRAN-77 languages. SVS X86/Pascal is one of the best respected and most widely distributed complers in the industry today. SVS X86/Pascal for Windows NT is a true native code compiler and specifically tailored and optimized to the Microsoft Windows NToperating system and Win32/Win32s applications development.

SL Corporation

240 Tamal Vista Blvd.Suite 110
Corte Madera, CA 94925
USA

SL-GMS

Contact: Inside Sales
Phone: (415) 927-1724
FAX: (415) 927-2931

Retail Price: $8,750.00 for first copy
RISC Version Available: Call.

Dynamic graphics tool for complex control systems.

SL-GMS is a toolkit for developing dynamic graphics screens for real-time or highly interactive applications. Non-programmers can design application screens in a standard drawing-tool mode, connect them to real-time data sources and animate screen objects to visualize changing data values. SL-GMS allows the design of custom 'GISMOs' to input values or control the application, and supports MOTIF and other X toolkit widgets.

Softool Corporation

340 S. Kellogg Ave.
Goleta, CA 93117
USA

CCC/Manager

Contact: Laurie Mix
Phone: (800) 723-0696
FAX: (805) 683-4104

Retail Price: $495.00
RISC Version Available: Yes.

Life Cycle Management for the Corporate Environment.

CCC/Manager version 2.0 provides comprehensive support for the entire software development life cycle. It provides change and version control for all software components, support for all phases of the life cycle, turnover and migration management, and impact management. It is used by all persons involved in the development process. The product features an easy to use GUI and command line interface. The product operates on networks and standalone PCs and can be interfaced to other host change management systems. The Windows NT version is a full 32-bit native implementation. CCC/Manager is available on over 20 platforms including IBM, UNIX, Digital, and the PC. Watch for release 2.2 in December of 1993. New features include: multi-directory structures, recursive reporting and checkin capabilities, and modeless windows execution.

Software Excellence By Design Inc.

340 S. Kellog Ave.
Goleta, CA 93117
USA

Zip Manager for Windows NT

Contact: Eric Anderson
Phone: (602) 375-9928
FAX: (805) 683-4105

Retail Price: $69.95
RISC Version Available: Call.

32-bit data compression for Windows NT.

ZIP Manager is a complete 32-bit archive file management program that creates ZIPcompatible files. PKZIP or other compression utilities are not needed! Familiar file manger functionality: fully email enabled; Drag and Drop server and client; works with up to 32 archive files at the same time; Express Mode allows the user to create and manage archives with just two dialog boxes; print the contents of any archive file; Create self-extracting archives. Many more unique features!

SQL Business Systems Inc.

17171 Park RowSuite 350
Houston, TX 77084
USA

SQLStor

Contact: Customer Service
and up with hardware.
Phone: (713) 578-7410
FAX: (713) 578-7413

Retail Price: $9,995.00 and up $5,500.00

RISC Version Available: Yes.

Automated database tape management system.

SQLStor is a revolutionary new tape management system focused at backing up database servers using robotics and autochanger technology. SQLStor has the capacity, 20GB--580GB, and the intelligence to follow instructions without any operator intervention. SQLStor's intuitive design manages and monitors the Data Base Administrator's defined retention cycles and backup schedules. The system automatically loads and unloads selected tapes based on the DBA's definitions, all without the aid of an operator. The traditional time consuming tasks of manually logging and tracking of tapes become obsolete. SQLStor provides improved data security by performing functions in an unattended mode and by allowing users to initiate a backup from any workstation without requiring access to the tape unit. The system protects against accidental operator tape erasures and insures the integrity of the tape's rotational cycle. SQLStor maintains a tape activity log of all backups and restores. The system also generates a tape catalog that can be viewed on-screen or printed to record the tape contents. SQLStor is implemented as a client-server application. The client-side application is used to manage the configurations of SQLStor and report on the activities performed by SQLStor. The client-side application is a Windows Multiple Document Interface Application that allows you to view and manage multiple windows at one time. SQLStor's server-side application resides on the database server and executes the scheduled backups...Anytime...All the time...Every time!

Square D Company

PowerLogic200 B Weakley Road
Smyrna, TN 37167
USA

System Manager and EXPlorer Software

Contact: Rob Smits
Phone: (615) 459-8545
FAX: (615) 459-0002

Retail Price: $3,250.00 -$8,910.00
RISC Version Available: Call.

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System Manager and EXPlorer are application software products for use by plant engineers, facilities engineers, and others within the plant or facility environment for data acquisition, storage, display, alarm/event monitoring/indication and more. Time Trending of Electrical Demand for instance helps operators avoid costs, optimize electrical equipment utilization, and avoid various problems with their systems to minimize downtime. In general, each of these applications provide information to the operators that help them make proactive, informed decisions from their desktop. The four product/bundles are EXPlorer, EXPlorer II, System Manager and System Manager Plus. Each offers increasing functionality. Various hardware products are supported by each application.

Stirling Technologies, Inc.

172 Old Mill Dr
Schaumburg, IL 60193-2873
USA

InstallSHIELD

Contact: Barry Pratt
Phone: (800) 3-SHIELD or (708) 307-9197
FAX: (708) 307-9340

Retail Price: $595.00
RISC Version Available: Call.

Installation.

InstallShield is a full-featured installation program builder for Windows, Windows NT and OS/2. Allows you to quickly and easily build GUI installations. A built-in simple install language allows you to create complete installers without any C programming. Percent complete & other feedback controls built-in. High-performance data compression. Help and Instruction windows. Automatically builds program groups, items and icons. Access to DLL functions for special needs. Installation logic based on hardware. Allows intelligent editing of INI and system files.

