

Windows 2000 Server

Chapter 15 - Startup Process

Understanding each step in the startup process is important for troubleshooting problems that can occur while starting up or that can prevent the computer from starting at all. Microsoft® Windows® 2000 also provides tools that you can use to identify and repair startup problems when they occur.

In This Chapter

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Starting Windows 2000
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Related Information in the Resource Kit

- For more information about recovery, see "Repair, Recovery, and Restore" in this book.
- For more information about using the registry to troubleshoot problems, see the Technical Reference to the Windows 2000 Registry (Regentry.chm) on the *Microsoft® Windows® 2000 Resource Kit* companion CD.

Windows 2000 Startup Requirements

The data contained in the system files is required to start the Windows 2000 operating system. During the startup process, various screens and messages are displayed on your screen.

The Windows 2000 startup process requires the following steps:

1. Power-on self test (POST) processing
2. Initial startup process
3. Bootstrap loader process
4. Selecting the operating system
5. Detecting hardware
6. Selecting a configuration
7. Loading and initializing the kernel (Ntoskrnl.exe)
8. Logging on

You can begin startup by one of the following methods:

- Turn on the computer.
- In the **Shut Down Windows** dialog box, select **Restart**.

Important Windows 2000 might not start or operate correctly if any hardware components do not initialize correctly. Startup fails if any of the files that are required to start Windows 2000 are not present in the correct folder, or if any of the files has been corrupted.

When you see **Press Ctrl+Alt+Delete to begin** in the **Welcome to Windows** dialog box, the loading and much of the initialization of Windows 2000 is complete. However, startup is complete only when you can successfully log on using the **Welcome to Windows** dialog box.

Starting Windows 2000

Table 15.1 describes specific files that are required to start Windows 2000.

Table 15.1 Files Required to Start Windows 2000

File	Location
NTLDR	Active Partition
Boot.ini	Active Partition
Bootsect.dos (required only for multiple booting)	Active Partition
Ntdetect.com	Active Partition
Ntbootdd.sys (Required only if you are using a SCSI-controlled boot partition, and the SCSI adapter does not have a SCSI BIOS enabled).	Active Partition
Ntoskrnl.exe	%SystemRoot%\System32
Hal.dll	%SystemRoot%\System32

SYSTEM key	%SystemRoot%\System32\Config
Device drivers	%SystemRoot%\System32\Drivers

Note The string %SystemRoot% is replaced by the directory in the boot partition that contains the Windows 2000 system files.

Power-On Self Test Process

When you turn on or restart a computer, it begins a POST routine. The POST routine determines the available amount of real memory and verifies the presence of required hardware components, such as the keyboard.

After the computer runs its POST routine, each adapter card with a basic input/output system (BIOS) runs its own POST routine. The computer and adapter card manufacturers determine what appears on the screen during POST processing.

Initial Startup Process

After the successful execution of the POST, the system BIOS then checks the first hard disk that is powered up.

When the hard disk is the startup disk, the system BIOS reads the master boot record (MBR) and loads it into memory. The system BIOS then transfers the execution of the startup process to the MBR. After the MBR loads a copy of the active partition's boot sector into memory, the boot sector code starts the operating system as defined by the operating system.

Bootstrap Loader Process

NTLDR is the bootstrap loader for the Windows 2000 operating system, and is responsible for the following operations:

- Enabling the user to select an operating system to start.
- Loading the operating system files from the boot partition.
- Controlling the operating system selection process and hardware detection prior to the Windows 2000 kernel initialization.

Before you can start the operating system, NTLDR and the following files must be in the active partition of your startup disk:

- Ntdetect.com
- Boot.ini
- Bootsect.dos (if you plan to boot more than one operating system on your computer)

Signature() Syntax

The signature() syntax is equivalent to the SCSI() syntax, but is used instead to support the Plug and Play architecture in Windows 2000. The SCSI controller number might vary each time you start Windows 2000, especially if you add new SCSI controller hardware after Setup is finished. Using the signature() syntax instructs NTLDR to locate the drive whose disk signature matches the value in the parentheses, no matter which SCSI controller number the drive is connected to. The following is an example of a Boot.ini file with a signature() entry:

```
signature(8b467c12)disk(1)rdisk(0)partition(2)\winnt="description"
```

Note If multiple preexisting Boot.ini entries use scsi() they are maintained and not converted to signature() syntax.

