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# Overview of NetWare 4.0 New Features

*Robert E. Jones*
Senior Technical Writer
Systems Research Department

NetWare 4.0 offers many new and exciting features not found in previous versions of NetWare. This AppNote highlights the most important new features and gives a feature-by-feature comparison between NetWare 4.0 and NetWare 3.11.

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## Introduction

NetWare 4.0 is the most advanced and powerful network operating system available today. This release represents the ninth generation of NetWare development. It adds a whole new dimension to network computing, extending network services and making network management easier than ever.

Currently, peer-to-peer networking is receiving a lot of attention in the computer industry. Although these types of networks can address the needs of small businesses or departments, they tend to introduce resource security and management problems in a corporate networking environment. For critical business data to be viably handled on a network, the underlying platform must be robust enough to handle network-wide administration and management. It must also provide ample security to protect sensitive corporate information.

NetWare 4.0 allows better management control, easier maintenance, and more flexible security options than any other network operating system currently available. It is the ideal platform for today's sophisticated networking needs, and it will continue to support those needs as network computing evolves in the future.

This Application Note introduces some of the major new features of NetWare 4.0. For those familiar with previous versions of NetWare, it contains a feature-by-feature comparison of NetWare 4.0 and NetWare 3.11. More detailed information is contained in subsequent AppNotes in this issue.

## NetWare 4.0 New Features

NetWare 4.0 inherits all the capabilities of earlier versions of NetWare and adds many new, exciting features. The most significant new features are the replacement of the bindery with NetWare Directory Services, increased security capabilities, and more flexible DOS client software. (These features, as well as installation, migration, and coexistence, are discussed in more detail in the other AppNotes in this issue.)

The sections which follow provide an overview of new features. For more information, refer to the NetWare 4.0 documentation.

## NetWare Directory Services

In NetWare 4.0, the bindery has been replaced by NetWare Directory Services (NDS). NDS maintains a global, distributed, replicated database of information about network resources such as users, groups, servers, volumes, printers, computers, modems, and so on. With NDS, it is now possible to integrate a diverse network of resources into a single, easy-to-use environment.

The advantages of NDS are many. NDS provides a new network-wide login which makes network navigation and resource access easier for authorized users. Instead of logging in to specific servers, users can now login to the network. They can then access all the resources and services they have rights to, without having to explicitly login or attach to other servers. NDS handles all of the address resolution issues in the background, so users are shielded from the complexity of having to understand the network topology, protocols, media, and communication links.

Because the NDS database is replicated, multiple copies of users' required login information are spread throughout the network. This replication allows users to login to the network whether or not their home server is on-line. As long as the servers that provide the necessary data or services are operational, the user can access them. In this sense, when a user is logged in to the network, servers become transparent to the process of actually using the network. Users only need one password to gain access to all network resources available to them.

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When a user accesses resources on the network (such as servers, volumes, and printers), authentication occurs in the background to verify that the user has rights to use those resources. NDS authentication works in combination with new access control features to provide network security.

More detailed information on NDS is contained in the NetWare Directory Services AppNotes in this issue.

## Server Memory Management

NetWare's server memory management capabilities have been redesigned in NetWare 4.0 to increase efficiency. The server can now manage memory in a way that provides a better overall utilization of server memory, and which also prevents server applications from running out of memory.

In NetWare 3.11, the operating system allocates memory in five or more memory pools that serve different purposes. When server applications run, the memory they need is allocated from these pools. But when some applications finish running, the memory management routines do not always make the memory available to other applications. This can cause memory problems for other applications, as memory from one pool cannot be reallocated to another memory pool.

NetWare 4.0 has only one memory allocation pool, and memory used by one application can be reallocated when that application is finished with it. This improved memory management cuts down on the number of necessary operations and helps the server run more efficiently.

## Data Storage Management

Many of today's new applications and data structures require significantly more storage space than in the past. NetWare 4.0 offers a number of new features that can help you manage increasing demands for data storage space.

**Block Suballocation**. Block suballocation allows small files, or that part of a file which exceeds the volume's default block size, to share a disk block with other files. This feature lets more files be stored in a smaller amount of space on a NetWare volume.