The ASK Group, Inc.

1001 Marina Village Parkway
Alameda, CA 94501
USA

ASK Embedded SQL for C for Microsoft Windows NT

Contact: Inside Sales
Phone: (800) 446-4737
FAX: (510) 748-2670

Retail Price: Call
RISC Version Available: Call.

C programming kit for Embedded SQL.

The Embedded SQL for C programming kit combines the flexibility of the C language with ASK Group advanced application development tools. Database procedures and other C programs can directly interface with INGRES(tm) databases. Embedded SQL for C speeds development dramatically. To make programming more efficient, the product includes complete libraries for database access and memory management. In your C language programs, you can link existing applications by including calls to other programs.

The ASK Group, Inc.

1001 Marina Village Parkway
Alameda, CA 94501
USA

ASK INGRES Networking for Microsoft Windows NT

Contact: Inside Sales
Phone: (800) 446-4737
FAX: (510) 748-2670

Retail Price: Call
RISC Version Available: Call.

Networking package for Windows NT Environment.

INGRES Networking provides a multi-network compatible client/server communications architecture. INGRES Networking technology and open architecture provide transparent connections for all clients to all servers. You can write applications without specifying the location of the target database. The INGRES Networking communications server, which resides with your database server, provides a multi-threaded communications server that can support multiple client/server connection pairs through separate communication threads. The open, standards-based implementation allows INGRES Networking to work efficiently over all major Windows NT networks.

The MathWizards

6246 Ohm CourtSuite 200
San Diego, CA 92122
USA

MathViews

Contact: Shalom Halevy
Phone: (619) 457-2971
FAX: (619) 458-5849

Retail Price: $995.00
RISC Version Available: Call.

MathViews - MATLAB compatible Interpreter with DDE support.

MathViews is a comprehensive, easy-to-use, fully interactive scientific and engineering envaironment for: Matrix and Array Algebra, Digital Signal Processing (DSP), Time Series Analaysis, and Data Visualization.MathViews provides a comprehensive set of operators and functions for performing real and complex vector and matrix operations, one- and two-dimensional FFTs, convolutions, correlations, and data manipulation. MathViews is compatible with the MATLAB syntax and will allow you to execute MATLAB M-files.MathViews offers a powerful programming environemnt for tackling demanding data analysis and mathematical problems. Program control flow (IF, ELSE, FOR, WHILE), mathematical and logical array manipulation operators, complex and real variables, intercative 2D and 3D graphics (X-Y linear, semilog, loglog, contour, and hidden lines). MathViews lets you even define your own functions. MathViews can be extended using Dynamic Link Libraries. MathViews provide a complete implementation of DDE both as a client and as a server. This allows you to exchange data with other Windows programs. MathViews has a full screen debugger to step-over or trace-into your script and function files.

Tower Technology Corporation

3300 Bee Caves Rd.Suite 650
Austin, TX 78746
USA

TowerEiffel for Windows NT

Contact: Robert Howard
Phone: (512) 328-6406
FAX: (512) 328-0466

Retail Price: $3,000.00 (4 seat license)
RISC Version Available: Call.

TowerEiffel is the team-oriented solution for object-oriented programming.

TowerEiffel is the most effiecient Eiffel compiler ever created. It yields the tremendous advantages of the highly acclaimed Eiffel language in a professional quality package that includes: -- automatic dependency analysis plus override tools. -- the standard Eiffel kernel libraries. -- tested compatability with other standard Eiffel libraries. -- compatability with the latest Eiffel 3 language definition. -- a suite of documentation extraction and browsing tools. -- a mechanism for distributing libraries without source code.TowerEiffel is the first Eiffel implementation that makes this language a practical choice for professional software development and the best choice for achieving the promised reusability and productivity of OOT.

Trillennium Corporation

3843 94th Avenue NE
Bellevue, WA 98004
USA

XPLib v2.0

Contact: Syril Hastings
Phone: (206) 453-2949
FAX: --

Retail Price: $495.00
RISC Version Available: Call.

Cross-Platform Libraries for simultaneous application development for the Macintosh, Windows 3.1, and Windows NT platforms.

XPLib version 2.0 is a set of three compile-time libraries that provide the necessary services to develop an application for Windows NT, Windows 3.1, and the Macintosh platforms using the same source code. C source code and distribution licenses are available. Support for other platforms are currently under development. XPLib provides support for memory, file, event, string, menu, window, control, graphics, text, bitmap, print, clipboard, dialog, and multiple document management.

Trimco

15950 Bay Vista DriveSuite 140
Clearwater, FL 34620
USA

WIN-Track Imaging System

Contact: Mike Boses
Phone: (813) 530-3600
FAX: (813) 531-6293

Retail Price: Call - Starts at $450.00
RISC Version Available: Yes.

A Leader in Technical Document Management Moves to Windows NT.

Trimco, a leading supplier of imaging systems and software for Windows 3.1 has announced Windows NT versions of its complete range. The products provide complete document management, from the initial scans through quality control, viewing, editing, hyper-linking, revising, routing, printing, and finally archiving . The company specializes in handling large documents used in engineering and other technical fields. These demand significant expertise in mass storage, network traffic optimization, and large scanner interfaces. Existing customers include Wisconsin Electric, Spar Aerospace, British Petroleum, Eurotunnel, and Air Products Corporation. The Trimco Image Editor is used to view, annotate, and edit scanned images. Like the editor, word processor, spreadsheet, CAD and other applications can be connected to the WIN-Track database at the center of the system. This permits scanned images to be used in parallel with other document types, all organized and access-controlled by a single database. The scalability, ability to handle large images, and security of Windows NT make it and Trimco's system a natural fit.