Advanced RISC Computing (ARC) path entries in the Boot.ini file start with "signature()" syntax in the following situations:

- The partition on which you installed Windows 2000 is larger than 7.8 gigabytes (GB) in size, or the ending cylinder number is higher than 1024 for that partition.
- The drive on which you installed Windows 2000 is connected to a SCSI controller whose BIOS is disabled, so INT13 BIOS calls cannot be used during the startup process.

Because the signature() syntax replaces the scsi() syntax, the same requirement applies in that a file named Ntbootdd.sys is required in the root folder of the system partition to address the SCSI controller at startup. This file is the specific SCSI miniport device driver for the SCSI adapter from which you are booting, renamed to Ntbootdd.sys, and placed in the root folder of the system drive.

Note If multiple pre-existing Boot.ini entries use scsi() syntax, they are maintained and not converted to signature() syntax.

For more information about signature() syntax, see the Microsoft Knowledge Base link on the Web Resources page at <http://windows.microsoft.com/windows2000/reskit/webresources>.

NTLDR

When NTLDR runs, it clears the screen and displays the bootstrap loader message:

```
OS Loader V5.0
```

NTLDR then performs the following steps:

- Switches the processor into the 32-bit flat memory mode. When a computer first starts, it runs in real mode, like an 8088 or 8086 CPU. Because NTLDR is mostly a 32-bit program, it must switch the processor to 32-bit flat memory mode before it can perform any other functions.
- Starts the appropriate minifile system. The code to access files on file allocation table (FAT) file system and NTFS file system volumes is built into NTLDR. This code enables NTLDR to read, access, and copy files.
- Reads the Boot.ini file, and displays the operating system selections. This screen is referred to as the bootstrap loader screen.
- Allows you to select an operating system from the bootstrap loader screen.

If you select an operating system other than Windows 2000, NTLDR loads Bootsect.dos and passes control to it. The operating system then starts up as normal, because Bootsect.dos contains the boot sector that was on the primary partition before you installed Windows 2000.

If you select Windows 2000, NTLDR runs Nttdetect.com to gather information about currently installed hardware.

- Allows you to choose between starting the computer in the configuration in use when Windows 2000 was last shut down (Default), or selecting troubleshooting and advanced startup options by pressing F8. For more information on safe mode, see "Safe Mode" later in this chapter.
- Loads and starts Ntoskrnl.exe. NTLDR passes the hardware information collected by Nttdetect.com to Ntoskrnl.exe.

Selecting the Operating System

NTLDR displays the bootstrap loader screen, where you can select an operating system to start. This screen is based upon the information in the Boot.ini file. The screen display is similar to the following:

```
Please select the operating system to start:
```

```
Windows 2000 Advanced Server
```

```
Use [↑] and [↓] to move the highlight to your choice.
Press ENTER to choose.
```

```
Seconds until highlighted choice will be started automatically: 29
```

```
For troubleshooting and advanced startup options for Windows 2000, press F8.
```

If you do not select an entry before the counter reaches zero, NTLDR loads the operating system specified by the default parameter in the Boot.ini file. Windows 2000 Setup sets the default entry to the most recently installed copy of Microsoft® Windows NT® version 4.0 or earlier. You can edit the Boot.ini file if you want to change the default to either an earlier version of Windows 2000 or to another operating system.

Windows 2000 Setup places the Boot.ini file in the active partition. NTLDR uses information in the Boot.ini file to display the bootstrap loader screen from which you select the operating system.

The following is an example of a Boot.ini file:

```
[boot loader]
timeout=30
default=multi(0)disk(0)rdisk(0)partition(1)\WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\WINNT="Windows 2000 Server" /fastdetect
```

The Boot.ini file has two sections, [boot loader] and [operating systems]. You can use the parameters in the [boot loader] section to customize startup, as described in Table 15.2.

