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LIST OF ACRONYMS

ACL	Access Control List
ACPI	Advanced Configuration And Power Interface
AD	Active Directory
APM	Advanced Power Management
APIPA	Automatic Private Internet Protocol Addressing
CA	Certificate Authority
CAL	Client Access License
DHCP	Dynamic Host Control Protocol
DNS	Domain Name System
EAP	Extensible Authentication Protocol
EFS	Encrypting File System
FEK	File Encryption Key
GPO	Group Policy Object
GPT	Group Policy Template
HCL	Hardware Compatibility List
IAS	Internet Authentication Services
ICS	Internet Connection Sharing
IPSec	Internet Protocol Security
L2TP	Layer Two Tunneling Protocol
LDAP	Lightweight Directory Access Protocol
LPD	Line Printer Daemon
MMC	Microsoft Management Console
NAT	Network Address Translation
NTFS	NT File System
ODBC	Open Database Connectivity
OSI	Open Systems Interconnection (Model)
OU	Organizational Unit
PCMCIA	Personal Computer Memory Card Interface Adapter
PnP	Plug and Play
PPP	Point To Point Protocol
PPTP	Point To Point Tunneling Protocol
PXE	Preboot Execution Environment

RAS	Remote Access Service
RIPrep	Remote Installation Preparation
RIS	Remote Installation Services
RRAS	Routing And Remote Access Service
SAM	Security Accounts Manager
SMP	Symmetric Multiprocessing
SMS	Systems Management Server
Sysprep	System Preparation
TFTP	Trivial File Transfer Protocol
UDF	Unique Database File
UNC	Universal Naming Convention
VPN	Virtual Private Network
WDM	Windows32 Driver Model

Installing, Configuring, and Administering Microsoft Windows 2000 Professional

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

About This Study Guide

This Study Guide provides all the information required to pass the Microsoft 70-210 exam ' Installing, Configuring, and Administering Microsoft Windows 2000 Professional. 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 Study Guide is specific to the 70-210 exam and not to Windows 2000 Professional. It includes the information required to answer questions related to Windows 2000 Server and Windows NT that may be asked during the exam. Topics covered in this Study Guide includes installing Windows 2000 Professional; implementing and conducting administration of resources; implementing, managing, and troubleshooting hardware devices and drivers; monitoring and optimizing system performance and reliability; configuring and troubleshooting the desktop environment; implementing, managing, and troubleshooting network protocols and services; and implementing, monitoring, and troubleshooting security.

Intended Audience

This Study Guide is targeted specifically at people who wish to take the Microsoft MCSE exam 70-210, Installing, Configuring, and Administering Microsoft Windows 2000 Professional. This information in this Study Guide is specific to the exam and 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 the exam, and consequently in this Study Guide are rather complex. We therefore suggest that a sound knowledge of CompTIA's A+, N+ and Server+ course work material would be advantageous.

How To Use This Study Guide

To obtain maximum benefit from this Study Guide we recommend that you:

- Study each chapter carefully until you fully understand the information. This will require regular and disciplined work

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

- Perform all labs that are included in this Study Guide to gain practical experience, referring back to the text so that you better understand the information. 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.

Good luck!

1. Installing and Deploying Windows 2000 Professional

You can install Windows 2000 directly from the CD-Rom or from a network share. The Windows 2000 installation process consists of four stages:

Stage 1: Hard Drive Preparation. In text mode Setup checks the hard drive for consistency and errors. It allows you to format and create the Windows 2000 partition if you need to and copies setup files to the hard drive. Setup then reboots the computer.

Stage 2: Setup Wizard. The graphical user interface Setup Wizard gathers information from you; such as regional settings, your name and organization, the Windows 2000 CD-key, and computer name. Creates the local Administrator user account and requests a password for it.

Stage 3: Installing Network Components. After the Setup Wizard has gathered the necessary information from you in Stage 2, it begins the network components installation. It detects your network adapter card; allows you to choose which network components, such as the network client, file and printer sharing and protocols, to install; allows you to join a workgroup or domain; and installs the components you have chosen.

Stage 4: Completing the installation. The Setup Wizard completes the installation by installing the start-menu items and applying and saving the configuration settings you chose in the previous stages. It then deletes the temporary setup files and reboots the computer.