Trinzic

One Harbour PlaceSuite 500
Portsmouth, NH 03801-3872
USA

AionDS

Contact: Jennifer Kuhn
Phone: (415) 328-9595
FAX: (415) 321-7728

Retail Price: $8,500.00
RISC Version Available: Call.

AionDS - Critical Business Applications Require Highly productive solutions.

AionDS is an object-oriented, graphical, client/server development environment that integrates all the enabling technologies to build Business Process Automation (BPA) applications faster, and deliver them with high quality and reliability across many production environments. Technolgies include; Objects, Rules, Graphical User Interfaces (GUIs), Automatic database interfaces, robust API and client/server and network support.Designed to support the full lifecycle of applications, AionDS runs in PC, mainframe, workstation and client/server and is best used for transaction-driven, embedded applications or applications that need to integrate closely with an organizations CASE strategy.

Visix Software, Inc.

11440 Commerce Park Dr.
Reston, VA 22091
USA

Galaxy Application Environment

Contact: Sheri Winter
Phone: (8000 832-8668 or (703) 758-8230
FAX: (703) 758-0233

Retail Price: $9,600, no runtime fees
RISC Version Available: Yes.

A multi-platform graphical development environment designed specifically to construct high-performance, commercial grade distributed applications.

Galaxy is a radical new approach to developing high performance application software. With Galaxy's cross-platform API and integrated tool set, applications can run enterprise-wide on a broad range of desktop and server platforms. Galaxy comes with a powerful runtime components that provide network-independent services such as gloabal hypertext help and inter-application communication.Supported platforms include Microsoft Windows 3.1, Microsoft Windows NT, UNIX, OS/2 and Macintosh. Galaxy is a one-for-one replacement for the Macintosh Toolbox, Microsoft Windows SDK, and the Motif and OPEN LOOK toolkits, and provides a superset of the capabilities of these environments. Galaxy applications can be compiled and run across multiple platforms with no code changes allowing developers to channel their efforts into the development of product functionality without regard to portability.

Visual Numerics, Inc.

9990 Richmond Ave.Suite 400
Houston, TX 77042-4548
USA

PV-WAVE Advantage

Contact: Inside Sales
Phone: (303) 530-9000
FAX: (303) 530-9329

Retail Price: Call.
RISC Version Available: Yes.

Visual Data Analysis Application Development Environment.

PV-WAVE Advantage is Visual Numeric's full featured Visual Data Analysis (VDA) envrionment. PV-WAVE Advantage is a command line system with powerful 2-D, 3-D and 4-D VDA system with extensive statistical and numerical libraries, and support for ODBC. Visual Numerics was formed in January 1993 when Precision Visuals and IMSL merged. PV-WAVE Advantage is an ideal tool for VARs, in-house developers, researchers, and systems integrators working in environments where large volumes of data need to be analyzed and displayed. PV-WAVE Advantage has sold over 8,000 licenses on the UNIX OS, and is now available on NT. Our customers work in dozens of markets and industries, including: Medical Research and Analysis, Aerospace, Automotive, Oil and Gas, Education and Research labs, Financial, Data base analysis, and many others... PV-WAVE Advantage's features include: -2-D, 3-D, and 4-D plotting and graphics -Animation -Volumetric rendering and analysis -Extensive Statistical and Numerical libraries -Powerful signal processing functions -ODBC support -OLE 2.0 support -Command line application interface -Interpretive and compiled application generation -Core code transport to PV-WAVE on UNIX -and dozens of other powerful features...

Visual Solutions

487 Groten Road
Westford, MA 01886
Country

VisSim

Contact: Carrie Lemieux
Phone: --
FAX: --

Retail Price: $3495.00
RISC Version Available: Call.

VisSim is a visually programmed, systems design and simulation environment.

VisSim is a visually programmed, systems design and simulation environment for engineers, scientists and financial analysts. Systems can be created from a choice of over 75 fundamental system components, including ASCII data input and output, arithmetic and boolean functions, adaptive integration methods, embedded plots, and DDE and DLL. VisSim has a number of add-ons that give it more functionality in specific applications: VisSim/Analyze for performing frequency domain analysis, VisSim/Neural-Net for adapative systems, VisSim/RT for real-time analysis and VisSim/C-Code for embedded processing.

VITAL

10755 Meadowglen Lane#238
Houston, TX 77042
USA

CRISP

Contact: Gigi Mehrotra
Phone: (214) 580-3448
FAX: (214) 580-7649

Retail Price: $149.99
RISC Version Available: Yes.

BRIEF & Vi users will not miss a beat on Windows NT.

Crisp is a fully customizable text editor which is extremely powerful, yet provides an amazingly user friendly editing environmet. It provides complete keystroke emulation of BRIEF and Vi in a windowing environment. CRISP has a superset of BRIEF compatible C like macro language. Users can run their favorite BRIEF/Vi macros. Crisp recognizes both BRIEF/UNIX like regular expressions. Template editing, unlimited undos, search & replace on columnar blocks, synchronized window movement, shell buffers etc, provide an envronment which is hard to beat. CRISP comes in both X/Windows GUI version with scrollbars, buttons, dialog boxes, mouse support, etc. as well as a character version. CRISP: For fast thinking individuals.