Table 15.2 Bootstrap Loader Parameters

Parameter	Description
Time-out	The time that the user has to select an operating system from the bootstrap loader screen

	<p>before NTLDR loads the default operating system.</p> <p>If the time-out value is 0, NTLDR immediately starts the default operating system without displaying the bootstrap loader screen.</p> <p>If you set this value to -1, NTLDR waits indefinitely for you to make a selection. You must edit the Boot.ini file directly because -1 is an illegal value for the System option in Control Panel.</p>
Default	The ARC pathname to the default operating system.

Each entry in the [operating systems] section includes the ARC pathname to the boot partition for the operating system, the string to display on the bootstrap loader screen, and optional parameters. The bootstrap loader screen presented earlier in this chapter is an example of the use of this section of the Boot.ini file.

You can use the Boot.ini file to start multiple versions of the Windows 2000 operating system, as well as one other operating system, including Microsoft® MS-DOS®, Microsoft® Windows® 95, and Microsoft® Windows® 98.

Boot.ini Switches

The switches listed in Table 15.3, which can be added to the end of the [operating system] section of the Boot.ini file, are not case sensitive. For more information about the **/MAXMEM** and **/SOS** switches, see "Problem Occurs After the Bootstrap Loader Starts" later in this chapter. The switch you want to add must be placed on a separate line of the Boot.ini file.

Table 15.3 Boot.ini Switches

Switch	Description
/BASEVIDEO	The computer starts up using the standard VGA video driver. If you have installed a new video driver and it is not working correctly, you can select the Windows 2000 entry with this switch to start the computer and change to a different driver.
/BAUDRATE=nnnn	Specifies the baud rate to be used for debugging. The default baud rate is 9600 if a modem is attached, and 19200 for a null-modem cable. Including this switch in the Boot.ini file causes the /DEBUG switch to activate.
/CRASHDEBUG	The debugger is loaded when you start Windows 2000, but remains inactive unless a kernel error occurs. This switch is useful if you are experiencing random kernel errors.
/DEBUG	The debugger is loaded when you start Windows NT, and can be activated at any time by a host debugger connected to the computer. Use this switch when you are debugging problems that are regularly reproducible.
/DEBUGPORT= comx	Specifies the communications port to use for debugging, where x is the communications port that you want to use. Including this switch in the Boot.ini file causes the /DEBUG switch to activate.
/MAXMEM:n	Specifies the maximum amount of RAM that Windows 2000 can use. Use this switch if you suspect that a memory chip is bad.
/NODEBUG	No debugging information is being used.
NUMPROC=x	Allows you to force a multiprocessor computer to start up with < n processors.
/FASTDETECT =[COMx COMx,y,z...]	Turns off serial and bus mouse detection in NTDETECT. Use this switch if you have a component other than a mouse attached to a serial port during the startup process. If you use /FASTDETECT without specifying a communications port, serial mouse detection is disabled on all communications ports.
/SOS	Displays the device driver names as they are being loaded. Use this switch when startup fails (while loading drivers), to determine which driver is triggering the failure.
/PAE	Specify the /PAE switch with the corresponding entry in Boot.ini to allow a computer that supports physical address extension (PAE) mode to start normally. In safe mode, the computer starts using normal kernels even if the /PAE switch is specified.

Editing Boot.ini

When you install Windows 2000, the read-only, system, and hidden attributes of the Boot.ini file are set.

Regardless of the value of these attributes, you can edit the timeout and default parameters in the Boot.ini file using the **System** option in Control Panel.

To edit the Boot.ini file with a text editor, you need to make the file visible and turn off the read-only attribute. You can change file attributes using My Computer or at the command prompt.

To change file attributes using My Computer

1. On the **Tools** menu, click **Folder Options**.
2. On the **View** tab, double-click **Hidden files and folders**.
3. Select either **Do not show hidden files and folders** or **Show hidden files and folders**.
4. Click **OK**.

Important If you change the path to the Windows 2000 boot partition, make sure to edit both the default path and operating system path entries. If you change one but not the other, a new choice is designated as the default selection and added to the bootstrap loader screen.