For example, in NetWare 3.11, if the default block size for a volume is 64 KB, and you create a 65 KB file, that file would use two complete disk blocks, or 128 KB. The remaining 63 KB in the second block is unused.

With NetWare 4.0's block suballocation feature enabled, any partially used disk block is divided into 512-byte suballocation blocks. These suballocation blocks are used to share the remainder of the block with any leftover fragments of other files. Using block suballocation in the example above, the system would allocate one disk block (64 KB) and two 512-byte suballocation blocks to store the 65 KB file. The remaining 63 KB of the second block is available for use by other files.

Block suballocation is enabled by default when NetWare 4.0 is installed.

**File Compression**. NetWare 4.0 provides a file compression feature which allows files to be compressed as they are saved to the hard disk. The files are automatically decompressed when they are retrieved. Enabling file compression lets NetWare volumes hold more on-line data by compressing files that are seldom accessed.

With this compression feature, you can effectively increase the amount of available disk space without adding new drives. The compression algorithm used can increase usable disk space up to 63%. For example, 600 MB of files on a volume could be compressed to as little as 222 MB. This can be a money-saving feature for environments where adding disk storage is financially prohibitive.

NetWare manages the file compression internally. Users (or the Supervisor) can flag individual files or directories either to be compressed after not being accessed for a time, or to never be compressed. When compression is enabled for a volume, the files flagged for compression are compressed after not being

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accessed for the specified amount of time. Files are automatically decompressed when accessed by a user.

**Data Migration**. Another new feature of NetWare 4.0 is data migration. This feature enables servers to transfer data that is used infrequently to an off-line storage device such as a disk, CD-ROM, or tape drive. NetWare 4.0 still sees the data as residing on the NetWare volume. If the user requests a file stored off-line, the file will demigrate back to the server's hard disk.

Data migration frees up valuable hard disk space for frequently accessed files, while still allowing full access to the migrated files.

**High Capacity Storage System**. The High-Capacity Storage System (HCSS) is a data storage and retrieval system that extends the storage capacity of the NetWare server by integrating one or more optical library units, known as jukeboxes, into the NetWare file system. (A jukebox is a high-capacity storage device that uses an autochanger to mount and dismount optical disks automatically.)

The HCSS works with data migration to move files between faster, low-capacity storage devices (the server's hard disk) and slower, high-capacity storage devices (optical disks in a jukebox). It uses rewritable optical disks (either one-sided or two-sided) so that it is possible to repeatedly write and erase data.

The files and directories on the jukeboxes are accessed using the same NetWare commands and function calls used to access data from the hard disks. Access can be made by either users or programs.

HCSS uses free space on the server's hard disk to temporarily store (or cache) the most active files. When space is needed to store additional files and the allocated space reaches a predetermined capacity, the least-active files are transparently moved to optical disks.

When a user requests a file stored on optical disk, HCSS automatically copies the file from the jukebox back onto the server's hard disk. This process, known as demigration, allows users to access their most active files quickly.

## Auditing

NetWare 4.0's auditing capabilities are much more powerful than in any previous versions of NetWare. Auditing allows authorized users (auditors) to audit past and present transactions on the network. These auditors act independently of network administrators to ensure that network records are accurate and confidential information is secure.

Transactions and events that can be monitored through NetWare 4.0 auditing include:

- Logins and logouts
- Trustee modifications
- File creations, deletions, reads, and writes
- Requests to manipulate queues
- Directory Services object creations, deletions, reads, and writes
- Events directly related to Directory Services objects
- Events directly related to users

With NetWare 4.0, auditors are able to track Directory Services events as well as file system and volume transactions. Auditing is enabled at the volume level for file system auditing, and at the container object level for Directory Services events.

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Auditors should not be Supervisors and should not have SUPERVISOR rights or equivalence. Auditors can track events and activities on the network, but should not be able to open or modify network files (other than the Audit Data and Audit History files), unless they are granted rights to do so by the network supervisor.

The AUDITCON audit program files are automatically installed on your system when you install or upgrade to NetWare 4.0.

## Other New Features

**Running NLMs in Protected Mode**. NetWare 4.0 has server memory protection features that guard OS memory from corruption by third-party NLMs. These features ensure that your server will not be halted by a faulty NLM.