Vox-L Inc. A Lateiner Dataspace Company

500 West Cummings ParkSuite 1700
Woburn, MA 01801-6336
USA

Vox-L Workstation

Contact: Joshua Lateiner
Phone: (617) 637-8330
FAX: (617) 937-8331

Retail Price: Call.
RISC Version Available: Yes.

Interactive Volume Visualization.

WATCOM International Corp.

415 Phillip Street
Waterloo, ON N2L 3X2
Canada

WATCOM C/C++32

Contact: Inside Sales
Phone: (800) 265-4555 or (519) 886-3700
FAX: (519) 747-4971

Retail Price: $599.00
RISC Version Available: Call.

WATCOM C/C++32 is a professional 32-bit C and C++ compiler and tools package for application development with extended DOS, Windows NT, Win32s, 32-bit Windows 3.x, OS/2 2.x, Novell NLMs and AutoCAD ADS/ADI.

WATCOM C/C++32 is a professional, high performance 32-bit C and C++ compiler and tools package for extended DOS, Windows NT, Win32s, 32-bit Windows 3.x, OS/2 2.x, Novell NLM and AutoCAD ADS/ADI. The C++ compiler provides comprehensive support for the AT&T version 3.0 language including templates, plus exception handling. New superscalar optimization strategy uses "riscification" and instruction scheduling to deliver improved performance on 486 and Pentium processors. The compiler can create a single, high-performance executable that runs on 386, 486 and Pentium processors. In a single package, C/C++32 supports a wide range of 32-bit Intel x86 host and target platforms allowing professional developers to leverage the cross development capabilities of today's operating environments including OS/2 2.x and Windows NT. The toolset including optimizing C and C++ compilers, debugger, profiler, royalty free DOS extender with 32 meg VMM support, licensed components of the Microsoft Windows 3.1 SDK, OS/2 2.1Toolkit and NetWare 4.0 SDK and much more.

WATCOM International Corp.

415 Phillip Street
Waterloo, ON N2L 3X2
Canada

WATCOM FORTRAN 77 32

Contact: Inside Sales
Phone: (800) 265-4555 or (519) 886-3700
FAX: (519) 747-4971

Retail Price: $599.00
RISC Version Available: Call.

WATCOM FORTRAN 77 32 is a compiler and tools package for multi-platform application development.

WATCOM FORTRAN 7732 is a 32-bit FORTRAN compiler and tools package for extended DOS, Windows NT, Win32s, 32-bit Windows 3.x, OS/2 2.x, NovellNLM and AutoCAD ADS. The hot, new F7732 code generator advances the performance envelope. New superscalar optimization strategy uses "riscification" and instruction scheduling to deliver improved performance on 486 and Pentium processors. The compiler can create a single,high-performance executable that runs on 386, 486 and Pentium processors. To ease porting of existing code from other platforms, F7732 has been enhanced with VAX, FORTRAN 90, Microsoft and IBM VS language extensions. F7732 supports the full FORTRAN 77 ANSI standard and is compatible with IBM's SAA FORTRAN language definition. F7732 is run-time compatible with WATCOM C/C++32 enabling you to create mixed language applications. F7732 includes a comprehensive toolset including optimizing compiler, linker, debugger, profiler, royalty free DOS extender with 32 meg VMM support, licensed components of the Microsoft 3.1 SDK, OS/2 2.1 Toolkit and NetWare 4.0 SDK and much more.

Welcom Software Technology

15995 N. Barkers LandingSuite 275
Houston, TX 77079-2494
USA

Texim Project

Contact: Customer Service
Phone: (800) 274-4WST or (713) 558-0514
FAX: 713-584-7828

Retail Price: $995.00
RISC Version Available: Yes.

Graphical Project Management Software - Making the Complex Clear and Simple.

Texim Project provides a new way of organizing and developing project plans. It offers state-of-the-art project management capabilities that combine task, resource, and cost information in an interactive graphical environment. It offers many options for data entry, review and reporting. It provides multi-project management through graphical WBS and OBS charts. The Time-scaled network diagram and full-risk management features help to separate Texim Project from other PC products. Texim Project has a seamless data exchange with Welcom Software's other planning system, Open Plan.

Wilson WindowWare Inc.

2701 California Ave SWSuite 212
Seattle, WA 98116
USA

File Commander

Contact: Margaret Premel
Phone: (800) 762-8383 or (206) 938-1740
FAX: (206) 935-7129

Retail Price: $49.95
RISC Version Available: Call.

File Commander.

The best extender for the Windows NT File Manager. It can add up to five menu items to the Windows NT File Manager menu bar. Even other File Manager extenders can be added into the File Commander menus, thus freeing up additional menu slots. From each of the added top-level menu items, File Commander allows you to make up to 99 menu items spread up to four levels deep. The menu items, when selected, execute our Windows Interface Language menu scripts. The menu items can gather filenames and other information into listboxes for the user to choose from, perform arithmetic, parse strings, move and resize windows, read and write WIN.INI variables, read and set environment variables, copy, move and delete files. Includes network, multimedia, DDEand OLE support. Has Sendkey statements and Dialog boxes. It can even access the hilited files in the File Manager window.

Wilson WindowWare Inc.