Detecting Hardware

Ntdetect.com detects installed hardware during the Windows 2000 startup sequence. Ntdetect.com passes this information to NTLDR and places a list in the registry. Ntdetect.com detects the following components:

- Computer ID
- Bus/adaptor type
- SCSI adapters
- Video adapters
- Keyboard
- Communication ports
- Parallel ports
- Floppy disks
- Mouse/pointing device
- Floating-point coprocessor

Ntdetect.com runs after you select an operating system on the bootstrap loader screen (or the timer times out). NTLDR has started when you see the message:

```
Starting Windows . . .
```

followed by a bar graph. When the bar graph becomes solid, the text mode switches to the graphical mode, and the Microsoft® Windows® 2000 Server Family screen is displayed.

Loading and Initializing the Kernel

After you choose a hardware profile or configuration, or when NTLDR automatically makes the selection for you, the kernel load phase of the Windows 2000 startup process begins. During this process, NTLDR performs the following operations:

- Loads the Windows 2000 kernel (Ntoskrnl.exe) and the hardware abstraction layer (Hal.dll) into memory (NTLDR does not initialize these programs yet).
- Loads the registry key HKEY_LOCAL_MACHINE \SYSTEM from %SystemRoot%\System32\Config\System.
- Selects a Configuration. The first hardware profile is highlighted by default. If you have created other hardware profiles, use the DOWN ARROW key to select the one that you want to use.
- Selects the control set that it uses to initialize the computer.
- Loads device drivers that have a Start value of 0x0.

Important Do not change the values in the folder %SystemRoot%\System32\Config\System.

For more information about hardware profiles, use see Windows 2000 Server Help.

Selecting the Control Set

The values of the entries in the HKEY_LOCAL_MACHINE \SYSTEM \Select subkey determine which control set to use.

If you did not press F8 when the OS Loader V5.0 screen was displayed, or if you have only one hardware

profile, NTLDR uses the control set identified by the value of the Default entry in the subkey HKEY_LOCAL_MACHINE \SYSTEM \Select. However, if you chose **Last Known Good Configuration** from the **Windows 2000 Advanced Options** menu that is displayed when you pressed F8 and you selected **Last Known Good Configuration** from the **Hardware Profile/Configuration Recovery** menu, the value of the LastKnownGood entry in the subkey HKEY_LOCAL_MACHINE \SYSTEM \Select specifies the control set.

Based on your actions and the value of the corresponding Select subkey entry, NTLDR determines which ControlSet00x to use. NTLDR sets the Current value of the subkey HKEY_LOCAL_MACHINE \SYSTEM \Select to the number of the control set it will use.

Note The two registry editors, Regedt32.exe and Regedit.exe, are included on the Windows 2000 Setup CD. You can use either one to view the registry. For more information about the registry, see the Technical Reference to the Registry on the *Windows 2000 Resource Kit* companion CD.

Loading Device Drivers

NTLDR scans the registry subkey HKEY_LOCAL_MACHINE \SYSTEM \CurrentControlSet \Services for device drivers with a Start value of 0x0. This value indicates that the device drivers should be loaded but not initialized. Device drivers are loaded into memory by using BIOS calls in real mode or by Ntbootdd.sys.

Next, Ntoskrnl.exe initializes the kernel. If the Boot.ini ARC path entry contains the /SOS switch, text similar to the following is displayed:

```
Microsoft (R) Windows 2000 (TM) Version 5.0 (Build xxxx)
1 System Processor (16 MB Memory)
```

Upon successful initialization, Ntoskrnl.exe:

- Creates the Clone control set by making a copy of the control set pointed to by the value of Current.
- Creates the HKEY_LOCAL_MACHINE \HARDWARE key using the information that was passed from NTLDR. This key contains the hardware data that is detected and computed at each system startup. The data includes information about hardware components on the system board and about the interrupts hooked by specific hardware devices.

Initializing Device Drivers

Ntoskrnl.exe initializes the low-level device drivers with a start value of 0x0, which were loaded during the Kernel load phase. Ntoskrnl.exe then scans the subkey HKEY_LOCAL_MACHINE \SYSTEM \CurrentControlSet \Services for device drivers with a Start value of 0x1, which are initialized as soon as they are loaded. They are not loaded by BIOS, but by the device drivers loaded during the kernel load phase and that have already been initialized.

