Introduction to Networking, Network Administration, and NetWare 6.5

Terms you’ll need to understand:
- Bindery
- NDS
- eDirectory
- SAN
- NCS
- iSCSI
- iFolder
- eGuide
- Virtual Teams
- File Versioning
- iPrint
- Open Source Services
- NSS
- Native File Access Protocol
- DOS
- NWSERVER
- SERVER.EXE

Techniques you’ll need to master:
- Identify major occurrences in the evolution of NetWare
- Identify NetWare 6.5 features
- Describe how NetWare 6.5 works with other operating systems
The first thing you need to do as you begin your NetWare 6.5 journey is to briefly look at the historical roots of NetWare 6.5. You will look at some of the new features of NetWare 6.5 and how Novell has classified some of these features and services. Then you will see how NetWare works with other operating systems. For example, you will learn which systems can function as a NetWare client and which can function as a server in a NetWare 6.5 network environment. Let the journey begin!

The first objective in this chapter is the only one that is not on the list of official test objectives. The content for this section is covered in the Novell authorized courseware under the objective “Identify NetWare 6.5 Features.” The material covered in this section is on the exam, so don’t overlook it.

A Brief History of the NetWare Operating System

Novell NetWare has a long and winding history. From the early 1980s on, NetWare has gone through many version upgrades. It is beyond the scope of this book to go all the way back to the early days of NetWare, when it was called ShareNet or S-Net. The versions that are of interest to you, as you prepare for the exam, start with NetWare 3. The versions, their major features and services, and their importance are covered in Table 2.1.

<table>
<thead>
<tr>
<th>NetWare Version</th>
<th>Features and Services</th>
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<tbody>
<tr>
<td>NetWare 3.x, including the following versions:</td>
<td>NetWare 3.0 shipped in the fall of 1989. With the release of 3.11, NetWare became a full 32-bit operating system that supported NetWare Loadable Modules (NLMS). NetWare 3.x primarily provided file and print services. NetWare 3.x stored user accounts in the bindery, which is a flat-file database that is stored on each server. The bindery was made up of three files:</td>
</tr>
<tr>
<td>NetWare 3.0</td>
<td></td>
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<tr>
<td>NetWare 3.11</td>
<td></td>
</tr>
<tr>
<td>NetWare 3.12</td>
<td></td>
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<tr>
<td>NetWare 3.2</td>
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(continued)
The only objects you would see in the bindery, when working in the SYSCON management utility, would be users, groups, printers, print servers, and print queues. Users had to log in to each server that they wanted to access. The process was to log in to the first server and attach to the second and subsequent servers. Rights assignments, also known as Trustee assignments, were made to users and groups. A group \textit{EVERYONE} existed when you wanted to grant rights to all users in the bindery.

**Table 2.1 A Brief History of NetWare (continued)**

<table>
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| NetWare 4.x, including the following versions: NetWare 4.0  
NetWare 4.10  
NetWare 4.11  
IntraNetWare  
NetWare 4.2 | NetWare 4.0 was introduced in early 1993. NetWare 4.x offered the same file and print services that were the mainstay of NetWare 3.x. NetWare 4.x supported up to 1,000 users, with licenses becoming additive with the release of NetWare 4.10. \textit{Novell Directory Services (NDS)} was introduced with NetWare 4. NDS is a directory naming service. It keeps track of all network resources through a hierarchical, relational database that is distributed and loosely consistent. Many consider it the main network service provided by NetWare 4.x. It is the precursor to the current directory service called \textit{eDirectory}. With NDS, users no longer logged in to a server, but to a tree. After they were authenticated, based on the rights assigned, users could access all network resources available to them in the tree. It no longer mattered which server an application, service, or resource was on. If a tree had 10 servers installed, a user could potentially access all 10 servers if the appropriate rights were assigned. The three major components of NDS were objects, properties, and values. |

(continued)
With NetWare 4.x and NDS, the directory was not housed on a single server. The directory, through the processes of partitioning and replication, was distributed to strategically placed servers throughout the tree. This provided a degree of fault tolerance.

NetWare 4.x also provided enhanced TCP/IP and Macintosh support.

