Novell NetWare 5.1

Unit 1

NetWare Access

Novell NetWare 5.1 is a network operating system (NOS) installed on a server, which provides access and services for many clients simultaneously. Day-to-day administration and network resource access is performed from a workstation. NetWare provides a very powerful system to organize and administer all the network resources called Novell Directory Services (NDS). NDS, often called “the tree,” is a hierarchical database of information that stores each network component as an object.

This unit outlines the NDS structure, and explains how to locate an object in the tree. It discusses server and workstation client components. This unit then concludes with an overview of the two utilities used to administer the system: ConsoleOne and NWAdmin.

Lessons

1. NetWare Servers and Clients
2. Novell Directory Services
3. NDS Naming
4. Login Process and Administration Tools
Terms

**Active Directory Service Interfaces (ADSI)**—Active Directory is a Microsoft technology for centralized management of directory information across multiple OSs and locations.

**Bindery**—In versions of Novell NetWare earlier than 4.0, the bindery is a network database that defines entities such as users, groups, and workgroups. The bindery has been replaced by NDS.

**Client**—A client is any network component that requests a service or resource from another component, either on the same computer or a different one. This term is often used to refer to a workstation with client software that provides access and redirection to network resources. However, a client application may also run on a computer that normally functions as a server. See Server.

**Container**—A container is an NDS object that stores and organizes other objects. It can represent a country, organization, or organization unit (geographic location or department).

**Context**—An object’s location in the NDS tree is referred to as its context.

**Current Context**—A current context is a user’s current navigational location in the NDS tree structure. It is the part of the tree a user is currently accessing.

**Distinguished Name**—A Distinguished Name is a complete description of an object’s context, also called a Fully Distinguished Name. It begins with a leading period, and includes all objects on the path back to [Root]. A Distinguished Name uniquely identifies every object in the tree.

**Domain Name System (DNS)**—DNS is the online distributed database system that maps human-readable computer names to IP addresses.

**Dynamic Host Configuration Protocol (DHCP)**—DHCP is a server process that simplifies IP network management by dynamically or statically assigning IP addresses to logical end stations for fixed periods of time.

**File Transfer Protocol (FTP)**—FTP is a TCP/IP Application Layer protocol used to transfer information between a client and server attached to a network.

**Internetwork Packet Exchange (IPX)**—IPX is Novell NetWare’s proprietary Network Layer protocol.
Java—Java is an interpreted, platform-independent, high-level programming language developed by Sun Microsystems. It is a powerful language with many features that make it attractive for the Web.

Jukebox—A type of CD-ROM drive that stores multiple CD-ROMs, and uses a mechanical device to read or write individual disks as needed, is referred to as a jukebox. Large jukeboxes are installed on networks to provide many users simultaneous access to the same CD-ROMs.

Leaf Object—A Leaf object, also called a leaf, is an NDS object that represents a user account or network resource, such as a printer, application, server, workstation, data volume, or network group. A Leaf object is the lowest level in the tree.

Link Support Layer (LSL)—LSL is the software component that routes multiple protocols communicating with one NIC. LSL is part of Novell NetWare’s ODI implementation of the Data Link Layer. ODI divides the Data Link Layer into two sublayers: LSL (upper sublayer) and MLIDs (lower sublayer). When a NIC driver is written according to the ODI specification, the LSL handles communication between upper-layer protocols and an MLID specific to that NIC.

Login Context—A User object’s location in the NDS tree is referred to as its login context.

Login Name—See Username.

Multiple Link Interface Driver (MLID)—MLID is part of Novell NetWare’s ODI implementation of the Data Link Layer. ODI divides the Data Link Layer into two sublayers: LSL (upper sublayer) and MLIDs (lower sublayer). Each MLID is unique to an underlying NIC and LAN medium (Ethernet, Token Ring, etc.). When a NIC driver is written according to the ODI specification, the LSL handles communication between upper-layer protocols and an MLID specific to that NIC.

Network Address Translation (NAT)—NAT is a system that allows an administrator to use one set of IP addresses within a LAN, and another set for external traffic. NAT can shield internal addresses from public networks, and make more efficient use of a few globally-unique IP addresses. NAT is often included in a router as part of a corporate firewall.
Network Driver Interface Specification (NDIS)—NDIS is a Microsoft-developed specification that enables multiple protocol support for a NIC.