Error Processing

If an error occurs during the loading and initializing of a device driver, the action taken is based on the value of the **ErrorControl** entry in the registry subkey HKEY_LOCAL_MACHINE \SYSTEM \CurrentControlSet \Services for the device driver that has a problem.

Logging On to Windows 2000

The Windows 2000 subsystem automatically starts Winlogon.exe, which starts the Local Security Administration, Lsass.exe. The **Welcome to Windows** dialog box appears, containing the text **Press Ctrl+Alt+Delete to begin**. Although Windows 2000 might still be initializing network device drivers, you can log on.

Next, the Service Controller (Screg.exe) checks the subkey HKEY_LOCAL_MACHINE \SYSTEM \CurrentControlSet \Services for services with a Start value of 0x2, which are loaded automatically.

Services are loaded in parallel, based on their dependencies. The dependencies are described in the **DependOnGroup** and **DependOnService** entries in the subkey HKEY_LOCAL_MACHINE \SYSTEM \CurrentControlSet \Services.

Note Windows 2000 startup is not considered complete until a user successfully logs on to the system. After a successful logon, the Clone control set is copied to the LastKnownGood control set.

Troubleshooting Startup Problems

If your computer fails to complete startup, it might stop, or it might display an error message. This section discusses ways to troubleshoot problems that can prevent Windows 2000 from starting.

The first step in figuring out what causes a startup problem is to determine if the problem occurs before or after the operating system takes control. If you do not see the bootstrap loader screen, the problem might be due to hardware failure. Possible causes also include a faulty MBR or partition table, or a damaged boot sector.

Damage can have several causes, including viruses. Viruses use BIOS calls to install themselves, so they are

operating-system independent. Windows 2000 traps BIOS calls while it is running, but cannot protect itself when the computer is multiple-booted by using MS-DOS. For more information about protecting your computer from viruses and recovering from problems with viruses, see the Microsoft Knowledge Base link on the Web Resources page at <http://windows.microsoft.com/windows2000/reskit/webresources>.

If the problem occurs after selecting Windows 2000 from the bootstrap loader screen, files that are needed by the operating system might be missing or corrupt. For more information, see "Options to Use When a System Does Not Start" later in this chapter.

Problem Occurs Before the Bootstrap Loader Starts

This section describes the problems that might occur between the time you turn the computer on until you see the bootstrap loader screen. Symptoms of problems in this group include the following:

- The computer hangs immediately after the power-on self test (POST).
- You do not see the bootstrap loader screen.
- You receive messages such as:
 - Missing operating system.
 - A disk read error occurred.
 - Insert a system diskette and restart the system.
 - Invalid partition table.
 - Hard disk error.
 - Hard disk absent/failed.

Table 15.4 lists symptoms, possible trouble causes and sources of more detailed information.

Table 15.4 Startup Problems

If You See Messages About or Suspect a Problem with . . .	Possible Problem	Source for More Information
POST routine	The POST routine is inaccessible.	"Hardware Problems" later in this chapter.
System partition	There is no system partition on the first hard disk.	"Disks Concepts and Troubleshooting" in this book.
Master boot record	The MBR is corrupt.	"Disks Concepts and Troubleshooting" in this book.
Partition table	The partition table is invalid.	"Disks Concepts and Troubleshooting" in this book.
Multiple-booting between Windows 2000 and MS-DOS	Bootsect.dos must be restored.	Windows 2000 Server Help.
Boot.ini	The Boot.ini file is missing.	"Problem Occurs after the Bootstrap Loader Starts" later in this chapter.
Bootstrap loader screen	NTLDR, is missing or corrupt.	"Problem Occurs after the Bootstrap Loader Starts" later in this chapter.
CMOS	The CMOS is corrupt, or the CMOS battery is run down.	"Disks Concepts and Troubleshooting" in this book.
Hardware	If you have installed new hardware or new drivers, they could be causing the problem, or a hardware component has malfunctioned.	"Hardware Problems" later in this chapter.

You might not be able to start your computer to troubleshoot the problem. If all of your volumes are formatted by using NTFS, you cannot use MS-DOS-based utilities.

Problem Occurs After the Bootstrap Loader Starts

This section describes problems that might occur after NTLDR starts executing until you successfully log on to Windows 2000.

