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70-218SG

Managing a Microsoft Windows 2000 Network
Infrastructure

Study Guide

DEMO Version

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Managing a Microsoft Windows 2000 Network Infrastructure

Exam Code: 070-218

Certifications:

Microsoft Certified (MCP)	
Microsoft Certified Systems Administrator (MCSA)	Core
Microsoft Certified Systems Engineer (MCSE)	Elective

Prerequisites:

Microsoft Windows 2000 Network and Operating System Essentials
Implementing Microsoft Windows 2000 and Server

About This Study Guide

This Study Guide provides all the information required to pass the Microsoft 070-218 exam – Managing a Microsoft Windows 2000 Network Infrastructure. It however, does not represent a complete reference work but is organized around the specific skills that are tested in the exam. Thus, the information contained in this Study Guide is specific to the 070-218 exam and not only to Managing a Windows 2000 Network Infrastructure. It includes the information required to answer questions related to the installation of Windows 2000 Server, Windows 98 and Windows NT that may be asked during the exam. Topics covered in this Study Guide includes Creating, Configuring, Managing, Securing, and Troubleshooting Network Resources; Configuring, Administering, and Troubleshooting the Network Infrastructure; Configuring, Managing, Securing, and Troubleshooting Active Directory Organizational Units and Group Policy; and Configuring, Managing, Securing, and Troubleshooting Active Directory Organizational Units and Group Policy.

Intended Audience

This Study Guide is targeted specifically at people who wish to take the Microsoft MCSA exam 070-218 – Managing a Microsoft Windows 2000 Network Infrastructure. This information in this Study Guide is specific to the exam. It is not a complete reference work. Although our Study Guides are aimed at new comers to the world of IT, the concepts dealt with in this Study Guide are complex and require an understanding of material provided for the MCSA / MCSE exams: 070-210 – Installing, Configuring, and Administering Microsoft Windows 2000 and 070-215 – Installing, Configuring, and Administering Microsoft Windows 2000.

Note: There is a fair amount of overlap between 070-218 and 070-210, 070-215 and 070-216. Don't skim over the information that seems familiar. Read over it again to refresh your memory.

How To Use This Study Guide

To benefit from this Study Guide we recommend that you:

- For best results, use this Study Guide in conjunction with the TestKing Study Guides for exam 070-210 and 070-215. These will provide you with valuable background information.
- Study each chapter carefully until you fully understand the information. This will require regular and disciplined work.
- Perform all labs that are included in this Study Guide to gain practical experience, referring back to the text so that you understand the information better. Remember, it is easier to understand how tasks are performed by practicing those tasks rather than trying to memorize each step.
- Be sure that you have studied and understand the entire Study Guide before you take the exam.

Note: Remember to pay special attention to these note boxes as they contain important additional information that is specific to the exam.

Good luck!

1. Installing and Deploying Windows 2000: A brief Overview

There are various ways of installing Windows 2000 Server, which can be installed clean, on a new computer or as an upgrade from Windows NT 4.0 Server. These are, however, not related to managing a Windows 2000 Network Infrastructure. What follows in this section is related to the exam.

1.1 Performing an unattended installation.

Microsoft allows for the automated installation of Windows 2000 through unattended installations. There are two important mechanisms through which an unattended installation can be performed. These are through:

- unattended answer files; and
- disk imaging using the System Preparation Tool

1.1.1 Using an unattended answer file.

The first mechanism you can use to perform an unattended installation of Windows 2000 is to use an **answer file**. An answer file is an automated script that supply's the Windows 2000 Setup program with all the information it would require during the installation.

You can use **Setup Manager** to create and modify an answer file. Setup Manager is located in the *deploy.cab* file in the *support/tools* folder on the Windows 2000 Installation CD and can be extracted to your computer by double-clicking on the *deploy.cab* file. This will display the files contained in the *deploy.cab* file. Right-click on the files and select **Extract** on the menu that pops up.

You can use Setup Manager to create an answer file for various types of unattended installations and you can also choose the answer file's level of automation. This can be:

- **Provide Defaults:** The answer file provides defaults that the user can see and allows the user to accept or change these settings during the installation.
- **Fully Automated:** No input is required from the user and the user cannot alter any of the settings.
- **Hide Pages:** All pages that the answer file provides answers for are hidden from the user.
- **Read Only:** The user can view any of the answers on the pages that are not hidden but cannot change them.
- **GUI Attended:** The first stage of the installation is automated but the user must supply the information required by the Setup Wizard during the graphical user interface stage (stages 2 and 3) of the installation.

1.1.2 Using the System Preparation tool (disk imaging).

With disk imaging it is possible to install and configure Windows 2000 and all the applications and application update packs on a test computer and then create an exact image of the hard drive that can then be used to install Windows 2000 and the applications on other client computers. These computers that will become recipients of the disk image installation are also referred to as target computers.

During an installation that uses disk imaging, the source files on Windows 2000 Installation CD are not used, except for the initial installation on the test computer. In other words, you would not be using *winnt.exe* or *winnt32.exe* to install the disk image on the target computers and thus will not run the Windows 2000 Setup program. Therefore, you will not be detecting the hardware devices and installing the appropriate drivers on the target computers. As a result, all the target computers must have the same hardware configuration as the test computer. You will also have to change the computer name of all the target computers as each computer on the network must have a unique name.

The **System Preparation tool** (*Sysprep.exe*) solves some of the problems associated with disk imaging. You would use the Sysprep, after installing and configuring Windows 2000, the applications and application update packages on a test computer, to prepare the computer of disk imaging. You would then run the disk imaging program after Sysprep has completed. Sysprep adds a mini-Setup Wizard to the disk image that will request the user-specific information such as productID, user name, network configuration, etc, on the first reboot of the target computer. This information can either be supplied by the user or by an answer file.

When using answer file with the sysprep tool, a Sysprep folder must be created on the *%systemdrive%* of the test computer or a ***Sysprep.inf*** file must be created and saved to a floppy disk that must be inserted at the beginning of the mini-Setup Wizard. The Sysprep folder that is created on the target computer when the disk image is copied is automatically deleted when the mini-Setup Wizard is completed.

Sysprep can also be used to force the target computer to perform a Plug and Play detection and to install the correct device drivers on the first reboot of the target computer; however, the target computer and the test computer must have identical hard disk controllers and compatible **Hardware Abstraction Layers**. The *-pnp* switch is used to force the target computer to detect its hardware configuration on its first reboot. A full list of Sysprep switches are listed in table 1.1.

TABLE 1.1: *System Preparation Tool Switches*

Switch	Description
-reboot	Restarts the test computer rather than allowing it to shut down after <i>sysprep.exe</i> is completed.
-quiet	Mini-Setup runs without user input. Requires an answer file.
-pnp	Forces a Plug and Play detection on the target computer.
-nosidgen	Does not regenerate the SIDs on the target computers.

1.1.3 Deploying Software applications

1.1.3.1 Overview

In Windows 2000 you can use a **Group Policy Object (GPO)** in conjunction with **Windows Installer** to automate and manage software installations, updates and removal from a centralized location. Group Policy can be used to assign the software application to a group of users that are organized into a unit (an

Group Policy ad GPO
Group Policy and GPO is discussed in detail in Section 8.4 of this Study Guide

(an Organizational Unit) and allow you to manage the various phases of software deployment.

There are four phases of software deployment:

- **Preparation:** preparing the files that allows you to use Group Policy to deploy the application software. This involves copying the Windows Installer package files to a software distribution point. The Windows Installer application files can be obtained from the application’s vendor or can be created through the use of third-party utilities.
- **Deployment:** the administrator creates a Group Policy Object (GPO) that installs the software on the target computers and links the GPO to the appropriate Organizational Unit. During this phase the software is installed.
- **Maintenance:** the software is upgraded with a new version or redeployed with a patch or a service pack.
- **Removal:** to remove software that is no longer required, you must remove the Windows installer package from the GPO that was used to deploy the software. The software is then automatically removed when a user log on or when the computer restarts.

1.1.3.2 Windows Installer

Windows Installer consists of Windows Installer **service**, which is a client-side service, and Windows Installer **package**. Windows Installer package uses the *.msi* file extension and contains all the information that Windows Installer services requires to install the software. The software developer provides the Windows Installer package with the application. If a Windows Installer package does not come with an application, you can create a Windows Installer package or repackage the application, using a third-party utility. Alternatively you could create an application file (*.zap*) that uses the application’s existing setup program. A *.zap* file is not a native Windows Installer package.