1.1 System Requirements

Before installing Windows 2000 Professional, you must ensure that the computer meets the minimum system requirements as indicated in Table 1.1.

TABLE 1.1: *Windows 2000 Professional System Requirements*

Hardware	Minimum requirement
Processor	Pentium 133 MHz
Memory	64 MB Ram
Hard disk space	2 GB with 650 MB free space (1 GB free space recommended)
Networking	Network adapter card
Display	Video display adapter card and VGA monitor
I/O devices	Keyboard and mouse or other pointing device

Note: Windows 2000 Professional offers support for a maximum of 2 processors and a maximum of 4 GB Ram

1.2 Installing Windows 2000 from the CD-Rom

When installing Windows 2000 Professional from the CD-Rom you can either boot directly from the CD-Rom or, if your computer system does not support booting from the CD-Rom, you can create boot disks.

1.2.1 Booting from the CD-Rom.

In your system BIOS set the CD-Rom drive as the *First Bootable Device*. This is usually set in the *BIOS Feature Setup*. While you are in the BIOS Setup you should also check that *Boot Sector Virus Protection* is

disabled. The Boot Sector Virus protection prevents any attempt that is made to write to the hard drive's boot sector or partition table. When BIOS detects an attempt to write to the boot sector it stops the computer and display an error message. The Windows 2000 Setup program must write to the boot sector, therefore the **Boot Sector Virus Protection** must be disabled.

Once you have configured the BIOS, place the Windows 2000 Professional Installation disk in the CD-Rom drive and reboot the computer. During the boot process you will be prompted to **press any key to boot from CD-Rom**. Once you have pressed a key the Installation of Windows 2000 Professional will begin.

1.2.2. Booting from boot disks.

If your computer system does not support booting from the CD-Rom, you will have to create boot disks on a computer that has an operating system installed on it already. On the Windows 2000 Professional Installation CD is a folder named **bootdisk** that contains a file named *makeboot.e e*. This file is used to create the Windows 2000 boot disks, a process that requires 4 high density floppy disks that can then be used to boot the computer and will load the drivers required to access the CD-Rom drive.

Note: Boot disks operate in a **16-bit DOS mode** environment. You therefore cannot use *winnt32.e e* to install Windows 2000 Professional as *winnt32.e e* is **32-bit** application. You must use *winnt.e e*, which is the 16-bit equivalent of *winnt32.e e*, instead.

1.3 Installing Windows 2000 over the network

To install Windows 2000 Professional over the network you must copy the **i386** folder from the Windows 2000 Professional Installation CD to a shared folder on the network. You must also ensure that the computer can connect to the network share when it is booted. To be able to boot to the network share the computer must have a **PXE compliant** network adapter. If the computer cannot be booted over the network you will have to create a network boot disk for the computer. A boot disk can be created by using the *rbfg.e e* utility. If you must use a boot disk to boot the computer, you will have to run *winnt.e e* to install Windows 2000 Professional. Boot disks operate in a **16-bit DOS mode** environment. You therefore cannot use *winnt32.e e* to install Windows 2000 Professional as *winnt32.e e* is **32-bit** application.

1.4 Performing an unattended installation.

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

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

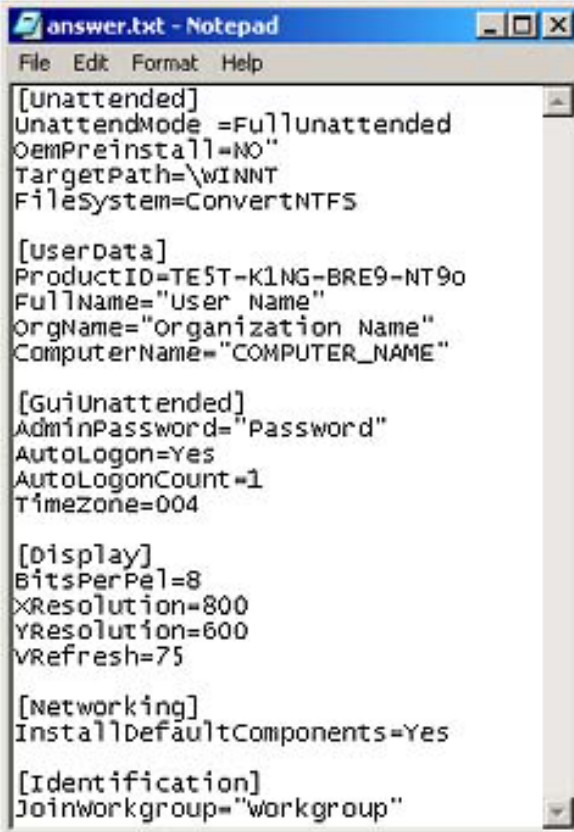
1.4.1 Using an unattended answer file.