Memory protection allows you to run NLMs in a separate memory domain called the OS_PROTECTED domain. After you have loaded an NLM in the OS_PROTECTED domain (ring 1, 2, or 3) and found it safe, you can load it into the OS domain (ring 0), where it can run most efficiently.

**Note:** All NLMs included with NetWare 4.0 have been tested and do not need to be run in an OS_PROTECTED domain.

**Packet Burst Protocol**. The packet burst protocol (or burst mode) capability which required a separate DOS client shell in NetWare 3.11 has been incorporated into the new client software. Packet burst is designed to transmit multipacket messages efficiently over an internetwork, which can result in faster data transmission between workstations and servers. Packet burst is enabled by loading PBURST.NLM on the server and entering a line in the workstation's NET.CFG file.

**Large Internet Packets**. The Large Internet Packet (LIP) feature allows increased throughput over network bridges or routers by increasing packet size. This feature is particularly helpful when using Ethernet or Token Ring architectures that allow larger packets to be sent over the network.

**Multiple Languages**. NetWare 4.0 has been adapted for use with multiple languages. The operating system, NLMs, and utilities use English as the default language, but they can be set to other languages as well. You can also set the server console keyboard for different languages.

**NetWare Print Services**. With NetWare 4.0, the hassle of having to know about print queues or print servers is eliminated. In bindery-based NetWare, only the print server and print queues exist as bindery objects; printers are defined as attributes of the print server. With NetWare Directory Services, print servers, print queues, and printers are all individual objects. They can be created and modified in any order with NetWare's text or graphical printing utilities.

One print server can now service up to 256 printers. Network printers can be attached directly to the network, to any NetWare server (via NPRINTER.NLM), or to DOS or OS/2 workstations (via NPRINTER.EXE). Users no longer need to know about print servers or print queues; they can send print jobs directly to a printer by specifying the printer name.

Other printing-related enhancements include support for:

- Configuring print queue polling time
- Unlimited number of print job configurations
- Third-party print job configurations
- Print jobs from Macintosh and NFS clients

## NetWare 4.0 Utilities

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The NetWare 4.0 utilities support Windows and OS/2 environments in addition to the DOS environment. Many utilities from earlier versions of NetWare have been consolidated into one, modified, or eliminated altogether. Also, new utilities and NLMs have been created for NetWare 4.0.

Figure 1 lists the NetWare 4.0 utilities, NLMs, and tools grouped according to functional categories. The Type column indicates the type of utility as follows:

Server Util Utilities which are entered at the server console prompt to monitor and control the network

Server NLM NetWare Loadable Modules which are loaded and run at the server

Text Util Character-based utilities which are run on DOS and OS/2 workstations

GUI Util New graphical user interface (GUI) utilities that allow supervisors to manage the network from Windows or OS/2 workstations

GUI Tools New graphical user interface (GUI) workstation tools that enable users to perform a variety of basic network tasks

Figure 1: NetWare 4.0 utilities grouped according to purpose.

| Category | Utility | Type | Description |
|---|---|---|---|
| General Administration | NetWare Administrator (NWAdmin) | GUI Util | Allows you to create NDS objects and assign property values and rights. (Graphical counterpart of the NETADMIN text utility.) |
| | NETADMIN | Text Util | Menu-driven utility that allows you to create NDS objects and assign property values and rights. Consolidates SYSCON, DSPACE, SECURITY,and USERDEF. |
| | UIMPORT | Text Util | Allows you to create many User objects at the same time using a (non-NDS) database. Replaces MAKEUSER. |
| Server Management | SERVMAN | Server NLM | Lets you change SET parameters in the .NCF files, and IPX/SPX, device, volume, and network information. |
| | MONITOR | Server NLM | Consolidates MONITOR and FCONSOLE. |
| | RCONSOLE | Server NLM | Consolidates RCONSOLE and ACONSOLE. |
| | DOMAIN | Server NLM | Creates a protected OS (OSP) domain to be run in Ring 1, 2, or 3. All new third-party NLMs should be developed and tested in an OSP domain. |
| | NWSNUT | Server NLM | NLM Utility User Interface module - provides a library |

