Payoff

As organizations increasingly move mainframe-based applications to client/server platforms, Information Systems managers and their staffs face the task of selecting one of several client/server operating environments, including UNIX, Novell Inc.'s NetWare, and Microsoft Corp.'s Windows Microsoft New Technology operating system. The selection process is further complicated because both client and server versions of Windows NT are available and each can be used in UNIX and NetWare environments. This article helps IS managers make a more informed decision regarding the suitability of Windows NT for their computing environments.

Introduction

Although the market penetration of Microsoft Corp.'s Windows Microsoft New Technology operating system at the client/server level only recently exceeded 10%, actual development of this client/server operating system began in 1988. Windows NT was primarily developed by a team of former Digital Equipment Corp. employees originally responsible for the development of DEC's VAX operating system, which explains why people familiar with VAX note many similarities between the two operating systems.

Windows NT version 4.0 represents the current version of the system and sports the Windows 95 interface. Both the client, known as Windows NT Workstation, and the server, known as Windows NT Server, are marketed by Microsoft. The key difference between the two versions of Windows NT concerns scalability and network and file support.

Windows NT Server, as its name implies, was developed as a network-based server. The operating system is optimized to support network requests to the server, which include the access and transfer of information in the form of files.

In addition, because the server is the focal point of a client/server network, Windows NT Server is scalable and able to operate on a computer containing up to four processors. An organization can therefore purchase a computer with a single processor that has a motherboard designed to support up to four processors and add processors as computing requirements increase.

In comparison, Windows NT Workstation was developed to favor workstation processing. This means that the workstation operating system does not have to be scalable to support additional network-related processing nor concerned with providing network services to users, which is a key function of Windows NT Server.

System Requirements

Both Windows NT Server and Windows NT Workstation currently operate on three hardware platforms: Intel X86-based processors, DEC AXP, and MIPS Reduced Instruction Set (Reduced Instruction Set Computer)computers. In addition, Apple Computer and IBM Corp. are considering porting both versions of NT to their PowerPC product line.
Windows NT Workstation requires 12M bytes of Random Access Memory when operating on Intel platforms and 16M bytes for use on Digital Equipment Corporation and Millions of Instructions Per Second RISC-based computers. Although Windows NT Server also operates with a similar amount of RAM, the amount is sufficient only when the server supports less than 50 workstations. As workstation support requirements increase, RAM requirements can increase; the applications supported by the server as well as the number of workstations supported govern the amount of RAM required. Although Microsoft publishes a guide to the minimum amount of memory that should be installed for use with Windows NT Server, networks with 50 or more workstations should use servers with a minimum of 32M bytes of RAM.

System Features

Both Windows NT Workstation and Windows NT Server include a core set of features that differentiate them other client/server operating systems, such as Novell's NetWare and UNIX-based systems. Those features include the scalability of the server operating system as well as security, performance monitoring, and network support enhancements. Examining these features provides IS and network managers with a basis for comparing and selecting a client/server operating system.

Scalability

As discussed previously, Windows NT Server is scalable, capable of running on a four-processor computer. In addition, because Windows NT operates on Intel, DEC Alpha, and MIPS machines, users can migrate their server from a relatively low-cost Intel single-processor platform to a multiprocessor higher performance DEC Alpha or MIPS platform while continuing to use NT.

NetWare is currently restricted to operating on Intel platforms and cannot provide the migration path associated with the use of Windows NT. Although UNIX operates on a variety of hardware platforms ranging from PCs to Sun Microsystems, Hewlett-Packard, and IBM high-performance workstations that function as servers, differences between the version of UNIX supported by each platform may inhibit organizations from migrating applications from one UNIX-based system to another. NT thus provides the only server-based operating system that is truly portable for applications migrated from one vendor platform to another.

Performance Monitoring

Both Windows NT Workstation and Windows NT Server include a performance-monitoring capability that is extremely valuable for determining when or if the current hardware platform should be changed. In addition to monitoring, for example, processor metrics, NT's Performance Monitor program also generate alarms and plots the performance of a large number of network-related metrics, such as session timeouts, retries, and number of open connections.

Under NetWare, performance monitoring is accomplished through the use of the MONITOR utility program, a passive tool that cannot be used to set alarms. Although several third-party products that perform in a manner similar to Windows NT in a NetWare environment are available, these products are not bundled with NetWare and require the expenditure of additional funds. Some versions of UNIX include a built-in performance monitoring capability, but most versions of it also depend on the use of third-
party products. Windows NT thus provides a built-in performance monitoring capability that remains in place if the need to migrate to a different hardware platform arises.