2701 California Ave SWSuite 212
Seattle, WA 98116
USA

WinEdit

Contact: Margaret Premel
Phone: (800) 762-8383 or (206) 938-1740
FAX: (206) 935-7129

Retail Price: $129.95
RISC Version Available: Yes.

WinEdit the Programmer's Editor.

Powerful text editor designed to take full advantage of the Windows graphical environment. A fantastic programmer's editor, with features designed for creating and maintaining program souce code. It uses MIDI, has the ability to edit files of almost unlimited size, gives immediate access to the Windows SDK and C language help files, and can print half sized two-up pages. Allows users to run their compiler or other programming tool from within the WinEdit environment. Built in support for most popular compilers. Contains a complete macro scripting language to allow the professional users to write their own WinEdit menu items.

WinSoft

1016 E. El Camino RealSuite 216
Sunnyvale, CA 94087
USA

Instant Prototyper

Contact: Phillip Jain
Phone: (415) 324-9552
FAX: (415) 324-9580

Retail Price: $149.00
RISC Version Available: Call.

Instant Prototyper rapidly designs professional 3D interface and lets you demo and test your design without coding or compiling.

Instant Prototyper creates WYSIWYG SAA applications by just pointing and clicking. You don't need to write any code. You can create main windows, dialogs, menus, radio/ check/push/hypertext/ help,icons, import graphics/bitmaps, scroll bars, list boxes, directories, text file display/editing, choice/pick lists, combo boxes, spreadsheet-like tables, status bar, tool bar. Customizable 3D look-and-feel is supported. Instant Prototyper lets you demonstrate and test your complete design including menus, windows and "live" data entry validation fields. Also, by upgrading to Instant Window, you can generate the complete 'C' code for your application's user interface. Versons available for DOS, Windows 3.1,Windows NT, OS/2 and UNIX.

WinSoft

1016 E. El Camino RealSuite 216
Sunnyvale, CA 94087
USA

Instant Windows

Contact: Phillip Jain
Phone: (415) 324-9552
FAX: (415) 324-9580

Retail Price: $495.00
RISC Version Available: Call.

Instant Window rapidly create bullet-proof, portable business applications with professional 3D look and feel.

Instant Window is an integrated Data Oriented, Validation Library available on multiple platforms. Edit controls include custom validation, display, password, optional and required entry, picture/range checks, business, money, date, time and C datatypes. It also includes spreadsheet-like scrollable tables, dialogs, mouse, menus, radio/check/push/hypertext-help buttons, status bar, tool bar, icons, import graphics/bitmaps, scroll bars, combo boxes/choice lists, directories, text file display/editing, color, error messages support and customizable 3D look-and-feel.Instant Window generates bug-free C/C++,COBOL code for your application's user interface. Instant Window code generator preserves the custom code during code regeneration. You can port across DOS, Windows and OS/2 by simply relinking the code to a different Instant Windows Portable Library. There is no royalty fees. Instant Window Extentions Library for $249 extra supports OLE, MDI, DDE, and Status-line.

Wolfram Research, Inc.

100 Trade Center Drive
Champaign, IL 61820-7237
USA

Mathematica for Windows NT

Contact: Inside Sales
Phone: (800) 441-MATH or (217) 398-0700
FAX: (217) 398-0747

Retail Price: Call.
RISC Version Available: Yes.

Mathematica for Windows NT.

Mathematica is a general system for doing numerical, symbolic, and graphical computation. It is used by researchers, students, engineers, physicists, analysts, and other technical professionals both as an interactive calculation tool and as a programming language. Mathematica's numerical capabilities include arbitrary-precision arithmetic and matrix manipulation. It can manipulate formulas directly in algebraic form, performing such operations as symbolic equation solving, integration, differentiation, and power series expansion. Mathematica generates two- and three-dimensional graphics, and animated graphics. Mathematica generates images in PostScript form, which can be converted to Encapsulated PostScript, raster, and Adobe Illustrator formats. Mathematica's front end supports 'Notebooks,' interactive documents that combine Mathematica input and output with text, graphics, and sound. Mathematica also provides high-level external program communcation via MathLink.

Wonderware Software Development Corp.

100 Technology Drive
Irvine, CA 92718
USA

DDE Servers

Contact: Gary Wilson
Phone: (714) 727-3200
FAX: (714) 727-3270

Retail Price: $400.00 each.
RISC Version Available: Call.

.

DDE Servers are input/output drivers that use the Dynamic Data Exchange (DDE) protocol to provide seamless data sharing between the InTouch MMI and programmable logic controllers (PLCs) or other control devices, including systems from leading manufacturers such as Allen-Bradley, GE-Fanuc, Modicon, Siemens, Opto-22, Texas Instruments and more. The servers' use of DDE also allows the exchange of data with any DDE-aware Windows or Windows NT applications such as Microsoft Excel, Microsoft Word, WordPerfect's WorldPerfect for Windows, Lotus 1-2-3 for Windows, etc.

Wonderware Software Development Corp.

100 Technology Drive
Irvine, CA 92718
USA

NetDDE

Contact: Gary Wilson
Phone: (714) 727-3200
FAX: (714) 727-3270

Retail Price: Call.
RISC Version Available: Call.

.

NetDDE is a family of enterprise-wide connectivity products that extends the data sharing capability of DDE over networks of computers and workstations. It provides connectivity over almost any network protocol, including NetBIOS, DECnet, TCP/IP, IPX and serial links. It works in multiple operating environments, including Windows, Windows NT, UNIX and VAX VMS.