Native Windows Installer

A *Native Windows Installer* package is identified by the *.msi* file extension. The Windows Installer package and the *.msi* is the same thing and are used interchangeably here.

Advantages of using Native Windows Installer packages:

- **Automatic File Repair** when a critical application file becomes corrupt. The application automatically returns to the installation source to retrieve a new copy of the file.
- **Clean Removal** without leaving orphaned files and without deleting shared files used by another application.
- **Transformable.** You can customize a Windows Installer package to meet the requirements set by your company by using authoring and repackaging tools. Transformed Windows Installer packages are identified by the *.mst* file extension.
- **Patches.** Patches and upgrades can be applied to the installed applications. These patches use the *.msp* file extension.

Note: A *.zap* file is not a native Windows Installer package and does not offer the same benefits as Windows Installer packages. It therefore does not support **automatic repairing** and cannot be transformed.

1.1.3.3 Deploying Service Packs

Windows 2000 supports the integration of service-packs called **slipstreaming**, so service packs can be integrated with the Windows 2000 installation files. This allows you to keep an image of the operating system. When Windows 2000 is installed from this image, the appropriate files from the service pack are also installed. To apply a new service pack, run the *update.exe* file from the service pack with the */slip* switch. This will replace the existing Windows 2000 files with the appropriate files from the service pack.

Note: You can apply a service pack to computers that are already running Windows 2000 by running the *update.exe* file that is shipped with the service pack. This replaces the existing Windows 2000 files with the appropriate files from the service pack.

1.2 The Windows 2000 Boot Process

1.2.1 Files Used in the Boot Process

A Windows 2000 Intel-based boot sequence requires a number of files. A list of these files, their appropriate locations and the stages of the boot process associated with each file are listed in Table 1.2

Note: *Systemroot* represents the path to your Windows 2000 installation folder, which by default is *C:\Winnt*

Table 1.2 Files Used in the Windows 2000 Boot Process

File	Location	Boot stage
Ntldr	System partition root (C:\)	Preboot and boot
Boot.ini	System partition root	Boot
Bootsect.dos	System partition root	Boot (optional)
Ntdetect.com	System partition root	Boot
Ntbootdd.sys	System partition root	Boot (optional)
Ntoskrnl.exe	<i>systemroot</i> \System32	Kernel load
Hal.dll	<i>systemroot</i> \System32	Kernel load
System	<i>systemroot</i> \System32\Config	Kernel initialization
<i>Device drivers</i>	<i>systemroot</i> \System32\Drivers	Kernel initialization

The string *systemroot* (typed as *%systemroot%*) represents the folder in the boot partition that contains the **Windows 2000 system files**.

1.2.1.1 Preboot Sequence

During startup, a Windows 2000-based computer initializes the boot portion of the hard disk and the preboot sequence begins. This sequence consists of four steps:

- The computer runs power-on self test (POST) process to determine the amount of physical memory; and
- The hardware components are present.
- If the computer has a Plug and Play (BIOS), enumeration and configuration of hardware devices occurs.
- The computer BIOS locates the boot device and loads and runs the master boot record (MBR).

Note: Windows 2000 modifies the boot sector during installation so that **Ntldr** loads during system startup. Therefore you should disable the **Boot Sector Virus Protection** in your BIOS Setup.

1.2.1.2 Boot Sequence

After the computer loads **Ntldr** into memory, the boot sequence gathers information about hardware and drivers in preparation for the Windows 2000 load phases. The boot sequence uses the following files: **Ntldr**, *Boot.ini*, *Bootsect.dos* (optional), *Ntdetect.com*, and *Ntoskrnl.exe*.

The boot sequence also has four phases:

- **Initial Boot Loader** During the initial boot loader phase, **Ntldr** switches the microprocessor from real mode to 32-bit flat memory mode, which **Ntldr** requires. Then, **Ntldr** starts the appropriate the minifile system drivers. The minifile system drivers are built into **Ntldr** so that **Ntldr** can find and load Windows 2000 from partitions formatted with either the FAT or NTFS file system.
- **Operating System Selection** During the boot sequence, **Ntldr** reads the *Boot.ini* file. If multiple operating systems are supported on the computer in the *Boot.ini* file, then the **Please Select The Operating System To Start** screen, which you can use to select the operating system that should be loaded within a specified time before the default operating system. If no *Boot.ini* file is present, **Ntldr** attempts to load Windows 2000 from the *Winnt* folder on the first partition of the first disk, typically *C:\Winnt*.
- **Hardware Detection** On Intel-based computers, *Ntdetect.com* and *Ntoskrnl.exe* perform hardware detection. *Ntdetect.com* executes if Windows 2000 should be loads. *Ntdetect.com* collects a list of installed hardware components and returns this list to **Ntldr** for later inclusion in the registry under the `HKEY_LOCAL_MACHINE\HARDWARE` key.
- **Configuration Selection** After **Ntldr** starts loading Windows 2000 and collects hardware information, the operating system loader process displays the **Hardware Profile/Configuration Recovery Menu** screen, which contains a list of the hardware profiles that have been created on the computer, if more than one hard profile exists on the computer. The first hardware profile is highlighted. You can press the Down arrow key to select another profile. You can also press L to invoke the **Last Known Good Configuration** option.

1.2.1.3 Kernel Load

After the configuration selection, *Ntoskrnl.exe*, the Windows 2000 kernel loads and initializes. *Ntoskrnl.exe* also loads and initializes device drivers and loads services. If you press Enter when the **Hardware Profile/Configuration Recovery Menu** screen displays, or if **Ntldr** makes the selection automatically, the computer enters the kernel load phase. The screen clears and a series of white rectangles appears across the bottom of the screen. During the kernel load phase, **Ntldr**:

- Loads *Ntoskrnl.exe* but does not initialize it.
- Loads the hardware abstraction layer file (*Hal.dll*).
- Loads the `HKEY_LOCAL_MACHINE\SYSTEM` registry key.
- Selects the control set required to initialize the computer.

- Loads device drivers with a value of 0x0 for the Start entry. These are typically low-level hardware device drivers, such as those for a hard disk.

1.2.1.4 Kernel Initialization

When the kernel load phase is complete, the kernel initializes and takes control from **Ntldr**. The system displays a graphical screen with a status bar that indicates load status. During the kernel initialization stage four tasks are performed:

- The Hardware key is created.
- The Clone control set is created.
- Device drivers are loaded and initialized.
- Services are started.

1.2.1.5 Logon

The logon process begins at the end of the kernel initialization phase, when the Win32 subsystem automatically starts *Winlogon.exe*, which starts Local Security Authority (*Lsass.exe*) and displays the Logon dialog box. This allows you to log on while Windows 2000 initializes the network device drivers.

Note: Windows 2000 startup is not considered **successful** until a user logs on at the computer. After a **logon**, the system automatically copies the Clone control set to the LastKnownGood control set making the current control set the **Last Known Good Configuration**.

1.3 The Boot.ini File

The *Boot.ini* file is a hidden file that the Windows 2000 Setup program saves in the active partition when you install Windows 2000. **Ntldr** uses information in the *Boot.ini* file to display the **Please Select The Operating System To Start** menu, from which you select the operating system that should be loaded.

1.3.1 Components of the Boot.ini File

The *Boot.ini* file includes two sections, **[Boot Loader]** and **[Operating Systems]** (SEE FIGURE 1.1) The **[Boot Loader]** section of a *Boot.ini* file contains the specified time that the **Please Select The Operating System To Start** menu is displayed and the default operating system that should be loaded if no selection is made within the specified time. The **[Operating Systems]** section of the *Boot.ini* file contains a list of all the operating systems that are installed on the computer.

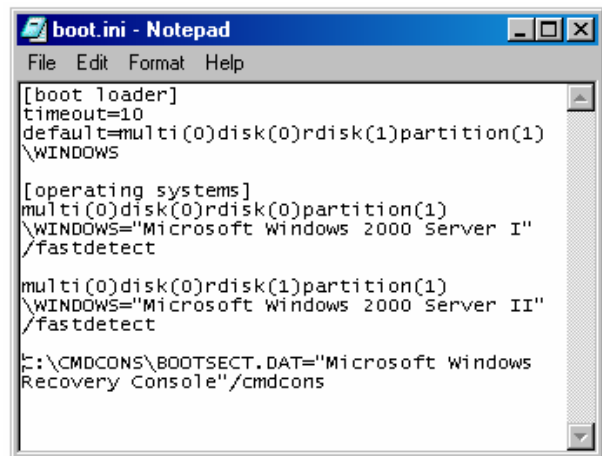


FIG1.1: A typical *Boot.ini* file. (NOTE the default ARC path)

1.3.2 ARC Paths

During installation, Windows 2000 generates the *Boot.ini* file, which contains **Advanced RISC Computing** (ARC) paths pointing to the computer's boot partition. For a list of ARC Paths see table 1.3.