The first mechanism you can use to perform an unattended installation of Windows 2000 Professional is to use an **answer file** (See FIG1.1). 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 Professional 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 **E** xtract on the menu that pops up.

You can use Setup Manager to create an answer file for an unattended installation, a sysprep install, and for a Remote Installation Services. You can also choose the 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.



```

answer.txt - Notepad
File Edit Format Help
[Unattended]
UnattendMode =FullUnattended
OemPreinstall=NO"
TargetPath=\WINNT
FileSystem=ConvertNTFS

[UserData]
ProductID=TEST-KING-BRE9-NT90
FullName="User Name"
OrgName="Organization Name"
ComputerName="COMPUTER_NAME"

[GuiUnattended]
AdminPassword="Password"
AutoLogon=Yes
AutoLogonCount=1
TimeZone=004

[Display]
BitsPerPel=8
XResolution=800
YResolution=600
VRefresh=75

[Networking]
InstallDefaultComponents=Yes

[Identification]
JoinWorkgroup="workgroup"

```

FIG1.1: An example of an answer file. (NOTE the ProductID in the UserData section and the VRefresh rate in the Display section)

Note: When creating a **Fully Automated** answer file, you must include all the information the Setup Wizard requires during the Installation this includes Product key, which must be specified in the **ProductID** variable in the **UserData** portion of the answer file. (See FIG1.1) If the ProductID is missing the installation is stopped during the graphical user interface stage and the following error message is displayed:

```

Unattended Setup is unable to continue because a Setup parameter
specified by your system administrator or computer manufacturer is
missing or invalid.

```

1.4.2 Using the System Preparation tool (disk imaging).

With disk imaging it is possible to install and configure Windows 2000 Professional 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 Professional 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 Professional 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.

Microsoft has created a **System Preparation tool** (*Sysprep.e e*) which solves some of the problems associated with disk imaging. You would use the Sysprep, after installing and configuring Windows 2000 Professional, 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 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 1.2.

TABLE 1.2: *System Preparation Tool Switches*

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

1.4.3 Using Remote Installation Services (RIS)

Remote Installation is the process of connecting to **Remote Installation Services** (RIS) server from a target computer and then performing an automated installation of Windows 2000 Professional on the target computer. This is the most effective method of deploying Windows 2000 Professional. Remote Installation allows administrators to install Windows 2000 Professional on client (target) computers throughout a network from a central location. It however requires that your network has a Windows 2000 server infrastructure in place and that the client computers support remote booting. A list of network services that the RIS server requires is listed in Tabe1.3.

TABLE 1.3: *Network services required by RIS*

Network Service	Reasons for RIS ReZuirement
DNS Service	Required for locating the Active Directory directory service and client computer accounts

DHCP Service	Required for supplying IP addresses to client computers
Active Directory directory services	Required for locating existing client computers and existing RIS servers

1.4.3.1 Setting up the RIS server

To set up a RIS server, you must install RIS on a NTFS partition that is at least 2GB size and that does not contain the operating system, i.e. the boot partition, and is not the system partition, i.e. the startup partition, by running the RIS Setup Wizard. And you must specify a Remote Installation Folder that cannot be on a Distributed File System (Dfs) shared folder or on an Encrypting File System (EFS) volume.

