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Version 3.0.0

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## Abstract:

This study guide will help you to prepare for the CompTIA Exam 220-201, A+ OS Technologies Exam. Exam topics include OS Common Components and Features, Command Prompt Commands, Installing, Configuring, Upgrading and Troubleshooting Windows 9x and 2000, Knowledge of Windows NT, and Basic Networking.

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## Contents:

What is an OS?.....	7
Functions .....	7
Components .....	7
Command Prompt (DOS).....	8
DOS System Files.....	8
Memory Management .....	8
Architecture.....	9
Command Prompt Utilities .....	10
Command Prompt Commands and Syntax.....	11
Commands to Check Drives .....	12
Partitioning Drives .....	13
Windows 3.x .....	13
Windows 9x .....	14
Installing Windows 9x.....	14
Windows 95 Hardware Requirements/Recommendations .....	14
Windows 98 Hardware Requirements/Recommendations .....	15
Installation Process.....	15
Failed Install.....	16
Emergency Startup Disk .....	16
Upgrading to Windows 9x .....	17
Boot Sequence of Windows 9x.....	18
Startup Menu .....	18
Windows 9x Registry .....	19
Navigation.....	21



**A+ Operating System Technologies**

Windows File Management .....23

Windows Keyboard Shortcuts to know .....24

Backups .....24

Configuring Windows 9x .....24

    Drivers.....24

    Printers.....25

    Memory Management.....25

Windows 9x Utilities.....26

    Start -> Programs -> Accessories -> System Tools -> .....26

Troubleshooting Windows 9x.....29

    Troubleshooting procedures .....29

    Common Errors and Problems .....30

    Invalid Page Faults .....32

    Common Problems.....32

    Troubleshooting Printer Connections and Configurations.....33

Windows NT 4.0.....33

    History of NT .....34

    Versions.....34

    Features .....35

        NT Server.....35

        NT Workstation .....36

Installing Windows NT.....36

    Hardware Requirements and Recommendations .....36

    Installation Process.....37

    Windows NT Boot Files .....38

    Upgrading to Windows NT 4.0 .....39



**A+ Operating System Technologies**

User and Group Accounts in NT .....39

Troubleshooting Windows NT4.....42

    Event Viewer .....42

    NT Boot Problems .....44

    Troubleshooting Printers .....45

Windows 2000 .....46

    Versions.....46

    Features .....46

    Installing Windows 2000 .....47

    Windows 2000 Hardware Requirements/Recommendations .....47

        Windows 2000 Partitions .....48

        Domain or Workgroup Selection.....49

        Installation Process .....50

        Upgrading to Windows 2000.....52

    Boot Sequence of Windows 2000 .....52

        Advanced Options Menu .....53

        Windows 2000 Required Boot Files .....53

    Administering Windows 2000 .....53

    Disk Management and Resources.....54

        Volume Sets .....54

    User and Group Management .....54

        User Accounts .....54

        Groups.....56

    Managing Security .....58

        Auditing .....58

    Troubleshooting Windows 2000 .....60



**A+ Operating System Technologies**

- Windows 2000 Utilities .....61
  - Start -> Control Panel .....62
  - Other Win2K Utilities.....65
- NT/2000 Registry .....66
  - Windows 98 REGEDIT .....67
  - Windows 2000 REGEDIT32 .....68
- Control Panel.....68
- Major Differences Between Windows Versions .....74
  - Windows 9x.....74
  - Windows NT .....74
    - NT Server vs. Workstation .....75
  - Windows 2000 .....75
  - Windows 3.x, XP, Me and Linux .....76
- Windows File Systems .....76
  - File Allocation Table (FAT) .....76
    - FAT limitations .....77
  - NTFS .....78
    - NTFS4 Limitations.....79
    - NTFS4 vs. NTFS5.....79
    - NTFS Folder and File Permissions .....80
- Viruses .....81
  - Types of Viruses.....81
  - Virus Sources .....81
  - Common Symptoms: .....81
  - Virus Prevention.....82
  - Recovering from a Virus .....82



**A+ Operating System Technologies**

Networks .....82  
Types of Networks:.....83  
Network Protocols .....84  
Installing and Configuring NIC.....85  
Installing and Configuring Network Connection .....86  
    Mapped Drive.....88  
    Network Drives .....88  
    Network Printers .....88  
Internet.....89  
Internet Access .....89  
    Installing and Configuring Internet Connection.....91  
    Configuring Internet Explorer .....93  
TCP/IP .....94  
    TCP/IP Utilities .....96  
Domain Names .....97  
    IP Addresses.....97  
    Domains .....97  
    URLs.....98  
Additional Notes: .....98



## What is an OS?

Every computer needs an Operating System. At the most basic level an Operating System (OS) is the interface between you, your software applications, and your computer hardware.

### **Functions**

Operating Systems interpret user commands and instructions (like typing on the keyboard or clicking with the mouse) and send requests to the proper application or device. An OS not only provides a user interface (text or graphic) to access/organize/manipulate/store data, but can also provide security and multitasking capabilities. Generally the OS is made up of a few core files with additional files for extended functionality and backward capability.

Primary OS functions:

- Communication (methods of communication) with hardware/software
- User interface
- Input/Output (standard, devices)
- Add, delete, move, store programs and data

Some important concepts to know about an operating system are:

- Minimum hardware requirements and recommendations (memory, processor, disk space, input/output devices)
- Boot files (to make an emergency [boot disk](#)) and sequence
- Important files and setup information
- New OS features
- File system structure
- Compatible applications

### **Components**

Know how to find and use the following Windows system components *thoroughly*:

- Control Panel
- My Computer
- Windows Explorer
- System Tools and Utilities
- Internet Explorer (customize)
- HELP



**Remember:** There are usually at least 3 ways to accomplish any task in any version of Windows. The exam may only offer you ONE. You will need to know multiple ways to accomplish tasks and find things.

Help: <http://www.microsoft.com/technet/maintain/hlpusr.asp>

## Command Prompt (DOS)

For the most part, you will not need to know DOS as an operating system for this exam. You will, however, need to know how to use Command Prompt (or Command Line) utilities and execute commands from the Command Prompt – especially for troubleshooting (booting from an emergency boot disk, for example).

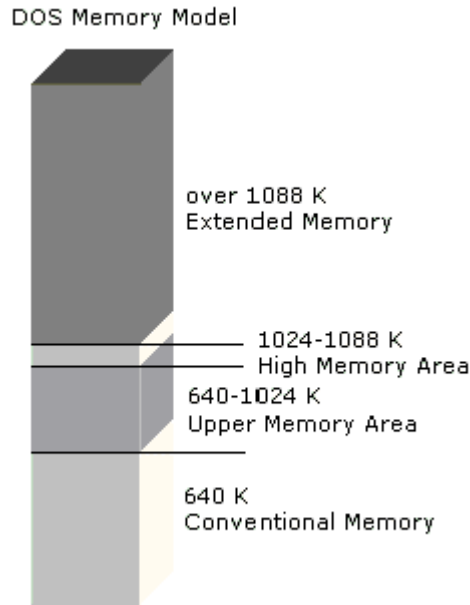
### DOS System Files

History: DOS is a 16-bit ([FAT16](#)), text-based interface OS for file and disk management, now it is integrated as the MS-DOS Command Prompt application in Windows.

### Memory Management

DOS is also quite particular about the amount of memory your system has. In particular, it doesn't really like memory over 1 MB (see the following image). For more information, read up on the [DOS memory model](#).

See also the section on [Memory](#)



### **Architecture**

To boot, DOS needs three core files and two configuration files, found in the root directory, loaded by the boot sector. If any of the three core files are missing, you will get the error "Missing operating system."

- IO.SYS is a core, hidden file that contains basic I/O device drivers and controls the boot process, including loading the files that follow it
- MSDOS.SYS is a core, hidden file that contains the DOS [kernel](#) (the main part of the OS) code. This file is the interface between applications and hardware drivers held in IO.SYS. (\*\*NOTE\*\* in Windows, this file is a text file, NOT the kernel of the Windows OS)
- CONFIG.SYS is a configuration text file that contains commands to load device drivers, memory managers, and system hardware configuration settings. These include DEVICE= and DEVICEHIGH=, for example.
- COMMAND.COM is a core file that provides the user interface, sometimes called the shell or Dosshell. It interprets and executes what is entered at the command prompt.



## A+ Operating System Technologies

- AUTOEXEC.BAT is a configuration text file that holds a list of boot DOS commands, like PROMPT \$P\$G, some [TSRs](#), and the MSCDEX drive label tread the CD-ROM.

DOS needs only:

- IO.SYS
- MSDOS.SYS
- COMMAND.COM

Additional Driver Files in DOS directory:

- HIGHMEM.SYS – Makes extended memory available
- EMM386.EXE – Simulates expanded memory, access to [UMA](#) for device drivers and TSRs
- MOUSE.SYS
- SMARTDRV.EXE – Disk caching
- ANSI.SYS – Display, cursor, and keyboard assignments
- POWER.EXE – Power saving support

### **Command Prompt Utilities**

You should practice using the following, or at least have an idea how and when to use them:

- FDISK.EXE
- FORMAT.EXE
- SYS.EXE
- EDIT.COM
- HIMEM.SYS
- EMM386.EXE
- SMARTDRV.EXE (for disk caching)
- MSD.EXE
- MSCDEX.EXE (for CD ROM support)
- MEM.EXE
- ATTRIB.EXE
- DEFRAG.EXE (also, from within Windows)
- DELTREE.EXE
- EXPAND.EXE
- LABEL.EXE
- SCANDISK.EXE
- SHARE.EXE
- CHKDSK.EXE



- EXTRACT.EXE (for those CAB files)
- XCOPY.EXE

**Additional Info:** Utilities are programs or files that you need to have order to run at the command prompt (.exe or .com extension). They are not the same as command interpreter functions (like DIR...) that the command prompt knows how to interpret. Utilities are programs you should probably have on an emergency and/or start disk.

## Command Prompt Commands and Syntax

Helpful to know first:

- A command prompt **switch** is a parameter that modifies a command, in the form of a forward slash / followed by a letter
- /? – Shows all the switches for any given command
- Wildcards – asterisk and question mark
  - ? - Replaces any single character (eg, ?? .sys)
  - \* - Replaces any number of characters (eg, \*.\* finds all files)

DIR – Shows the contents of a directory

- /P – Pause after each screen
- /W – Wide list format

CD – Changes directories

- \ - Goes to root (backslash!)

MD – Make (create) a directory

RD – Remove directory/subdirectory

REN – Rename file [old name] [new name]

DEL – Delete files

DELTREE – Delete entire tree (including subdirectories, files, and directory)

TREE – display the directory structure with all subdirectories

- | more – displays one screen at a time (pipe)

MOVE – Move files

SYS – Copies the 3 DOS system files to a partition/drive, making it bootable

COPY – Copy files and directories [from] [to]

XCOPY – Directory-level copy (with extra switches)

- /S – Copies system files
- /E – Copies empty subdirectories as well
- /H – Copies hidden files as well
- /V – Verifies each file as it is written

DISKCOPY – Copies entire disk

ATTRIB – sets Attributes of a file or a folder



- +/-R – Read Only
- +/-A - Archive
- +/-S - System
- +/-H - Hidden

VER - Displays the MS-DOS version number

SETVER – Displays or updates the current version table

MEM - Displays the amount of used and free memory

- /C – will show programs loaded into the first 1MB of memory (conventional, upper, reserved, extended)

Read more:

[DOS Commands](#)

[DOS for Generation Y](#) by Hal Bennick

[Bootdisk.com](#)

## Commands to Check Drives

CHKDSK - Checks the disk status and displays a status report (Can fix disk errors)

- /F – Fixes/Repairs lost clusters/chains

SCANDISK - Starts Microsoft Scandisk, a disk analysis and repair tool, that checks a drive for errors and corrects any problems it finds

- Note: Key in troubleshooting

DEFRAG – defragmentation of a hard drive

EDIT – enables editing

UNFORMAT – unformats a disk

- /TEST - Lists all the files/directories that would be recovered by UNFORMAT

UNDELETE – for recovering deleted files,

- Only works if they haven't been overwritten since their deletion

MSCDEX – CD ROM driver support

SCANREG – Scans registry

FORMAT – For (re)creating file systems

- [drive letter] /S – makes the drive bootable (system)
- [drive letter] /Q – doesn't scan for disk errors (quick)
- [drive letter] /U – doesn't copy current FAT table, i.e., doesn't save information to use the UNFORMAT afterward (unconditional)

FDISK – For (re)creating partitions (see below)



## Partitioning Drives

Partitions are either primary (bootable) or extended (not bootable, logical drives). The primary partition is always C:. Your primary partition stores the OS and the Master Boot Record ([MBR](#)). FDISK will only allow you to create ONE primary partition, even though you can have up to 4 (dual-booting).

If you have a large hard disk, and the system can only see (for example) 2.1 GB or 8.4 GB, that is a BIOS limitation or file system limitation. The maximum partition size (FAT16 – 2.1 GB; FAT32 – 2 TB) refers to the primary partition only.

**NOTE:** One drive, one primary partition. Two drives, multiple partitions.

Read more on [FDISK](#)

Read more on Windows File Systems [HERE](#)

## Windows 3.x

*Historical Information only: Windows 3.x is not explicitly covered on the exam.*

Windows 3.x, while not a true operating system, is a 16-bit ([FAT16](#)) GUI (Graphical User Interface) for DOS. Windows 3.11 (Windows for Workgroups) also provides peer-to-peer networking functionality (sharing resources).

Windows 3.x required a 386 with at least 2 MB RAM, DOS 3.1, a floppy drive, and 6 MB of free disk space. Its main components are the File Manager and the Program Manager (interface file is PROGMAN.INI).

To start Windows 3.x, DOS has to boot and the DEVICE=HIMEM.SYS must be loaded. From there, WIN.COM is loaded (typing WIN at the command prompt or adding WIN to the last line of AUTOEXEC.BAT) which executes the GUI and the kernel of

Windows 3.x:

- KRNL386.EXE
- USER.EXE
- GDI.EXE
- SYSTEM.INI
- WIN.INI
- PROGMAN.EXE (Program Manager – shell program)

**Note:** The main INI files were SYSTEM.INI, WIN.INI and PROTOCOL.INI. The Registry replaces these in Windows 9x.



## Windows 9x

In contrast to Windows 3.x, Windows 95 was a true OS. It is a 32-bit (FAT32) OS with backward compatibility for FAT16 files and programs. Windows 95 had two releases – OSR1 and OSR2. 95 OSR2 and 98 allow hard drive partitions greater than 2 GB, and fully integrate Internet Explorer. It provides a GUI, a common user interface, and a customizable interface. Using a swap file, it can use [virtual memory](#). It also allows data sharing, greater networking abilities, and multitasking. And, most importantly, Windows 95 and 98 provide plug and play (PnP) support (Plug n Play is another way of saying built-in driver support.)

- Windows 9x still needs DOS.
- Windows 9x supports extended file names up to 255 characters in length.
- Windows 9x can run 16-bit or 32-bit applications (with the DLL files for both to maintain backward capability)

### Worth noting is:

Parameters entered in CONFIG.SYS, AUTOEXEC.BAT, SYSTEM.INI AND WIN.INI files override Windows 9x default parameters. You should only enter parameters for backwards compatibility or when troubleshooting a problem. Believe it or not, *SYSTEM.INI is still a required file to run Windows 9x. If you delete it, Windows 8x will not boot.*

### Installing Windows 9x

#### Windows 95 Hardware Requirements/Recommendations

	Min Required	Recommended
Processor	386DX	Pentium
Memory	4-8 MB	16-32 MB
Display	VGA	SVGA
Disk Space	50-55 MB	200 MB
Others	Floppy drive, keyboard	CDROM, mouse



**Windows 98 Hardware Requirements/Recommendations**

	<b>Min Required</b>	<b>Recommended</b>
Processor	486DX	Pentium
Memory	24 MB	32-64 MB
Display	VGA	SVGA
Disk Space	225 MB	400 MB
Others	Floppy drive, keyboard	CDROM, mouse

**Installation Process**

1. Prepare a DOS Boot Disk, that includes:
  - FORMAT
  - FDISK
  - EDIT
  - SYS
  - ATTRIB
  - CONFIG.SYS
  - AUTOEXEC.BAT
2. From a Command Prompt, type SETUP
3. SCANDISK runs first, then you get the setup window
4. Checks the system for the minimum requirements
5. End User License Agreement (EULA) – and the pleasure of agreeing to it
6. Select directory (default is C:\WINDOWS)
7. Choose Setup Type
  - Typical (default option, for most desktops)
  - Portable (for laptops, installs briefcase, for example)
  - Compact (if limited disk space)
  - Custom (for experienced users)
8. Fill in the Windows Product Key (*I recommend writing it right on the CD itself!*)
9. Fill in user information: name, company
10. You will be prompted whether to analyze your computer before the install or not (devices, hardware detection)



(You will be prompted through a series of pop up windows for particular components, depending on which setup type you are installing. If Custom was chosen, you can select the components individually here.)

11. Prompt for Networking information and options (whether or not you have a [NIC](#))
12. Prompt to make an Emergency Boot (Startup) Disk
13. And now you wait..... while a big white line becomes a big blue line (i.e., the big INSTALL) and you get to read the promo windows about Windows. Wheee
14. Finishing Setup – Restarts computer
15. You will be prompted for your password to Microsoft Networking
16. PnP Hardware will be set up
17. Control Panel settings, including Time Zone and Printers can be selected and/or installed next.
18. And now you've installed Windows 95 or 98.

See also:

[All MS OSeS in 1500 Words or Less](#)  
[Window 98 Unleashed](#)

### Failed Install

If for any reason the Windows Setup crashes and burns, you will need these three files to recover from a failed install:

- SETUPLOG.TXT
- DETLOG.TXT
- DETCRASH.LOG

### Emergency Startup Disk

You've will need to have at least ONE of these laying around for that one time that everything is utterly pooched (technical jargon for screwed up beyond recognition). It might be you or it might be a user that got it to that point, but you have to be ready to fix it.

To create a Startup disk you can:

- Make one when installing the OS, or
- Go to **Control Panel -> Add/Remove Programs -> Startup Disk -> Create Disk.**



Then put a HD (high density 1.44 MB) floppy disk in the A: drive and click OK. The files on the Startup disk include:

- ATTRIB.EXE
- CHKDSK.EXE
- COMMAND.COM
- DRVSPACE.BIN (disk compression)
- EBD.SYS (Emergency Boot Disk identifier)
- EDIT.COM
- FDISK.EXE
- FORMAT.EXE
- IO.SYS
- MSDOS.SYS
- REGEDIT.EXE (Registry editor)
- SCANDISK.EXE
- SYS.COM
- UNINSTAL.EXE (Removes Windows 95)

**Note:** And EBD (Emergency Boot Disk) is not the same as an ERD (Emergency Repair Disk) – both will be covered later.

**Note:** To edit AUTOEXEC.BAT, CONFIG.SYS, WIN.INI, and SYSTEM.INI, you go to **Start -> Run**, and type **SYSEDIT**.

### Upgrading to Windows 9x

Before upgrading to Windows 95 from Windows 3.x or DOS, you should edit CONFIG.SYS and AUTOEXEC.BAT, removing any unnecessary entries and [TSRs](#).