In 1996, IntraNetWare was released, enhancing the network capabilities available with NetWare 4.11. The primary enhancements were the capability to function as a Web server, FTP server, router, Internetwork Packet Exchange/Sequenced Packet Exchange (IPX/IP) gateway, and application launcher. NAL (NetWare Application Launcher) was the precursor to the modern-day ZENworks for Desktops.

NetWare 5.x, including the following versions:
NetWare 5.0
NetWare 5.1

In the late 1990s, NetWare 5.0 was released. Up until NetWare 5.0, NetWare was primarily a network operating system that used IPX/SPX. The main reason behind this was that NetWare before NetWare 5 was considered a LAN operating system. With the release of NetWare 5.0, a native TCP/IP protocol stack was made available with the core operating system. This enabled NetWare to shed its LAN chains and move into the world of WANs. IPX/SPX was still available, but Novell encouraged its customers to migrate to TCP/IP. For those who could not, two strategies were made available:

➤ Both IP and IPX stacks could be used simultaneously.
➤ A Compatibility Mode Driver, with a Migration Agent, was made available for those who were transitioning from IPX to IP.

NetWare 5.x, using the native TCP/IP stack, enhanced its capabilities by including a Web server, FTP server, NNTP server, and the capability to function as a DNS/DHCP server.
With the release of NetWare 6.0, Novell has begun its move toward OneNet, anytime, anywhere access to networked resources, regardless of the operating system platform. With NetWare 6, Novell also began its entrance into the world of open source services and applications.

One of the main features and services introduced with NetWare 6 is eDirectory and the multitude of platforms that it can work on. eDirectory is the successor to NDS, introduced with NetWare 4. eDirectory is more mature and robust than its predecessors, and it still provides centralized administration of network resources through a distributed, replicated directory.

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Table 2.1 includes a great deal of information. All of it is relevant to your understanding, but of particular interest to you should be three facts: when NDS was introduced; what existed before NDS; and when TCP/IP was introduced as a native protocol.

Now that this chapter has explored some of NetWare's history, it will examine the new features and services introduced with NetWare 6.5.

**Identify NetWare 6.5 Features**

Novell, with the release of NetWare 6.5, has introduced a host of new features and services. For the sake of organization, Novell has divided these features and services into four categories:

- Business Continuity Services
- Productivity-Enhancing Services
- Open Source Services
- Web Application Services
Chapter 2

Business Continuity Services

To provide customers with high availability, support for the branch office, consolidation of servers, and backup, Novell has included several features with NetWare 6.5. The following are Business Continuity services:

➤ Internet Small Computer Systems Interface (iSCSI) support is included. With iSCSI, you can create an economically affordable Storage Area Network (SAN) using an existing Ethernet infrastructure. A fibre-channel SAN is also possible with iSCSI, although it is much more expensive.

➤ Novell Cluster Services (NCS) has been enhanced from its origin in NetWare 6.0. NCS 1.7 is a server clustering system that provides failback, failover, and load balancing for mission-critical environments. Some of the major features of NCS 1.7 are as follows:

➤ NCS supports SANs that are based on SCSI, iSCSI, or fibre-channel technology.

➤ NetWare 6.5 supports, out of the box, a 2-server cluster.

➤ You can upgrade NCS 1.7 to support a maximum of 32 nodes in a cluster.

➤ You can manage NCS by using ConsoleOne or Remote Manager, a browser-based management utility.

Productivity-Enhancing Services

Novell labels services that help users securely access their data in a timely manner as productivity-enhancing services. These include the following:

➤ eDirectory is the latest generation of NDS. It can run on a multitude of platforms including Linux and Windows 2003 Server, and it is LDAP-enabled. One of the major benefits of eDirectory is that it is scalable and has an extensible schema. This book discusses the role of the schema in Chapter 5, "Introduction to eDirectory."

➤ iPrint is Novell's anytime, anywhere printing solution based on Novell Distributed Print Services (NDPS) and Internet Printing Protocol (IPP). Users can print from their home to their office printer by using a Web browser interface.

➤ iFolder lets users have access to their files from home, the office, or while on the road. Without copying files back and forth to a floppy disk,
users can access the latest version of their data when and where they need it with an Internet connection and a browser that is Java enabled.