TABLE 1.3: ARC Path Naming Conventions

Convension	Description
multi(x) scsi(x)	The hardware adapter or disk controller . Use scsi only to indicate a SCSI controller on which SCSI BIOS is not enabled. All other hardware adapter or disk controllers use multi . (x) represents a number that indicates the load order of the hardware adapter. The hardware adapter first to load and initialize receives number 0.
Disk(y)	The SCSI ID . For multi, this value (y) is always 0
Rdisk(z)	A number (z) that identifies the disk and starts with (0).
Partition(a)	A number (a) that identifies the partition. Partition numbers start with (1)

Note: The lowest ARC Path is multi(0) disk(0) partition (**1**) and not multi(0) disk(0) partition (**0**)

1.3.3 Boot.ini Switches

You can add a variety of switches to the entries in the [Operating Systems] section of the *Boot.ini* file to provide additional functionality. Table 1.4 lists some of these switches.

1.4 Advanced Boot Options

The Windows 2000 advanced boot options include Safe Mode, Enable Boot Logging, Enable VGA Mode, Last Known Good Configuration, Directory Services Restore Mode, and Debugging Mode.

TABLE 1.4: Boot.ini Switches

Switch	Description
/basevideo	Boots the computer using the standard VGA video driver.
/fastdetect=[comx comx,y,z.]	Disables serial mouse detection. Without a port specification, this switch disables peripheral detection on all COM ports. By default, this switch is included in every entry in the Boot.ini file.
/maxmem:n	Specifies the amount of RAM that the operating system should use.
/noguiboot	Boots the computer without displaying the graphical boot status screen.
/sos	Displays the device driver names as they are loading.

- **Safe Mode** can be used if your computer does not start properly. Pressing **F8** during the operating system selection phase displays a screen with advanced options for booting Windows 2000. If you select Safe Mode, Windows 2000 loads only basic files and drivers that are required to support the operating system. If your computer does not start using safe mode, you can try Windows 2000 Automatic System Recovery. You can also choose **Safe Mode With Networking**, which is the same as Safe Mode except

that it adds the drivers and services required to enable network access, and **Safe Mode With Command Prompt**, which is the same as Safe Mode except when the computer restarts, it displays a command prompt.

- **Enable Boot Logging** logs the loading and initialization of drivers and services in the *ntbtlog.txt* file, which is located in the *windir* folder and can be used for troubleshooting boot problems.
- **Enable VGA Mode** option starts Windows 2000 with a basic VGA driver.
- **Last Known Good Configuration** starts Windows 2000 using the registry information that Windows 2000 saved after the last successful startup of Windows 2000. Windows 2000 startup is not considered **successful** until a user logs on at the computer. After a **logon**, the system automatically copies the Clone control set to the LastKnownGood control set making the current control set the **Last Known Good Configuration**

Note: Windows 2000 startup is not considered **successful** until a user logs on at the computer. After a **logon**, the system automatically copies the Clone control set to the LastKnownGood control set making the current control set the **Last Known Good Configuration**.

1.5 The Recovery Console

The Recovery Console is a **command-line** interface that can be used to perform a variety of troubleshooting and recovery tasks, including

- Starting and stopping services;
- Reading and writing data on a local drive; and
- Formatting hard disks.

1.5.1 Installing and Starting the Recovery Console

You can install the Recovery Console from the Windows 2000 Installation CD by running the `winnt32` command with the `/cmdcons` switch from the command prompt. After Recovery Console is installed, you can access it from the **Please Select Operating System To Start** menu. You can also use the Windows 2000 Installation CD to start your computer and then select the Recovery Console option when you are prompted to choose repair options.

Note: You can instruct the Windows 2000 Setup program to install the **Recovery Console** when you install Windows 2000 by installing Windows 2000 with the `winnt` command and adding the `/e` and `/cmdcons` switches. The `/e` switch specifies that the Windows 2000 Setup programme must run a command after the final stage of the installation of Windows 2000 is finished and the `/cmdcons` switch specifies that the command must install the recovery console onto the hard drive. The full command would be similar to this: **Winnt/e:z:\i386\winnt/cmdcons**

1.5.2 Using the Recovery Console

The Recovery Console provides you with a limited set of dos-based administrative commands that you can use to repair your Windows 2000 installation. A list of the Recovery Console commands is shown in table 1.5.

TABLE 1.5: Some Recovery Console commands

Command	Description
Chdir (cd)	Displays the name of the current folder or changes the current folder
Chkdsk	Checks a hard drive and displays a status report
Copy	Copies a single file from a stiffy drive or CD-Rom drive to the hard drive
Delete (del)	Deletes one or more files
Dir	Displays a list of files and subfolders in a folder
Disable	Disables a system service or a device driver
Enable	Starts or enables a system service or a device driver
Exit	Exits the Recovery Console and restarts your computer
Fdisk	Manages partitions on your hard disks
Fixboot	Writes a new partition boot sector onto the system partition
Fixmbr	Repairs the master boot record of the partition boot sector
Format	Formats a disk
Help	Lists all of the Recovery Console commands
Listsvc	Lists the device drivers and services that are currently installed on the computer
Mkdir (md)	Creates a folder
Rmdir (rd)	Deletes a folder
Rename (ren)	Renames a single file
Systemroot	Sets the current folder to the systemroot folder of the system that you are currently logged on to
Type	Displays a text file

2. Managing Windows 2000

Control Panel can be used to configure hardware settings, manage user-specific settings, and manage computer-specific settings.

2.1 Installing New Hardware

Installing a new device to a Windows 2000 computer typically involves physically connecting the device to the computer; loading the appropriate device drivers; and configuring the device properties and settings if required.

Note: To be able to install a device you must be logged on as an **administrator** or as a member of the **Administrators group**.

When you install a **Plug and Play** device, Windows 2000 automatically configures the device so that it works properly with the other devices that are already installed on the computer. This includes assigning the appropriate system resources, such as Interrupt Request (**IRQ**) line number, Direct Memory Access (**DMA**) channels, Input/Output (**I/O**) port addresses and **Memory Address** ranges, to the device. Each device must be assigned a unique system resource or the device will not function properly. When you install a non-Plug and Play, or a legacy device, you must use the **Add/Remove Hardware Wizard**. If Windows 2000 does not detect the device you must configure the system resources for the device manually. You can assign system resources to the device in Device Manager.

Note: Some old **legacy ISA** devices require the use of a specific IRQ number that Windows 2000 may have assigned to a Plug and Play device. In this event you should **reserve** the IRQ that is required by the device in your **system BIOS**. Windows 2000 then will assign another IRQ to the Plug and Play device that was using the IRQ that you have reserved.

Note: When you install Windows 2000 on a new computer that does not have a standard **Hardware Abstraction Layer (HAL)** or a **RAID** device that is **not detected** by the Windows Setup program, you must install the drivers for these devices during the **text portion** of the Windows 2000 Setup program.

2.2 Using Driver Signing

Some device drivers and some applications overwrite existing operating files as part of their installation process. These files can cause system errors that are difficult to troubleshoot. Microsoft has greatly simplified the tracking and troubleshooting of altered files by digitally signing the original operating system files and allowing you to verify these signatures.

2.2.1 Configuring Driver Signing

You can configure how the computer responds to unsigned files on **HARDWARE** tab of **SYSTEM**. Here you can configure one of three responses:

- **Ignore** allows any files to be installed regardless of whether they are digital signature or not.
- **Warn** displays a warning message before allowing the installation of an unsigned file. This is the default option.
- **Block** prevents the installation of unsigned files.

Note: When you change the default Driver Signing option, you must select the **Apply setting as system default** check box in the **Driver Signing Options** dialog box. This will make the new settings the default system setting. If you do not select the **Apply setting as system default** check box, the settings will revert to the old setting when the computer is next rebooted.

2.2.2 The File Signature Verification Utility

Windows 2000 also provides a File Signature Verification utility, *sigverif*, that allows you to view the file's name, its location, its modification date, its type, and its version number.

2.3 Configuring Hard Disks

2.3.1 Disk Storage Types

Windows 2000 provides support for two types of disk storage: **basic storage**, which uses basic disks and is the standard storage type; and **dynamic storage**, which uses dynamic disks. Basic disks can be divided into up to four partitions that can either be **primary partitions** or **extended partitions**. You can have multiple primary partitions but only one extended partition. You can create multiple primary partitions to which enables you to **dual boot** between Windows 2000 and other operating systems such as Windows 98. One of the primary partitions must be set in **fdisk** as the **active partition** as the **boot files** required to start the operating systems must be located on the active partition.