When upgrading, you will be asked if you want to save the system files. If you do save your system files, they will be renamed, but you can uninstall them from **Control Panel -> Add/Remove Programs**

Read more on Upgrading to Windows 98:

<http://www.microsoft.com/technet/win98/upgr98.asp>



## **Boot Sequence of Windows 9x**

To boot Windows 95, there are 4 stages: Hardware/[BIOS](#), to [Real Mode](#), to [Protected Mode](#), to the OS and desktop initialization, in this order:

### BIOS

- [POST](#) – Power On Self Test
- [PnP BIOS](#) – assigning system resources (without conflicts)
- [IPL](#) or [Bootstrap](#) – initiates the program to load the OS into memory

### Real Mode (16 bit)

- IO.SYS – takes over from BIOS, “Starting Windows 95...”
- MSDOS.SYS – IO.SYS processes MSDOS.SYS and parameters in AUTOEXEC.BAT
- CONFIG.SYS (not needed, 95 defaults override it)
- COMMAND.COM – Command Line interface (processes requests before they are sent directly to the processor \_ a translator)
- AUTOEXEC.BAT – COMMAND.COM processes AUTOEXEC.BAT, to load TSRs and DOS applications (not needed, 95 defaults override it)

### Protected Mode (32 bit)

- WIN.COM (automatically loads now by default)
- VMM32.VxD – virtual machine manager
- SYSTEM.INI – loads DEVICE= parameters

### OS and Desktop (16-bit and 32-bit for backward compatibility)

- KERNEL32.DLL, KRNL386.EXE (kernel)
- GDI32.EXE, GDI.EXE
- USER32.EXE, USER.EXE
- EXPLORER.EXE (interface)

## **Startup Menu**

If Window 9x failed to boot properly previously, if Windows detects a problem, or if you press F8 while it is loading, you will go to the Startup Menu.

1. Normal – no troubleshooting help
2. Logged – bootlog.txt to find where the failure occurred
3. Safe Mode (F5) – default after problems – does not process the Registry, CONFIG.SYS, AUTOEXEC.BAT, SYSTEM.INI, drivers, or extended peripherals



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4. Safe Mode with network support (F6) – Safe mode but loads NIC drivers, protocols, and clients
5. Step-by-step Confirmation (SHIFT F8) – choose which commands are executed during the boot sequence
6. Command Prompt only – when Safe Mode fails
7. Safe Mode Command Prompt (SHIFT F5) – to reinstall from scratch
8. DOS (F4)

For example, if you are having trouble on Bootup, try Step-by-Step Confirmation, which goes through these steps, in this order:

- Create BOOTLOG.TXT? - Y/N
- Load CONFIG.SYS? - Y/N
- Load HIGHMEM.SYS? - Y/N
- Start EMM386.EXE? - Y/N
- Start SETVER.EXE? - Y/N
- Load DISPLAY.SYS? - Y/N
- Load COUNTRY.SYS? - Y/N
- Load DBLBUFF.SYS? - Y/N
- Load IFSHLP.SYS? - Y/N
- Load AUTOEXEC.BAT? - Y/N (start up command files) ...
- Load WIN? - Y/N
- Load WIN Drivers? - Y/N
- Enable Network Support - Y/N
- Start Display - Y/N ... (Windows Start up screen)
- (more device drivers) - Y/N
- MSMOUSE.VXD- Y/N

### **Windows 9x Registry**

The Registry's function is to store system PnP and hardware configuration information and user-specific details. The Registry replaces the .INI files of Windows 3.x, and stores the system hardware and configuration information in the /WINDOWS/ folder. The Registry is divided into two files, both read-only and hidden:

- SYSTEM.DAT – system settings
- USER.DAT – users settings



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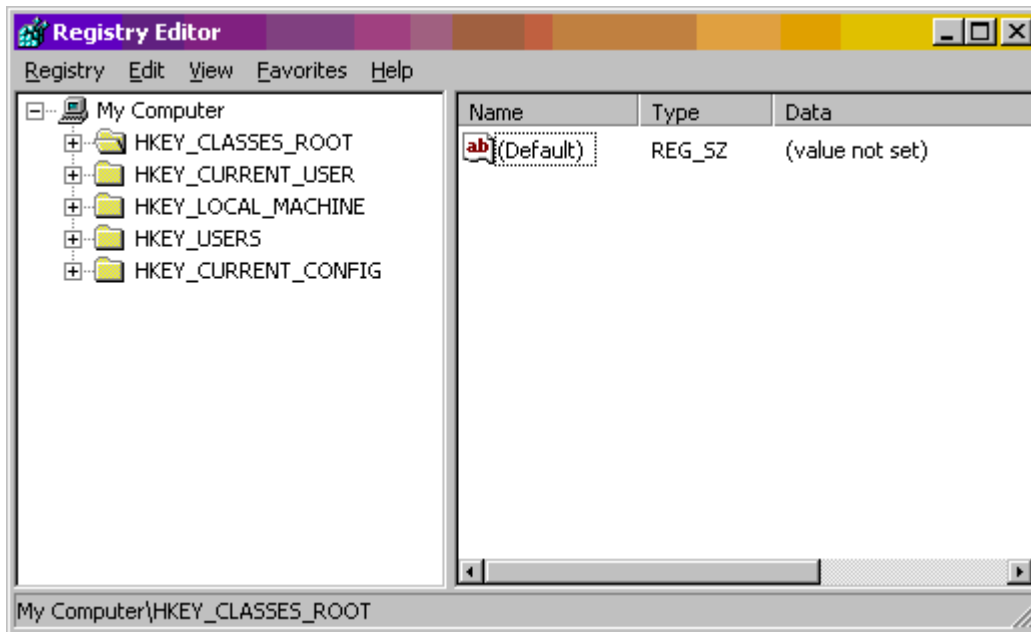
The Registry, though resembling a directory tree structure, is a database of keys: each key has a value or set of subkeys. You can edit and access the Registry using REGEDIT.EXE.

Top-level Keys:

- HKEY\_LOCAL\_MACHINE – common hardware settings
- HKEY\_CURRENT\_CONFIG – current config of hardware
- HKEY\_CLASSES\_ROOT – file associations
- HKEY\_DYN\_DATA – hardware devices (info held in RAM)
- HKEY\_USERS – config information of all users ever logged into the system
- HKEY\_CURRENT\_USER – config information for current user

You can search, add a key, add or change a value, delete a key or value, or rename keys and values.

Go to **Start -> Run -> Regedit**





Windows automatically backs up the registry every time it is booted. The previous version of the registry files are SYSTEM.DA0 and USER.DA0. The Registry can be used for troubleshooting and performance enhancement in Windows 9x.

Read more on Corrupted 9x Registry:

<http://www.microsoft.com/technet/win98/recreg.asp>

See also [NT/2000 Registry](#)

### **Navigation**

Navigating through Windows 9x becomes second nature after awhile, but you will need to know specific details of where to find things in Windows. So, take some notes on how to get to (*and what you can do when you get there*):

- Windows Explorer – folder structure and files (Folders replace DOS directories)
- My Computer – floppy drive, hard drive, CD ROM, Control Panel, Dialup Networking, Printers
- My Computer -> Properties – System Properties, Device Manager, Hardware Profiles Configuration – *\*\* Getting System Information \*\**
- Disk Cleanup Utilities, Error-checking, Backup, Defragmentation
- Scheduled Tasks
- Control Panel – Telephony Services, Add/Remove Programs, Add/Remove Software, System, Mouse, Display, Networking...
- Making Shortcuts
- Changing/Displaying Properties
- Hidden file extensions (in List view: **View -> Options -> Hide MSDOS file extensions**)
- Folder, file and print sharing
- Finding folders/files (Search)
- Task Manager

98 My Computer:



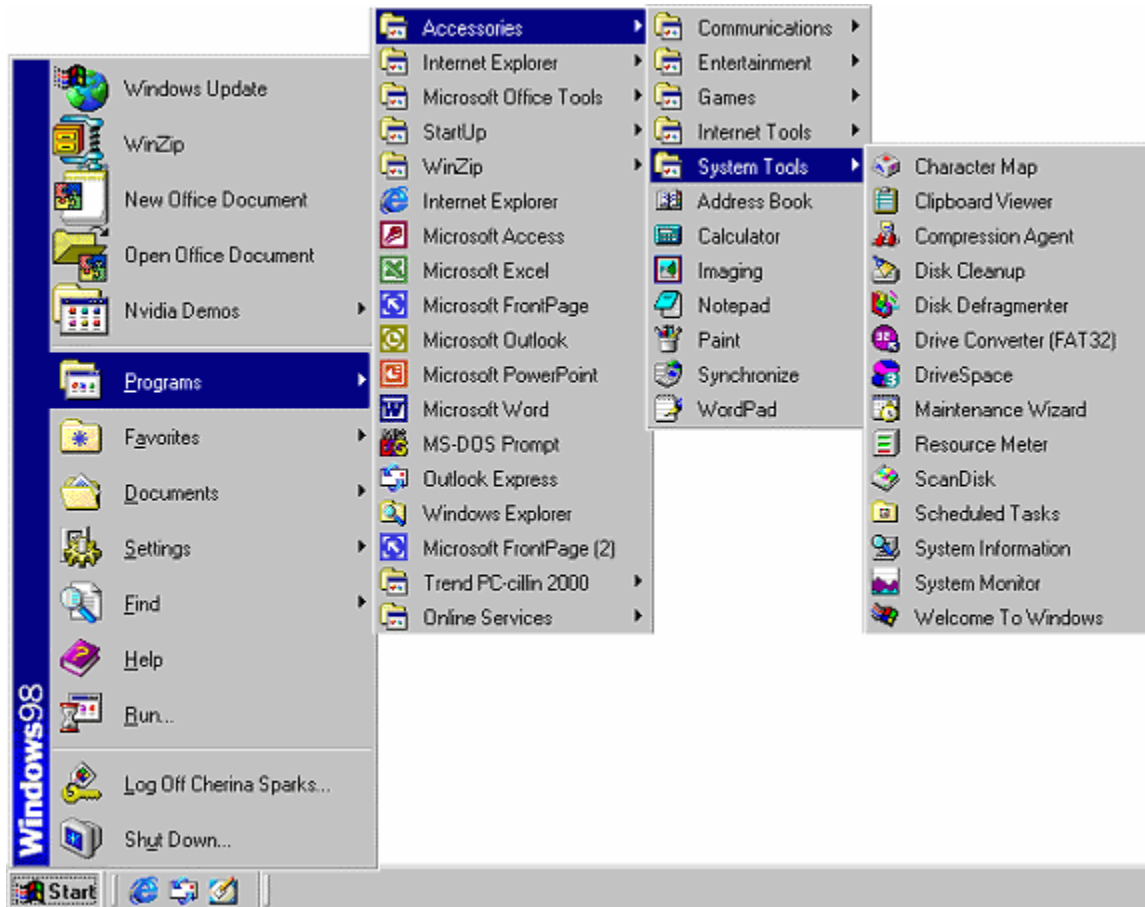
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98 System Tools:



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### Windows File Management

Know how to:

- Create, move, rename, and delete Folders
- Create, move, rename, and delete Files
- Change the appearance of a folder (icons, list, details, reorder by name, date...)
- Drag and drop folders, single files, multiple files
- Create shortcuts



**Note:**

- Folder names cannot contain the characters: \ / : \* ? " < > |
- Filenames cannot contain the characters: \ / : \* ? " < > | and [ ]

**Windows Keyboard Shortcuts to know**

- CTRL A – select all
- CTRL C - copy
- CTRL V - paste
- CTRL X - cut
- CTRL Z – undo
- ALT TAB – toggle between open applications
- ALT PRINTSCREEN – capture top window open (including error messages)
- Windows Key – start menu
- SHIFT click – selects all between two clicks
- CTRL click – selects just those clicked
- RIGHT CLICK – reveal menu selections for any file, folder, shortcut...
- CTRL ALT DEL – launches Task Manager (\*\* not in NT or 2000 though)

**Backups**

- **Copy** – copies selected folders and files to the backup device without turning off archive bit
- **Full** – backs up every folder and file, turns off archive bit
- **Incremental** – backs up only folders and files with the archive bit on, and turns off the archive bit
- **Differential** – backs up only folders and files with the archive bit on, but doesn't turn the archive bit off.

**Configuring Windows 9x**

**Drivers**

- Plug n Play (Configuration Manager, PC BIOS, Registry, Bus and port emulators, Resource allocation, setup and device installer)
- **Control Panel -> Add New Hardware Wizard**
- Device Manager -> Resources (IRQ, I/O)
- Right-click Properties



- Advanced properties

## Printers

To install a printer in Windows 9x/NT/2000, go to **Setting -> Printers -> Add Printer**, or **My Computer -> Printers**, or **Control Panel -> Printers**, and walk through the Print Wizard.

- View Print Queue
- Add Local/Network Printer
- Port LPT1
- Install Printer Drivers
- Changing default printer and other printer settings **Printers -> Properties**

**Note:** If print jobs are garbled check Spool Settings:

[Enhanced Metafile](#) (EMF – independent of printer type) and RAW (printer-specific) are file formats for print jobs sent to the [spool](#). **Printer Properties -> Spool Settings -> Details**

## Memory Management

- **Real Mode** – single task environment (DOS)
- **Protected Mode** – virtual machine created to access extended memory; memory and hardware are “protected” from direct access from applications by the OS (allocating processor time and memory)
- **Conventional Memory** – 0-640KB (runs DOS)
- **Upper Memory Area (UMA)** – 640-1024KB (video RAM, BIOS) – made up of Upper Memory Blocks (UMB)
- **Extended memory (XMS)** – everything above 1MB (1024KB): Pentiums can support up to 4 GB of memory.
- **High Memory Area (HMA)** – 1024-1088KB – first 64KB of extended memory

At the Command Prompt, type “MEM /C” to see your memory information.

HIMEM.SYS enables Windows 9x to use extended memory. It must be loaded in the CONFIG.SYS file, like this:

```
DEVICE=C:\<DOS OR WINDOWS directory>\HIGHMEM.SYS
```



EMM386.EXE enables DOS to access XMS.

**Windows 9x Utilities**

**SMARTDrive** is used to improve disk performance with RAM and read/write caching.

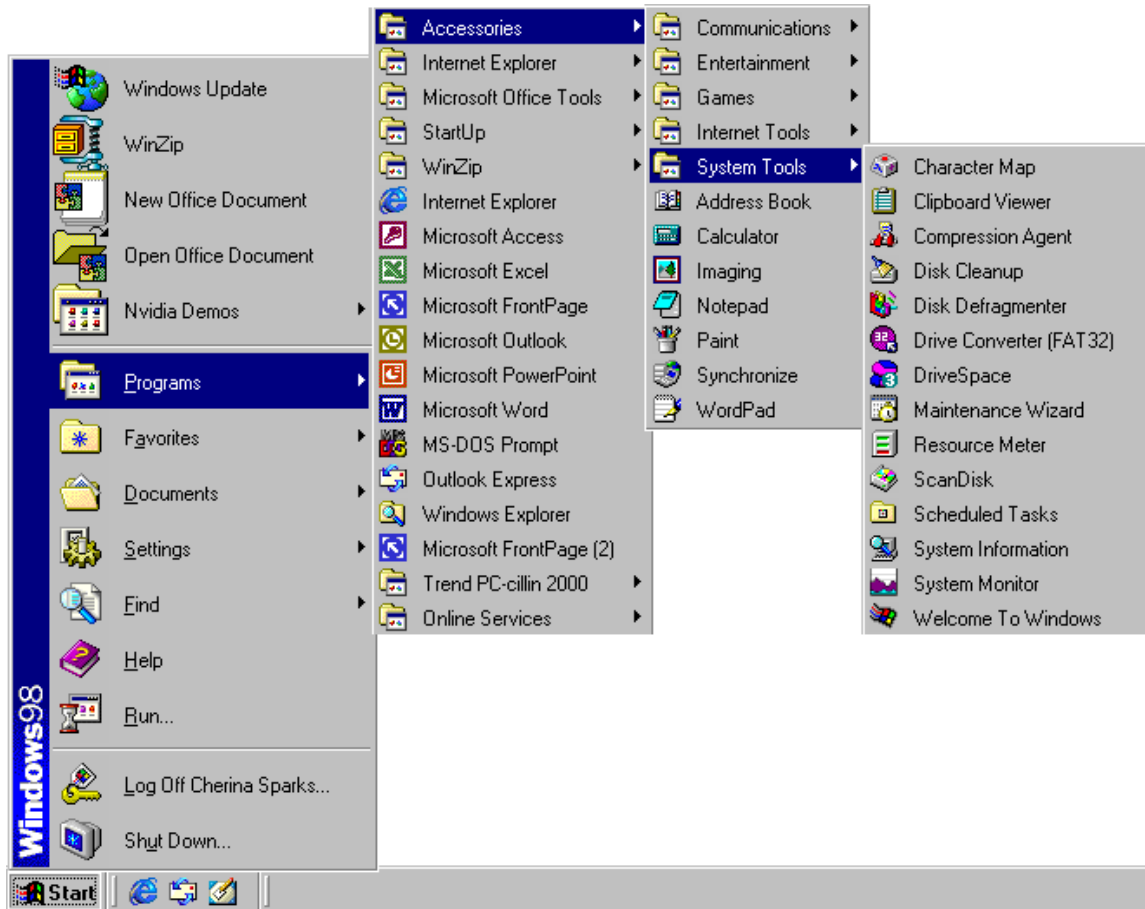
[Virtual Memory](#), using hard disk space as simulated memory, in Windows 9x is configured **in My Computer -> Properties -> System -> Performance**. Do not disable virtual memory.