Novell Directory Services (NDS)—NDS, commonly called “the tree,” is a hierarchical database of information about users and network resources that manages all network components through a single interface. NDS version 8 is available on other NOS platforms, such as Microsoft NT, Sun Solaris, UNIX, and IBM.

Open Data Link Interface (ODI)—ODI is a Novell-developed specification that enables multiple protocol support for a NIC.

Redirection—The term “redirection” refers to a client software process that decides whether a request for a computer service (for example, read a file) is for the local computer or network server.

Relative Distinguished Name—A Relative Distinguished Name is a description of an object’s tree location, relative to the user’s current context. It does not begin with a leading period, and specifies only enough information to get to the object from the current context.

[Root]—[Root] is the highest level of the NDS tree structure, which acts as a placeholder for the entire tree.

Server—Any program that provides a service to a client program is referred to as a server. This term is often used to refer to the computer that hosts the server program; however, a server program may also run on a computer that normally functions as a client. See Client.

Simple Network Management Protocol (SNMP)—SNMP is a network management protocol based on the manager/agent model, in which a complex central manager directs simple device-based agents to supply information or change configurations. The original version of SNMP was derived from SGMP and published in 1988.

Snap-In—A snap-in is a modular software extension that adds specific functionality to an application.

Username—A username is the name of a user’s Leaf object in NDS. It is the login name required for a user to log in.
Lesson 1—NetWare Servers and Clients

A NetWare server is only one component of the network environment. It provides services such as login authentication, security, file system storage, and printing. Client workstations support the applications that request network services. To provide connectivity between NetWare server(s) and client workstations, a complete network infrastructure must also be in place.

Objectives

At the end of this lesson you should be able to:

• Describe the components of a NetWare network
• Detail NetWare server components
• Detail the components of the client workstation that support networking
• Install the workstation client software

Key Point

*NetWare workstations request access to services and resources. Servers grant that access.*
The Network

A network is made up of many independent and interdependent entities that, when working properly, can request, provide, and share network resources. The Network Diagram presents a simple configuration for a common network.

A network, therefore, is made up of:

- Physical communications media, such as copper cables, optical fibers, microwave, cellular, or infrared, that carry signals (electrical, optical, or radio) from one node to another.

- Network interface cards (NICs) that connect each device to a physical medium, and transmit and receive signals. Each NIC is connected to a copper or optical fiber by means of a cable. In an unbounded wireless medium, such as infrared or cellular, a NIC connects to a wireless channel by means of a radio or infrared transceiver.

- Protocols that allow data transport and communication between servers, workstations, and peripheral devices. Protocols not only provide standards for communication, but also provide a transport process, service request capabilities, error checking, and many other important features.

- Peripheral devices that are shared network resources too expensive to connect to individual workstations. For example, high-capacity or color printers, fax machines, shared disk storage and CD-ROM devices can be shared by many different workstations.
One or more servers running any NOS.

One or more workstations running an operating system (OS) such as disk operating system (DOS), Windows, Macintosh, or UNIX/Linux.

The NetWare Server

A server is a network device configured to service many client requests simultaneously. In a Novell network environment, a server is a computer that runs the NetWare OS and handles client requests for services.

Note: A server cannot be used as a workstation.

The architecture of a NetWare 5.1 server handles memory, central processing unit (CPU) resources, and network and disk access very efficiently and reliably. Thus, NetWare 5.1 minimum server requirements are very low: Pentium 266 processor, 128 megabytes (MB) of random access memory (RAM), 1 gigabyte (GB) of disk space, video graphics adapter (VGA) monitor, NIC, mouse, and CD-ROM. However, because it processes multiple simultaneous client requests, a server should have higher-end hardware components than a typical workstation, such as high-speed or multiple NICs, more memory, faster processor, and larger disk storage capacity.

Resources and Services

A NOS is a suite of software components that provide server-based network resources and services. The NetWare kernel is a core application that provides fast and efficient multiuser access to network resources. Other capabilities are loaded over the kernel, using NetWare Loadable Modules (NLMs) to provide additional services and resources.

It is important to understand the difference between a network resource and network service.

- A network resource is a component a client requests to use. For example, files on the server, or shared printers connected to the network, are examples of resources.