The RIS creates and uses CD-based images and disk images. The process of creating the disk image is similar to the process required when using the sysprep tool; first install and configure Windows 2000 Professional on a test computer, install and configure your applications, apply application update packs and then use the **Riprep utility** to create a **Riprep image**. Unlike the Sysprep tool, however, RIS creates its own disk images and does not require third party software. The Riprep utility automatically removes the test computer's SID from the image and creates an answer file based on the configuration of the operating system on the test computer.

1.4.3.2 Client requirements for Remote Installation

To deploy the image on the client computers, the client computers must be able to connect to the RIS server by booting from the network adapter card. To do this the client computer requires a **P-compliant network adapter**, which has a special chip that supports network booting. If the computer does not have a PXE-compliant network adapter card, you must use the *Rbfge.e* file to make network a boot disk for the computer. The network boot disk can then be used to simulate the PXE boot process.

In addition, the user account that will be used to perform the installation must be assigned the right to 'Logon as a batch job' and must be assigned permissions to create computer accounts in the domain that they will be joining.

1.4.4 Deploying Software applications

1.4.4.1 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 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

GROUP POLICY

Group Policy and Organizational Units are related to the Administration and management of a Windows 2000 network. They are covered in detail in the TestKing Study Guide 70-217: Implementing and Administering a Microsoft Windows 2000 Directory Services Infrastructure e am and in the TestKing Study Guide 70-218: Managing a Microsoft Windows 2000 Network Environment. For the 70-210 e am you are not reZuired to understand the intricacies of these tools. Therefore it will not be discussed in detail here.

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.

1.4.4.2 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.

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.

1.5 Upgrading to Windows 2000 Professional

You can upgrade all earlier Windows operating systems, with the exception of Windows 3.1, Windows for Workgroups 3.1 and Windows NT Workstation 3.5, directly to Windows 2000. **Windows 3.1** must first be upgraded to Windows 95 or Windows 98 and can then be upgraded to Windows 2000 Professional. **Windows for Workgroups 3.1** and **Windows NT Workstation 3.5** must first be upgrade to Windows NT Workstation 3.5.1 or Windows NT Workstation 4.0 and can then be upgraded to Windows 2000 Professional.

TABLE 1.4: Windows 2000 Professional Upgrade Paths

Operating System	Upgrade Path
Windows 3.1	First upgrade to Windows 95 or Windows 98 and then Windows 2000 Professional
Windows for Workgroups 3.1	First upgrade to Windows NT Workstation 3.5.1 or Windows NT Workstation 4.0 and then Windows 2000 Professional
Windows 95	Windows 2000 Professional
Windows 98	Windows 2000 Professional
Windows NT Workstation 3.5	First upgrade to Windows NT Workstation 3.5.1 or Windows NT Workstation 4.0 and then Windows 2000 Professional
Windows NT Workstation 3.5.1	Windows 2000 Professional
Windows NT Workstation 4.0	Windows 2000 Professional

You can use Windows 2000 to generate an **upgrade compatibility report** that can be used to check whether the devices and drivers on the existing operating system are compatible with Windows 2000. You can generate this compatibility report by running the *winnt32 /checkupgradeonly* command or the *Chkupgrd.e e* utility, which runs the Windows 2000 Readiness Analyzer but must be downloaded from Microsoft website. The */checkupgradeonly* switch of the *winnt32* command runs the first part of the Windows 2000 Setup program and checks only for compatible hardware and software. For a full list of *winnt32* switches, see Table 1.5 and for a full list of *winnt* switches see Table 1.6.

TABLE 1.5: WINNT32 switches

Switch	Description
<i>/checkupgradeonly</i>	Checks the computer for upgrade compatibility with Windows 2000
<i>/copydir:folder_name</i>	Creates a folder in the <i>systemroot</i> folder (which contains the Windows 2000 system files).
<i>/copysource:folder_name</i>	Creates a folder in the <i>systemroot</i> folder. Files created with <i>/copysource</i> are automatically deleted after the installation is completed.
<i>/cmd: command_line</i>	Specifies a command to be run before the final phase of Setup.
<i>/cmdcons</i>	Adds a Recovery Console option to the operating system selection screen.
<i>/debug[level] [:file_name]</i>	Creates a debug log at the specified level.
<i>/m:folder_name</i>	Specifies that Setup must copy replacement files from another location and to look for files in that location first.
<i>/makelocalsource</i>	Specifies that Setup must copy all installation files to the hard drive.