Windows 98:

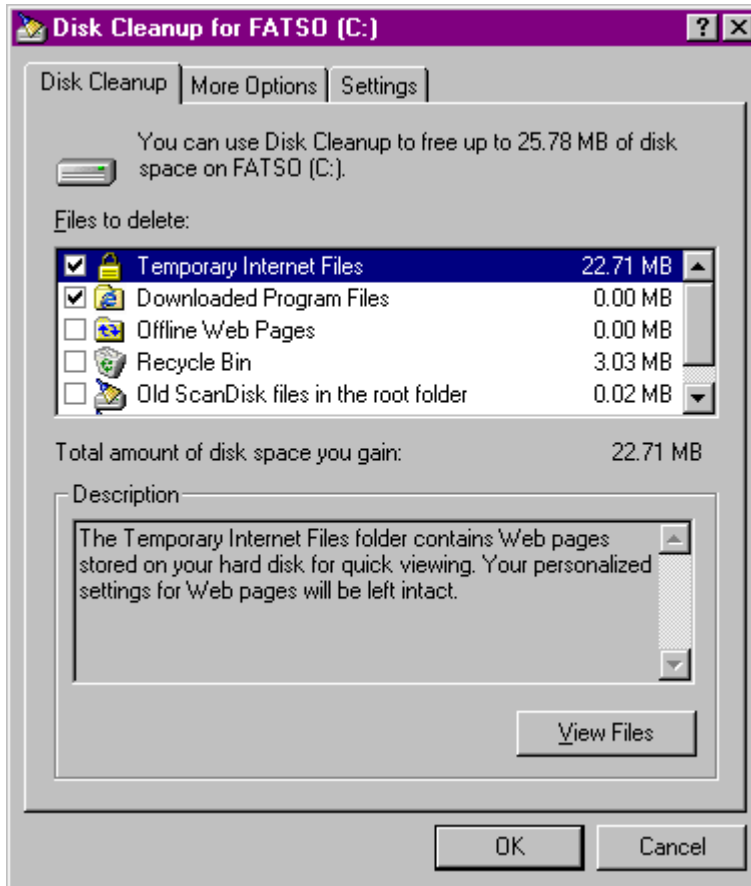
**Start -> Programs -> Accessories -> System Tools ->**



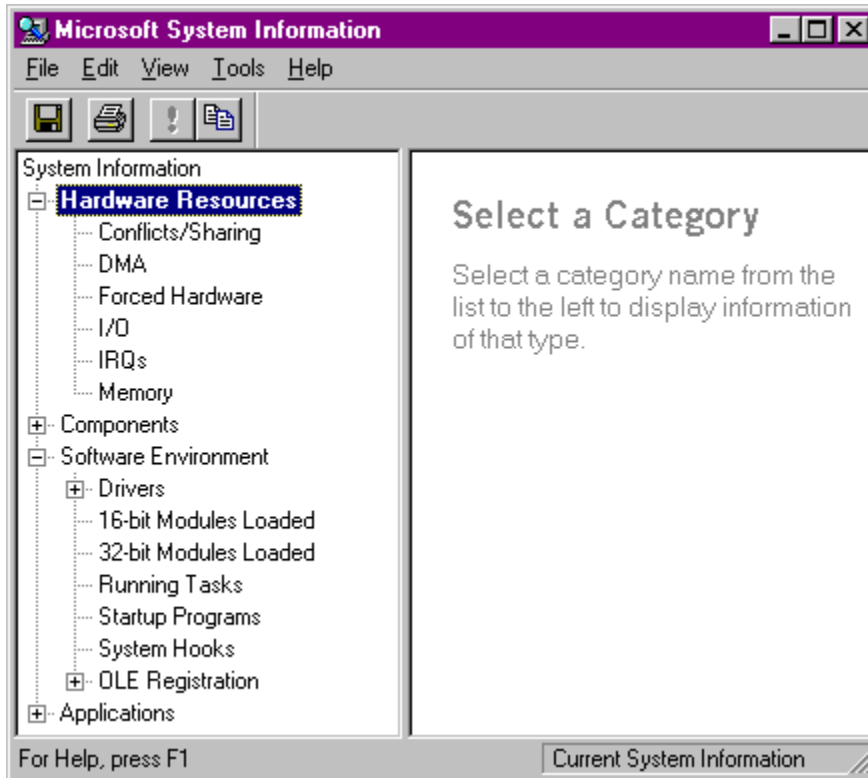
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- **Disk Clean up** – deletes .tmp files, empties recycle bin and Temporary Internet Files



- **Defrag** – defragments a hard drive
- **System Monitor** is a Windows utility that tracks system resources (troubleshooting)
- **MS System Information**: for reading configuration and registry information



- **Dr. Watson** – captures debugging information when an application fault occurs.
- **Maintenance Wizard** – used to schedule tasks like backup, defrag, disk cleanup, etc.
- **Backup** – from the Maintenance Wizard

### **Troubleshooting Windows 9x**

#### **Troubleshooting procedures**

- Gather information and ask questions
- Be prepared
- Be calm
- Take your time



- Concentrate
- Be flexible (Don't assume anything)
- Consult (find resources)
- Know when to give in
- Cure the problem not the symptom
- Do not create new problems in process
- DOCUMENT everything you do

See Also:

- [Introduction to Troubleshooting](#)
- [Troubleshooting the Boot Process](#)
- [Troubleshooting Display Issues](#)

Troubleshooting Windows 9x

- <http://www.annoyances.org/win98/index.html>
- <http://www.bootdisk.com/swapfile.htm>
- <http://www.winplanet.com/winplanet/reports/620/1/>
- [http://www.techtutorials.com/Windows\\_9x/Troubleshooting/](http://www.techtutorials.com/Windows_9x/Troubleshooting/)

MS How to's: <http://www.microsoft.com/technet/httasks.asp>

**Common Errors and Problems**

Symptom	Diagnosis
"No OS Found"	Corrupt or missing IO.SYS and/or MSDOS.SYS. "SYS C:" restores them
"SYSTEM DISK INVALID "	Missing IO.SYS "SYS C:" to restore
"Invalid VxD dynamic link call from IFSMGR(03)"	Missing MSDOS.SYS "SYS C:" to restore
"Missing COMMAND.COM" or "Bad or missing command interpreter"	COMMAND.COM missing or corrupt. Use an EBD and copy the file to the C:\ or "SYS C": to restore
may be looking for PATH	
<a href="#">General Protection Fault (GPF)</a>	Same memory allocated for more than



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	one application
Windows Protection Errors	Device driver failures or conflicts in CONFIG.SYS and SYSTEM.INI Run SYSEDIT and start disabling DEVICE=
Fatal Exception Errors <a href="#">BSOD</a>	A software or hardware error or illegal instruction that windows cannot contain.
Illegal Operation Errors (My favorite peeve)	Illegal Operation errors or 'program crashes' are actually invalid page faults (IPF). The error message is similar to:  'This program has performed an illegal operation and will be shut down.  Usually transitory, but see below if not
Windows not booting completely	Try Safe Mode (without drivers, first, in case of conflicts) – which bypasses AUTOEXEC.BAT and CONFIG.SYS
Hard drive errors	Run CHKDSK and SCANDISK
Error in CONFIG.SYS, line xxx	Put a semi-colon at the beginning of the line to bypass it. If everything works, remove the line completely.
SYSTEM.INI not found, and Windows won't boot	Restore from EBD.
Won't boot to GUI	Corrupted <a href="#">SWAP</a> file. Boot into Safe Mode (F5) and disable Virtual Memory (temporarily – remember to enable it as soon as things are working!!).  Usually when running out of HDD space.
Corrupted registry	Restore from backup SYSTEM.DA0 and USER.DA0



### Invalid Page Faults

"This program has performed an Illegal Operation and will be shut down." (aka, this is why we HATE Windows at least sometimes).

A key part of troubleshooting IPFs is to determine how widespread the problem is:

- Is the problem reproducible or does it occur at random?
- Does the problem occur only in the current application or in other applications as well?
- Are there specific, known issues about the application that describe your problem? (check the manufacturers website – maybe a known bug)
- Does the problem happen only with a particular file handled by that application?
- Does the problem occur only at a particular time, such as while printing?

If you cannot make the error occur again, you can assume you have solved the problem. If the error occurs in other applications, most probably the fault is not with the application but with Windows, a component of Windows or a piece of software that is running in the background. Check with the program vendor's site if there are known issues with the application that may cause IPFs under specific circumstances.

If the IPF is specific to a certain file opened by this application, the file may be too large, or damaged.

Read More on General Windows Troubleshooting:

<http://www.windrivers.com/tech/troubleshoot/index.htm>

Study Break:

[Windows 98 Easter Egg Hunt](#)

### Common Problems

Some things to always check, especially if any changes have been made recently, are:

- Check connectors and cables
- Check port, device
- Check BIOS
- Check software configuration (drivers, etc)



- Check for conflicts
- Reseat components, if possible
- Virus check

New Hard drive causing problems?

<http://www.microsoft.com/technet/win98/recreg.asp>

### **Troubleshooting Printer Connections and Configurations**

- Printer not working: switched on, plugged in, online, check cables
- Paper jam: cheap paper, wrong type, stored improperly, loaded improperly
- Output corruption: printer driver, check setup
- Poor quality: toner/ribbon low, cheap/wrong paper
- Laser memory errors: not enough RAM
- Blank pages: OPC drum, corona wire improperly seated.

See also:

[Introduction to Troubleshooting](#)

[How Printers Work](#)

[Managing Hardware with Windows Device Manager](#)

[The Service Call](#)

[Troubleshooting the Boot Process](#)

[Troubleshooting Display Issues](#)

## **Windows NT 4.0**

This A+ OS exam doesn't cover much of NT, but you need to know about it as a legacy OS. I've included a bunch of information that applies to both Windows NT and 2000, and will help you study – even if you don't get many questions on this section in the exam.

You will need to know about upgrading to/from NT, NT File System, and the differences between NT and 9x/2000. The rest just helps to know.

**Note:** Every time I just say NT (and the exam too), I mean NT 4.0.



## History of NT

In 1993, Windows NT (New Technology, supposedly) 3.1 was introduced. The design requirements for this operating system included:

- Extensibility--designed in modules, which can be replaced or upgraded without a complete overhaul of the system, only of the section of code concerned
- Portability--can run on [RISC](#) or [CISC](#)-based systems (at the time, more important than now. Reduced Instruction-Set Computing machines were the powerhouses then)
- Reliability and Robustness--refers to the ability of the OS to insulate applications and processes from each other so that one may crash without affecting the others and bringing down the whole system
- Compatibility--able to run applications designed for DOS, Win16, Win32, OS/2, and POSIX-compliant systems (a UNIX standard). Also able to provide full connectivity on a network with Apple, Novell, Banyan, UNIX, and IBM machines.
- Distributed processing--in a client-server relationship, tasks are doled out according to the capabilities of each--a distributed application will perform the heavier processing tasks on the server, and the graphic-intensive user interface on the client.
- Security--network resources are protected from intrusion, damage, and theft through an object-oriented file system and access control lists.

The original NT 3.1 fell short of some of these. A later and common upgrade was NT 3.5 (quickly modified to NT 3.51--NT 3.5 is rare), and the present widely used version, Windows NT 4.0 in 1996. "NT4" has since had seven Service Packs published which fix "bugs", add newly developed features, upgrade internal utilities (such as IE and IIS) or (in the case of SP5) fix previous SPs... ;)

## Versions

There are three versions of NT4 (though you really just need to know the first one):

- Workstation
- Server
- Terminal Server (*You don't need to know anything about this version: just forget we even mentioned it.*)



Windows NT is 32-bit multitasking operating systems designed to run in a networking environment, rather than a standalone role. WINNT 4.0 is meant to be used in a business setting rather than for home use.

Though NT Server offers a few more capabilities, the Setup program for both Workstation and Server is WINNT.EXE.

## **Features**

Specific cool things about NT include:

- Stability - WinNT is more stable and secure than the W9x OSes.
- New Registry - so fundamentally different from the W9x systems that there is no direct upgrade possible. WinNT does away (almost) entirely with .INI files- all configuration data is kept in the Registry.
- Multiple platforms and support for other OSes
- Multitasking and multithreading
- Security
- Built-in Networking
- Big hard storage stuff is okay (large capacity for memory and disks)
- Multiple Protocol Support (TCP/IP, NetBEUI, NWLink, DLC, AppleTalk, etc)

Most implementations of NT use the new file system called [NTFS](#), which is incompatible with FAT16 or [FAT32](#). Rather than having a [File Allocation Table](#), it has a [Master File Table](#) and many other capabilities, like software-based [RAID](#) support (like stripe sets and volume sets), and file-level security.

Read more on NTFS under [Windows File Systems](#)

**Note:** The one area where NT lags behind Windows 9x and 2000 is in PnP support.

## **NT Server**

NT Server is:

- Maximized for delivering files to clients, printing, performing centralized administrative tasks in the domain
- Supports a theoretically unlimited number of simultaneous connections.
- The base server system upon which specialized software can be run, such as SQL Server (advanced database), Exchange Server (Email management), SMS Server (remote management), SNA Server (interface with mainframes), and IIS (Inter- or intranet services).



On install, NT Server can be designated as a [Domain Controller](#) (participating in Domain security and access control) or as a Member Server (for storing and distributing data upon request).

### NT Workstation

NT Workstation is:

- Maximized for running process-intensive, number crunching applications locally.
- Limited to ten simultaneous connections, which enables it to operate either as a client in a Domain or as a resource in a Peer-to-Peer setting.

Most of the security and utility functions of NT Server are also available on NT Workstation in a scaled-down or localized form. Users may be managed and performance can be tracked, but only for the machine itself.

<http://support.microsoft.com/directory/content.asp?ID=FH;EN-US;ntw40&FR=0&SD=GN&LN=EN-US&CT=SD&SE=NONA>

### Installing Windows NT

Installation procedures for Intel/[CISC](#) machines fall into two basic types:

- A single, *local* install from CD-ROM, or
- A single or multiple install from a *remote* machine through a shared network directory.

### Hardware Requirements and Recommendations

The minimum and recommended requirements to install NT4 Workstation are as follows (**Note:** NEVER go with the minimum. Consider the "recommended" as real minimum!):

	Min Required	Recommended
Processor	486	Pentium
Memory	12 MB	16MB
Display	VGA	SVGA



Disk Space	110 MB free space	250-300 free
Others	CDROM, floppy, or NIC	NIC

## Installation Process

The first step in installing Windows NT4 is to check the Hardware Compatibility List ([HCL](#)) to make sure the hardware platform is compliant with Microsoft requirements. All peripheral devices must be on the HCL as well. Primarily this means that proven, tested device drivers (which translate commands from the OS to the device) are available and approved.

1. To install NT Workstation to a single PC, locate the three 1.44 MB floppy disks and the CD that contains the system files. Boot the machine from the floppy marked "Setup Boot Disk". You will be prompted to insert disk 2, and then disk 3. This loads enough of the OS so that the system files from the CD can be obtained and copied.
2. Insert the CD, and follow the prompts that follow.  
(**Note:** It's a good idea to have a blank 1.44 MB floppy handy, as during Setup you will be given the option to make an [Emergency Recovery Disk](#). Use this option.)
3. The faster option for a single, and the only way for a multiple installation, is to write the system files over the network. This can be directly from a CD-ROM drive on a server, with a share created for the i386 directory, but even faster is by loading the contents of the i386 directory onto the server's HDD and sharing that.
4. At the client machine(s), run either WINNT.EXE (for a new installation) or WINNT32.EXE (for an upgrade from NT 3.51 or for a reinstall of NT4--this is a 32-bit app and runs faster on a machine previously set up as 32-bit).  
WINNT32 Switches:
  - o /B - Put boot files on hard drive instead of using boot floppies (takes an extra 4-5MB of hard disk space).
  - o /S - Specify source file location(s) - multiple locations will speed up installation.
  - o /U - Specify answer file location for use with unattended installation - MUST be used with /s to specify source file location(s).
  - o /T - Specifies location of temp directory created for install (/t:<path>).



## A+ Operating System Technologies

- /OX - Create the setup disks from CD-ROM or shared network folder. Used to replace damaged boot disks.
- /F - Don't verify files. Can speed up installation.
- /C - Don't check for free space when creating boot disks.
- /I - Specify setup information (.inf) file. This file tells setup how to run. The default name is DOSNET.INF.

**NOTE:** A [RISC](#)-based box must be installed from a CD-ROM. Before beginning, consult the manual for the procedure on how to start programs from a CD drive--differences exist among the various types. For a fresh installation, run SETUPLDR.EXE; an upgrade of a previous installation again takes WINNT32.EXE.

5. Regardless of the type of installation, you will be prompted for information during the process. The alternative, and the best for multiple install, is to provide an Answer file and a Uniqueness Database File. These provide the Setup application with configurations and settings automatically. Information you will need in these files or in person include:
  - The Product ID number; can be on the CD case, the manual, or a separate card
  - A NetBIOS name of 15 characters or less; must be unique to each machine
  - A Domain and/or Workgroup name, depending on which the PC will connect to
  - Administrator password--14 characters or less; should be the same on all machines in the network to avoid migraines
  - Which protocols to install. [TCP/IP](#) is the default, but NetBEUI or NWlink (for connectivity with Novell NetWare servers) may be required as well.
  - NIC settings--IRQ, I/O base port address, DMA, shared memory, and type of cable interface (the Express option will install the first NIC it finds, load default settings, and ask for confirmation. Custom install provides the option to do this or select the card and the settings manually).
  - Local printer name and port--optional.

### Windows NT Boot Files

- NTLDR (loader file)
- NTDETECT.COM (recognizes hardware)



- BOOT.INI (OS menu)
- BOOTSECT.DOS (alt boot sector)
- NTOSKRNL.EXE (kernel)
- HAL.DLL
- SYSTEM32\CONFIG (hive, registry)
- SYSTEM\32\DRIVERS\\*.SYS (boot sequence, drivers)
- NTBOOTDD.SYS (SCSI disk driver)

### Upgrading to Windows NT 4.0

You cannot directly upgrade from Windows 9x – the OSes are too different. It is possible to upgrade an existing NT 3.1 or NT 3.51 installation to NT 4.0, and retain all preferences, security information, and application data. (Always back up all data before doing so!) It is NOT possible to upgrade Windows 95 or 98 directly to NT. The Registries are too dissimilar in structure.

### User and Group Accounts in NT

User Accounts are managed in [User Manager for Domains](#) (NT Server) or User Manager (NT Workstation). Only local groups and users may be viewed, created and edited in User Manager. A local group and the permissions set for it will only apply to the local machine and its resources, whether accessed at the machine or over the network. The permissions of a global group can apply to any number of machines in the Domain.

The clearest method of access control is to put users into global groups at the server--add global groups to local groups as needed--and manage the permissions of the local group. Giving permissions directly to users can lead to conflicts and should be avoided.

There are two user accounts created by default

- Administrator
- Guest

Both these accounts may be modified but never deleted. Both these accounts represent a possible security hole if not modified. Both should at least be renamed, and the Guest account should remain disabled if not needed.

**Note:** Every account created is associated with a SID (Security Identifier) which is (supposedly) "unique in all space and all time". When the account is modified, even



## A+ Operating System Technologies

renamed and reconfigured, the SID remains identical. If the account is deleted and then reconstructed exactly--username, password, permissions, everything--the SID is not. As NT sees the new account, it is completely different. (Headaches have sprung from this one...)

- A user name must be unique, and should be descriptive. A good idea is to set a naming convention for usernames, such as first initial, last name, and location/job code. (e.g. ckent8cb might mean Clark Kent, 8th floor, City beat)
- Usernames must be 20 characters or less, without these: \"/>[][:><,.?\*+= (you can use these in passwords, however)
- Full Name is optional, but handy in large enterprises
- Description is optional; again handy for managing large numbers of users
- Password is case-sensitive (brainbug is different from BrainBug) and can be up to 14 characters in length. A good password is at least 8 characters and includes lower case, capitals, numerals, and symbols. (e.g. WTH\_y0u??, 12gaSH07gun!, CAP741n-who?!, H07Yc0wb4+m4N!....)
- Passwords should be easy to remember, but hard to crack. It can be done. Account options can adjust security levels as needed.
- User Must Change Password--if the Admin has assigned or reassigned the user's password, this enables the user to access his account but must change the password at the next logon.
- User Cannot Change Password--good for an account that numbers of people must access; also for assigning lazy users tough passwords (instead of their birth date or license plate).
- Password Never Expires--good for accounts used by NT services such as Backup, or the Anonymous account used by IIS for FTP access.
- Account Disabled--useful for guarding the account of a user on vacation, or when an account is set up perfectly and the user must be replaced. Deleting and recreating accounts is not as good when users are replaced; a better move is to disable and then rename the account when needed.

It is useful to make a template of accounts that will be allowed similar access permissions. Set up an account with the desired configurations and Copy it when needed. All settings except username, full name, "account disabled", and password transfer over.