- A network service is a process, or system of processes, that allows access to the requested resource. For example, Novell Distributed Print Services (NDPS) provides client access to shared network printers.
Core Services

NetWare can provide a multitude of services; for a complete list, visit Novell’s World Wide Web (Web) site at http://www.novell.com. Some core services of a NetWare server include:

- **NDS**—NDS is the hierarchical database of network resources that provides the most important service beyond actual communications. It locates, manages, secures, and provides access to network resources. NDS is explained in more detail in Lessons 2 and 3 of this unit.

A NetWare 5.1 server manages and provides access to network resources by using NDS. NDS stores information about all network resources as objects in a hierarchical database. When a client requests a resource, the server looks it up in NDS and finds its location on the network. The server then checks to see whether the client has the appropriate rights to use the resource. If so, the server grants access to the client. The NDS Access Diagram shows the complete process for every network resource request.

![NDS Access Diagram]

**NDS Access**

- **Security**—Many levels of security are applied in a NetWare environment, such as login restrictions, NDS security, and file system access security. NetWare uses ongoing or real-time authentication, verifying users’ rights each time they request a resource. Therefore, rights changes take effect immediately; a user does not have to log out and log in before rights updates take effect. In addition, NetWare provides a number of high-end security services that offer data and password encryption. When implemented, these can make NetWare an incredibly secure network server environment. Additional security topics are covered in Units 2, 3, and 5.
Lesson 1—NetWare Servers and Clients

- **File System Access**—File access was the foundation for the first NetWare server, and remains one of its most important services. Today's file system access allows for larger storage capacity, fault-tolerant disk systems, file sharing, and fast disk access. Data protection is also provided, because servers are generally backed up nightly. NetWare can also access alternate file system devices such as CD-ROMs, optical jukeboxes, tape devices, and other near-line storage systems. The NetWare file system is covered in detail in Unit 4.

- **Print Services**—NDPS is a new printing environment that speeds print requests, eases administration, reduces network traffic, and can automatically download printer drivers to the workstation. It includes several gateways, such as Hewlett-Packard and Xerox, to create an enterprise-wide printing environment, and offers complete backward compatibility with queue-based printing in NetWare 3 and 4. Additional details on NDPS are presented in Unit 7.

- **Application Access**—Access to specific applications can be defined for individual users, group members, workstations, or by several other methods. NetWare can use the Zero Effort Networking (ZENworks) Application Launcher to distribute applications to the workstation. An NDS object is created for the application, then the object is associated with the appropriate user accounts. The application can then be deployed to the workstation through several different methods. Application Launcher and ZENworks are discussed in Unit 8.

- **Workstation Management**—NetWare can also use ZENworks to manage the desktop environment through policies. Policies give an administrator complete control over the client desktop without ever touching the workstation itself. By using policies, the administrator can modify workstation settings, fix problems, and update the workstation. ZENworks and workstation management are covered in Unit 8.

- **Web Services**—NetWare 5.1 provides a complete Web development, hosting, and deployment platform for intranets or the Internet. It includes Enterprise Server for hosting sites, IBM Websphere for Java application deployment, open standards for Java development, File Transfer Protocol (FTP) services, news and multimedia services, support for Domain Name System (DNS) and Dynamic Host Configuration Protocol (DHCP), Network Address Translation (NAT), and a host of other Web-enabled solutions. These services are covered in Novell's *Advanced Administration* course (#570).
• Storage Management Services—This service backs up servers, workstations, NDS, open databases, and the Groupwise electronic mail (e-mail) system. Backups are an essential tool to recover lost or corrupted data.

The Workstation

A workstation is a standalone computer that is the primary user interface for day-to-day work. The workstation is called a client when it requests network services or access to network resources. NetWare client software is available to support most popular OSs, such as:

• DOS—Used on legacy systems compatible with the IBM personal computer (PC).
• Macintosh—An optional product provides file and print sharing for Macintosh clients.
• UNIX—An optional product called NetWare NFS provides Network File System support and communicates by means of Transmission Control Protocol/Internet Protocol (TCP/IP) with the UNIX host.
• Linux—Caldera OpenLinux and Red Hat Linux provide NetWare client access.

When a user performs a task, the workstation determines whether it can fill the request locally. If it cannot, workstation hardware and software work together to request the services from a network resource.