<code>/noreboot</code>	Prevents Setup from rebooting the computer following the file copy phase. This enables a command to be entered by the user prior to completing setup.
<code>/s:source_path</code>	Specifies the source location of Windows 2000 installation files.
<code>/syspart:drive_letter</code>	Copies Setup startup files to a hard disk and marks the drive as active. You can then install the drive on another computer. When you start that computer, Setup starts at the next phase. This requires use of the <code>/tempdrive</code> switch.
<code>/tempdrive:drive_letter</code>	Specifies a drive to contain temporary setup files and installs Windows 2000 on that drive.
<code>/unattend [number][:answer_file]</code>	Performs an unattended installation using an answer file that provides your custom specifications to the Setup program.
<code>/udf:id[,udf_file]</code>	Indicates an identifier (ID) that Setup uses to specify how a Uniqueness Database File (UDF) modifies an answer file.

Note: *winnt32.e e* is a **32-bit** application. It cannot be used in a DOS-based environment such as DOS mode. Boot disks operate in a **16-bit DOS mode** environment. You therefore cannot use *winnt32.e e* to install Windows 2000 Professional from a boot disk. You must use *winnt.e e*, which is the 16-bit equivalent of *winnt32.e e*, instead.

TABLE 1.6: WINNT switches

Switch	Description
<code>/a</code>	Enables accessibility options
<code>/e[:command]</code>	Specifies a command to be executed at the end of Setup's GUI mode.
<code>/r[:folder]</code>	Specifies an optional folder to be installed on the hard drive. Setup retains the folder.
<code>/r [:folder]</code>	Specifies an optional folder to be installed on the hard drive. Setup deletes the folder after installation
<code>/s[:sourcepath]</code>	Specifies the source location of Windows 2000 files.
<code>/t[:tempdrive]</code>	Specifies a drive to contain temporary setup files.
<code>/u[:answer file]</code>	Performs an unattended installation using an answer file that provides your custom specifications to the Setup program. This requires the <code>/s</code> switch.
<code>/udf:id[,UDF_file]</code>	Indicates an identifier (ID) that Setup uses to specify how a Uniqueness Database File (UDF) modifies an answer file.

1.6 Deploying Service Packs

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

You can also apply a service pack to computers that are already running Windows 2000 by running the *update.e* file. This replaces the existing Windows 2000 files with the appropriate files from the service pack.

1.7 The Windows 2000 Professional Boot Process

1.7.1 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 1.7

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

TABLE 1.7 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.e e	<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

Note: The string *%systemroot%* represents the folder in the boot partition that contains the Windows 2000 system files.

1.7.1.1 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.

1.7.1.2 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 appears, allowing you to select the operating system that should be loaded within a specified time before loading 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. This is usually C:\Winnt.
- **Hardware Detection** On Intel-based computers, Ntdetect.com and Ntoskrnl.exe perform hardware detection. Ntdetect.com executes if Windows 2000 should be loaded. 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 hardware 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.

1.7.1.3 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 0 0 for the Start entry. These are typically low-level hardware device drivers, such as those for a hard disk.

1.7.1.4 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.

1.7.1.5 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**.

1.8 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 Professional. **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.

1.8.1 Components of the Boot.ini File

The *Boot.ini* file includes two sections, **[Boot Loader]** and **[Operating Systems]** (See FIG1.2). 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.

1.8.2 ARC Paths

During installation, Windows 2000 generates the

```

[Boot Loader]
timeout=30
default=multi(0)disk(0)rdisk(1)partition(2)\ WINNT

[Operating Systems]
multi(0)disk(0)rdisk(1)partition(2)\
WINNT="Microsoft windows 2000
Professional" /fastdetect

multi(0)disk(0)rdisk(1)partition(1)\ WINNT="windows
NT workstation
Version 4.00"

multi(0)disk(0)rdisk(1)partition(1)\ WINNT="windows
NT Server
workstation 4.00 [VGA mode]" /basevideo /sos

C:\ = "previous operating system on c:"

```

FIG1.2: A typical *Boot.ini* file. (NOTE the ARC path)