- **Profile** button is used to specify a Home Directory to contain the user's personal settings, applications, and working folders/data files. It can also set



- up a logon script to connect the user automatically to the parts of the network the user normally accesses.
- **Dial-in** is for configuring the user's Remote Access settings. By default, there are five group accounts installed in User Manager.

Seldom is it necessary to create groups--the defaults cover a good range of requirements.

- **Administrators** - not the Administrator account, but a local group that users may be added to which gives full power to make changes in the Domain or Workgroup as well as locally.
- **Power Users** - membership in this group allows several administrative powers beyond normal user but short of Administrator. Most useful are the right to access the PC from the network, create and manage user accounts, and manage shares on printers, files and folders. (Unique to NT Workstation--not available on NT Server.)
- **Backup Operators** - gives the rights necessary to access directories and files to back them up into storage.
- **Users** - allows rights necessary to operate the machine, such as log on locally, shut down the PC, and create/manage local group and user accounts.
- **Guest** - again, not the Guest account, but a local group which users may be added to for access to the machine or domain. This group has no default rights; they must be added as required.

On an NT Server, several other local groups are added as default, such as Server Operator, Account Operator, Print Operator (no Power User), and three global groups--Domain Administrators, Domain Users, and Domain Guests.

All these groups have built-in, predefined, unchangeable abilities, and default, modifiable user rights. These are controlled from the User Rights Policy box accessed from the Policy drop-down.

Account Policies regarding password age and length, lockout settings, and enforcing logon hours are accessed from Account in the Policy drop-down.

Adding user accounts to group accounts (or removing them) is managed by selecting the group account and clicking the User, Properties drop-down.

See also [User and Group Accounts](#) in Windows 2000



### **Troubleshooting Windows NT4**

Several built-in utilities exist in NT4 for detecting and diagnosing problems before and after they occur. These are also useful for optimizing performance. Just because these are so fun to play with is no reason to forget the basics--always check the connections and cables first, in case of a catastrophic failure. In case of a more minor problem, check Event Viewer.

#### **Event Viewer**

**Event Viewer**- has three separate logs to inspect:

- Application - logs all information pertinent to the running of applications, including failures.
- Security - records policy changes, logon and access attempts; may be used to audit file and directory access if enabled in the Properties for these. Auditing causes a small overall performance drop, so use only when necessary.
- System - shows all significant system activity. After checking connections, the System log should be your first step in diagnosis

Log items are marked with a blue I for routine informational items, a ! in yellow for events worth watching, and a red stop sign for items which may be critical to operation, such as the failure of a service to start.

Filtering is available to narrow the events listed, and is in the View drop-down. Events may be filtered by date/time, event ID, event type, user, and the event source. As hundreds of system events are logged per hour, narrowing the items viewed is a good idea.

All logs may be recorded as a file, (three options) in:

- Binary form that only Event Viewer can read
- Plain readable text, or
- Comma-delimited text that can port to an Excel spreadsheet.

### **Windows NT Diagnostics**

**Windows NT Diagnostics** - in Administrative Tools, or **WINMSD.EXE** from the command line, provides a snapshot of all important system configurations. No editing is possible, but everything about the system is viewable from here.



### **Performance Monitor**

**Performance Monitor** - provides a finely controllable EEG-like view (by default) of all aspects of system operation. Other views available are histogram (bar graph), report (numeric average), and alert, which can broadcast an admin alert over the network or be set to run a program when specified thresholds are crossed (such as less than 10% HDD capacity remaining).

Perfmon allows selection of:

- Objects--HDD, memory, processor; also processes, threads, pagefile, cache, system, browser, and more. When a utility is added (such as SNMP) it will add objects to the Perfmon list.
- Counters--specific aspects of the object chosen, such as Memory: page hits, page faults, page-ins, page-outs, allocated memory, unused memory, etc.
- Instances--specific occurrences of counters--page faults per sec, total page faults, "hard" and "soft" page faults...

Perfmon may be logged over time and used to establish a baseline of normal performance to compare against any abnormal activity.



## Task Manager

**Task Manager** - provides a quick and handy method of checking the system status and managing applications. Right-click on the taskbar or press Ctrl-Alt-Esc to invoke it. TaskMan has three tabbed pages to view:

- Application - shows all running programs, and may be used to shut down any that are unresponsive by usual means.
- Processes--shows all running processes and resources used by each. The priority of these may be changed here.
- Performance--a rough look at CPU and memory usage in real-time. Good for a quick overview and to identify if Perfmon is needed.

Check out:

<http://www.i386.com/default.asp?page=pages&category=ADMIN&keyword=booting>  
<http://www-csag.ucsd.edu/projects/comm/ntrsc.html>

No exp with NT? Check out these demos

<http://www.exitnow.com/skillbuilder/viewlets/windowsnt4.htm>

## NT Boot Problems

**If experiencing boot problems, do not log on.** Same thing applies to Windows 2000. Upon logon, the boot process is completed, and parts of the registry are backed up as being good. It's even called "LastKnownGood" (not a reference to a bachelor party BTW). So instead of logging on and saving a corrupt controlset key to the Registry, reboot and hammer the spacebar, which will restore the LastKnownGood settings to the current Registry. Choose a hardware configuration and press L. This may also work if editing the Registry directly causes those instant problems previously warned about, or if a corrupt driver is loaded and crashes the system.

If the bootup fails completely, pull out the three boot disks and the Emergency Repair Disk created on installation (and hopefully kept current). The ERD is not a boot disk. It contains compressed Registry files and a program which extracts and overwrites them into the damaged Registry.

Read More on Using **RDISK /S** to create ERDs in NT 4.):

<http://www.cert.org/security-improvement/implementations/i028.01.html>

**Note:** The **ERD** is made or updated by running RDISK.EXE (the /S switch is recommended--it updates security and account information). Click either Create or



Update Repair Disk ("Create" requires a preformatted floppy). It is possible to run over the capacity of a single 1.44MB disk; RDISK prompts for another if so.

The boot disks may be produced after installation by running WINNT32.EXE with the /OX switch. This does not reinstall the OS, it just makes the floppies.

If the system partition changes, the **BOOT.INI** file (about the only .INI file NT uses) will need editing (the system partition is the one with the boot files--not the boot partition, with the system files. Confusing, but true.). The RASH (Read, Archive, System, Hidden) attributes will have to be removed to edit it, and restored after. Remember that the controller and disk values begin at 0, and the partition numbering begins at 1. Error messages involving NTLDR or NTOSKRNL are your clue that BOOT.INI needs attention.

Read more on Troubleshooting Startup and disk problems:  
<http://www.microsoft.com/TechNet/winnt/reskit/troubles.asp>

### Troubleshooting Printers

Printers (or Print Devices in NT lingo) are another story in themselves. The first things to check are always the physical side:

- Is the printer on?
- Is it out of paper?
- Is there a paper jam inside?
- Is the cable connection secure?

When NT workstation sends a print request to an NT server, the server automatically checks the client for the correct printer driver. If not present, or if out of date, the server downloads the printing software to the client. The driver is rarely the problem between NT systems.

As with everything else NT, different groups and users can have different levels of rights assigned. Different printer shares may vary as to rights granted. Each user or group can have different priorities, or scheduled hours of use. Any or all of these may cause a problem.

If the printing process is running slowly, check to see that the spool directory drive has enough space. By default this is in the same partition as the system files; this



can only be changed in the Registry by directly editing. Keep the printer spool drive defragmented.

**Note:** As NT has no native defrag utility, this is done by hand or with a third-party application.

In the case of complete printing failure, try:

- Stopping and restarting the spooling service may clear the jam.
- Deleting and reinstalling the printer is a last resort--all the shares, rights, and other settings will have to be redone.

Logging and auditing may be enabled for printers. These entries are sent to Event Viewer, and can be filtered for easier inspection.

**Note:** Much of the Troubleshooting in NT is the same for Windows 2000.

## Windows 2000

Windows 2000 (Win2K for short) is another leap from the previous versions of Windows in that it basically combines the best parts of all its predecessors.

### Versions

There are four versions of Windows 2000 (though you really need only deal with what is common to all of them, and the first one in particular):

- Windows 2000 Professional – desktop/client OS \*\*\*
- Windows 2000 Server – server platform
- Windows 2000 Advanced Server – enterprise edition
- Windows 2000 Datacenter Server – most powerful server

Read more about Server vs. Professional:

<http://www.microsoft.com/technet/chats/trans/sw20620.asp>

### Features

- Windows 2000 provides built-in networking support
- Full Internet integration
- Customizable Admin Tools and Start Menu (a learning menu)



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- Better Hardware support – good PnP support, compatibility between 98 and 2000 drivers
- [USB](#) support
- File System support for FAT32, FAT16, NTFS4, and NTFS5 (default)
- Backup Options – including a utility for scheduled backups (Task Scheduler)
- [Kerberos](#) authentication protocol and Smart Cards for security (file level encryption and user identification for Internet access)
- [VPN](#) and remote/mobile user access
- [IPP](#) (Internet Printing Protocol)

### **Installing Windows 2000**

There are three ways to install Windows 2000:

1. From the Win2K setup floppies, then loading files from the CDROM
2. Booting from the CD
3. Connecting to the network server and installing from shared location

### **Windows 2000 Hardware Requirements/Recommendations**

	<b>Min Required</b>	<b>Recommended</b>
Processor	Pentium 133 (Ha! Good one, Bill)	Pentium 350 MHz
Memory	64 MB	128 MB
Display	VGA	SVGA
Disk Space	650 free MB, 2 GB available	2 GB free, 6.4 GB available
Others	Floppy drive, keyboard, mouse, 12x CDROM (not req'd if installing over a network)	24x CDROM, floppy, PCI NIC



All devices should be on the Win2K Hardware Compatibility List (HCL) – HCL.TXT file is in the SUPPORT folder on the Windows 2000 CD.

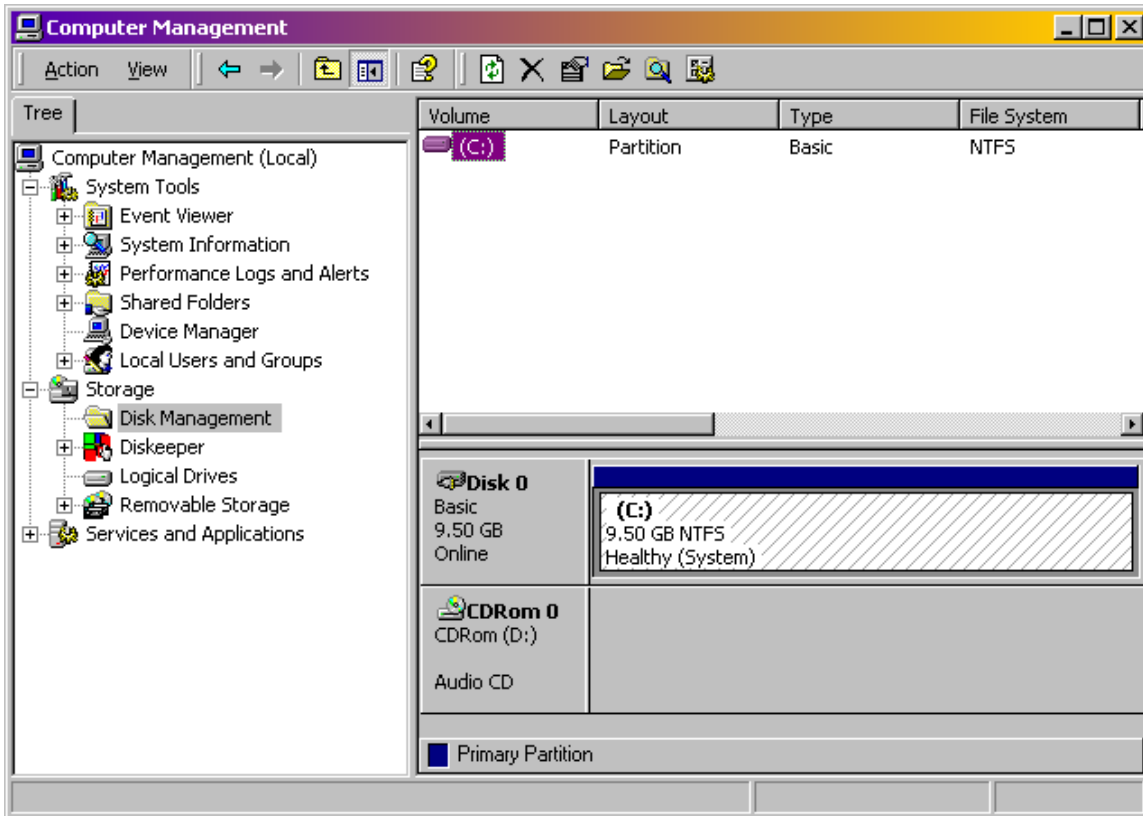
Read more on HCL:

<http://www.microsoft.com/hcl/default.asp>

### **Windows 2000 Partitions**

Windows 2000 can be installed on an existing Partition or a new one. The Setup program allows you to choose (select, create, delete) partitions for the OS only. Partitions must be at least 650 MB, but 1 GB is recommended.

Leaving FDISK behind now, you can create partitions using the Disk Management Utility after Install.



### Domain or Workgroup Selection

Windows 2000 ships with built-in networking. Win2K allows workstations to operate as members of workgroups and domains.

- A **Workgroup** is a group of computers operating as a P2P network sharing resources and connections and user-level security at the workstation.
- A **Domain** is a collection of computers sharing the same security database (Active Directory service) with user accounts and domain security information.

Before the Installation, you will need:

- Domain name in your DNS (Domain Name System) on your server
- Computer account within the domain



- Domain Controller and DNS Server (Win2K Server must have a Domain Controller, which holds the user account and validates logins on the DNS Server.)

### Installation Process

Depending on the type of installation (network, local) you may also need to Create a Distribution Server and configure the client workstation for Network Installations first.

1. Create boot floppy disks (you'll need 4) from the Win2K CD. Open **Windows Explorer -> My Computer** and go to the CD subdirectory **\BOOTDISK**. Double click **MAKEBOOT.EXE** and select the floppy drive (A:). You will be prompted for the next disk. When done, click Close.
2. If you are creating a distribution server to install the OS across a network, you will need to create a folder (**W2000P**) for you source files, and copy all the files from the **I386** folder on the Windows 2000 CD into it. Then, share the folder to be able to access it from the client machine. This is your distribution share.
3. At the client machine, make sure you have the minimum hardware requirements (650MB!!)
4. If this is an upgrade, use the existing Network client OS to connect to your shared network folder W2000P. If this is a client machine without a [NOS](#), use a boot disk which includes MSClient (for network connections)
5. TYPE in **NET USE W: \\Servername\W2000P** to connect to the distribution share.
6. Run the Setup program: WINNT32.EXE on 9x/NT machines; WINNT.EXE on Win3.x machines.
7. The WINNT/WINNT32 program will create a Temporary folder and copy the installation files into it.
8. Restart you computer to begin the installation process.

### After restarting the machine:

1. Start the setup program



2. Text Mode setup
  - Create partition for Win2K
  - Select the File System
  - Format the partition, if needed
  - Copy installation files to the hard drive
3. Restart the computer
4. Setup Wizard (graphic mode)
  - Choose Regional Settings
  - Enter name and organization
  - Enter the Product Key (write it on the CD!)
  - Enter a 15 character computer name, unique to the network (ask your Net Admin for this)
  - Choose a password for the local Administrator account
  - Fill in the Date and Time
5. Network Configuration
  - Auto-detects NICs and installs Windows Networking (Client for Microsoft Networks, File and Print Sharing, TCP/IP)
  - Choose to join a workgroup or a domain
6. Final Bits to Tidy up
  - Create Start menu shortcuts
  - Setup choices applied
  - Configuration saved to hard drive
  - Temp files deleted
7. Last Restart



### **Upgrading to Windows 2000**

On Windows 9x or NT machines, use WINNT32.EXE to start Setup. On Windows 3.x, you use WINNT.EXE. This will create a temporary folder and copy installation files into it. The computer will need to restart before the rest of the Installation process.

<http://www.microsoft.com/windows2000/professional/howtobuy/upgrading/path/win9x.asp>

### **Boot Sequence of Windows 2000**

1. POST
  2. PnP Devices
  3. Locates MBR
  4. NTLDR (Real mode to 32 bit memory model and then loads the drivers to read the file system))
  5. BOOT.INI (location of other OS files)
  6. BOOTSECT.DOS (for multi-boot systems when another OS is detected)
  7. NTDETECT.COM (hardware detection)
  8. WINNT\SYSTEM32\NTOSKRNL.EXE (initialized \*\*\*Win2k kernel file\*\*\*)
  9. HAL.DLL (Hardware Abstraction Layer for hardware independence)
  10. WINNT\SYSTEM32\CONFIG\HKEY\_LOCAL\_MACHINE\SYSTEM key (the key from the Registry for the device drivers to be initialized)
  11. WINNT\SYSTEM32\drivers\\*.SYS (low-level device drivers loaded)
- Graphic Display...
12. HKEY\_LOCAL\_MACHINE\HARDWARE key (the key from the Registry for detecting hardware and settings)
  13. Clone copy of control set is created (prior setup)
  14. Device Drivers loaded
  15. Windows 2000 services started
  16. Logon prompt (after login, the clone control set is copied to the LastKnownGood control set in case of a system boot failure)



**Note:** Just like NT, the LastKnownGood Control set remembers the last time Win2K booted successfully. If Win2K fails on startup, DO NOT logon before shutting down the system, as it will overwrite the last good config. Pressing F8 on Startup will get you to the Last Known Good selection on the Advanced Option menu.

After a failed boot in NT or 2000, **do not logon.**

### **Advanced Options Menu**

In Windows 9x, this menu was called the Startup menu, but in Win2k, it's called the Advanced Options menu. Press F8 to access it as the system is booting:

- Safe Mode
- Safe Mode with Networking
- Safe Mode with Command Prompt
- Enable Boot Logging (WINNT\NTBTLOG.TXT)
- Enable VGA mode
- Last Known good Configuration
- Directory Services Restore Mode (Domain Controllers only)
- Boot Normally

### **Windows 2000 Required Boot Files**

- NTLDR (loader file)
- NTDETECT.COM (recognizes hardware)
- BOOT.INI (OS menu)
- BOOTSECT.DOS (alt boot sector)
- NTOSKRNL.EXE (kernel)
- HAL.DLL
- SYSTEM32\CONFIG (registry)
- SYSTEM\32\DRIVERS\\*.SYS (drivers)

### **Administering Windows 2000**

Win2K has a centralized location for Management Utilities called the **Microsoft Management Console (MMC)**. It is the location for applications called Snap-ins. Consoles can be saved in either author or user mode, with full access, limited access (multiple window), or limited access (single window).