Note: If you plan to dual boot between Windows 2000 and **Windows 95**, **Windows 98** or **OSR2**, the primary partition must be formatted with the **FAT** or **FAT32** file system.

Basic disks can be converted to dynamic storage from which **dynamic volumes** can be created. Windows 2000 supports three types of dynamic volumes: **simple volumes**, which are created from disk space on a single physical disk and is not fault tolerant; **spanned volumes**, which can contain disk space from up to 32 physical disks and are also not fault tolerant; and **striped volumes**, which can combine the free space from up to 32 physical disks into one logical volume.

2.3.2 Configuring File Systems

Windows 2000 supports the **FAT**, **FAT32** and **NTFS** file systems. A computer can contain a combination of file systems but each file system must be located on a separate partition or volume.

Note: DOS, Windows 95, Windows 98 and Windows Millennium Edition cannot access data on NTFS formatted disks.

The NTFS file system used by Windows 2000 is **version 5**. This is a new version of NTFS with new features that were not available in NTFS version 4 used by Windows NT 4.0. Windows NT 4.0 cannot therefore fully support all the features of NTFS version 5. NTFS version 5 offers a number of benefits that include:

- File compression
- File and folder level security
- File encryption using Encrypting File System (EFS)
- Disk quotas
- NTFS permissions

You can **convert** a disk from the FAT and FAT32 file to NTFS at any time without data loss by using the **convert** command from a command prompt and using the **fs:ntfs** switch. When you format the data on the disk is lost.

2.3.3 Encrypting File System (EFS)

EFS is a new feature that has been introduced with Windows 2000 and can be used to encrypt files and folders on NTFS volumes. When a user encrypts a file, only that user will be able to use the file. They can use the encrypted file without having to decrypt the file first. EFS can be implemented from Windows Explorer or from the command prompt using the **Cipher** command. The syntax for the cipher command is: **cipher [/e | /d] [/s:folder_name] [/a] [/i] [/f] [/q] [/h] [/k] [file_name [...]].**

For a list of Cipher command switches see table 2.1.

- EFS is only supported on **NTFS version 5**
- **Compressed files** cannot be encrypted using EFS
- **System files** cannot be encrypted
- Encrypted files cannot be **shared**
- Encrypted files or folders that are moved or copied to partitions or volumes that are not formatted with the NTFS file system will become decrypted
- Files and folders on network computers can be encrypted if you have the necessary access **permissions** to the network computer's NTFS volume and if file encryption is enabled on the network computer.

Table 2.1: *Command-line Switches for the Cipher command*

Switch	Description
/e	Encrypts the specified folders and marks them so that files that are added later will be encrypted.
/d	Decrypts the specified folders. Files that are added to the folder will no longer be encrypted.
/s:folder	Performs the specified operation on folders in the given folder and all subfolders
/a	Performs the specified operation on files and folders.
/i	Continues performing the specified operation even after errors have occurred.
/f	Forces the encryption operation on all specified files, even those that are already encrypted.

/q	Reports only the most essential information.
/h	Displays files with the hidden or system attributes.
/k	Creates a new file encryption key.
<i>File_name</i>	Specifies a pattern, file, or folder.

2.3.4 Volume Mounting

The Disk Management tool can be used to mount local drives to an **empty folder** on an NTFS volume. This empty folder becomes the mount point. When a physical disk is mounted to a folder, it is assigned a **drive path** rather than a drive letter. The Administrator can identify and manage volume mount points by using the *mountvol.exe* command-line tool. To mount a drive:

- Open **MY COMPUTER**
- Open **CONTROL PANEL**
- Open **ADMINISTRATIVE TOOLS**
- Click on the **COMPUTER MANAGEMENT**
- Expand **STORAGE**
- Open **DISK MANAGEMENT**
- Right-click the partition or volume you want to mount
- Click **CHANGE DRIVE LETTER AND PATH**
- Click **ADD**
- Type the path to the *Empty Folder*

2.3.5 File Compression

Windows 2000 supports file and folder level compression. Compressed files can be read and written to by any Windows-based or MS-DOS-based application without first having to be uncompressed by another program. When you access a file via a Windows-based or MS-DOS-based application, NTFS automatically uncompresses the file. When you save or close the file again, NTFS compresses it again. Therefore NTFS allocates **disk space** based on the **uncompressed file size** and not on the compressed file size.

2.3.5.1 Copying and Moving Compressed Files and Folders

When copying a file within an NTFS volume, the file inherits the compression state of the target folder.

- When moving a file or folder within an NTFS volume, the file or folder retains its original compression state.
- When copying a file or folder to another NTFS volume, the file or folder inherits the compression state of the target folder.
- When moving a file or folder to another NTFS volume, the file or folder inherits the compression state of the target folder. Because Windows 2000 treats a move as a copy and then a delete, the files inherit the compression state of the target folder.
- When moving or copying a file or folder to a **FAT volume**, Windows 2000 automatically uncompresses the file or folder. This is because Windows 2000 only supports file and folder compression on NTFS volumes.

- When moving or copying a compressed file or folder to a **floppy disk**, Windows 2000 automatically uncompresses the file or folder, as floppy disks are formatted with the FAT file system. Floppy disks cannot support the NTFS file system.

2.4 Backing Up and Restoring Data

Performing regular back ups of the data on hard disks prevents **data loss** due to disk drive failures, power outages, virus infections, and other such incidents. If data loss occurs, and you have performed regular backup jobs, you can restore the lost data.

2.4.1 Windows Backup

Windows 2000 provides **Backup And Recovery Tools**. This includes the Backup Wizard, which you can use to easily back up and restore data. To launch Backup

- Click on the **START** button
- Point to **PROGRAMS**
- Point to **ACCESSORIES**
- Point to **SYSTEM TOOLS**
- Click **BACKUP**

Alternatively:

- Click on the **START** button
- Click **RUN**
- Type **ntbackup** in the text box
- Click **OK**

You can use Backup to back up data manually or you can schedule regular unattended backup jobs. You can back up data to a file or to a tape. Files can be stored on hard disks, removable disks, and recordable compact discs and optical drives.

To successfully back up and restore data on a Windows 2000 computer, you must have the appropriate permissions and user rights.

All users can back up their own files and folders, and files for which they have the Read, Read & Execute, Modify, or Full Control permission.

All users can restore files and folders for which they have the Write, Modify, or Full Control permission.

By default, members of the **Administrators and Backup Operators** groups have the **Backup Files and Directories**, and the **Restore Files and Directories** user rights and can therefore back up and restore all files regardless of the assigned permissions.

2.4.2 Backup Types

Backup Wizard provides five types of backup that define which data is backed up. Some backup types use backup **markers**, also known as archive bits, which mark a file as having changed. When a file changes, an attribute is set on the file that indicates that the file has changed since the last backup. When you back up the file, this **clears** or resets the attribute.

- **Normal** – backs up all selected files and folders and does not rely on markers to determine which files to back up. During a normal backup, any existing marks are cleared and each file is marked as having been backed up. Normal backups speed up the restore process because the as the files are the most current therefore you do not need to restore multiple backup jobs.
- **Copy** – backs up all selected files and folders without looking for or clearing markers.
- **Incremental** – only backs up selected files and folders that have a marker and then **clears** the markers. Thus, if you did two incremental backups in a row on a file and nothing changed in the file, the file would not be backed up the second time.
- **Differential** – only backs up selected files and folders that have a marker but does not clear markers. Thus if you did two differential backups in a row on a file and nothing changed in the file, the entire file would be backed up each time.
- **Daily** – backs up all selected files and folders that have changed during the day and does not look for or clear markers.

3. Configuring the Windows 2000 Network

Windows 2000 supports both Workgroup Networks and Domain-Based Networks. **Workgroup Networks** are also referred to as Peer-to-Peer networks and are the simplest type of network. They are ideal for networks of less than ten computers and supports file and print sharing. **Domain-Based Networks** are common to large companies and benefit from centralized administration. This results in the implementation of stronger security models with users requiring a user account to logon access network resources.

3.1 Creating Network Connections

In Windows 2000 you can create number of network connections. These include local area network (LAN) connections, remote connections, Virtual Private Network (VPN) connections and direct connections. All these connections are created in the **NETWORK AND DIAL-UP CONNECTIONS** folder.