Using Checked Version of NTDETECT

NTDETECT detects installed hardware components.

There is a debug version of Ntdetect.com on the *Windows 2000 Resource Kit* companion CD, called Ntdetect.chk. If Ntdetect.com fails to detect all of the hardware that you think it should find, you can use Ntdetect.chk to help isolate the problem. Typically, a mouse or a disk controller is the cause of the problem.

To use the debug version of Ntdetect:

1. Rename Ntdetect.com to Ntdetect.bak in the root folder of your system partition.
2. Copy Ntdetect.chk from Support\Debug\I386 to the root folder.
3. Rename Ntdetect.chk to Ntdetect.com.

The utility InstallD, included on the *Windows 2000 Resource Kit* companion CD, performs the same functions.

Ntdetect.com has the hidden, system, and read-only attributes set when you install Windows 2000. Clear these attributes to make the file visible.

After Ntdetect.chk displays information about the components, press ENTER to continue. Ntdetect.chk next displays information about the current nodes for the controllers and peripherals. Press ENTER at the end of each screen.

When you have finished using Ntdetect.chk, rename Ntdetect.com to Ntdetect.chk and rename Ntdetect.bak to Ntdetect.com.

Using the /MAXMEM Switch

The Boot.ini file has a **/MAXMEM** switch which you can use specify the maximum amount of RAM that Windows 2000 can use. You can use this switch to troubleshoot memory parity errors, mismatched SIMM speeds, and other memory-related problems. To use this switch, the memory must be contiguous. Never specify a value less than 32 for Windows 2000 Professional.

Include this switch at the end of the ARC path specified in the [operating systems] section of the Boot.ini file. In the following example Windows 2000 Professional is restricted to using only the first 32 MB RAM.

```
[operating systems]
multi(0)disk(0)rdisk(0)partition(1)\winnt="Windows 2000 Professional"
/fastdetect /MAXMEM=32
```

Note For Windows 2000 Server, use a minimum of 64 MB.

For more information about troubleshooting memory problems, see "Troubleshooting Strategies" in this book.

Using the /SOS Switch

You can add the **/SOS** switch to the Boot.ini file to have NTLDR display the kernel and device driver names while they are being loaded. Use this switch if Windows 2000 does not start up and you think a driver is missing or corrupted. For information about changing Boot.ini switches, see "Boot.ini Switches" earlier in this chapter.

Hardware Problems

If a device fails to initialize during the POST routine, you might not be able to gain access to it. If you have not changed or added devices since the last startup, check for the following:

- Controller cards are seated properly.
- Cables are properly connected.
- Disks are turned on.

If you have changed hardware or device drivers since the last startup, the problem might be with the new configuration. You should check that:

- SCSI devices are terminated properly.
- There are no IRQ conflicts.
- The BIOS is enabled on only the first SCSI controller (if at all).

During the startup process, the **Hardware Profile/Configuration Recovery** menu provides options for using alternative configurations. If you have checked the above items and Windows 2000 does not complete startup, try using one of the other configuration options listed in the **Hardware Profile/Configuration Recovery** menu.

For more information about hardware problems, see "Troubleshooting Strategies" in this book, or see the

Microsoft Knowledge Base link on the Web Resources page at <http://windows.microsoft.com/windows2000/reskit/webresources>.

Note On NTFS volumes, you need to use Windows 2000-based utilities, such as DiskProbe, to examine information on the volume. DiskProbe is a low-level disk editor that you can use to examine and change individual disk sectors.

If you use the Windows 2000 Setup floppy disks, try using the following utilities:

- The Computer Management snap-in in Administrative Tools where you can view system information.
- The DiskProbe tool, a low-level disk editor that you can use to examine and change individual disk sectors.

Options to Use When a System Does Not Start

Windows 2000 provides a variety of options that you can use when a computer does not start, including safe mode, the Recovery Console, and the Emergency Repair Disk (ERD). You can use safe mode to start the computer with only minimal necessary services. Safe mode options, including Last Known Good Configuration, are especially useful if a newly-installed driver is causing the problems.