The MMC (Microsoft Management Console) is the central location for Windows 2000 management utilities (called Snap-ins). **Start -> Run -> MMC**

More on MMC Snap-ins:

<http://support.microsoft.com/support/kb/articles/Q230/2/63.ASP>

<http://support.microsoft.com/support/kb/articles/Q271/1/35.ASP>

## **Disk Management and Resources**

### **Volume Sets**

A volume is a unit of storage, logical or physical (whole or part of a drive) used by Windows 2000 dynamic storage for fault tolerance and backup:

- Simple Volume – No fault tolerance. disk space from one disk only.
- Spanned Volume – No fault tolerance. Disk space from more than one disk, information is written on one disk until full, then the next, then the next
- Striped volume (aka [RAID 0](#)) – to improve disk access. Data is written simultaneously to all disks (stripe set). Stripe Sets may be created by selecting 2 to 32 areas of free space on 2 to 32 physical HDDs. This enables writing and reading across two or more HDDs simultaneously and can speed up read/write access. There is no fault tolerance on a simple stripe set.
- Mirror Sets (RAID 1) and Stripe Sets with Parity (Duplexed) (RAID 5) are available only on NT/2000 Server. These use multiple HDDs for faster access and/or recoverability of data in case one drive fails.

### **User and Group Management**

Just like Windows NT, Win2K has two types of accounts:

- Local (this computer login)
- Domain (accounts reside on the domain controllers)

Like Windows NT, There are two built-in User Accounts that can be changed, but not deleted:

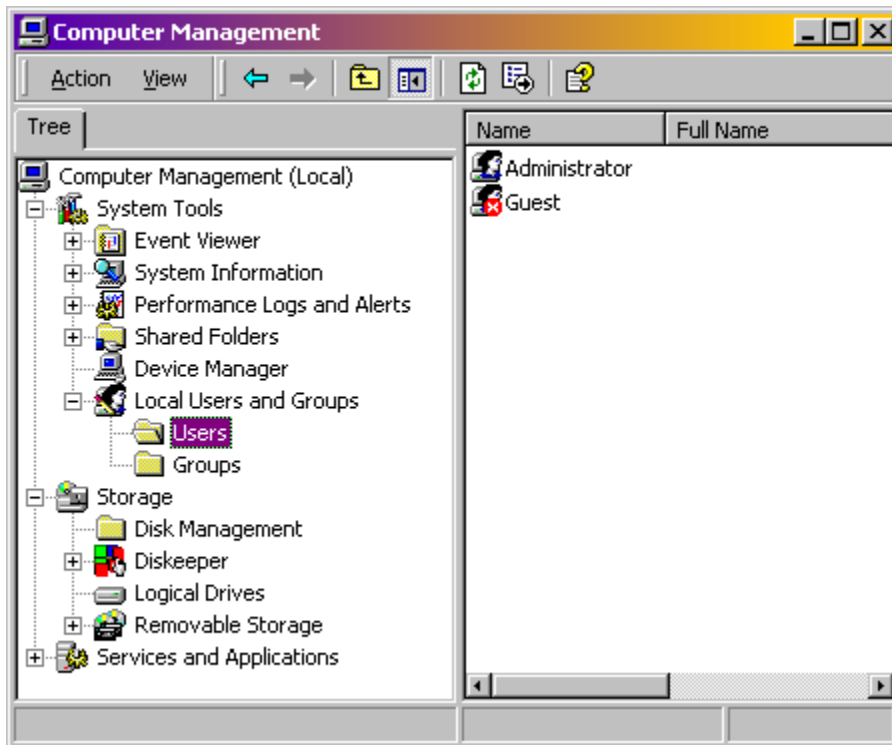
- Administrator (god rights)
- Guest (default disabled)

### **User Accounts**

You create User Accounts using the **Local Users and Groups** snap-in:



Go to **Admin Tools -> Computer Management -> Users folder ->**



Right click and select **New User:**



**New User** [?] [X]

User name: [ ]

Full name: [ ]

Description: [ ]

Password: [ ]

Confirm password: [ ]

User must change password at next logon

User cannot change password

Password never expires

Account is disabled

[ Create ] [ Close ]

Fill in the fields:

- Username (required)
- Full name (helpful in larger environments)
- Description
- Password (recommended)
- User must change password at next login
- User cannot change password
- Password never expires
- Account is disabled

### Groups

A group is simply a collection of user accounts that make it easier to assign permissions and rights to a number of users.



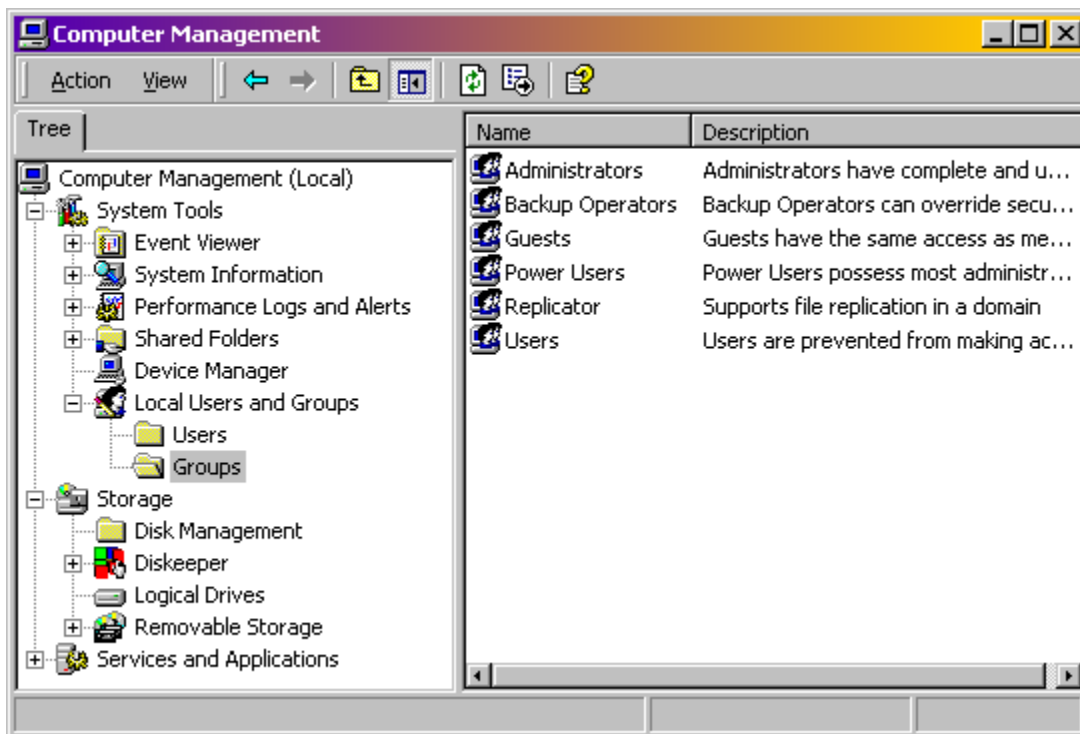
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Win2K Professional (like NT Workstation) can only create Local groups. You need a unique name (less than 256 character with no back slashes: \), and can add and remove members as needed.

**Note:** Shift + Click to add multiple user accounts at once, or use Ctrl + Click to add a consecutive list of users.

**Built-in Groups:**

- Administrators (god power)
- Power Users (some admin privileges)
- Backup Operators (can backup and restore folders/files)
- Replicator (when directory replication is used)
- Users (all new users are automatically added to this group)
- Guests (limited rights)





Win2K also has Built-in System Groups:

- Everyone (all users who access the system)
- Authenticated Users (all users with a valid account)
- Creator Owner (Group owners)
- Interactive (user currently working locally)
- Network (groups of user accounts/users currently connected to the network)

### **Managing Security**

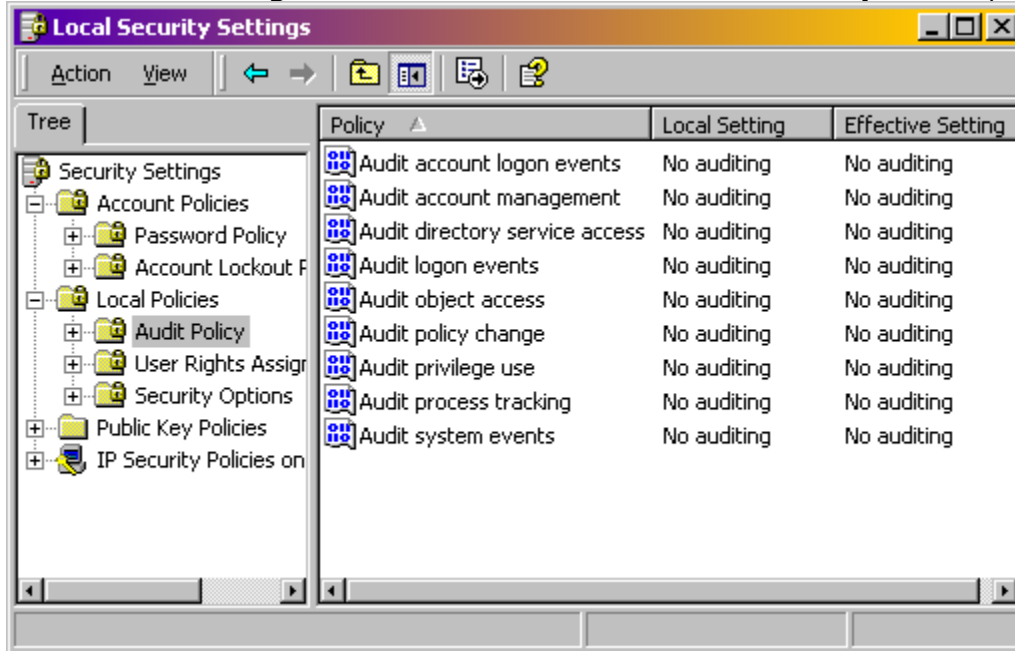
#### **Auditing**

Auditing enables the Administrator to track user accounts and system events, using the security log in Event Viewer. This log includes the action taken, the user who did it, whether successful or unsuccessful. Also includes:

- Account management
- Logon events
- Object access
- Policy changes
- Privilege use
- System Events

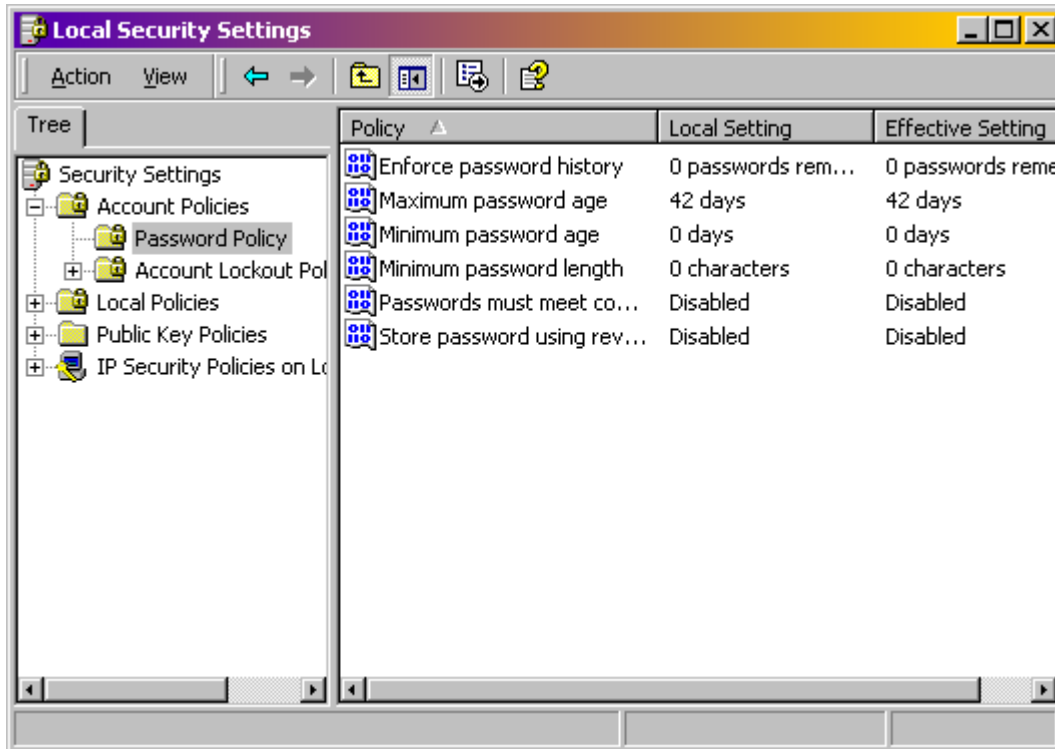


Go to **Start -> Programs -> Admin Tools -> Local Security** to set up Auditing:



And Password Policy to:

- Enforce password history (can keep up to 24 passwords, to prevent reusing)
- Max password age (42 days, below)
- Min password age (when a password can be changed again)
- Min password length (...to a max of 14 characters)
- Meet complexity requirements
- Account Lockout duration (time of lockout after exceeding logon attempt threshold)
- Account Lockout threshold (number of login attempts allowed)
- Reset account lockout (after a number of login attempts)



Logon Security Options include:

- Allow system to be shut down without having to logon
- Disable CTRL + ALT +DEL requirement for logon
- Do not display last user name on logon screen
- Automatically logoff user when login time expires
- Rename Admin account
- Rename guest account
- **NOTE: There are MANY options here...**

### **Troubleshooting Windows 2000**

For system recovery, try the **Recovery Console**, a command line interface, or **Emergency Repair**, which copies system files and replaces ones damaged/missing, on the Windows 2000 CD. Select the **Repair** option for either Recovery Console or Emergency Repair.



Read more:

[Top 15 Admin Tasks for Win2K](#)

[MS How it Works](#)

[MS Step-by-step](#)

[Troubleshooting what to know](#)

[Windows Professional HELP](#)

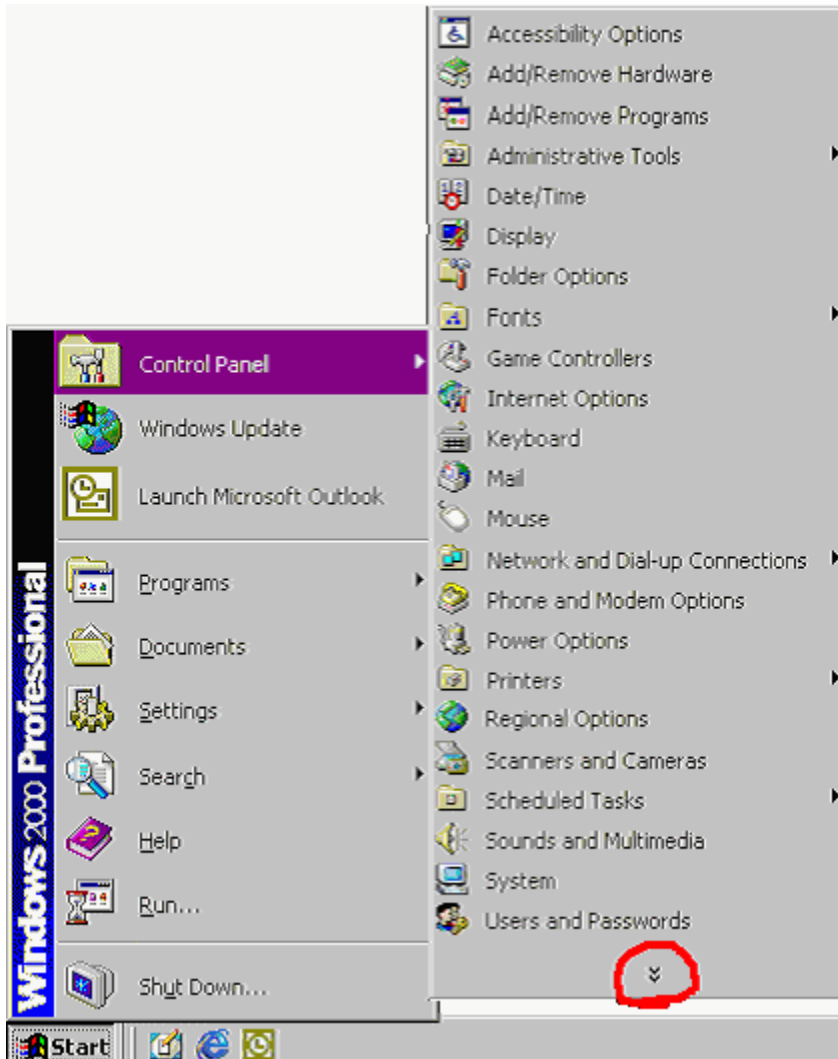
Don't have access to Windows 2000? Check out [MS's online demos](#)

### **Windows 2000 Utilities**

There are at least 3 ways to open every utility: from the Start Menu, from the Control Panel, from MMC.



**Start -> Control Panel**

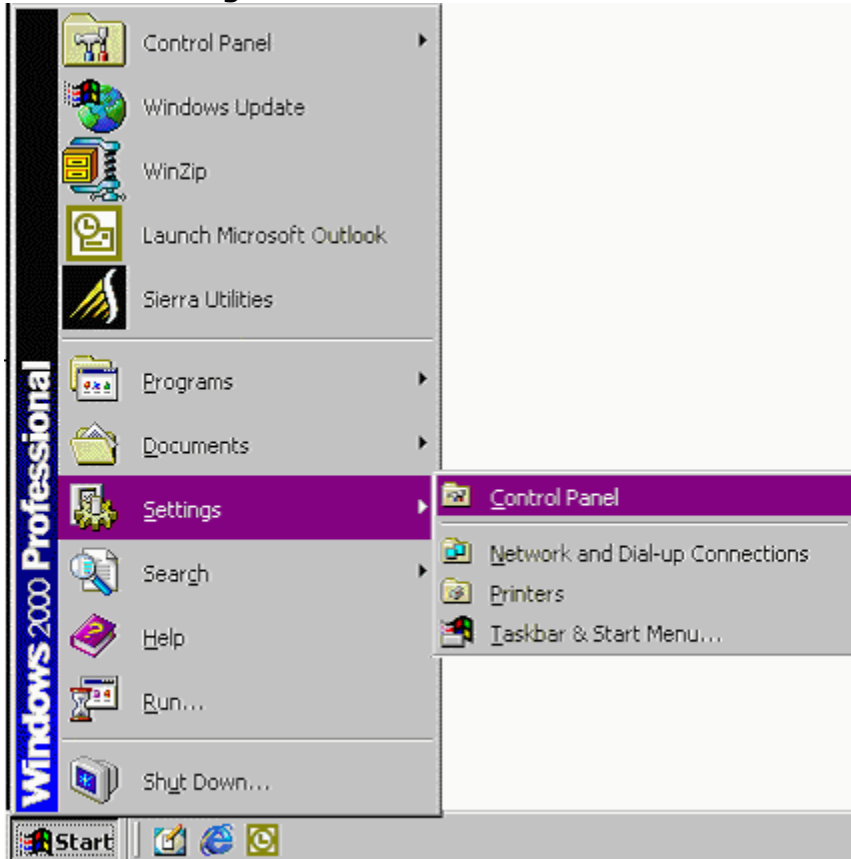


See the two little down arrows? That is the (annoying) learning menu in Windows 2000. The menu only shows you what you have accessed recently. If you don't use it, Windows doesn't show it. If you mouse over the two little down arrows, the menu opens up.