➤ Virtual Teams lets users create a team for real-time collaboration purposes.

➤ eGuide is a Web-based address book, enabling users to find the names, addresses, and phone numbers that are stored in eDirectory.

➤ File Versioning lets users restore earlier versions of their files without having to call you or one of your help desk technicians.

➤ Novell Storage Services (NSS) provides NetWare 6.5 users quick file access to large data stores, such as large databases that are common today.

➤ Native File Access Protocol in NetWare 6.5 supports numerous file protocols that are native to Macs, Unix, Linux, and Windows. Clients no longer need to have the Novell Client installed to access data that is stored on a NetWare 6.5 server.

You might see the information that follows on Open Source Services in Novell Authorized courseware under two different objectives. For the sake of brevity, I am addressing it under the “NetWare 6.5 Features” objective.

Open Source Services

Novell is rapidly becoming a major player in the open source environment. One of the indications of this is the inclusion of five major Open Source Services/applications with NetWare 6.5. These let you take advantage of the flexibility of open source solutions while remaining with a historically stable networking operating system.

The phrase open source means that the source code for operating systems and associated applications is freely distributable. It is not proprietary. Those who make changes are asked to freely distribute those changes to all interested parties. If you develop an open source application, you can license it and distribute it yourself. However, you are asked to make all code available.

Following are the five major Open Source Services/applications that Novell ships with NetWare 6.5:

➤ Apache Web Server version 2.0.45 is the most popular Web server available today.
➤ Tomcat Servlet Engine version 4.0.18 is an open source engine for running Java applications.

➤ MySQL Database version 4.0.12 is a popular open source database solution.

➤ Perl 5.8 for NetWare is an open source language for creating dynamic Web sites.

➤ PHP 4.2.3 for NetWare is a cross-platform, server-side scripting language that is capable of quickly hosting Web applications.

You must know the five Open Source Services/applications for the exam. Do not worry about the version numbers. Just know that Apache, Tomcat, Perl, PHP, and MySQL make up the Open Source Services feature set.

One piece of trivia that you might come across in your NetWare 6.5 research is that the acronym AMP is a shortcut for Apache, MySQL, Perl/PHP. The only open source solution missing in the AMP acronym is Tomcat, which is the application engine.

Web Application Services
The Novell exteNd application server version 5.0 that comes with NetWare 6.5 gives administrators and developers a method of deploying standards-based applications that are cross-platform and high performance. It is a high-performance J2EE Web application server.

Describe How NetWare Works with Other Operating Systems
No major network environment can be solely dependent on a single network operating system. Most environments today are made up of two or more platforms. It is imperative that you know how NetWare 6.5 interoperates with each platform. Three relationships are of particular importance:

➤ How NetWare interacts with DOS

➤ Which operating system platforms can function as a NetWare 6.5 client

➤ Which platforms can function as a server if eDirectory is installed
How NetWare Interacts with DOS

NetWare 6.5 has an interesting relationship with DOS. NetWare 6.5 cannot by itself boot a computer. It relies on DOS to boot the computer. Therefore, a DOS partition is required on a NetWare 6.5 server. DOS partition requirements are discussed in Chapter 3, “Installing and Configuring NetWare 6.5.”

During the boot process, depending on whether you are running MS-DOS or DR-DOS, three system files are required.

If you are using MS-DOS, these are the three files:

➤ Io.sys
➤ Msdos.sys
➤ Command.com

If you are using DR-DOS, which comes with the NetWare 6.5 operating system, these are the three files:

➤ Ibmbio.com
➤ Ibmdos.com
➤ Command.com

After you boot the computer, you are at a C: prompt. You can then load the NetWare 6.5 operating system by entering two commands:

➤ cd\NWSERVER
➤ SERVER.EXE

The preceding description assumes that you are not autoloading the server operating system by placing the two commands in your AUTOEXEC.BAT file. Chapter 3 discusses the CONFIG.SYS and AUTOEXEC.BAT files and their role in a NetWare 6.5 installation.

The NWSERVER directory is the DOS folder that holds the executable that launches the server operating system. The server operating system is launched when SERVER.EXE is run.