A **Local Area Network** is also referred to as an intranet and has client support, such as Client for Microsoft Networks and Client Services for NetWare; services, such as Files and Printer Sharing; and user network protocols. A network **protocol** is a set of rules and conventions for computers use to communicate over a network. Windows 2000 supports:

- **TCP/IP**, which is the default protocol and is installed automatically in Windows 2000;
- **NetBEUI**, which is a nonroutable protocol suited for small networks of less than ten computers;
- **AppleTalk**, which allows a Windows 2000-based computer to communicate on Apple Macintosh networks;
- **NWLink (IPX/SPX)**, which allows a Windows 2000-based computer to communicate on Novell NetWare networks; and
- **DLC**, which is a nonroutable protocol that allows a Windows 2000-based computer to communicate to an IBM host.

Note: The AppleTalk protocol requires a Windows 2000 Server that is configured with Windows 2000 Services to function properly.

You can also specify the **protocol binding** order to optimize network performance by placing the protocol that is used the most at the top of the protocol bindings list. The computer will then attempt to use this protocol first when a user attempts to make a connection to a server.

- **Remote connections** allow for mobile users to dial into their corporate LAN and are also used to establish a connection to the Internet via an Internet Service Provider (ISP).
- **Virtual Private Networks (VNP)** use a tunneling protocol to secure a private network that is established across a public network. Windows 2000 supports two tunneling protocols that can be used to create a VNP connection:

- **Point-to-Point Tunneling Protocol (PPTP)**, which is a TCP/IP protocol that can encapsulate TCP/IP, IPX/SPX, or NetBEUI protocols. PPTP tunnels must be authenticated by using the same authentication mechanisms as PPP connections; and
- **L2TP**, which is a combination of PPTP and Layer 2 Forwarding. L2PT does not provide data encryption but relies on **Internet Protocol Security (IPSec)**, which is group of services and protocol that supports the secured transfer of information across an IP internetwork.

3.2 Configuring automatic IP Addressing

In Windows 2000 client computer can obtain automatically obtain an IP address from a DHCP server or through Automatic Private IP Addressing.

3.2.1 DHCP Addressing

If the network has a server running the Dynamic Host Configuration Protocol (DHCP Service, it can automatically assign TCP/IP configuration information to the client computers if the client computers are configured as DHCP clients. You can then configure any client running Windows 2000, Windows 95, and Windows 98 to obtain TCP/IP configuration information automatically from the DHCP Service. This can simplify administration and ensure correct configuration information.

3.2.2 Automatic Private IP Addressing

Windows 2000 supports a new mechanism for automatic address assignment of IP addresses for simple LAN-based network configurations called **Automatic Private IP Addressing (APIPA)**. This mechanism is an extension of dynamic IP addressing and enables the configuration of IP addresses without using static IP address assignment or installing the DHCP Service.

On a computer running Windows 2000 you must configure a network LAN adapter for TCP/IP and click **Obtain an IP Address Automatically in the Internet Protocol (TCP/IP) Properties** dialog box for the Automatic Private IP Addressing feature to function properly.

APIPA can be used to set up IP configuration to allow network communication on a single subnet and is also used when the client computer cannot contact the DHCP server for IP address configuration. APIPA uses an addressing range from **169.254.0.1 through 169.254.255.254** and a subnet mask of **255.255.0.0**.

When you use DHCP to automatically configure TCP/IP information, the DHCP server supplies the necessary configuration information to the DHCP clients and ensures that the clients use the correct

IP Address

An IP address is a logical 32-bit address that identifies a TCP/IP host. Each network adapter card in a computer running TCP/IP must have a unique IP address, which has two parts: a network ID that identifies all hosts on the same physical network, and a host ID that identifies a host on the network. An IP Address of 192.168.1.66 indicates that the network ID is 192.168.1, and that the host ID is 66.

Subnet Mask

Subnet mask is used to subnets that divide a large network into multiple physical networks connected with routers. A subnet mask blocks out part of the IP address so that TCP/IP can distinguish the network ID from the host ID. When TCP/IP hosts try to communicate, the subnet mask determines whether the destination host is on a local or remote network. To communicate on a network, the computers must have the same subnet mask.

Default Gateway

The default gateway is a device on a local network that stores network IDs of other networks in the enterprise or Internet. To communicate with a host on another network you must configure an IP address for the default gateway. TCP/IP sends packets for remote networks to the default gateway, which forwards the packets to other gateways until the packet is delivered to a gateway connected to the specified destination.

configuration information. Then, DHCP automatically updates client configuration information to reflect changes in network structure and the relocation of users to other physical networks, without manually reconfiguring client IP addresses.

Every time a DHCP client starts, it requests an IP address from a DHCP server. Once the DHCP server receives the request, it selects an IP address from a predefined range of addresses in its database and offers this address to the DHCP client. If the client accepts the offer, the DHCP server leases the IP address to the client for a specified period of time. The default duration of an IP address lease is eight days. The client then uses the IP address to access the network.

The IP addressing information sent by the DHCP server to the DHCP client includes:

- An IP address;
- A subnet mask; and
- Optional values, such as:
 - A default gateway address
 - The IP addresses of Domain Name System (DNS) servers
 - The IP addresses of Windows Internet Name Service (WINS) servers
 - Domain name

3.2.3 The DHCP Lease Process

The DHCP client waits one second for an offer. If it does not receive an offer, it rebroadcasts the request four times at 2, 4, 8, and 16 second intervals. If the client does not receive an offer after four requests, it uses an IP address in the reserved range from 169.254.0.1 through 169.254.255.254. This ensures that clients on a subnet without a DHCP server can communicate with each other. The DHCP client continues in an attempt to find a DHCP server every five minutes. When a DHCP server becomes available, clients receive valid IP addresses, allowing them to communicate with hosts both on and off their subnet.

DHCP uses a four-step process to lease IP addressing information to DHCP clients. This process is also referred to as **DORA**: **D**iscovery, **O**ffer, **R**quest, and **A**cknowledgment

- **IP Lease Discovery**

When a client computer either starts or initializes TCP/IP for the first time, it initializes a limited version of TCP/IP and broadcasts a DHCP discovery (**DHCPDISCOVER**) message for IP addressing information. At this stage the client does not have an IP address. It therefore uses **0.0.0.0** as its IP address. The client also does not know the IP address of a DHCP server, and therefore uses **255.255.255.255** as the destination address. The DHCPDISCOVER message is broadcast to the entire subnet and contains the hardware address of the client's network adapter, which is known as the media access control (MAC) address; and the client's computer name so that DHCP servers can determine which client sent the DHCPDISCOVER message.

- **IP Lease Offer**

The second stage in the DHCP lease process is the IP lease offer. All DHCP servers that have an IP address that is valid for the network segment to which the client is connected respond with a DHCP offer (**DHCPOFFER**) message. This message includes:

- The client's hardware address
- An offered IP address
- A subnet mask
- The length of the lease
- The IP address of the offering DHCP server

Each responding DHCP server reserves the offered IP address so that it does not offer it to another DHCP client before the requesting client accepts the address.

- **IP Lease Request**

The third stage is the IP Lease Request. During this stage the DHCP client responds to the first offer that it receives by broadcasting a DHCP request (**DHCPREQUEST**) message to accept the offer. The DHCPREQUEST message includes the server identification of the server whose offer it accepted. All other DHCP servers then retract their offers and retain their IP addresses for other IP lease requests.

- **IP Lease Acknowledgement**

The final stage is IP Lease Acknowledgement during which the DHCP server that issues the accepted offer broadcasts a DHCP acknowledgement (**DHCPACK**) message to acknowledge the successful lease. This message contains a valid lease for the IP address and other configuration information. When the DHCP client receives the acknowledgment, TCP/IP initializes by using the configuration information that the DHCP server provides. The client also binds the TCP/IP protocol to the network services and network adapter, permitting the client to communicate on the network.

3.2.3.1 Automatic Lease Renewal

At specific intervals, a DHCP client attempts to renew its lease to ensure that it has up-to-date configuration information. A DHCP client attempts to renew its lease **when 50 percent of the lease duration has expired**. The DHCP client sends a DHCPREQUEST message to the DHCP server from which it obtained the lease. If the DHCP server is available, it renews the lease and sends the client a DHCPACK message with the new lease duration and any updated configuration parameters. The client updates its configuration when it receives the acknowledgment. If the DHCP server is unavailable, the client continues to use its current configuration parameters and a DHCP client cannot renew its lease at the 50 percent interval, the client continues to use its current configuration parameters. It then broadcasts a DHCPDISCOVER message to update its address lease at regular intervals and accepts a lease that is issued by any DHCP server.