You can turn off the learning menu:

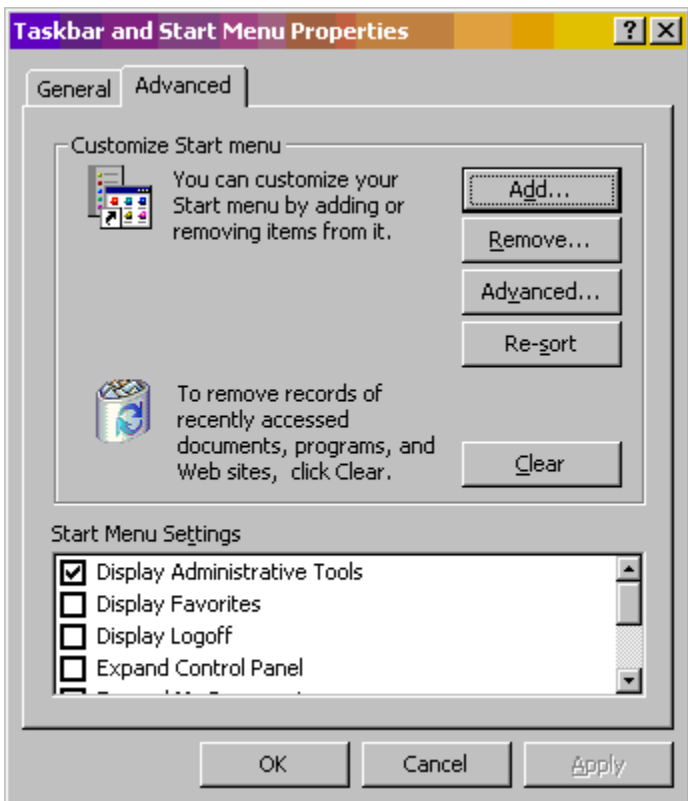
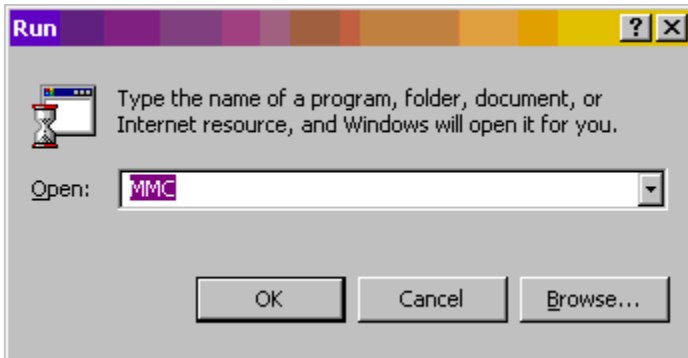
**Start -> Settings -> Control Panel**



**Start -> Run**



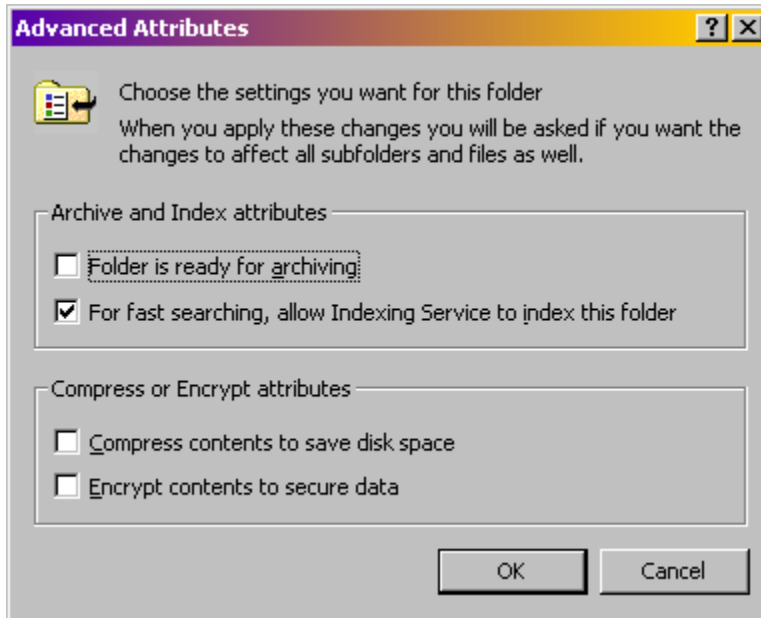
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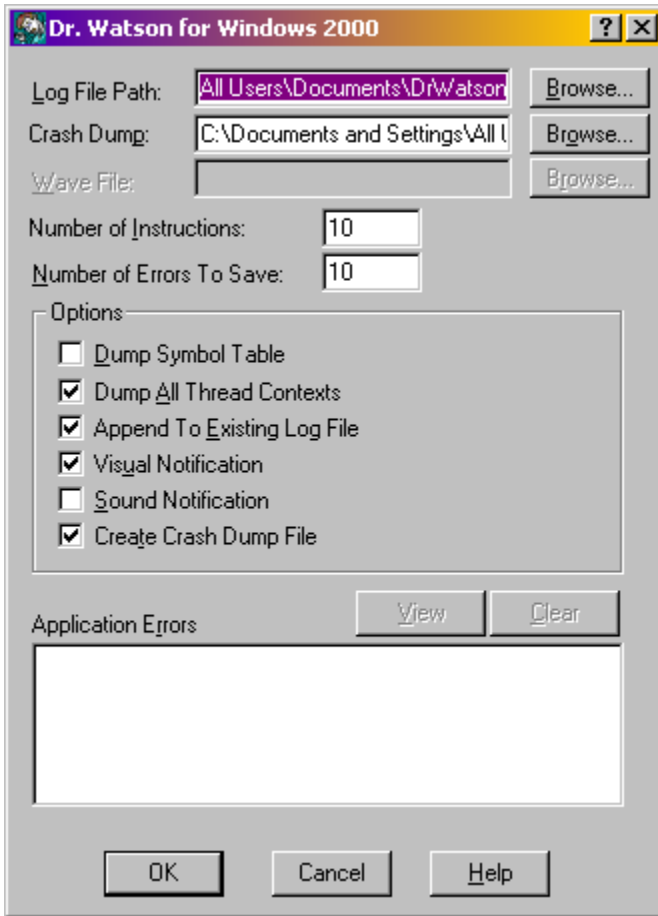


### Other Win2K Utilities

- Convert.exe – to convert from FAT/FAT32 to NTFS
- File Compression and Encryption – access from **Folder/File Properties** (right click) -> **General tab** -> **Advanced button**



- **Disk Quotas** are accessed from right clicking on a drive and selecting **Properties** -> **Quota tab**. Disk quotas are used on a per-user, per-volume basis and define the amount of space used for each users files and folders.
- **Encrypting File System (EFS)** – allows NTFS volumes to be secured.
- **Dr. Watson** - detects information about system and program failures, then records the info into a log file. In the event of a program error, Dr. Watson starts automatically.



**Note:** Encrypted files can't be compressed, and compressed files can't be encrypted.

Read more on EFS:

<http://www.microsoft.com/technet/win2000/win2ksrv/technote/nt5efs.asp>

### **NT/2000 Registry**

The Registry in Windows is the central source of configuration information for the system. Those .INI files (which in older OSes performed this function also) that



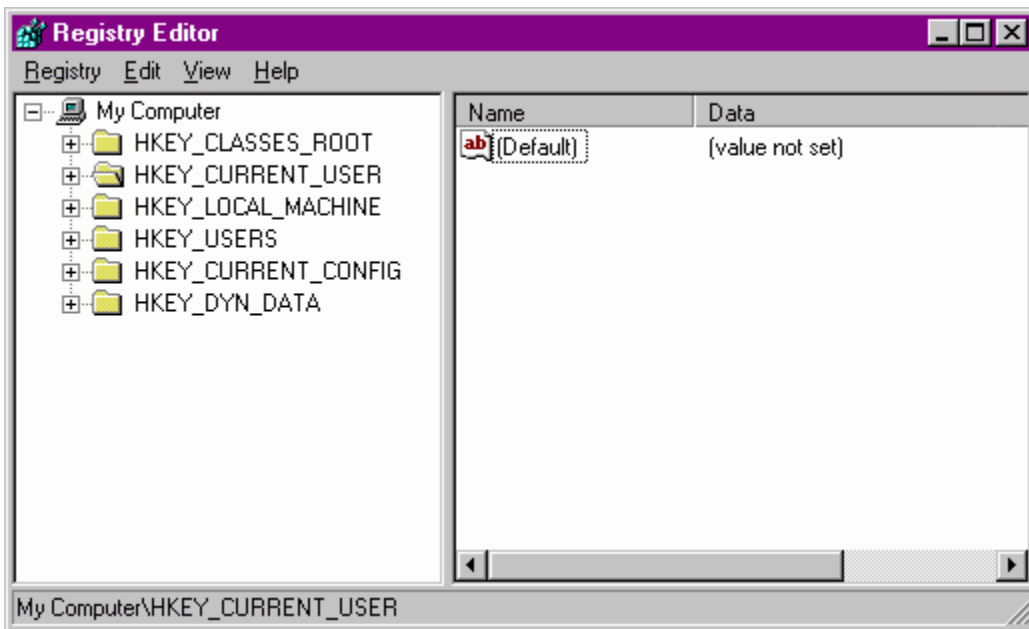
remain are strictly for backward compatibility with 16-bit applications.

It is possible to edit the Registry directly with two separate utilities: REGEDIT.EXE and REGEDT32.EXE. The major difference is; REGEDIT is easier to find keys with, and REGEDT32 is easier to edit keys with. This is only recommended for experts—one, repeat ONE false entry can crash the system instantly, and force a fresh reinstall of the OS. An Administrator can view and edit the Registry of a remote machine.

The GUI tools are far safer and easier to use, and can handle 95% of configuration tasks.

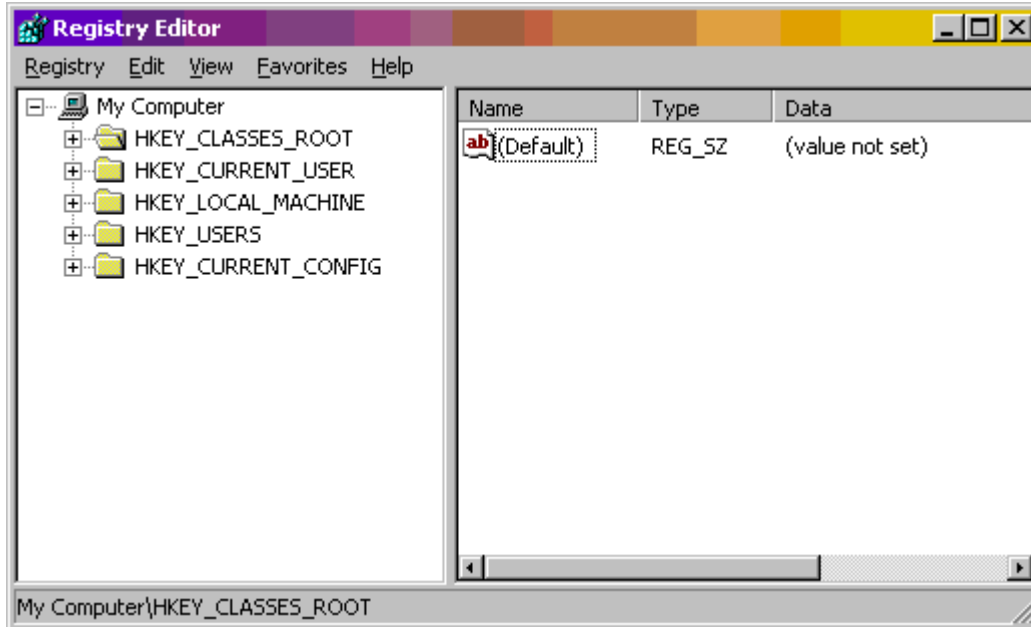
Click **Start -> Run** and type either **REGEDIT** or **REGEDIT32**

### Windows 98 REGEDIT





## Windows 2000 REGEDIT32



See also section on [Windows 9x Registry](#)

## Control Panel

Control Panel is the main configuration tool for managing the user environment and the system environment (system settings). One machine may store separate local user profiles so that each user who logs on is given his own settings for the Desktop, applications, printers, Taskbar, Favorites, and History. If the user has no local profile, a call to the server will deliver his roaming profile if the user has one stored; otherwise a Default user profile is loaded.





Icons in the Control Panel represent utilities including:

- **Add/Remove Programs** - a wizard walk-through for installing or modifying applications
- **Add/Remove Hardware** - a wizard walk-through for installing or modifying hardware and plug n play devices
- **Network** settings--local IP address, computer name, Domain/Workgroup name, names and IP addresses of DNS, WINS, DHCP servers, and hardware settings for NIC
- Peripheral devices - configure the **Keyboard, Mouse, Modems, Game Controllers**
- **Internet Options** - configure home page, history, internet security
- **Multimedia** - manage settings for audio, video
- **ODBC** - manage database connectivity
- **Display** settings - controls resolution, refresh rate, colours used, wallpaper, screensavers
- **Printers** and Ports--comm settings for serial ports; install, remove and set printer options (notice this is a shortcut)
- **Power Management** - standby and power scheme settings
- **Fonts**--add and remove font selections, toggle TrueType
- **Date and time** - duh
- **SCSI** - handles Small Computer System Interface settings for SCSI controllers, tape drives (if you have a SCSI host adapter)



SCSI Adapters

- **System** - system startup settings, system environment variables, virtual memory settings, recovery options, and multitasking settings

**In NT:**



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- **User Manager** – (NT) creates, edits, and views user profile information. Sets user permissions, local group permissions, and local system policies. Two permanent user accounts are set by default--Administrator and Guest. These can be changed but never deleted.
- **Disk Administrator** – (NT) formats the HDD(s), sets partitions, chooses file systems.
- **UPS** - configures uninterrupted power supply.



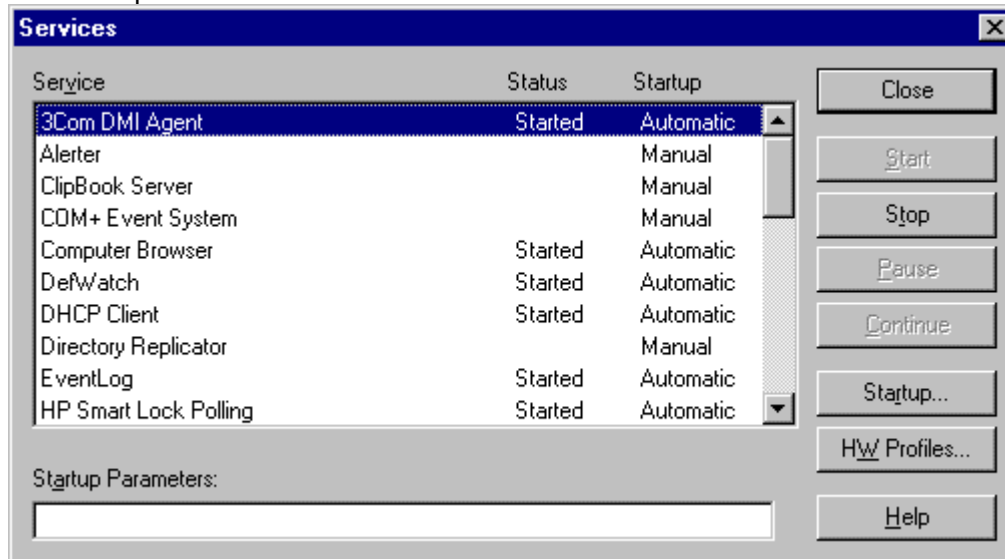
UPS

- **Services** – a shortcut only. Starts, stops and pauses various services.



Services

For example:





**In 2000:**

- **Folder Options** – settings for all folders



Folder Options

- **Users and Passwords** – where you set “Users must enter a username and password to use this computer” and “Require users to press Ctrl-Alt-Del before logging on”

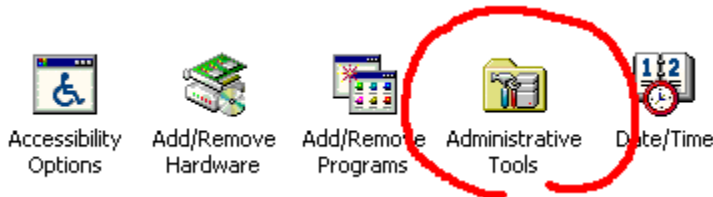


Users and Passwords

- **Administrative Tools** Folder shortcut (also **Start -> Programs -> Admin Tools**)

**Note:** When the Add/Remove Hardware wizard closes (click Finish) in Windows 2000, it opens the Hardware Troubleshooter in the Windows help.

Part of the Windows 2000 Control Panel:



Windows 2000 Admin Tools:

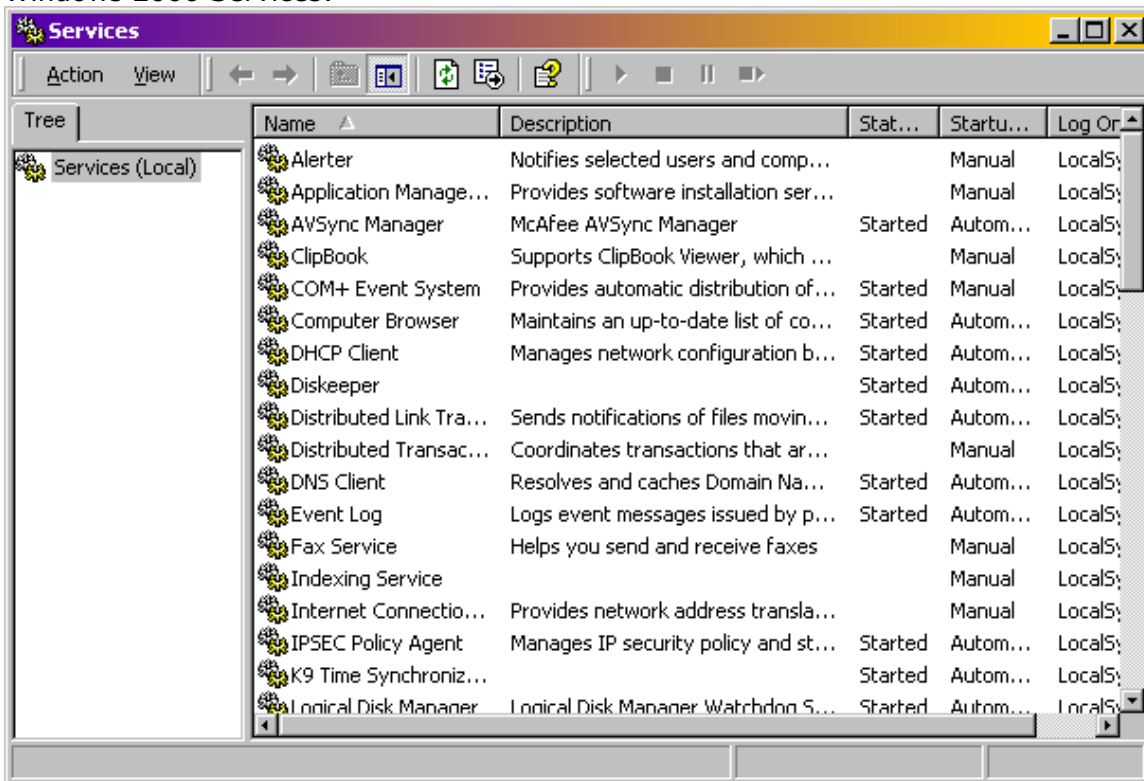


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**Note: Services** is now a shortcut under Admin Tools in the 2000 Control Panel

Windows 2000 Services:





Read more about using the [Windows 2000 Control Panel](#)  
Read more about [Desktop User Profiles](#)

## Major Differences Between Windows Versions

Windows 95, 98, NT, and 2000 all share basically the same desktop, but there are some significant differences.