After the server is up and running, NetWare no longer needs DOS to function. You can run the following server console command to remove DOS from server RAM:

➤ SECURE CONSOLE
In earlier versions of NetWare, you could also use the `REMOVE DOS` command to remove DOS from server memory. However, `REMOVE DOS` is not supported in NetWare 6.5.

Now that you have your NetWare 6.5 server booted, using DOS, the following question arises: Which operating system platforms can function as a NetWare 6.5 client?

### Operating System Platforms That Can Function as a NetWare 6.5 Client

To answer the question of which operating system platforms can function as a NetWare 6.5 client, you must fully understand what a server is and what a client is. A *server* is a computer that provides resources and services. A *client* is a computer that requests resources and services from a server. NetWare 6.5 is a client/server operating system. Part of the operating system resides on the server, whereas the requesting part resides on a client.

A host of operating system platforms can serve as NetWare 6.5 clients. Some use the Novell Client, whereas others access a server either with a browser or through the Native File Access Protocol (NFAP). Those that are of interest for this test involve the platforms that use the Novell Client. They include the following:

- DOS
- Linux/Unix
- Windows 9x/Me
- Windows NT Workstation and Server
- Windows 2000 Professional and Server
- Windows XP Home and Professional
- Windows 2003 Server

### Platforms That Can Function as a Server if eDirectory Is Installed

Now that you know the platforms that can function as a NetWare 6.5 client, you need to be able to identify those that can function as an eDirectory server. The following server platforms can interoperate with NetWare 6.5:
It is important to note here that we are not talking about NetWare servers, but server platforms that can interoperate with NetWare 6.5 when eDirectory is installed on them. In other words, we are referring to the platforms that eDirectory can be installed on.

Although this is Novell's official list of platforms that eDirectory can be installed on, and you must know this list for the exam, in the real world, this list is not 100% accurate. The two standouts that are not on this list are Windows 2000 Professional and Windows XP Professional. (Although I have not tried it, I would also guess Windows NT 4 Workstation should be included.) You can, in reality, install eDirectory on both of these platforms, and they will interoperate just fine with NetWare 6.5 servers. You would not do so in a production environment, but to say that they cannot have eDirectory installed is not accurate.

Having said that, for the exam, know that Windows 2000 Professional and Windows XP Professional are not on the official list of server platforms that interoperate with NetWare 6.5.
Exam Prep Questions

1. Which version of NetWare stored user accounts in a flat-file database?
   A. NetWare 3.12
   B. NetWare 4.11
   C. NetWare 5.1
   D. NetWare 6.5
   Answer A is correct. NetWare 3 and earlier used a flat-file database system called the Bindery to store user accounts. NetWare 4, 5, and 6 use a hierarchical, relational database that is distributed and loosely consistent to store user accounts. Answers B, C, and D are incorrect.

2. Which version of NetWare initially introduced the concept of users logging into a tree, as opposed to a server?
   A. NetWare 3
   B. NetWare 4
   C. NetWare 5
   D. NetWare 6.5
   Answer B is correct. The concept of users logging into a tree, as opposed to a server, was introduced with NetWare 4 and NDS. When users logged into a server and then had to attach to a second or third server, they were using NetWare 3 or earlier versions of the operating system. NetWare 5 and NetWare 6.5 use a more mature version of NDS called eDirectory. With eDirectory, users log into a tree, not a server. Answers A, C, and D are incorrect.

3. Which of the following services are classified as Productivity-Enhancing Services in NetWare 6.5? (Choose two.)
   A. eDirectory
   B. File Versioning
   C. MySQL
   D. iSCSI-based SAN
   Answers A and B are correct. The productivity-enhancing services that come with NetWare 6.5 are eDirectory, File Versioning, iPrint, eGuide, iFolder, Virtual Teams, Novell Storage Services (NSS), and support for various file protocols that are native to Macs, Unix, Linux, and Windows. MySQL is classified as an Open Source Service, whereas iSCSI-based SANs are classified by Novell as both a Business-Continuity Service and a high-availability solution. Answers C and D are incorrect.
4. Which operating systems can function as a client in a NetWare 6.5 environment? (Choose all that apply.)
   A. ☐ DOS
   B. ☐ MAC
   C. ☐ Windows XP Home
   D. ☐ Windows 2003 Server

   Answers A, C, and D are correct. DOS, Linux, Windows XP Home and Professional, and Windows 2003 Server can all function as a client in a NetWare 6.5 environment. Answer B is incorrect. The MAC environment is not classified as a NetWare 6.5 client environment.