Client Reservations

You can configure a scope so that the DHCP server always provides the same IP address to a computer that requires a permanent IP address, such as a DNS server. This is called *client reservations*.

3.2.3.2 Manual Lease Renewal

You can use the IPConfig command with the /renew switch to manually renew an IP lease if you need to update DHCP configuration information immediately if you want DHCP clients to immediately obtain the address of a newly installed router from a DHCP server, renew the lease from the client to change this configuration. Windows 3.51, Windows NT 4.0, Windows 2000, and Windows XP clients can use the IPConfig command with the /release switch to release a lease while Windows 95 and Windows 98 clients must use the **winnipcfg** command. These commands send a DHCPRELEASE message to the DHCP server to

release a client lease. After you issue this command, the client can no longer communicate on the network by using TCP/IP.

Note: You must **authorize** a DHCP server before the server can issue leases to DHCP clients. This prevents unauthorized DHCP servers from offering incorrect IP configurations to clients. However, only DHCP servers running Windows 2000 Server check for authorization. Other DHCP servers can still operate even though they are not authorized. You must be a member of the Enterprise Administrators group to authorize a DHCP server as you need network-wide administrative privileges to authorize a DHCP server.

3.3 Name Resolution

Windows 2000 supports the use of user-friendly domain names to represent the IP address of a host or a client. This however requires name resolution so that the computer can identify the IP address that the user-friendly name refers to. Windows 2000 supports two types of name resolution: NetBIOS name resolution and host name resolution.

3.3.1 NetBIOS Name Resolution

Although Microsoft has phased out NetBIOS name resolution, it remains in Windows 2000 for compatibility purposes. Two of the mechanisms implemented for NetBIOS name resolution are **Windows Internet Naming Service (WINS)**, which is a NetBIOS name server that stores NetBIOS names and their IP Addresses; and the LMHOSTS file, which is a static text file that contains a list of NetBIOS names and their corresponding IP addresses and is stored on the local computer.

3.3.2 Host Name Resolution

Windows 2000 uses Domain Name Services (DNS) to resolve host names. DNS name servers resolve forward and reverse lookup queries. A forward lookup query resolves a user-friendly domain name to an IP address. A reverse lookup query resolves an IP address to a user-friendly domain name. A name server can resolve a query only for a zone for which it has authority. If a name server cannot resolve the query, it passes the query to other name servers that can resolve the query. The name server caches the query results to reduce the DNS traffic on the network. This is the primary means for Windows 2000 and Windows XP client computers to locate and communicate with other computers on an IP network. However, clients using earlier versions of Windows, such as Windows 98 or Windows NT 4.0, which use NetBIOS names for network communication, require Windows Internet Name Service (WINS) to register NetBIOS computer names and resolve them to IP addresses. This ensures that clients that use earlier versions of Windows can locate network resources and can communicate with other computers on network.

The recommended way to configure a DNS client is to make it a DHCP client and set the appropriate TCP/IP options.

To configure Windows 98 client computers to use DNS for name resolution

DNS Zones

DNS uses *domain name space* is the naming. The DNS database is indexed by name; therefore, each domain must have a name. As you add domains to the hierarchy, the name of the parent domain is appended to its child domain. Consequently, a domain's name identifies its position in the hierarchy. Thus the domain name studyguides.testking.com identifies the studyguides domain as a child domain or subdomain of the testking.com domain and testking as a subdomain of the com domain. A discrete portion of the domain name space is represented as a zone. Zones provide a way to partition the domain name space into manageable sections.

- On the Windows 98 Client computer, click on the **START** button
- Point to **SETTINGS**
- Click on **CONTROL PANEL**
- Double-click **NETWORK**
- Double-click the **TCP/IP PROTOCOL** that is bound to the network adapter
- Click on the **PROPERTIES**
- Click the **DNS CONFIGURATION** tab
- If a DNS server is available, click **ENABLE DNS**
- Click on **HOST**
- Type the client **computer name**
- Click on **DOMAIN**
- Type the **DNS domain name**
- In the DNS Server Search Order dialog box, use the **ADD** button to enter the IP addresses of the DNS servers that you want this client to use

To configure Windows NT 4.0 client computers to use DNS for name resolution

- On the Windows 98 Client computer, click on the **START** button
- Point to **SETTINGS**
- Click on **CONTROL PANEL**
- Double-click **NETWORK**
- Click **TCP/IP PROTOCOL**
- Click on **PROPERTIES**
- In the **DNS SERVER SEARCH ORDER** dialog box, on the DNS tab, use the **ADD** button to enter the IP addresses of the DNS servers that you want this client to use
- Click on **HOST**
- Type the client **computer name**
- Click on **DOMAIN**
- Type the **DNS domain name**

To configure Windows 2000 client computers to use DNS for name resolution

- On the **DESKTOP**, right-click **MY NETWORK PLACES**
- Click **PROPERTIES**
- Open the **PROPERTIES** dialog box for the connection
- Open the **INTERNET PROTOCOL (TCP/IP) PROPERTIES** dialog box
- Click **USE THE FOLLOWING DNS SERVER ADDRESSES**
- In the **PREFERRED DNS SERVER** dialog box, type the IP address of the primary server
- If you are configuring a second DNS server, in the **ALTERNATE DNS SERVER** dialog box, type the IP address of the additional DNS server.

To configure the primary DNS suffix:

- Right-click **MY COMPUTER**
- Click **PROPERTIES** to open the System Properties dialog box.
- On the **NETWORK IDENTIFICATION** tab, click **PROPERTIES**
- In the **COMPUTER NAME CHANGES** dialog box, click **MORE**
- In the **DNS SUFFIX AND NETBIOS COMPUTER NAME** dialog box, in the Primary DNS suffix of this computer dialog box, type the DNS domain name for the computer.

To configure Windows XP client computers to use DNS for name resolution

- Right-click **MY NETWORK PLACES**
- Click **PROPERTIES**
- Open the **PROPERTIES** dialog box for the connection
- Open the **INTERNET PROTOCOL (TCP/IP) PROPERTIES** dialog box.
- Click **USE THE FOLLOWING DNS SERVER ADDRESSES**
- In the **PREFERRED DNS SERVER** dialog box, type the IP address of the primary server
- If you are configuring a second DNS server, in the **ALTERNATE DNS SERVER** dialog box, type the IP address of the additional DNS server.

3.4 Testing IP Connections

3.4.1 Using the IPConfig Utility

The IPConfig utility is a command-line utility that can be used to display the TCP/IP configuration of your computer. This information can be used to verify that the client computer has received a valid IP configuration from DHCP. It can also display the IP configuration, and parameters for the network connection on your computer. This information can be used to verify that the client computer is configured with the correct WINS and/or DNS server IP addresses.

Table 3.1: *IPConfig Switches*

Switch	Function
/all	Displays the configuration all network interfaces.
/release <adapter>	Releases the IP address for a specified network adapter card.
/renew <adapter>	Renew the IP address for the specified network adapter card.
/flushdns	Clears all entries from the DNS Resolver Cache on the local computer.
/registerdns	Renews the local computer's DHCP lease and reregisters DNS names.
/displaydns	Displays the contents of the DNS Resolver Cache on the local computer.
/showclassid <i>adapter</i>	Displays all the DHCP class IDs allowed for the specified network adapter card.

<code>/setclassid adapter</code>	Modifies the DHCP class ID for the specified network adapter card
<code>/?</code>	Displays a list of all the IPConfig switches and their functions

Note: DNS clients **cache** the name resolution information it receives from DNS responses to its name resolution queries and uses this information to resolve future queries locally. When a query cannot be resolved locally, the client sends the query to the DNS server. However, when a server or remote host renews its IP address lease in DHCP, the local client computer will not hold the correct information in cache and will thus resolving names incorrectly. In this event you can use the **/flushdns** switch of the IPConfig utility to clear the cache on the local client computer.

3.4.2 Using the ping Utility

The ping utility is another command-line utility that can be used to test low-level communication over IP to another host on the network in the form of an echo request. If the ping utility fails, it returns an error message. You can receive various messages when you use the ping utility:

Table 3.2: Ping Errors

Error Message	Problem
Destination host unreachable	there is an IP routing problem between your computer and the remote host
Unknown host hostname	none of the client's name resolution mechanisms recognize the name that you typed - check that you typed the host name correctly
Request timed out	the name resolution mechanisms have recognized the name, but the remote host did not receive the request or did not respond to it - check connectivity to the remote host

3.4.3 Using the tracert Utility

The tracert utility is similar to the **ping** utility, except that it reports back from each router on the path from your client computer to the remote host. If you know the network topology in your organization, you can determine which router is unresponsive or slow.