Workstation Hardware

The workstation hardware includes the computer itself, as well as the NIC that connects the workstation to the physical network medium. Workstation and network hardware provide the communication path for data signals; however, they do not guarantee communication is meaningful. In other words, hardware is not concerned about the content or usage of the data.

To interpret signals as meaningful messages, workstations and other networked devices must install two types of software components: workstation software and network connectivity software.
The workstation software differs depending upon the OS installed on each computer. All versions of the local workstation software have generally the same requirements: to provide a user interface, and to request and access network resources. The workstation software provides the user interface, while network connectivity software enables communications with the network. The workstation software component is illustrated on the Workstation Software Diagram.

**Workstation Software**

- **Application Services**—The highest level in the diagram represents application services, which differ from application programs. Application programs are software tools such as word processors, spreadsheets, databases, and e-mail readers. These application programs do not communicate directly with the network; they require the OS and client software components to perform that function. The application programs merely request a service or resource, and expect the request to be fulfilled. The application services shown here are the client software components that request services for the application programs. These services include operations such as retrieving a file, printing data, sending an e-mail message, or authenticating a login request.

- **Workstation OS**—The workstation OS provides a user interface, as well as a means to service local requests. It is responsible for providing local disk access and storage, printing, and browsing capabilities to see network resources. If the workstation cannot service the request locally, it will look to the network client software to provide access to the network. It also helps create the Network Layer packet with the appropriate upper-layer information.
NetWare Client—The client consists of numerous modules used for request and redirection services. Notice it snaps around the OS, and therefore enhances the network capabilities of the workstation. The client provides the means to access NetWare services, manage data, and enforce security. It provides redirection services for requests that cannot be handled locally, by identifying a network resource that can fulfill the request. It manages the transport of data to and from the workstation in the proper format. Finally, the client provides the login screen, which allows an individual to access network resources, and provides a secure network environment.

Network Connectivity Software

The lower half of the Workstation Software Diagram shows the network connectivity software, which is used for the actual communications process. Network connectivity software creates, formats, secures, and sends data and request packets across the network.

Open Data Link Interface (ODI) and Network Driver Interface Specification (NDIS)

ODI is a Data Link Layer component that allows a single NIC to support multiple protocols. On the NetWare client, ODI allows both Internetwork Packet Exchange (IPX) and IP to be bound to a single workstation’s NIC. Before ODI, a NIC could communicate with only one protocol at a time; a workstation had to reboot before connecting to systems using different protocols. To achieve similar interoperability, Microsoft defined NDIS, which provides multiple protocol support and communication on Microsoft workstations.

32-bit Client Link Support Layer (LSLC32)

Below the client is the protocol support component LSLC32. This is the software that implements ODI/NDIS capabilities. While ODI and NDIS allow multiple protocols to be supported, LSLC32 does all the work. Link Support Layer (LSL) routes inbound traffic to the appropriate protocol stack and applies the correct protocol header information to outgoing packets.

LSL acts like a multilingual telephone operator. If someone calls speaking Spanish, the operator routes the call to a Spanish-speaking department. If the call is in English, it is routed to an English-speaking department. LSL works the same way, by routing inbound IPX packets to the IPX protocol stack, and IP packets to the IP protocol stack.
**LAN Section**

Three types of connectivity components are found at the Physical Layer:

- Topology support modules (TSMs)—EtherTSM, TokenTSM, and FDDITSM help determine the appropriate header information and communication methods necessary to access each type of network.
- CMSM is the media support module in the ODI architecture.
- A local area network (LAN) driver allows communication with the NIC. Without this important component, network access is not possible.

**Workstation Software in Action**

To help you understand how these components work together, let us consider the process of sending an e-mail message:

1. A user uses an e-mail application to create and send a message.
2. The e-mail application requests e-mail transmission from an application service.
3. The application service requests e-mail transmission from the workstation OS.
4. The workstation OS determines that it cannot service the request internally. It then redirects the request to the network.
5. The NetWare client intercepts the e-mail message, adds information about the requested services, and redirects it to the protocol stack for servicing.
6. LSLC32 adds the appropriate protocol headers and additional routing information.
7. Physical Layer software components add addressing information and transmit the packet on the network.