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| | | | of routines used by certain NLMs (such as SERVMAN and MONITOR). |
| NDS Management | Partition Administrator | GUI Util | Allows you to manage NDS partitions and replicas. (Part of the NetWare Administrator utility.) |
| | PARTMGR | Text Util | Allows you to manage NDS partitions and replicas. |
| | TIMESYNC | Server NLM | Controls time synchronization on servers running NDS. |
| | DSREPAIR | Server NLM | Repairs and corrects problems in the NDS database. (Similar to what BINDFIX and BINDREST did for the bindery.) |
| Storage Management | LIST DEVICES | Server Util | Displays disk device information for the server. |
| | SCAN FOR NEW DEVICES | Server Util | Scans for disk hardware that has been added since the server was last booted. |
| | MAGAZINE | Server Util | Confirms whether requests to insert and remove magazines in the server have or have not been satisfied. |
| | MEDIA | Server Util | Confirms whether requests to insert and remove media in the server have or have not been satisfied. |
| | CDROM | Server NLM | Allows the server to use a CD-ROM disk as a read-only volume. |
| | RTDM | Server NLM | Real Time Data Migration. (See third-party documentation.) |
| Mirroring | MIRROR STATUS | Server Util | Displays all mirrored logical disk partitions and their status. |
| | REMIRROR PARTITION | Server Util | Starts the remirroring of logical disk partitions. |
| | ABORT REMIRROR | Server Util | Stops the remirroring of logical disk partitions. |
| File Management | FILER | Text Util | Consolidates FILER, VOLINFO, SALVAGE, and PURGE. |

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|---|---|---|---|
| | | | |
| | FLAC | Text Util | Consolidates FLAC, FLAGDIR, and SMODE. |
| Security and Auditing | RIGHTS | Text Util | Consolidates RIGHTS, ALLOW, GRANT, REMOVE, REVOKE, and TLIST. |
| | AUDITCON | Text Util | Allows independent auditors to audit network transactions, NDS events, and events specific to a volume or server. (Consolidates ATOTAL and PAUDIT.) |
| Printing | PCONSOLE | Text Util | Allows you to create Print Server, Print Queue, and Printer objects to set up the printing environment. |
| | NPRINTER | Text Util<br>Server NLM | Allows any printer to be used as a network printer, whether attached to a DOS or OS/2 workstation or to a NetWare server. |
| Backup | SBACKUP | Server NLM | Completes backup requests directed to it from the network. (Consolidates NBACKUP.) |
| International- ization | KEYB | Server Util<br>Server NLM | Allows you to select a nationality or language. |
| | LANGUAGE | Server Util | Sets the server or NLMs to use a specific language. |
| Remote Boot | RPL | Server NLM | Remote Program Load enables remote booting of IBM PC-compatible diskless workstations. |
| Client Utilities | LOGIN | Text Util<br>Server NLM | Consolidates ATTACH and LOGIN. |
| | MENU | Text Util | Allows you to create a menued working environment for users. |
| | NETUSER | Text Util | Allows users to access network attachments, manage drive mappings, send messages, and set up print jobs. (Replaces SESSION.) |
| | NDIR | Text Util | Consolidates NDIR, CHKDIR, LISTDIR, and CHKVOL. |
| | NLIST | Text Util | Allows users to view information about files, directories, users, groups, volumes, servers, and queues. (Consolidates SLIST |

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| | | | |
|---|---|---|---|
| | | | and USERLIST.) |
| | SEND | Text Util | Consolidates SEND, CASTON, and CASTOFF. |
| | CX | Text Util | Allows users to change context, or position, in the Directory tree. |
| | Tools for Windows – OS/2 | GUI Tools | Tools for Windows and OS/2 are installed as a group in the Program Manager (Windows) or on the desktop (OS/2). |

# NetWare Feature Comparison

Figure 2 provides a comparison of features common to NetWare 4.0 and NetWare 3.11, as well a listing of many features new with NetWare 4.0.