Wyvern Technologies

1565 Carling AveSuite 20A
Ottawa, Ontario K1Z 8R1
Canada

Camelot

Contact: Paul Throop
Phone: (613) 729-8236
FAX: (613) 729-8838

Retail Price: $749.00 Introductory Price
RISC Version Available: Call.

.

Camelot is a fully integrated, object-oriented, graphical development environment. Camelot offers developers a truly seamless platform-independent environment. The software is multi-version allowing the user to install Camelot on a Windows 3.1, Windows NT, OS/2 2.0, Macintosh or DOS platform.

XVT Software, Inc.

4900 Pearl East CircleSuite 107
Boulder, CO 80308-9917
USA

XVT Portability Toolkit

Contact: Customer Service
Phone: (800) 678-7988 or (303) 443-4223
FAX: (303) 443-0969

Retail Price: $1,750.00 if purchased separately

RISC Version Available: Call.

Portable GUI Development Solution.

The XVT Portability Toolkit is a powerful development environment that allows you to build and maintain a single C or C++ application that is portable to seven different popular GUI (Graphical User Interface) environments and more than twenty-six different systems. The result: Your application is available to the widest market without the time and expense of developing for each GUI separately. Available for Microsoft Windows, Windows NT, Macintosh, OS/2 Presentation Manager, OPEN LOOK, OSF/Motif, and character systems for DOS, UNIX, and VMS.

XVT Software, Inc.

4900 Pearl East CircleSuite 107
Boulder, CO 80308-9917
USA

XVT-Design 2.0

Contact: Customer Service
Phone: (800) 678-7988 or (303) 443-4223
FAX: (303) 443-0969

Retail Price: $1,750.00 if purchased separately

RISC Version Available: Call.

Portable GUI Development Solution.

XVT-Design 2.0 is an interactive design solution that generates portable GUI code and resources for the XVT Portability Toolkit. XVT-Design 2.0 allows programmers to interactively design a portable interface using a broad selection of sophisticated elements. The interface can be designed, coded, and tested without leaving XVT-Design. Developers can immediately view and test the interactions between elements and completely specify how elements of the interface interact with the non-interface portion of the application. XVT-Design 2.0 not only manages the elements of the design, but also manages all of the program code associated with GUI itself and the code that links the GUI to the rest of the application.

There are no companies beginning with this letter.

There are no 32 bit applications beginning with this letter.

WOSA: Delivering Enterprise Services to the Windows-Based Desktop

Windows™ Open Services Architecture (WOSA) is a single, open-ended interface for enterprise computing environments that can provide your users and applications developers with seamless access to information, without them having to know anything about the underlying network or back-end services. In addition, business applications built using WOSA will continue to work, despite changing computing environments and information resources, protecting your corporation's technology investments.

WOSA services fall into three categories: **common application services**, **communication services**, and **vertical market services**.

See Also:

The Benefits of WOSA

The WOSA Architecture

The WOSA Architecture

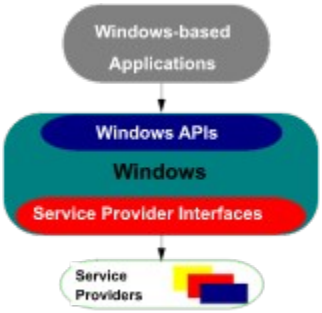
WOSA uses Windows dynamic link libraries (DLLs) to link software components at run time. Using DLLs, applications connect to services dynamically, using the definition of the interface. WOSA's benefits can be measured across two dimensions: **choice** and **risk**.

On the application side, the interfaces to services such as **ODBC** are an extension to the Windows programming interface. Commercial or corporate developers can extend an application by using these functions as they would file and print services.

On the service-provider side, drivers can be distributed that link Windows desktops in the same way most printers are supported today. The benefit to the developer and the user is that applications are unaffected by changes to back-end services.

Graphical Representation of WOSA Architecture

ODBC
Open Database Connectivity



WOSA Architecture

Open Architecture: Increased Choices

WOSA can give your users and IS department a wider choice of vendors, applications, operating environments, and hardware platforms. Thousands of applications are available on the Windows platform and WOSA provides interoperability with the rest. With WOSA, your IS managers can tailor solutions to effectively meet the needs of individual users.

Open Architecture: Reduced Risk

WOSA can help your company use its existing information resources to build useful and productive business applications, as it moves to client-server computing on the PC platform. As your data resource needs grow, WOSA can re-implement services on more powerful platforms, without requiring changes to business applications. Your company can also transparently substitute different implementations of an existing service if it needs to.

The Benefits of WOSA

WOSA can help reduce the costs of solution development in a changing computing environment

Through standardized interfaces, WOSA can help you to:

- **Protect Your Software Investment**
- **Implement More Cost-Effective Software Solutions**
- **Integrate Multi-Vendor Components Flexibly**
- **Shorten Development Cycles for Solutions**
- **Ensure Extensibility to Include Future Services**

Protect Your Software Investment

Existing WOSA-based applications can access, without modification, new service implementations on a variety of platforms, such as SQL Server for Windows NT, DB2 on MVS, or Oracle on VMS. Users can work with new information resources without learning how to use new applications.

More Cost-Effective Software Solutions

WOSA-based off-the-shelf applications are available today. IS managers can use these products to create integrated software solutions that are as powerful as the more expensive, custom alternatives. WOSA's modular approach makes it easy to tailor software solutions to specific business needs. With WOSA, IS managers can focus on making the enterprise more effective without getting sidetracked by frustrating compatibility issues.