To compare, see also:

<http://www.microsoft.com/technet/win2000/win2kpro/default.asp>

<http://www.microsoft.com/technet/win2000/win2ksrv/default.asp>

<http://www.microsoft.com/technet/winnt/default.asp>

<http://www.microsoft.com/technet/win98/default.asp>

See also:

[All MS Oses in 1500 Words or Less](#)

### **Windows 9x**

The main differences between Windows 95 and 98 are desktop changes. Specifically, Windows 98 has:

- Fully integrated IE
- Full 32-bit operation (including 32-bit [WDM](#) device drivers)
- Standardised 32-bit drivers
- FAT32 file system
- Long filenames
- Pre-emptive multitasking (applications given a *timeslice* to complete a task)
- Support for more hardware (including multiple displays) and remote access
- Plug N Play support (Windows 95 was leaps ahead of Windows 3.x)
- More System Management Utilities, like MSI (Microsoft System Information), Dr. Watson and Maintenance Wizard

Also read: [Pre-emptive Multitasking Explained](#)

### **Windows NT**

Windows NT is significantly different from previous Windows Oses. NT is/has:

- Real 32-bit environment



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- More expensive
- More robust (reliable)
- Much better security (mandatory login, auditing, access, control)
- User, group, and permission management
- Requires a better system (more hardware) to run (RISC-based machines, multiple processors)
- Support for Multiple platforms and other Oses (POSIX and OS/2)
- Better multitasking and [multithreading](#)
- More networking capabilities built-in
- Multiple protocol support
- NTFS (supports FAT or NTFS file systems)
- More of a business OS, than home use
- \*\*\*POOR PnP support\*\*\*
- \*\*\*No Device Manager\*\*\*

### NT Server vs. Workstation

- Server allows unlimited network connections, where as Workstation allows only 10
- Server allows up to 256 Remote sessions; Workstation only 1.
- Server login to local machine and domain; Workstation login to local machine
- Server has fault tolerance (RAID 0,1,5)
- Server can handle [SMP](#) and 4 processors; Workstation [SMP](#) and 2 processors
- Server has a domain-based management architecture

Same differences are seen comparing Windows 2000 Professional and Server.

### Windows 2000

Windows 2000 combines the best of all versions of Windows -- supposedly ;)

- File Level Encryption ([EFS](#))
- Most expensive
- You can choose your file system with 2000, either FAT32 or NTFS
- Full Internet integration (including IPP – Internet Printing Protocol – and ICM – Image Colour Management)
- Even better hardware support (larger disks, great PnP support, multiple processors like NT)
- Most hardware intensive OS yet
- Scheduled Backup options, including CD-R and ZIP devices, and Tasks
- Increased networking requirements



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- Improved Security (Kerberos Authentication Protocol, aka encryption) – file level encryption
- Customisable admin tools (MMC, Snap-ins), start menu (a “learning menu”)
- Cannot delete system-required files (as 2000 keeps a second copy that will automatically replace any deleted system file)
- Active Directory support
- Auditing
- Better user, group, and permission management
- Mobile users support

### **Windows 3.x, XP, Me and Linux**

None of these OS are covered on the A+ exam – so we’re not covering the major differences between them. ;)

## **Windows File Systems**

There are three Windows file systems:

- [CDFS](#)--Compact Disc File System; a read-only file system, not configurable
- [FAT](#)--File Allocation Table; primarily for compatibility with other OSes (dual-booting)
- [NTFS](#)--New Technology File System; fast, reliable, secure, and robust
- (Also HPFS – High Performance File System – to convert from OS/2)

### **File Allocation Table (FAT)**

Windows 9x uses FAT32, with FAT16 drivers for backward capabilities.

Each partition on a hard drive needs to be formatted to hold files (high level formatting) and folders that the OS can access. The FORMAT command creates and configures File Allocation Tables (FAT) and creates the root directory to build the OS upon.

Hard drives store data in areas called sectors, up to 512 Bytes. If you have a file smaller than 512B, the rest of the sector goes to waste. If you have a file over 512B, the OS fills unused, non-sequential sectors until the file is stored completely (this is why you will eventually need to “defrag” every hard drive, too). Once files are written to the disk, the OS needs to remember which sectors have parts of which file: in other words, a File Allocation Table.



FAT16 means the file system uses 16 bits to write addresses (4 hexadecimal numbers: 0000-FFFF). By doing the math, you will see why we outgrew this years ago. Our hard drives got too big: 16 bits equals 65,536 (64K) of sectors.

$$65,536 (64K) \times 512K = 33,554,432 \text{ Bytes (or 32,768 KB or 32 MBs)}$$

To get partitions larger than 32MB with FAT16, we used *clusters* or *file allocation units*: contiguous sectors acting like one sector in the FAT table. With between 4 to 64 sectors/cluster, FAT16 was able to see partitions up to 2 GBs (32K clusters).

With Windows 95 OSR2, [FAT32](#) was introduced. FAT32 means the FAT table has 32-bit addresses (8 hexadecimal numbers). This also enabled long file names (beyond the 8.3 dos standard). Depending on the cluster size (4-32 sectors/cluster), FAT32 can read partitions up to 2 Terabytes (4K clusters).

Under NT, FAT is actually [VFAT](#), Virtual FAT. The major difference is that hardware is not accessed directly (A virtual device driver "fools" the system into thinking that it is), which contributes to robustness. The file system will not crash with the hardware. It relies upon a linked-list directory structure, which reduces performance on large partitions (each directory entry is linked to the next--the longer the chain, the slower the access) and limits its practical size. A FAT partition is required on [RISC](#) machines (for the boot files) and on dual-boot (NT and DOS/Windows systems) machines.

The VFAT used by NT is more flexible than the old DOS FAT--filenames up to 255 characters including the entire path are allowed, periods and spaces in filenames are fine, and case is preserved (without being case-sensitive--FILE.TXT equals File.TXT equals file.txt) Restricted characters are the same-- [ ] , ' / ; : \ = + ^ \* ? < > |

### FAT limitations

- No local security (share permissions only)
- Performance begins dropping on partitions over 200MB, especially with large numbers of files
- Performance degrades quickly by file fragmentation
- Theoretical upper limit of 4GB (improved from DOS FAT's 2GB)
- Low fault-tolerance; subject to physical and logical disk errors
- Supports only low-level file attributes (read-only, archive, system, hidden)



## A+ Operating System Technologies

- The root directory is limited to 512 entries. Since long filenames are stored in secondary directory entries (one per 13 extra characters beyond 8), too many of those can actually lead to Windows being unable to create files in root, and quite quickly.

**Note:** There is a command-line-only utility to change a partition from FAT to NTFS – convert.exe. (To convert back to FAT from NTFS requires third-party software not supported by NT) The syntax is:

```
C:\ convert [drive letter/partition]: /FS:NTFS /v
```

You cannot convert a drive while the drive is being accessed. It may be scheduled for conversion at next bootup, before shares are accessible.

**Note:** To convert from FAT16 to FAT32, the conversion utility is CVT1.EXE

### **NTFS**

There are two versions of NTFS, NT File System: 4 (NT) and 5 (2000). The following pertain to both.

- NTFS uses a MFT: *Master File Table*. NTFS allows you to adjust the sizes of clusters, and can support 2 Terabytes (default) up to 16 Exabytes.
- NTFS, as the name implies, is NT's proprietary file system. It supports far more useful characteristics
  - Fault tolerance
  - Extended attributes (such as date of creation),
  - Object-oriented file and directory security (including auditing file use)
  - File-level compression
  - Faster locating method (branching tree), and
  - A truly awesome maximum capacity.
- NTFS keeps a log of all read/write transactions. For example, if on a SCSI disk, it will automatically scan for bad clusters, mark them as bad and avoid them, and move data to good clusters. If the error is discovered during a write, the data will be rewritten to a sound sector. If a read operation discovers a bad cluster, however, it cannot be read, and the data is lost.
- Extended attributes were added for [POSIX](#) compliance. This includes time stamping for file creation, accessing, and modification. Filenames are case sensitive (e.g. file.txt and File.txt are treated as different and can be stored in the same folder). "Hard links", where the same file is accessed by two different filenames, is also supported.



## A+ Operating System Technologies

- Permissions can be set and auditing enabled for individual folders and files. The permissions differ slightly for files and folders, and can be combined with normal share permissions to allow very fine-tuning.
- NTFS supports compression at the drive/partition-, folder/directory-, or file-level.
- Search functions look for files alphabetically in a branching search. This is much faster than following entries linked in a consecutive chain. Space for new files is allocated dynamically, which means defragmentation is required much less frequently.
- The theoretical maximum size of an NTFS file or partition is 16 Exabytes. No existing hardware can take advantage of this. An Exabytes is  $2^{60}$  bytes...or a gigabyte OF gigabytes, for a total of 16 billion gigabytes in a single partition...not a limitation.

### NTFS4 Limitations

- Filenames may not contain the characters `><|*"/?:\`
- Does not support file encryption
- Works best on partitions over 50MB
- Cannot format 1.44MB floppies because of high overhead (about 5MB per partition) required
- If dual-booting to an OS other than NT, you must have at least one small FAT partition also.
- Must reboot after reformatting a ZIP drive or other removable media (looked all over, and can't find out why)

### NTFS4 vs. NTFS5

Windows 2000 uses an updated version of NTFS (sometimes called NTFS5). The major improvements are:

- File and/or directory encryption
- Per-user, per-volume disk quotas
- Hierarchical Storage Management (reparse points)
- Mount points
- Distributed link tracking support
- Sparse-file support
- Volume change tracking
- Encryption. Encryption. Encryption.

Windows 2000 Server will require the use of NTFS5 format on all domain controllers.



Similarly, it is likely that most other servers will be using the NTFS5 format to take advantage of the new Windows 2000 Server features.

**Note:** Installing Windows 2000 will automatically convert NTFS4 to NTFS5. Also, NTFS4 cannot repair NTFS5 volumes, but NTFS5 can repair NTFS4 volumes.

Read more on NTFS5:

[msdn.microsoft.com/library/periodic/period00/NTFSpart1.htm](http://msdn.microsoft.com/library/periodic/period00/NTFSpart1.htm)

[www.microsoft.com/TechNet/win2000/win2ksrv/da1100.asp](http://www.microsoft.com/TechNet/win2000/win2ksrv/da1100.asp)

[http://www.microsoft.com/NTServer/nts/deployment/migration/PrepWinNT/4\\_ThingsToDo.asp](http://www.microsoft.com/NTServer/nts/deployment/migration/PrepWinNT/4_ThingsToDo.asp)

Read more on Dual Booting issues with NTFS:

<http://www.microsoft.com/technet/winnt/winntas/Tips/techrep/dualboot.asp>

<http://www.sysinternals.com/ntw2k/freeware/NTFSCHK.shtml>

Differences between FAT and NTFS and HPFS (OS/2 file system)

<http://support.microsoft.com/support/kb/articles/Q100/1/08.ASP>

### **NTFS Folder and File Permissions**

NTFS permissions secure resources and determine user/group access.

Folder Permissions include:

- Read – ability to read
- Write – ability to view attributes, permissions
- List – ability to view names of files and subfolders
- Read/Execute – read, plus run applications
- Modify – Read/Execute and Write permissions, plus modify and delete
- Full Control – All of the above, plus changing permissions
- Deny – overrides any other permission



File Permissions include:

- Read – ability to read
- Write – ability to view attributes, permissions
- Read/Execute – read, plus run applications
- Modify – Read/Execute and Write permissions, plus modify and delete
- Full Control – All of the above, plus changing permissions
- Deny – overrides any other permission

Permissions are assigned with the Access Control List (ACL). User permission entries in that list are called Access Control Entry (ACE) to allow or deny access to files and folders.

## Viruses

### Types of Viruses

- Boot Sector – attacks boot sector, FAT table, partition table
- Program or Executable – attacks program files (like .COM, .EXE, .SYS for example)
- Excel/Word Macro – infects a document, infects templates and all documents created afterward
- Trojan – programs that do something other than what the user thinks they do
- Bimodal or Bipartite – boot sector and executable functions
- Polymorphic virus – changes its signature to prevent detection by anti-virus software

### Virus Sources

- Email attachments (word document, exe file...)
- Internet downloads
- Infected floppy disk

### Common Symptoms:

- Boot failure
- Reformatted drives (hard drive, floppy)
- FAT or MBR corrupt
- Files corrupt
- Strange messages/graphics on the screen



**Note:** Any error can be caused by a virus. Always better to do a virus check FIRST, especially when you encounter strange errors/problems.

### **Virus Prevention**

- Never turn the computer on (Hey! It works, okay!?)
- Anti-virus software ([McAfee](#), [Norton/Symantec](#), [Dr. Solomon...](#))
- Regular updates to your virus software (and regularly scheduled virus checks)
- Educate users (virus check email, attachments, Internet downloads)
- Know where the software came from
- Do regular backup

**Note:** Make sure you have clean boot disks just in case.

Protecting Users from themselves:

<http://www.microsoft.com/technet/maintain/protuser.asp>

### **Recovering from a Virus**

- Sometimes you can't. Accept that now.
- Boot from a *clean* floppy and detect, then remove the virus.
- Restore data from Backups (do another virus scan – make sure the backup isn't infected.)

See also:

[Practicing Safe Hex Pt. 1 \(About viruses\)](#)

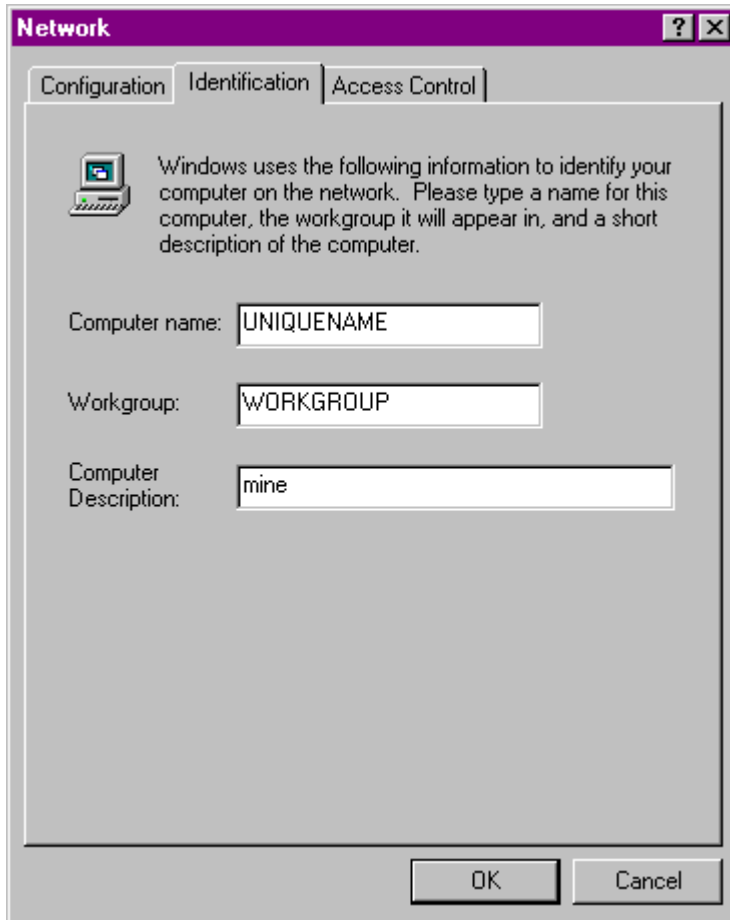
[Practicing Safe Hex Pt. 2](#)

[Practicing Safe Hex Pt. 3](#)

## **Networks**

A network is simply two or more computers able to communicate and share data. To network any computer, it must have a unique name (up to 15 characters) on the Network, in addition to a unique MAC Address and IP Address.

You set up the Computer Name, Workgroup and Description from **Control Panel -> Network -> Identification** tab:



**Types of Networks:**

- Peer-to-peer (Windows 9x)
- Server-based (Windows NT and 2000)

See also:

- [Networking the Basics - Part 1](#)
- [Networking the Basics - Part 2](#)
- [Networking the Basics - Part 3](#)



### **Network Protocols**

A [protocol](#) is the means by which one computer packages data and sends it out over the wire, and the receiving computer unpackages it for use. Protocols define a common standard for communication between machines, and specify the sequence of actions taken during transmission.

Network protocols break data into [packets](#) for transmission. This is more efficient and fail-safe than a continuous stream over the wire. If an error occurred, it would affect the entire transmission and the whole thing would have to be resent. If a packet is lost or corrupted, the packet is simply resent with less time and effort. Breaking data into packets also means several machines can send data at about the same time.

A packet consists of three parts (exact contents differ between protocols):

- Header--begins with a signal that a packet is being sent, names/addresses of source and destination machines, and synchronization info for reassembly
- Data--the actual information "inside the envelope"
- Trailer--usually contains error-catching information, such as Cyclic Redundancy Check

The protocol at the source machine is responsible for breaking the data into the right size chunks, attaching header and trailer information, and transmitting the packet. At the receiving end, the protocol reads all headers going by for its own name or address, intercepts the right packets, strips off the "envelope", and places the data in a cache or buffer. The "envelopes" are then used to reassemble the data chunks into the proper order and check for errors.

When we refer to a "Protocol", we most often mean a group, or suite, of separate protocols that work together or separately. When designed to work in a specific sequence, the suite is referred to as a stack. Common protocol stacks/suites are:

- **Open Systems Interconnection** - the OSI protocol suite was designed to link many dissimilar hardware platforms running many disparate OSes.
- **AppleTalk** - modelled in layers after OSI; provides connectivity among Apple machines and PC-based networks.
- **NetBEUI** - NetBIOS Extended User Interface is proprietary to Microsoft networks. It is not routable and is only used within Local Area Networks. It is fast, simple, and self-configuring. It operates by means of broadcasts and user-friendly names, used in small networks



## A+ Operating System Technologies

- **IPX/SPX** - Novell's routable protocol suite for a client-server environment. Partially based on Xerox Network Systems protocols. It used to require a separate NIC to run; with Open Data-link Interface, can now be bound to the same NIC with other suites. Netware utilizes a "default tree and context" or a binary mode. Netware 3.x is bound to a single server, and needs to be configured for several different "frame types". Netware 4.x eliminates these details, and operates by means of an IPX address composed of the hardware address, the network address, and a socket number. With Netware 5.x and up, Novell is phasing out IPX/SPX, and switching over to TCP/IP. To avoid paying licensing fees, Microsoft has developed its own implementation of IPX/SPX (called NetWare Link) for connecting to systems running older NetWare versions.
- **Internet Protocol suite** - composed of hundreds of separate protocols, and commonly referred to as **TCP/IP**. Used on the Internet, but also common in LANs.

See more on TCP/IP under [Internet Protocols](#) and [TCP/IP](#) in detail.

### **Installing and Configuring NIC**

To install a Network Interface Card:

1. Power off the PC and remove the mains power cord (*mains power is the AC power supply in a building, comes from an electrical outlet*)
2. Take ESD precautions
3. Remove system case cover
4. Find available expansion slot
5. Remove blanking plate (covering slot at the back of the system case)
6. Insert NIC, pressing firmly into place, and securing with a screw
7. Replace case
8. Connect external cables (including the power cord to mains power)
9. Power on
10. Check BIOS, Plug n Play
11. Install drivers (Add/Remove Hardware or Network)
12. Check for conflicts in Device Manager

When you turn the computer on, if the NIC is PnP, the system should automatically detect the new hardware. You may be prompted for the driver to run it and allocate resources accordingly.