5. Windows NT 4 Server can _______________________.
   A. ☐ Only serve as a client in a NetWare 6.5 environment
   B. ☐ Only function as an eDirectory server in a NetWare 6.5 environment
   C. ☐ Function as both a server and a client in a NetWare 6.5 environment
   D. ☐ Function as neither a server nor a client in a NetWare 6.5 environment

   Answer C is correct. Windows NT 4 Server can function as both a client and a server in a NetWare 6.5 environment. You can install eDirectory on a Windows NT 4 server and make it part of an existing tree, or you can create a new tree. The Windows platforms are flexible in a NetWare environment. Answers A, B, and D are incorrect.

6. Which of the following are the boot files that DR-DOS uses? (Choose three.)
   A. ☐ Command.com
   B. ☐ Io.sys
   C. ☐ Msdos.sys
   D. ☐ Ibmbio.com
   E. ☐ Ibmdos.com

   Answers A, D, and E are correct. The DR-DOS boot files are Ibmbio.com, Ibmdos.com, and Command.com. The MS-DOS boot files are Io.sys, Msdos.sys, and Command.com. Answers B and C are incorrect.

7. Which NetWare 6.5 Productivity-Enhancing Service lets your users restore earlier versions of their files without calling you or a help desk technician?
   A. ☐ PHP
   B. ☐ File Versioning
   C. ☐ Virtual Teams
   D. ☐ NSS
Answers B is correct. File Versioning is a NetWare 6.5 Productivity-Enhancing Service that lets users restore earlier versions of their files without having to call you or one of your help desk technicians. Answer A is incorrect. PHP is classified as a NetWare 6.5 Open Source Service. Answer C is incorrect. Virtual Teams is a Productivity-Enhancing Service that allows users to create a team for real-time collaboration purposes. Answer D is incorrect. NSS is a Productivity-Enhancing Service that provides NetWare 6.5 users with quick file access to large data stores, such as large databases that are common today.

8. Which NetWare 6.5 Web application service provides administrators with a method of deploying standards-based applications that are cross-platform and high-performance?

A. ❑ PHP
B. ❑ Apache
C. ❑ NCS
D. ❑ Novell exteNd Server

Answer D is correct. The Novell exteNd application server that comes with NetWare 6.5 provides administrators and developers with a method of deploying standards-based applications that are cross-platform and high-performance. Answers A and B are incorrect. PHP and Apache are Open Source Applications and Services that are available with NetWare 6.5. Apache is the Web server, whereas PHP is an open source development language. Answer C is incorrect. NCS is classified as a high-availability solution. NCS is a server-clustering system that provides failback, failover, and load balancing for mission-critical environments.

9. You want to implement NCS in your NetWare 6.5 environment. Which types of shared networks does NCS support? (Choose three.)

A. ❑ SCSI
B. ❑ iSCSI
C. ❑ Fibre-channel
D. ❑ Token-ring

Answers A, B, and C are correct. NCS supports SCSI, iSCSI, and fibre-channel environments. It does not support token-ring environments. Answer D is incorrect.
10. You have decided to upgrade your existing NetWare environment because of the open source applications that come with NetWare 6.5. Which of the following is an open source application that comes with NetWare 6.5? (Choose three.)
A. Perl
B. MySQL
C. Open Office 1.1
D. Tomcat
E. Filer

Answers A, B, and D are correct. The five open source applications that come with NetWare 6.5 are Perl, PHP, Apache, Tomcat, and MySQL. Answer C is incorrect. Even though Open Office 1.1 is open source, it does not come with NetWare 6.5. It does come with several versions of SuSE Linux Desktop. Answer E is incorrect. Filer is a NetWare-specific utility that is found in the SYS:/Public directory. It is not open source now, but stay tuned. Many of Novell's proprietary applications, with the uniting of SuSE Linux and NetWare in Open Enterprise Server (OES), might become open source in the near future.