Using net and nbtstat to Manage NetBIOS Name Resolution

The net command can be used to view the computer's network settings. The Net config workstation command is a net command that is used for testing NetBIOS name resolution. The Net config workstation command reports the NetBIOS name and the domain name of the computer while the nbtstat command is used to check the state of current NetBIOS over TCP/IP connections, to update the Lmhosts cache, and to determine your registered name. This command can also be used to troubleshoot and preload the NetBIOS name cache.

Table 3.3: *nbstat Commands*

Command	Description
nbstat -n	Lists the NetBIOS names registered by the client
nbstat -c	Displays the NetBIOS name cache
nbstat -R	Manually reloads the NetBIOS name cache by using entries in the Lmhosts file with a #PRE parameter
nbstat /?	List all the nbstat commands

The DNS server contains information about a portion of the DNS namespace. A DNS client queries a DNS server for information about the DNS namespace; the server can query other DNS servers to resolve a query from the client. In other words, when a DNS server receives a DNS request, it attempts to resolve the request by locating the information in its own database first. If it cannot locate the information, it sends a request to the other DNS servers in the domain.

3.4.4 Lookup Types

The zone lookup type determines the tasks that a DNS server will perform. When you create a zone, you specify whether the zone will be used for resolving forward or reverse lookup queries by specifying the zone type.

- **Forward lookup.** A request to map **a name to an IP address**. This is the most common type of lookup, and is used to locate a server's IP address so that a connection can be made to it. This type of request requires name-to-address resolution.
- **Reverse lookup.** A request to map **an IP address to a name**. This lookup type is most commonly used when you know an IP address, but you want to know the domain name that is associated with the IP address. For example, if you monitor IP connections that are made to a server, you can use a reverse lookup to locate the domain name associated with the IP address of the connecting computer. This type of request requires address-to-name resolution.

3.5 DNS Zones

A zone is a contiguous portion of the domain namespace for which a DNS server has authority to resolve DNS queries. You can divide the DNS namespace into zones, which store name information about one or more DNS domains or portions of a DNS domain. For each DNS domain name included in a zone, the zone becomes the authoritative source for information about that domain. DNS servers can host various types of zones. To limit the number of DNS servers on your network, you can configure a single DNS server to support, or host, multiple zones. You can also configure multiple servers to host one or more zones to provide fault tolerance and distribute the name resolution and administrative workloads.

Zone file. The resource records that are stored in a zone file define a zone. The zone file stores information that is used to resolve host names to IP addresses and IP addresses to host names.

To create a zone, open the DNS console, right-click the name of the server to which you want to add the zone, and then click New Zone to start the New Zone wizard. The wizard prompts you to select a zone type and specify the domain name for the zone.

Note: To create zones and administer a DNS server that is not running on a domain controller, you must be a member of the **Administrators group** on

that computer. To configure a DNS server that is running on a domain controller, you must be a member of the DNSAdmins, Domain Admins, or Enterprise Admins group.

The following table describes the three types of zones that you can configure, and the zone files associated with them.

Table 3.4: *Zone Types*

Zone type	Description
Standard primary	Contains a read/write version of the zone file that is stored in a standard text file. Any changes to the zone are recorded in that file
Standard secondary	Contains a read-only version of the zone file that is stored in a standard text file. Any changes to the zone are recorded in the primary zone file and replicated to the secondary zone file. Create a standard secondary zone to create a copy of an existing zone and its zone file. This allows the name resolution workload to be distributed among multiple DNS servers
Active Directory integrated	Stores the zone information in Active Directory, rather than a text file. Updates to the zone occur automatically during Active Directory replication. Create an Active Directory integrated zone to simplify planning and configuration of a DNS namespace. You do not need to configure DNS servers to specify how and when updates occur, because Active Directory maintains zone information

3.5.1 Caching-only DNS servers

Caching-only DNS servers perform name resolution on behalf of clients and then **cache the results**. They are not configured to be authoritative for a zone, so they do not store standard primary or standard secondary zones instead the cache is populated with the most frequently requested names. These names and their associated IP addresses are available from the cache for answering subsequent client queries. Caching-only DNS servers help to reduce traffic across a WAN links as they do not maintains zone files, as do a primary DNS server, nor do they hold a copy of a zone file, as do a secondary DNS server. Therefore, they do not generate zone transfer traffic. You can configuring a Caching-Only DNS Server by installing the DNS Server service on a Windows 2000 computer, **without configuring any forward or reverse lookup zones**.

3.5.2 Zone Files

Zone files contain the information that a DNS server references to resolve host names to IP addresses and to resolve IP addresses to host names. This information is stored as resource records that populate the zone file. A zone file contains the name resolution data for a zone, including resource records that contain information for answering DNS queries. Resource records are database entries that contain various attributes of a computer, such as the host name or FQDN, the IP address, or the alias. DNS servers can contain the following types of resource records.

Table 3.5: Resource Record Types

Resource record type	Function
A (address)	Contains name-to-IP address mapping information, which is used to map a DNS domain name to a host IP address on the network. An A resource record is also referred to as a host record
NS (name server)	Designates the DNS domain names for the servers that are authoritative for a certain zone or that contain the zone file for that domain.
CNAME (canonical name)	Allows you to provide additional names to a server that already has a name in an A resource record. A CNAME resource record is also referred to as an alias record.
MX (mail exchanger)	Specifies the server to which e-mail applications can deliver mail.
SOA (start of authority)	Indicates the starting point or original point of authority for information stored in a zone. The SOA resource record is the first resource record created when you add a new zone. It also contains several parameters used by other computers that use DNS to determine how long they will use information for the zone and how often updates are required.
PTR (pointer)	Used in a reverse lookup zone created in the in-addr.arpa domain to designate a reverse mapping of a host IP address to a host DNS domain name
SRV (service)	Registered by services so that clients can locate a service by using DNS. SRV records are used to identify services in Active Directory.

3.5.3 Zone Transfers

Zone transfer is the process of replicating a zone file to another DNS server. Zone transfers occur when names and IP address mappings change in your domain. When this happens, the changes to the zone are copied from a master server to its secondary servers. In Windows 2000, zone information is updated by **incremental zone transfer (IXFR)**, which replicates only changes to the zone file and not the entire zone file. DNS servers that do not support IXFR request the entire contents of a zone file when they initiate a zone transfer. Zone transfer occurs when:

- A **master server** sends a notification of a change in the zone to one or more secondary servers. When the secondary server receives the notification, it queries the master server for the changes.
- A **secondary server** queries a master server for changes to the zone file. This occurs when the DNS Server service on the secondary server starts, or when the refresh interval on the secondary server expires.

You can configure the frequency of a zone transfer by modifying the **Start of Authority (SOA)** resource record. The SOA resource record specifies the domains for which the zone is authoritative, and the parameters for how zone transfers occur. It also contains administrative information about the zone.

A secondary server queries its primary server for updates to a zone file and uses the serial number in the SOA resource record to determine whether changes have been made to the zone. If the serial number has changed, a zone transfer occurs to update the records on the secondary server. If a secondary server does not receive updates from its master server, you can use the Nslookup utility to compare the serial numbers in each server's SOA resource record. To compare serial numbers by using the Nslookup utility:

- Click on the **START** button
- Click on **RUN**
- On the **RUN** dialog box, type **CMD**
- Click **OK**
- At the **COMMAND PROMPT** that appears, type **NSLOOKUP**
- Type the **name of the primary server**
- Type **set type=SOA**
- Type **domain name** in which the primary server resides
- **Record** the serial number that appears in the SOA resource record
- Type the name of the **secondary server**
- Type **set type=SOA**
- Type **domain name** in which the primary server resides
- **Record** the serial number that appears in the SOA resource record
- Type **EXIT**

You can force a zone transfer by increasing the serial number on the primary server. To do this open DNS on the server that hosts the primary zone file. You can locate DNS on the Administrative Tools menu. In DNS open the Properties dialog box for the zone, and then click the Start of Authority tab. Click Increment to increase the serial number, and then click OK.

3.5.3.1 Zone Transfer Security

You can also specify the servers that are authorized to receive zone transfers for the zone by selecting one of the options on the Zone Transfers tab of the Properties dialog box for the zone. These options are:

- **To any server.** Enables zone information to replicate to any server.
- **Only to servers listed on the Name Servers tab.** Enables zone information to replicate only to the servers that are listed on the Name Servers tab of the Properties dialog box for the zone. The Name Servers tab contains a list of servers that are in the same domain as the zone.
- **Only to the following servers.** Specifies whether you want to allow zone transfers only to the servers that you list under IP address on the Zone Transfers tab of the Properties dialog box for the zone.