Integrate Multi-Vendor Components Flexibly

The flexible, open architecture of WOSA supports multi-vendor environments and multiple implementations of a single type of service in any environment. WOSA facilitates the switch from one implementation to another. This is important if your long-range plans require changing to new products, and it is critical if you are unsure of your long-term requirements. Because its DLL-based implementation links at run time, WOSA makes it easy to add support for new service-providers without having to make changes to the Windows-based applications.

Shorten Development Cycles for Solutions

WOSA relieves corporate developers from the burden of managing access to various back-end services, by providing this access in the system software. This feature eliminates the need for application developers to reinvent solutions for each new service implementation, allowing them to provide access to new implementations by "plugging" existing components together without any additional programming.

Ensure Extensibility to Include Future Services

WOSA is designed to be extensible. New types of services can be added to the architecture without disrupting existing ones. Applications can can be extended, without modification, to take advantage of entirely new services.

Common Application Services

- **Open Database Connectivity (ODBC)** provides seamless access across heterogeneous database systems from within Windows-based applications.
- **Messaging Application Program Interface (MAPI)** helps mail-enabled, Windows-based applications to communicate and interoperate with multiple mail services.
- **Windows Telephony** helps desktop applications access corporate telephone networks, independent of the type of telephone network or the type of PC-telephone connection.
- **License Service Application Program Interface (LSAPI)** makes it easier for corporations to implement centralized software license management.

Open Database Connectivity

ODBC alleviates the need for developers to learn multiple programming interfaces by providing a universal data access interface. It allows an organization to develop applications that integrate legacy data, providing a smooth upgrade path as system throughput, database size, or number of users increases. Additionally, ODBC can support disparate databases across the company with a single programming interface.

ODBC enjoys extensive industry acceptance from database vendors, application vendors, and corporate developers. The list of products using ODBC is continually growing: ODBC drivers have been completed for over 20 different database server products. ODBC connectivity is already available in many popular front-end applications and development tools such as Microsoft® VisualBasic™, Powersoft™ PowerBuilder™, and KnowledgeWare® ObjectView. ODBC is a good demonstration of the way WOSA is making access to critical enterprise resources easier to implement and use.

Messaging Application Program Interface (MAPI)

Electronic-mail has become an important part of the communication infrastructure within many corporations. However, companies have found that the introduction of electronic mail alone has not solved their communication and productivity problems. This is due largely to the complexity of most electronic mail applications and their inability to truly integrate information for enterprise-wide workgroup applications. Ideally, a corporate computer network should serve as a highly efficient communication backbone.

MAPI is flexible and open. MAPI-based applications are not tied to a specific vendor's electronic mail system, and MAPI supports existing standards such as the X.400 API Association Common Messaging Calls (CMC). Using MAPI, Windows-based applications can provide users with straightforward access to workgroup and enterprise-wide communications.

For Additional Information:

How MAPI Works

How MAPI Works

MAPI acts as a layer between applications and the underlying messaging systems. This allows both components to be developed independently, which makes it easier to write powerful messaging-enabled applications that will work across multiple systems. If you are working on a Windows-based desktop, you can select drivers from the control panel as if you were installing different printers.

MAPI frees you to choose messaging systems and applications according to your needs--not their compatibility. As drivers become available, a single application can work with multiple messaging systems such as Microsoft® MAIL, Novell® MHS, and IBM® PROFS®. Once a driver is installed, you need not be concerned with the underlying messaging system.

By using a single client application to handle all of these systems, you reduce the costs of development, application purchases, user training, and system administration. Migrating to a new messaging subsystem is simple, because all front-end applications written to the MAPI interface will work transparently with any system with a MAPI service-provider interface.

Windows Telephony

Nearly every business desktop has a phone sitting next to a PC, and no communication between them. While modems are widely used for data transport, they do not provide control of the phone network beyond simple connections on an analog network. Furthermore, the PC is not a full participant in the global telephone network.

Windows Telephony gives basic phone function to your PC. For example, with Windows Telephony, you can establish, answer, hold, transfer, conference, or park a call. Windows Telephony also supports a broad range of telephone network types, including analog, key system, PBX, ISDN, and cellular. Because it operates independently from the underlying telephone network and equipment, Windows Telephony isolates applications from the complexity of individual networks, greatly simplifying development. The API provides maximum flexibility for transparently connecting PCs to all types of telephone systems.

With broad support from both the PC industry and all major telephone system manufacturers, Windows Telephony presents exciting opportunities for the development of new products integrating the telephone and computer. (**See Examples**) More options will emerge as products are developed on the Windows Telephony API specification.

New Applications with Windows Telephony

- Through the visual interface of computer software applications, users will be able to access even the most sophisticated telephone features without having to remember complex codes and instructions.
- Computer will be able to control personal communication management, automatically handling incoming telephone calls.
- Windows Telephony can be used to automate tasks requiring telephone access. For example, a personal information manager can be used to look up telephone numbers and place calls.
- Instead of checking separate sources for fax, voice, and electronic mail, computer users will be able to review and manage all of these messages from one integrated location.
- Computer users in geographically separate locations will be able to combine the functions of their computers and their telephones to share visual as well as audio information.