The entire process works in reverse when the workstation receives a server response or reply message. Incoming messages work through the stack from the bottom to top, as each component strips off its header information. Finally, the data contained in the packet is delivered to the appropriate application.
Installing Workstation Client Software

As we have seen, client software is installed on top of the workstation OS. The installation process requires very little configuration and is relatively quick.

To install client software on a Windows-based workstation, launch the WINSETUP.EXE file at the root of the CD or in the ZENworks directory. The client CD has an autorun feature that automatically begins the installation process when the CD is inserted. As illustrated on the WINSETUP Opening Installation Screen Diagram, as WINSETUP starts up, the initial installation screen offers a choice of installing ZENworks for desktops, the NetWare workstation client software including Netscape Navigator, and online documentation.

The installation process offers either a Typical or Customized option. The Typical option uses all the default settings, and the Custom option requires you to provide protocol support, login authentication type, and additional software components to install. The screens and options differ slightly depending on the version of the client being installed.
Protocol Support

NetWare supports IPX only, IP only, or both IPX and IP. One of these protocol options must be selected during the client installation process, as illustrated on the Protocol Preference Screen Diagram. Most configurations support both IP and IPX; this choice allows backward compatibility with previous NetWare versions, while also providing support for NetWare 5.1 Java capabilities and Internet access.

![Protocol Preference Screen](image-url)
Login Authentication

NetWare supports two types of login authentication, as illustrated on the Authentication Selection Screen Diagram. For access to a NetWare 4.x server or later, choose NDS connectivity. NetWare 3.x servers only allow for bindery connection, logging in directly to the server instead of the NDS tree environment.

![Authentication Selection Screen Diagram]

Authentication Selection Screen

When you click Next to move to the next installation step, you are prompted to choose a Typical or Custom Installation. If you select Typical, the installation will automatically install the necessary client software, with no additional configuration steps (except for configuring preferred settings, which can be done later through the Windows Control Panel).

As part of a classroom installation, select Custom Installation. As illustrated on the Optional Components Screen Diagram, this selection allows you to choose whether to install additional components such as:

- Workstation management through ZENworks
- NDPS printing
- Simple Network Management Protocol (SNMP) support
- Remote access dial-up services
- Remote workstation backup capabilities using Target Service Agent
- Active Directory Service Interfaces (ADSI) for Active Directory Service (ADS) support

Optional Components Screen

For classroom purposes and most business installations, select the first two options: **Novell Workstation Manager** and **Novell Distributed Print Services**.

To complete the software installation, click **Install**. Then, when prompted, reboot the workstation.

Post-Installation Configuration

Once installed, NetWare resources are available in Network Neighborhood, Windows Explorer, and browsers such as Netscape Navigator. The client is also incorporated into other functions of the OS, such as providing NetWare property information and the ability to map logical drive letters to network disk drives for easier access. The client also places an N icon in the Windows system tray to provide NetWare login services, connection information, password and account management, and other client services.
To Configure the Client or Inspect its Current Settings

1. Right-click the **Network Neighborhood** icon, and select **Properties**. The Network dialog box appears and displays the Configuration tab, as illustrated on the Network Dialog Box Screen Diagram.

![Network Dialog Box Screen Diagram]

2. In the installed network components list, select **Novell NetWare Client**.

3. Click **Properties** to access the client’s settable parameters.

4. To exit and save changes, click **OK**. To exit without saving changes, click **Cancel**.
Activities

To install the NetWare client on the workstation, follow the steps detailed in this lesson. As you do, make the following choices:

- In the Protocol Preference screen, select the IP and IPX option.
- In the Login Authenticator screen, select NDS to allow access to NetWare 4.x or later server environments.
- Select Custom Installation to review the available options. For class purposes, select only the first and second options: Novell Workstation Manager and Novell Distributed Print Services.
- When the installation program asks if you want to configure preferred settings, select No.

1. List the five steps NetWare follows to access a network resource after the user makes a request.

2. List at least five workstation OSs that can be used as NetWare clients.

3. What function does LSLC32 perform?
4. What were ODI and NDIS developed to support?

5. List the three protocol options available when installing the client.

Extended Activities

1. Go to Novell’s support page at http://www.novell.com. In the Downloads section, identify the latest version of the NetWare client.

2. Go to Novell’s product Web page at http://www.novell.com and locate a document that provides additional information on the features and services available with NetWare 5.1.