3.5.4 Active Directory Integrated Zones

Active Directory integrated zone data is stored as an Active Directory object and is replicated as part of domain replication. This provides the following advantages:

- **No single point of failure.** With Active Directory integrated zones, changes made by using the dynamic update protocol can be made to any server that hosts the Active Directory integrated zone, rather than to a single server.
- **Fault tolerance.** All Active Directory integrated zones are primary zones. Therefore, each domain controller that hosts an Active Directory integrated zone maintains the zone information. Only domain controllers that reside in the Active Directory domain in which the zone data is stored can host the zone.
- **Single replication topology.** Zone transfers occur automatically as part of Active Directory replication, eliminating the need to configure replication for DNS and Active Directory separately.
- **Secure dynamic updates.** With Active Directory integrated zones, you can set permissions on zones and records in those zones. Also, updates that use the dynamic update protocol can come from only authorized computers. You can create Active Directory integrated zones only on servers that are configured as domain controllers and that have the DNS Server service installed on them.

3.6 Dynamic Updates

When a client receives a new IP address from a DHCP server, the name-to-IP address mapping information that is stored on a DNS server must be updated. By default, Windows 2000 and Windows XP clients and Windows 2000 DHCP servers can register with DNS and dynamically update DNS with their name-to-IP address mapping information with DNS servers that are configured to support dynamic updates.

Note: Static DNS servers are not able to interact dynamically with DHCP when client configurations change. It is therefore recommended that you **upgrade** all DNS servers from Windows NT 4.0 to Windows 2000 to enable them to support dynamic updates.

However, computers running earlier versions of Windows, such as Windows NT and Windows 98 are not able to update DNS therefore you must **configure the DHCP server to update A and PTR resource** records for these clients.

When you configure dynamic updates you must configure the DNS server for dynamic updates; the DHCP server for dynamic updates; and the client computers for dynamic updates.

3.6.1 Secure Dynamic Updates

You can configure the DNS server to perform secure dynamic updates for **Active Directory integrated zones**. With secure dynamic updates, the authoritative DNS server accepts new registrations only from computers that have a computer account in Active Directory, and accepts updates only from the computer that originally registered the record. The DNS server refuses updates until the DHCP servers and clients encrypt the information. Secure dynamic updates allow you to specify which users and groups are authorized to modify zones and resource records and will prevent unauthorized users from modifying zones and resource records.

To configure secure dynamic updates on the DNS server:

- Click on the **START** button
- Point to **PROGRAMS**
- Point to **ADMINISTRATIVE TOOLS**
- Click on **DNS**
- Open the **PROPERTIES** dialog box for the Active Directory integrated zone on the DNS server that you want to configure.
- Click on the **GENERAL** tab
- In the **ALLOW DYNAMIC UPDATES** list, click **ONLY SECURE UPDATES**
- Click **OK**

Domain Controllers are also identified by the specific **services** that they provide. Windows 2000 uses DNS to locate domain controllers by resolving a domain or computer name to an IP address. DNS servers use the information in the **SRV resource record** and the **A resource record** to locate domain controllers. SRV resource records map a particular service to the domain controller that provides that service. The format of an SRV resource record contains this information and TCP/IP specific information. When a domain controller starts, the Net Logon service running on the domain controller uses the DNS dynamic update feature to register with the DNS database the SRV resource records for all Active Directory–related services that the domain controller provides. Therefore, a computer running Windows 2000 can query a DNS server when it must contact a domain controller.

3.6.2 SRV Resource Records and A Resource Records

When a domain controller starts, it registers SRV resource records and an A resource record that contains its DNS computer name and its IP address. A DNS server then uses this combined information to resolve DNS queries and return the IP address of a domain controller so that the client computer can locate the domain controller. In Windows 2000, domain controllers are also referred to as **Lightweight Directory Access Protocol** (LDAP) servers because they run the LDAP service that responds to requests to search for or modify objects in Active Directory.

3.6.3 Creating Resource Records

You can create resource records manually for clients that are unable to create them dynamically such as Windows NT 4.0 servers that have a static IP address. To create a new resource record, open DNS. Right-click the name of the zone to which you want to add the new resource record, and then click the type of resource record that you want to create, or click Other New Records for a complete list of resource records.

3.6.4 Using nslookup to resolve DNS problems

You can use nslookup to verify that the information contained in resource records is correct. Nslookup has two modes: interactive mode and noninteractive mode. You should use **interactive mode** when you require more than one piece of data and **noninteractive mode** when you require a single piece of data, or when you want to include an Nslookup command in a command or batch file. Type the Nslookup syntax at the **command** prompt, and the data is returned.

3.7 Security for Remote Connections

Windows 2000 uses authentication and authentication protocols to ensure network security. **Authentication** refers to the process in which the computer or network system checks a user's name and password against an authoritative database and only grants access if the user name and password match those in the database. **Authentication protocols** are used to transmit and receive user names and passwords. Windows 2000 supports a number of authentication protocols:

- **PAP** is the least secure authentication protocol and transmits passwords in plain text, i.e. unencrypted. This is used when two computers cannot negotiate a more secure form of authentication.
- **SPAP** is a proprietary authentication protocol used by Shiva clients to dial in to computers running Windows 2000 Server and by Windows 2000 clients to dial in to Shiva servers.
- **CHAP** resolves the problem of transmitting passwords in clear text by negotiating a secure form of encrypted authentication by using Message Digest 5 (MD5), which is a challenge-response hashing scheme.
- **MS-CHAP** uses the same type of authentication but uses MD4 as its hashing method.
- **MS-CHAP v2** is more advanced than CHAP and MS-CHAP and uses mutual authentication, stronger initial data encryption keys, and different encryption keys for sending and receiving data.
- **EAP** is an extension of PPP, which is the basis for PPTP, works with dial-in, PPTP and L2TP clients, and allows additional authentication methods with PPP. These include smart cards, public key authentication and certificates.

3.8 Internet Connection Sharing (ICS)

ICS is a new feature that has been introduced with Windows 2000. It allows one computer to host an Internet connection for a network and provides IP address allocation, network address translation (NAT) and name resolution services for all ICS clients.

3.8.1 Configuring Internet Connection Sharing

The computer hosting ICS must have two connections; one to the internal network and one to the Internet. Once these connections have been created, you can enable ICS:

- Click on the **START** button
- Point to **SETTINGS**
- Open **NETWORK AND DIAL-UP CONNECTIONS**
- Right-click on the desired remote connection and select **PROPERTIES**
- Select the **SHARING** tab on the **DIAL-UP CONNECTION PROPERTIES** dialog box that appears.
- Select the **ENABLE INTERNET SHARING FOR THIS CONNECTION** check box.

Note: You configure the Internet Connection for ICS, not the computer.

3.8.2 Configuring ICS Clients

The ICS client computers network properties must be configured as follows:

- LAN using Client for Microsoft Networks, TCP/IP, and file and printer sharing
- TCP/IP configured to obtain IP address and DNS server address automatically from a DHCP server.

- Start **Internet Explorer**
- Click on the **TOOLS** drop down menu
- Select **INTERNET OPTIONS**
- Click on the **CONNECTIONS** tab
- Select **NEVER DIAL A CONNECTION** in the **DIAL-UP SETTINGS**
- Click on **LAN SETTINGS**
- Select the **AUTOMATICALLY DETECT SETTINGS** check box
- Clear the **USE AUTOMATIC CONFIGURATIN SCRIPT** and the **USE A PROXY SERVER** check boxes
- Click on **OK** to close **LAN SETTINGS**
- Click on **OK** to the **INTERNET OPTIONS** dialog box

3.9 Connecting to a Novell NetWare Network

Windows 2000 computers can use **NWLink**, **Client Services for NetWare**, and **Gateway (and Client) services for NetWare** to connect to a Novell NetWare-based server using IPX/SPX.

3.9.1 Configuring NWLink

The NWLink protocol allows Windows 2000 computers to gain access to applications running on Novell NetWare-based servers. The configuration of NWLink involves three components: frame type, network number, and internal network number. When you install NWLink, Windows 2000 automatically detects a **frame type**, which defines the way that the network adapter card formats data and should match the frame type on the NetWare server; and a **network number**, which must be unique for each network segment and all computers on a segment using the same frame type must use the same network number to communicate with one another. Windows 2000 also provides a generic internal network number. However, you must manually specify an internal network number if you plan to run FPNW or IPX routing.