If safe mode does not start the computer, you can use the Recovery Console. Using the Recovery Console is recommended only for advanced users or administrators. You can access the Recovery Console to start the system by using the Windows 2000 Setup CD or the Setup floppy disks that you created from the CD. The Recovery Console is a command-line interface that allows you to perform tasks such as starting and stopping services and accessing the local drive.

The ERD provides another option if safe mode and the Recovery Console do not start the system. If you have already created an ERD, you can start the system with the Windows 2000 Setup CD or the Setup floppy disks, and then use the ERD to restore core system files.

Safe Mode

Safe mode is a diagnostic tool for troubleshooting problems that can occur with starting and running Windows 2000. It is only accessible when the computer is started. As part of the **Windows 2000 Advanced Options** menu, safe mode allows the user to specifically control how the computer starts Windows 2000.

If the computer fails to startup properly, on the next restart, Windows 2000 displays the **Windows 2000 Advanced Options** menu, containing several startup troubleshooting options. You can also manually prompt Windows 2000 to display the **Windows 2000 Advanced Options** menu.

When starting Windows 2000 in safe mode, only essential drivers and system services are loaded, including the mouse, keyboard, CD-ROM and standard VGA device drivers, and the Event Log, Plug and Play, Remote Procedure Call (RPC), and the Logical Disk Manager system services. This makes safe mode useful for isolating and resolving error conditions that are caused by faulty applications, system services, and device drivers that are started automatically.

Although a computer started in safe mode has only a minimum of necessary services, you can access all partitions on functioning physical disks. Use safe mode for system startup in situations such as the following:

- If Windows 2000 seems to stall for an extended period of time.
- If Windows 2000 does not work correctly or has unexpected results.
- If your video display does not work correctly.
- If your computer suddenly slows down.
- If you need to test an intermittent error condition.

Once in safe mode, you can disable or delete a system service, a device driver, or automatically started application that is preventing the computer from starting normally.

To use a safe mode option, restart your computer, and then press F8 when you see the **Boot** menu. The **Windows 2000 Advanced Options** menu appears:

```
Windows 2000 Advanced Options Menu
```

```
Please select an option:
```

```
Safe Mode
```

```
Safe Mode with Networking
```

```
Safe Mode With Command Prompt
```

```
Enable Boot Logging
```

```
Enable VGA Mode
```

```
Last Known Good Configuration
```

```
Directory Services Restore Mode (Windows 2000 domain controllers only)
```

```
Debugging Mode
```

```
Boot Normally
```

Use [vπ] and [δoovπ] to move the highlight to your choice.
Press Enter to choose.

Select an option, and then press ENTER. The **Boot** menu is displayed again, with the words "Safe Mode" displayed in red at the bottom. Select the operating system installation that you want to start, and then press ENTER.

Important When you select the operating system installation to start, you must choose a version of Windows 2000. Do not choose another Windows-based operating system.

When you use one of the safe mode options the environment variable Safeboot_Option is set to either Network or Minimal.

The default Microsoft VGA driver is used for display (640 x 480 x 16 colors). You must log on in all modes (either by a domain or the local SAM, depending on which safe mode option you choose).

Table 15.5 describes the **Windows 2000 Advanced Options** menu.

Table 15.5 Windows 2000 Advanced Options Menu

Option	Description
Safe Mode (Safeboot_Option=Minimal)	Starts Windows 2000 using basic files and drivers only, without networking. The drivers and files used are for mouse, monitor, keyboard, mass storage, base video, and default system services.
Safe Mode with Networking (Safeboot_Option=Network)	Similar to standard safe mode, but also adds essential services and drivers needed to start networking.
Safe Mode with Command Prompt (Safeboot_Option=Minimal)	Similar to standard safe mode but loads the command interpreter instead of Explorer.exe as the user shell.
Enable Boot Logging	Creates a log file, Ntbtlog.txt, during startup where the names and status of all drivers loaded into memory are recorded. The log file is stored in the %SystemRoot% folder.
Enable VGA Mode	Starts the computer in basic VGA mode in cases of corruption or incompatibility of currently installed video driver. The basic video driver is always used when you start Windows 2000 in any kind of safe mode.
Last Known Good Configuration	Starts Windows 2000 using the settings (registry information) that Windows saved at the last shutdown. Use Last Known Good Configuration only in cases of incorrect configuration. It does not solve problems caused by corrupted or missing drivers or files. All system setting changes made after the last successful startup are lost.
Directory Service Restore Mode	Allows restores of Active Directory on a domain controller. This option is not available on computers that are running Windows 2000 Professional or on member servers.
Debugging Mode	Starts Windows 2000 in kernel debug mode, which allows a debugger to access the kernel for troubleshooting and system analysis.
Boot Normally	Starts Windows 2000, loading all normal startup files and registry values.