License Service Application Program Interface

In a concerted effort to help standardize software licensing and reduce the burden of implementing custom licensing systems, an association of software vendors has developed the License Service Application Program Interface. With the License Service API, an application does not need to know anything about the type of network in use, the types of computers in the enterprise, or the types of license policies available, to enjoy seamless access to a licensing mechanism. As a result, desktop applications do not need to be rewritten when the network, computers, or license policies change. In other words, the License Service API enables applications to connect to the licensing services they need across multiple computing environments in a platform-independent manner.

The License Service API effort was founded by Brightwork Development, Digital Equipment Corporation, Gradient Technologies, Microsoft Corporation, and Novell. Many other vendors have subsequently become involved in the effort.

Communication Services

- **Windows SNA Application Program Interface** standardizes the method for host connectivity by providing open access to IBM® SNA APIs.
- **Windows Sockets** allows Windows-based applications to access network services across multiple transport protocols such as TCP/IP, IPX/SPX and AppleTalk®.
- **Microsoft RPC** is a remote procedure call facility that is compatible with the Open Software Foundation's DCE RPC. RPC makes it easier to build distributed client-server applications across heterogeneous networks.

Windows SNA API

Although SNA connectivity has always been available, each vendor has implemented this connectivity in slightly different ways, which has resulted in frustrating compatibility issues between products. To work around compatibility problems, many corporations have chosen a single vendor to provide their SNA connectivity software.

The Windows SNA API is a standard interface between Windows-based applications and SNA networks, developed jointly by over twenty different vendors. This single interface specification gives any Windows-based application seamless access to SNA networks, no matter which connectivity software is used. The specification includes full support for the SNA services including HLLAPI, APPC, CPI-C, CSV and LU0. The implementation is fully compatible with IBM® OS/2® Extended Services, and has wide industry support.

Windows Sockets

The Windows Sockets specification defines a network programming interface for Microsoft® Windows™ which is based on the Berkeley Sockets programming model--the standard for TCP/IP networking. Windows Sockets extends the Berkeley Sockets model to more efficiently handle programming issues, such as blocking calls, in a non-preemptive Windows 3.x environment. Because Windows-based applications connect seamlessly with services in any TCP/IP network regardless of specific implementation, compatibility concerns are eliminated.

The Windows Sockets interface also extends beyond traditional UNIX sockets programming, by allowing transparent connection to network services across other transport protocols, such as IPX/SPX, AppleTalk®, DECnet™ and XNS™. Windows Sockets was designed to remove any TCP/IP-specific conventions, eliminating the need to develop multiple versions of applications to access byte-stream-oriented data transmissions on different transport protocols.

Remote Procedure Call (RPC)

Microsoft RPC is compatible with the Open Software Foundation Distributed Computing Environment (DCE) RPC. Applications written to the Microsoft RPC specification also interoperate seamlessly with other DCE-based applications. This allows distributed client-server applications to be developed across multiple computing environments.

Using Microsoft RPC, Windows NT™ based machines can act as RPC clients and servers in distributed environments that use DCE-compatible RPC. In addition, Windows 3.x and MS-DOS machines can connect as clients within such environments, opening up a powerful realm of distributed services for Windows-based applications. The DCE is one of the many service-providers compatible with WOSA. Microsoft RPC will soon offer features such as encrypted sessions, authentication services, and the ability to obtain naming services from both Windows NT and DCE servers. Microsoft is aware of an ongoing need for numerous, distributed systems that can coexist, and its goal for WOSA is to transparently integrate these systems.

Vertical Market Services

Extensibility is a key WOSA design feature. As the Windows operating system becomes an enterprise standard for building mission-critical applications, WOSA is being extended to define standard interfaces to the specialized computing services found in various vertical markets.

- **WOSA Extensions for Financial Services** provide Windows-based applications with a standard interface to services common in the banking industry.
- **WOSA Extensions for Real-Time Market Data** allow Windows-based applications to receive live market data from many different sources.

WOSA Extensions for Financial Services

The WOSA Extensions for Financial Services are being developed by the **Banking Systems Vendor Council**, a group whose members are leading software and hardware vendors in the financial services markets. The extensions define a standard application program interface (API) and service-provider interface (SPI) that allow the development of interoperable Windows-based applications and service-providers. The group's first release defines standard interfaces for access to various specialized peripherals found in the banking industry--passbook/journal/receipt printers, magnetic card readers, PIN pads, and other specialized devices. Future releases are expected to address other issues critical to financial enterprise computing, such as:

- Financial transaction messaging and management
- Network and system management
- Security
- Emerging technologies such as object-oriented development and pen computing

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WOSA Extensions for Real-Time Market Data

The two most pervasive types of information in the securities industry are real-time price quotations and news stories, on sources like Reuters and Quotron. While an entire industry has developed to process and distribute "live" information, there is no standard way to capture it within desktop applications. Many sources of real-time market information are incompatible with each other, making the information difficult to manipulate. WOSA Extensions for Real-time Market Data solve this problem, and open the door for more powerful, integrated applications.

WOSA Extensions for Real-time Market Data are being developed by the **Open Market Data Council for Windows**, to provide a standard mechanism in which applications can exchange live market data and news. The group is currently developing the specification based on a technology known as Object Linking and Embedding 2.0 (OLE 2.0). OLE 2.0 is a powerful means for applications to freely exchange data. Through OLE 2.0, Windows-based applications will be able to receive and exchange the important real-time market data that is the lifeblood of the banking and securities industries. Through WOSA Extensions for Real-time Market Data, applications will receive live market data in a common, open format, no matter what the data source.

Members of the Open Market Data Council for Windows

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