**Security**

Users of Windows NT notice immediately that once the system is installed, unauthorized individuals cannot power the hardware off and back on and take control of the computer by inserting a disk into the A drive. Instead, NT has a User Manager that limits access to the computer to predefined users, such as the administrator and any guest or individual accounts that permit employees to use a workstation or a server.

Exhibit 1 illustrates the Windows NT User Manager screen common to both server and workstation versions of the operating system. To illustrate the utility of the User Manager, Exhibit 2 shows the user properties it supports. Note that an authorized person can assign and change user passwords as well as control the password's expiration and, if so desired, disable an account.

**Windows NT User Manager Screen**

**User Properties Supported by the Windows NT User Manager**

NetWare is similar to Windows NT in its support of predefined groups, such as guests and administrators (called supervisor under NetWare). The key difference between NetWare and Windows NT lies in the ability of client workstations in the latter system to control access to the computer and in ease of use.

In the Group Memberships dialog box, for example, simply clicking on a button after highlighting an entry changes a user's group membership. Although NetWare has a similar feature, it requires slightly more manual intervention, which becomes significant if a server supports a large number of users. In the case of UNIX, each version of the system differs in its security and network administration, so the administration training effort increases if computer platforms are switched.

**Network Support**

One of the most important features of any server is its ability to support organizational networking requirements. Windows NT truly excels in this area, because it supports a diverse and comprehensive range of network protocols ranging from Network Basic I/O System to AppleTalk, IBM's Data Link Control (Data Link Connections), NetWare's NWLink Internetwork Packet eXchange/Sequenced Packet eXchange, and TCP/IP (Transmission Control Protocol/Internet Protocol).

In addition to supporting a large variety of networking protocols, Windows NT includes direct support for more than 20 network adapter cards and indirect support for more than 100 additional adapters. Direct adapter support is in the form of drivers included in the operating system, and indirect support is in the form of vendor-supplied drivers that typically accompany the hardware as a disk with files that must be loaded by the operating system.

Exhibit 3 illustrates the Windows NT Network Settings dialog box. This dialog box is invoked from the icon labeled Network in the Windows NT control panel, a method
<table>
<thead>
<tr>
<th>Username</th>
<th>Full Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrator</td>
<td></td>
<td>Full-time account for administering the computer/\domain.</td>
</tr>
<tr>
<td>Guest</td>
<td></td>
<td>Full-time account for guest access to the computer/\domain.</td>
</tr>
<tr>
<td>User</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Groups</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administrators</td>
<td>Members can fully administer the computer/\domain.</td>
</tr>
<tr>
<td>Backup Operators</td>
<td>Members can bypass file security to back up files.</td>
</tr>
<tr>
<td>Guests</td>
<td>Users granted guest access to the computer/\domain.</td>
</tr>
<tr>
<td>Power Users</td>
<td>Members can share directories and printers.</td>
</tr>
<tr>
<td>Replicator</td>
<td>Supports file replication in a domain.</td>
</tr>
<tr>
<td>Users</td>
<td>Ordinary users.</td>
</tr>
</tbody>
</table>
similar to the one employed by users of Windows and Windows 95 to control network settings. Thus, in addition to supporting a wide range of network protocols, use of Windows NT may significantly reduce training and administrative costs for many organizations.

**Windows NT Network Settings Dialog Box**

Although NetWare supports several network protocols, its main built-in support is limited to IPX/SPX, the native method of communications used in a NetWare environment. The use of other network protocols commonly requires the acquisition of drivers from the Novell bulletin board or user forum and the loading of those drivers on workstations and servers. Similarly, most UNIX systems are limited to a built-in support of TCP/IP, requiring other network protocols to be acquired and loaded onto workstations and servers.

Another advantage of Windows NT is its capability to support multiple network bindings, or the association of a network protocol to a network adapter or a network service to a network protocol. It is important to note that Windows NT supports more than 10 simultaneous bindings, which makes a server most suitable for supporting NetWare, UNIX, AppleTalk, and other network protocols transported from different client or server platforms to a Windows NT server.