Figure 2: Feature comparison between NetWare 4.0 and 3.11.

| FEATURE | NetWare 4.0 | NetWare 3.11 |
|---|---|---|
| OPERATING SYSTEM ARCHITECTURE | | |
| Maximum number of user connections per server | 1000 | 250 |
| User configuration (stratification) | 5, 10, 20, 50, 100, 250, 500, 1000 | 5, 10, 20, 50, 100, 250 |
| Maximum number of server connections per client workstation | 50 (configurable in client VLM) | 8 |
| Object-based global naming service | Yes (NetWare Directory Services) | No |
| Single login to network | Yes | No |
| MEMORY AND DISK REQUIREMENTS | | |
| Minimum server memory requirements | 6 MB | 4 MB |
| Optional Ring 3 memory protection | Yes | No |
| Dynamic Ring 3 reinitialization on failure | Yes | No |
| Continuous Ring 0 operation on Ring 3 fail | Yes | No |
| Hard disk space used by operating system | 12 to 60 MB | 9 MB |
| FILE SYSTEM AND STORAGE | | |
| Read-ahead cache | Yes | No |
| Intelligent data compression | Yes | No |
| Support for data migration hardware (optical jukebox, read/write optical, and so on) | Yes | No |
| Real-time Data Migration – High Capacity Storage System (HCSS) | Yes | No |
| NETWORK SECURITY | | |
| Restrict login to specific Medium Access Control addresses | Yes (optional) | No |

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| | | |
|---|---|---|
| Compression directory and file attribute | Yes | No |
| Migration directory and file attribute | Yes | No |
| SECURITY AUDITING | | |
| File system auditing | Yes | No |
| NDS event auditing | Yes | No |
| Independent network auditor | Yes | No |
| Independent auditor password | Yes | No |
| Multiple auditors | Yes | No |
| Audit user security transactions | Yes | No |
| Audit user file transactions | Yes | No |
| Audit supervisor transactions | Yes | No |
| Audit file creation statistics | Yes | No |
| Audit directory creation statistics | Yes | No |
| Audit volume statistics | Yes | No |
| Transaction logs | Yes | No |
| Filter transaction logs | Yes | No |
| Transaction monitoring/automatic log updates | Yes | No |

| | | |
|---|---|---|
| NETWORK MANAGEMENT | | |
| Determine who has console/supervisor privileges | Yes | No |
| View console operation status | Yes | No |
| View supervisor equivalent status | Yes | No |
| View hierarchical Directory tree | Yes | No |
| Remote console session security | Yes | No |
| Remote console modem callback | Yes | No |
| NETWORK NAME SERVICES (Directory Services) | | |
| Maximum number of tree levels | 15 | N/A |
| Object oriented | Yes | No |
| Directory object creation (user, volume, alias, organization, print server, queue, printer group, computer, directory map, bindery objects, and so on) | Yes | No |
| Extensible schema (set of objects and attributes) | Yes (programmed) | No |
| Maximum number of attributes per object | Unlimited (default set of attributes per object type) | N/A |
| Maximum length of attribute fields | Unlimited | N/A |
| Partition database | Yes (logical subtree) | No |

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| | | |
|---|---|---|
| Physical location of partitions | One or more servers | N/A |
| User-definable partitions | Yes | N/A |
| Partitions replicated across multiple servers | Yes | N/A |
| Root partition replicated | Yes | N/A |
| Read-only partitions | Yes | N/A |
| Read/Write partitions | Yes | N/A |
| Background authentication | Yes | N/A |
| Background synchronization | Yes | N/A |
| Protocol independent | Yes | N/A |
| Unicode enabled | Yes | N/A |
| External name service synchronization | Yes | N/A |
| Object and property access rights (add, delete, rename, move, read, compare, list, modify, browse) | Yes | N/A |
| Name searching (white paging) | Yes | No |
| Topical searching (yellow paging) | Yes | No |

| | | |
|---|---|---|
| TIME SYNCHRONIZATION | | |
| International time zone support | Yes | No |
| Daylight Savings Time support | Yes | No |
| User-configurable time synchronization | Yes | No |
| Single reference time server | Yes (optional use of external atomic clock) | No |
| Multiple primary time servers | Yes | No |
| Multiple secondary time servers | Yes | No |
| BACKUP SERVICES | | |
| Workstation backup | Yes (DOS, OS/2) | No |
| NETWORK PRINTING | | |
| Maximum shared printers per print server | 256 | 16 |
| RAM used on workstation-attached network printer | 4,976 bytes (parallel) 5,488 bytes (serial) | 4-20 KB |

| | | |
|---|---|---|
| NETWORK UTILITIES | | |
| Approximate number of utilities | 50 | 130 (consolidated) |
| IMAGING (Optional Service) | | |
| Attribute search | Yes | No |
| Image manipulation | Yes | No |
| Distributed data migration (Mass Storage System - MSS) | Yes | No |