If you are using, or have used, Remote Install Services to install Windows 2000 on your computer, the advanced startup options might include options related to restoring or recovering your system using Remote Install Services, in addition to the options described above.

If you plan to start the computer in safe mode and then use Backup with Removable Storage, the only safe mode options you can use are **Enable VGA Mode**, **Last Known Good Configuration**, and **Directory Services Restore Mode**.

When the computer is started with any of the safe mode options except **Last Known Good Configuration**, a boot log of devices and services that are loading is created. The log is saved to the file Ntbtlog.txt in the folder in which Windows 2000 is installed (typically \Winnt).

If the problem was caused by a newly-installed driver, you might be able to start the computer using the **Last Known Good Configuration** option so you can research the problem with the driver. If there were other causes, after starting the computer in safe mode, you can use Event Viewer, System Information, Control Panel, Backup, and other tools to try to diagnose and correct the problem.

Recovery Console

The Recovery Console is a command-line console designed to help you recover when your Windows 2000-based computer does not start. You can use the Recovery Console after starting the computer with the Windows 2000 Setup CD or the Setup floppy disks. You can use the Recovery Console to obtain limited access to NTFS, FAT, and FAT32 volumes without starting the graphical interface.

To use the Recover Console, you must be logged on as an administrator.

Caution The Recovery Console is powerful. It is recommended that you use Recovery Console only if you are an advanced user or administrator who can use basic commands to identify and locate problem drivers and files.

Each time you use Backup to back up the system state data, a copy of the registry is placed on the local system partition in a subfolder of %SystemRoot%\Repair\RegBack. You can use the Recovery Console to copy files from %SystemRoot%\Repair\RegBack to %SystemRoot%\System32\Config (the location of the registry). After you do this, the registry contains the information it had when the system state was last backed up. Changes made after that time are lost.

Caution Do not use a registry editor to edit the registry directly unless you have no alternative. The registry editors bypass the standard safeguards provided by administrative tools. These safeguards prevent you from entering conflicting settings or settings that are likely to degrade performance or damage your system. Editing the registry directly can have serious, unexpected consequences that can prevent the system from starting and require that you reinstall Windows 2000. To configure or customize Windows 2000, use the programs in Control Panel or Microsoft Management Console (MMC) whenever possible.

For more information about the Recovery Console, including a list and description of available commands, see "Repair, Recovery, and Restore" in this book.

Emergency Repair Disk

If your system does not start, and neither safe mode nor the Recovery Console has helped, you can try using the Emergency Repair Disk option in Backup. If you have prepared an ERD beforehand, you can use it to repair system files (after you start the system using the Windows 2000 Setup CD or Setup floppy disks).

The ERD can make only basic system repairs, such as to the system files, the boot sector, and the startup environment. The ERD does not back up data or programs, and it is not a replacement for regular system backups.

For more information about the ERD, see "Repair, Recovery, and Restore" in this book.

If you cannot fix the problem by using one of the options described above, try removing the disk from the computer and installing it as a second disk on another computer that is running Windows 2000. You can then use Windows 2000-based utilities for troubleshooting. For more information about using disk troubleshooting utilities, see the Windows 2000 Resource Kit Tools Help.

Caution Moving disks between computers is not recommended because problems can arise if the disk controllers on the two systems are incompatible or are configured differently. However, if the two computers have the same configuration, you might be able to identify and correct the problem.

Additional Resources

- For more information about troubleshooting startup problems, see the Microsoft Knowledge Base link on the Web Resources page at <http://windows.microsoft.com/windows2000/reskit/webresources>.

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