In addition, because Windows NT Workstation also supports the same bindings capability as Windows NT Server, a Windows NT Workstation can be used to obtain simultaneous access to NetWare servers and Windows NT servers. This is accomplished through use of the Frye Utilities for NetWare Management program, a NetWare-based utility program that provides NetWare server performance metrics, operating under Windows NT. In fact, owing to Windows NT's extensive support of different network protocols and network adapter cards, it is quite common for users of Windows NT Workstation to employ that operating system to connect to multiple server platforms.

**Advantages of Other Operating Systems**

Although Windows NT Server includes features that make it the server of choice for many organizations, Novell's NetWare continues to excel in two key areas:

- The ability to support thousands of users.
- Suitability of the directory structure for an enterprise network.

Unlike Windows NT, which can only keep pace with NetWare 4.1 when supporting up to 100 to 200 users, NetWare supports several times that number of users without significant performance degradation. This means that large organizations may require multiple Windows NT servers in place of one large NetWare 4.1 server.

As for directory services, under NetWare 4.X, a hierarchical enterprise-wide structure can be set up that lets users on one network easily access resources on other segments. In comparison, Windows NT's Domain Services, although efficient in terms of set up and resource management, uses a replication scheme that becomes inefficient for large groups. For this reason, NetWare is probably the network of choice for large organizations with thousands of workstations.
Implementation Considerations

Although Windows NT is relatively easy to install, careful planning is required to ensure that its rich set of options are appropriately configured and implemented.

Before installing the operating system, it is prudent to review the bundled products distributed with Windows NT, such as the built-in File Transfer Protocol (file transfer protocol) server capability included in Windows NT Server. Before simply clicking on the appropriate button to install the FTP software module, IS staff must determine whether to set up the module to permit anonymous access or access only to persons with accounts on the NT server. Similarly, with the introduction of Windows NT 4.0 Server, Microsoft added a bundled Web site software module that turns an NT server into a World Wide Web server. Using the software, however, requires the correct configuration of several software settings, such as IP address and address mask, so that the server can recognize requests directed to it.

Because of the number of variables that may require settings, an appropriate testing procedure is key to any implementation plan. A well-thought-out test plan should ensure that each service thought be operational works according to the desired configuration of the operating system. For example, installation of the FTP server software on a Windows NT server as an anonymous FTP server should be tested by accessing the server with an FTP client to verify the configuration of the FTP server module.

In addition, if the server will be connected to the Internet as well as the organization's private network, the connection should be verified through both the internal (i.e., private) network connection and the Internet. This dual verification ensures that access through the Internet resulting in data flowing through a router with filters set up as a firewall barrier or as a firewall allows access to the FTP server. If it does not, IS staff then have time to request the necessary modifications to the router or firewall before moving to a production environment.

Another important consideration in an implementation plan involves global applications, such as calendaring or E-mail. Although available products vary greatly in terms of requirements, they share many common elements, including the need for a predefined naming structure. Instead of simply naming E-mail post offices as PO1, PO2, and PO3, for example, it is more effective and efficient for users and staff both in terms of meaningfulness and diagnostic testing to use site names such as ATLANTA, BOSTON, or MACON.

Conclusion

Windows NT Server is a robust, scalable operating system with substantial built-in security, performance-monitoring, and networking capabilities. IS managers in organizations whose future networking requirements are anticipated to grow should consider using the Windows NT Server operating system because it runs on different platforms and supports the use of multiple processors. This allows the organization to retain the use of the operating system as its networking requirements grow.

In addition, because Windows NT Server's security, performance-monitoring, and networking capabilities now exceed the features offered by NetWare and most UNIX systems, NT is a more robust operating system. Perhaps this explains why several trade journals predict that Windows NT will encompass more than 50% of the server market by 1998.

Although Windows NT offers several advantages over competitive network operating systems, it is important to remember that technology does not remain static. Novell's
planned new version of NetWare may provide some of the key features now associated with Windows NT. In addition, NetWare continues to retain several advantages over Windows NT that make it more suitable for large networks.

Because most IS managers and network administrators must make decisions based on released technology, it is important to note that Window's NT Workstation provides access to NetWare servers, and Windows NT Server can be used in a NetWare IPX/SPX networking environment. This means that the use of both Windows NT platforms coexists with NetWare as well as with TCP/IP UNIX-based systems. Thus, another key reason to consider the use of Windows NT is to be able to use one or more of the new applications being developed to run on an NT server without having to change an existing network.

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