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| | | |
|---|---|---|
| Image compression | Yes | No |
| Content document architecture | Yes | No |
| **APPLICATION PROGRAM INTERFACES (APIs)** | | |
| Image Enabled NetWare (optional Kodak services) | Yes | No |
| Hierarchical storage (data migration) | Yes | No |
| Document management services | Yes (post 4.0 release) | No |
| **COMMUNICATION PROTOCOLS** | | |
| Large Internet Packet (LIP) | Yes | No |

| | | |
|---|---|---|
| **CLIENT SUPPORT AND INTEROPERABILITY** | | |
| **DOS** | | |
| Modular client requester architecture | Yes (VLM) | No |
| Number of files stored on a DOS workstation by the network operating system | 20 (4 plus 16 optional VLMs) | 4 |
| Conventional memory (640KB area) used (Use of XMS/EMS supports built in; small footprint when used) | 53KB (requester, IPXODI, LSL, LAN driver) | 59KB (shell, IPXODI, LSL, LAN driver) |
| Additional conventional memory used with packet burst (Use of XMS/EMS supports built in; small footprint when used) | 53KB | 63KB |
| Extended memory support | Yes | Yes (HMA only) |
| LPT ports on client | LPT1 – LPT9 (VLMs support) | LPT1 – LPT3 |
| **Windows** | | |
| Windows 3.0 NetWare Tools | Yes (expanded user tools) | Yes (basic user tools only) |
| Windows 3.1 NetWare Tools | Yes (expanded user and admin. tools) | Yes (basic user tools only) |
| Packet burst included with Windows client | Yes (requester) | No (shell) |
| Load client software after Windows | Yes | No |
| Login under Windows | Yes | No |
| **UNIX** | | |
| NeXT workstation support | Yes | No |

| | | |
|---|---|---|
| **CLIENT UTILITIES FOR NETWARE ADMINISTRATION** | | |
| **Supported Platforms** | | |
| Windows | Yes (3.1 only) | No |
| OS/2 2.0 Presentation Manager (PM) | Yes | No |
| **Supervisor Administrative Functions** | | |
| Single administrative tool for network | Yes (Windows, PM) | No |

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| | | | |
|---|---|---|---|
| File system (move, copy, trustees, salvage, rights) | DOS, Windows, PM | DOS | |
| Directory services (create/delete objects; edit attributes) | DOS, Windows, PM | N/A | |
| Search NDS Directory | DOS, Windows, PM | N/A | |
| Move objects in Directory Services tree | DOS, Windows | N/A | |
| Directory Services security | DOS, Windows, PM | N/A | |
| Directory Services partition management | DOS, Windows | N/A | |
| Printing (queues, printers, print servers) | DOS, Windows | DOS | |
| End User Tools | | | |
| Change/Set Directory Services context | DOS, Windows, PM | N/A | |
| Browse Directory Services | DOS, Windows, PM | N/A | |
| User tools work with both bindery and Directory Services | DOS, Windows, PM | N/A | |
| Change file rights and attributes | DOS, Windows, PM | DOS | |
| Login | DOS, Windows, PM | DOS | |
| Client install | DOS, PM | DOS | |

| NETWORK INTERFACE CARD SUPPORT | | | |
|---|---|---|---|
| Client | | | |
| Ethernet default frame type | IEEE 802.2 | Raw 802.3 | |
| NDIS protocol stack supported (via ODINSUP) | Yes | No | |
| Third-party drivers supported | Yes (approx. 150 included in box) | Yes (Novell drivers only included in box) | |
| Server | | | |
| Ethernet default frame type | IEEE 802.2 | Raw 802.3 | |
| Third-party drivers supported | Yes (approx. 150 included in box) | Yes (Novell drivers only included in box) | |
| DOCUMENTATION | | | |
| Available on CD-ROM | Yes | No | |
| Windows-based documentation viewer | Yes | No | |

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