If the system did not automatically find the NIC, you can go to **Control Panel -> Add/Remove Hardware** to install it manually.

You can also add the driver (or update it) manually by going to:

1. **Control Panel -> Network**
2. Click **Add**
3. Select **Adapter**
4. Find the right make, model and click **OK**
5. Click **Have Disk** if you have the driver disk

**Note:** If you are troubleshooting a problem device, and you suspect the driver – choose the driver Windows has for your piece of hardware, and see if that fixes the problem.

### **Installing and Configuring Network Connection**

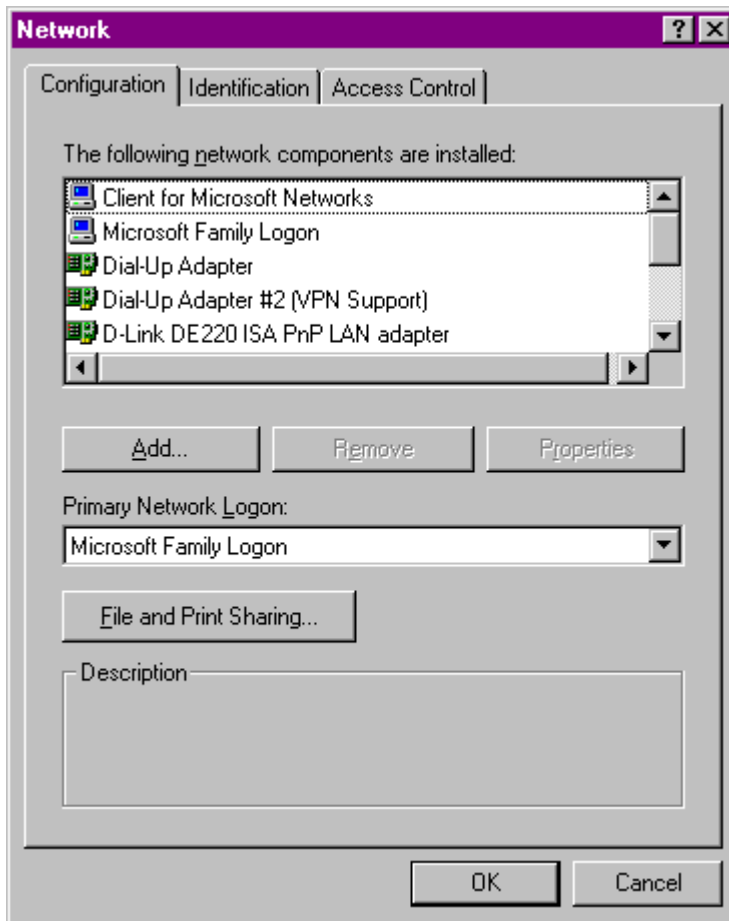
Configuring networking can be done during Setup (installation), by going to **Control Panel -> Network**, or by right clicking on **Network Neighborhood** and selecting **Properties**:

From Network Properties you can configure:

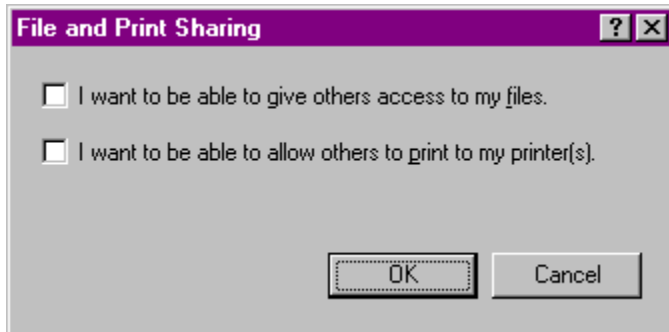
- Client software to access resources across the network
- Adapter settings and drivers
- Protocols to be used (including TCP/IP, NetBEUI, etc)
- Services like File and Print Sharing



Windows 98 view:



You need to enable **File and Print Sharing**, before you select certain files, folders, drives, or printers to be shared:



Shared resources look like this:

Shared Folder	Shared Drive	Mapped Drive
	 Local Disk (C:)	 Websites (X:)

More resources:

[How to share a local printer](#)

### Network Drives

To access a drive across the network, you must *map* the drive and assign it a drive letter:

1. Find the drive you want to map to in **Network Neighborhood / My Network Places**
2. Right click the share name and select **Map Drive**
3. Choose the drive letter
4. Select Reconnect at login
5. Click OK

Mapped drives follow [UNC](#) (Universal Naming Convention) syntax:

Path: [\\servername\share](#)

### Network Printers

You connect to Network printers from the **Network Neighborhood / My Network Places** window:



1. Click **Install New Printer**
2. Select **Network Printer**
3. Select the Printer
4. Enter the printer name
5. Choose whether this is your default printer
6. Click **Finish**

## Internet

The Internet is the biggest WAN there is. In many ways, it is the conglomeration of all networks together. It is made up of dissimilar networks, OSes, hardware. What enables them all to talk on the Internet is common protocols, and universal standards for software and hardware.

- [URLs](#) – Uniform Resource Locator
- HTML web pages
- Web browsers
- Electronic mail
- Newsgroups
- FTP and Gopher
- IRC – Internet Relay Chat
- Internet phone and videoconferencing

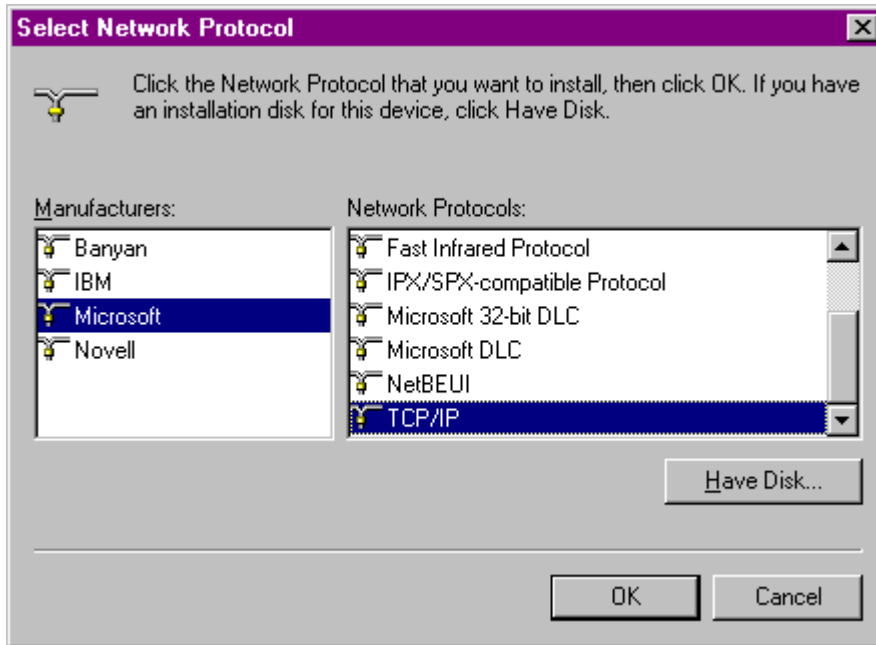
### Internet Access

Internet Access requires:

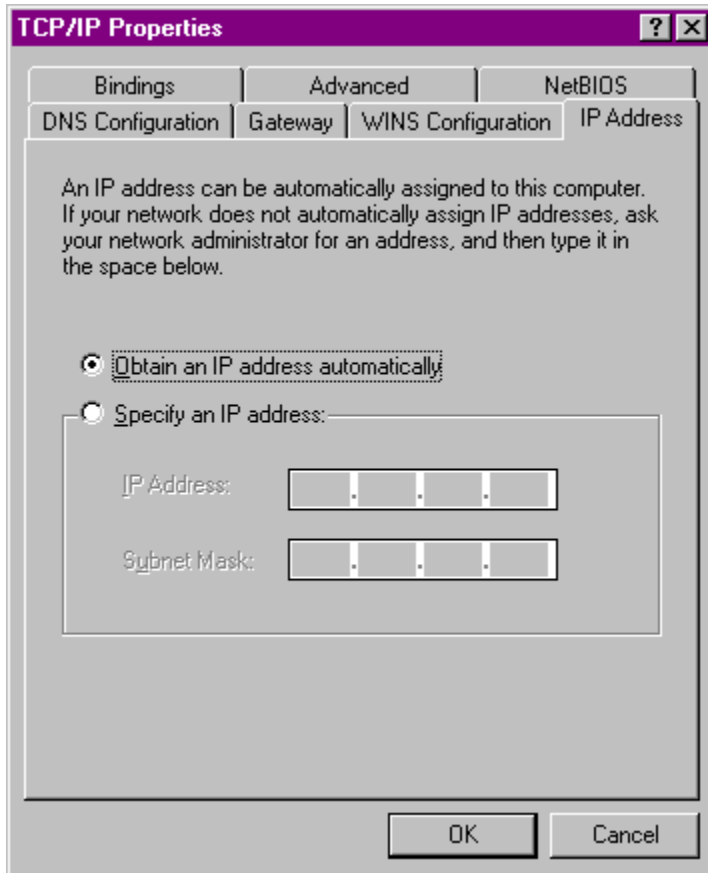
- Dialup services (telephone, DSL, ISDN) or leased lines (cable modem, T1...)
- Internet Service Provider (ISP)
- Browser
- TCP/IP

To access the Internet, you must first configure TCP/IP. In Windows 9x:

1. Go to **Control Panel -> Network -> Add** (we've been here already, remember?)
2. Select **Protocol** and click Add
3. Select **Microsoft** and **TCP/IP**



4. Click Properties to Configure the IP Address, WINS and DNS Configurations. When you select **Obtain IP address automatically**, Windows is using DHCP (Dynamic Host Configuration Protocol). WINS config is the Microsoft Mechanism that resolves computer names to IP addresses. DNS config resolves UNC names (MS servers) of TCP/IP Hosts to IP addresses.



### Installing and Configuring Internet Connection

Under **My Computer**, or in **Start -> Programs -> Accessories**, choose **Dial-up Networking**, and select **Make New Connection**:

1. Name the connection
2. Select the device (modem) to connect with
3. Enter the phone number and country
4. Click **Finish**



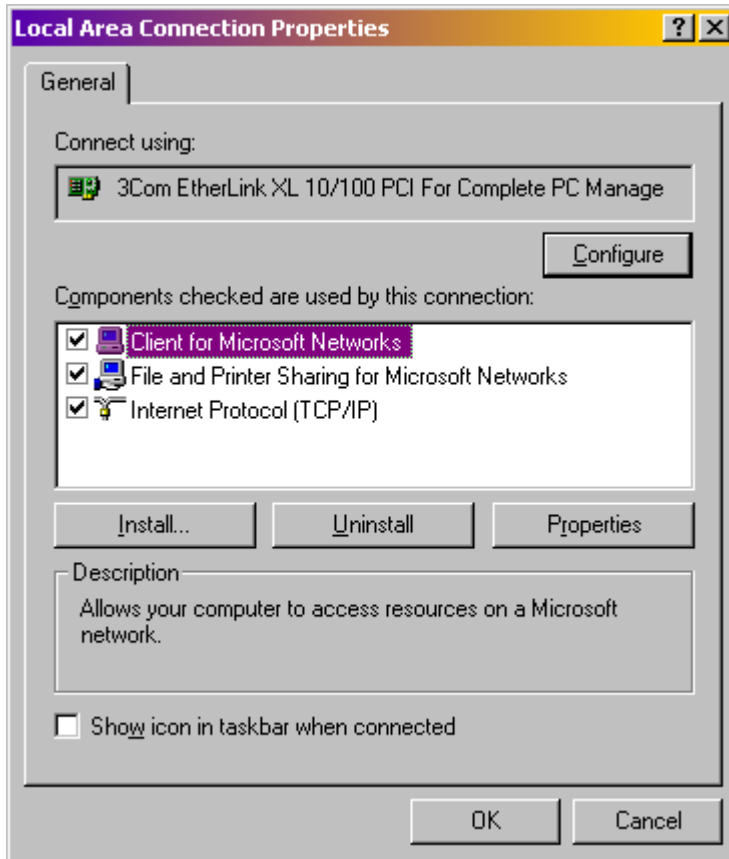
The new connection will be listed beside the Make New Connection icon in Dial-up Networking:



**Note:** Know the **Properties** display when you right click on the connection.



Windows 2000 Connection Properties window:



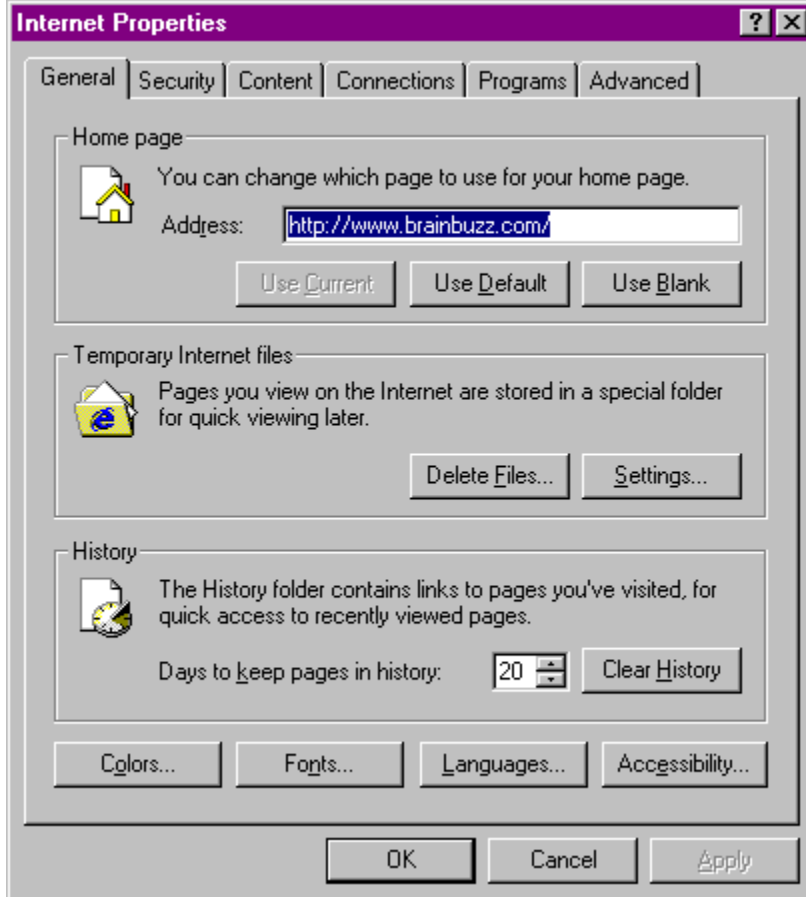
### Configuring Internet Explorer

You configure your Internet browser to connect using:

- Dial-up connection (modem)
- Proxy Server (ISP gateway)
- LAN



You can also configure all your **Internet Options** (from the Control Panel):



### **TCP/IP**

TCP/IP is the Internet Protocol that provides a communication method for all systems connecting to the 'Net. It is composed of hundreds of separate protocols, and commonly referred to as TCP/IP.

Some of the important ones are:

- **TCP** - Transmission Control Protocol takes the datastream and divides it into packets, then delivers them and waits for an acknowledgement. At the other



## A+ Operating System Technologies

- end it receives the packets, sends an ACK, and reassembles the packets in sequence. It establishes a session with the receiving machine, defining session parameters with a "three-way handshake".
- **IP** - Internet Protocol places source and destination IP addresses in the header, and assigns the routing information.
  - **ICMP** - Internet Control Message Protocol handles transmission errors. The PING utility uses ICMP. Some routers can also send ICMP "source quench" messages to a host to slow the rate of transmission if the router is being overworked.
  - **UDP** - User Datagram Protocol functions similarly to TCP, but does not establish a session or verify transmission. This is called "connectionless". Less reliable than TCP but faster.
  - **HTTP** - HyperText Transfer Protocol transmits data via HyperText Markup Language. It is the basis for the World Wide Web. An HTML page may contain links to any other HTML document. It operates over TCP (connection-oriented) but may or may not establish a session for longer than the transmission, depending on the version. Most of the Web now supports HTTP 1.1, which allows persistent connections. It is called a "stateless" protocol because commands are executed without regard for the previous command. To make Web pages interactive, other technologies such as ActiveX, Java, and JavaScript were developed, as well as "cookies"--small files that are stored on the client and returned to the server to identify the user and customize the page the server sends.
  - **ARP** - Address Resolution Protocol enables the discovery of physical hardware addresses. A host broadcasts a request by IP address, and the remote host with that IP address returns a message containing its MAC address. Both types of address must be in the header of a packet. The physical address never changes, but the destination IP address changes every "hop" (any passage through a router or host).
  - **RARP** - Reverse ARP is used by the host to discover its own IP address. The host broadcasts its physical address, and the RARP server (a piece of software, not a separate machine) returns the information. Mostly important to diskless workstations.



## A+ Operating System Technologies

- **SNMP** - Simple Network Management Protocol enables monitoring of network activity when installed. By itself, it does nothing; it enables separate monitoring utilities to report.
- **Gopher** - A pre-WWW cataloguing utility now replaced by HTTP. Almost extinct.

See also [Network Protocols](#)

### TCP/IP Utilities

- **FTP** - File Transfer Protocol is an older but still preferred method of down- and up-loading files across the Net. Based on connection-oriented TCP.
- **TFTP** - Trivial File Transfer Protocol is similar to FTP but uses UDP.
- **Telnet** - Emulates a terminal and is used to execute commands on a server. Supports character-based functions only; GUI functions require the X-Window system on the client.
- **RCP, RSH, REXEC** - also for getting or putting files on a server. Authentication is handled differently, either by password or a username match in the server's .RHOSTS file.
- **LPR** - runs a print job on a host running Line Printer Dæmon
- **PING** - "Packet INternet Groper" (Doubtful--probably just named after the SONAR term) enables verification that an IP address is active on the network. Without switches applied it returns the number of hops, the name of the router or host, and transit time in milliseconds. Go to a command line and enter "PING /?" for switch syntax.
- **IPCONFIG** - a WinNT/2000 command that verifies the TCP/IP configurations of the host. The default is to display the IP address, subnet mask, and default gateway. Adding the switch /all returns more information...much more.
- **WINIPCFG** - a Win9x command similar to above. Returns a GUI window.
- **NSLOOKUP** - views entries on a DNS server; displays domain names paired with IP addresses.



## A+ Operating System Technologies

- **NETSTAT** - displays current TCP/IP connections and protocol stats. Enter NETSTAT /? at the command prompt for a list of options available with this.
- **NBTSTAT** - returns status of NetBIOS names resolved to IP addresses, and checks the status of NetBIOS sessions. Again, NBTSTAT /? gets you help on the switches.
- **ROUTE** - views and enables editing of the host's routing tables. Used especially if the default gateway develops problems.
- **TRACERT** - displays all the routing hops a packet takes to its destination. Results may vary, as "intelligent" routers may send packets by different routes depending upon the traffic on a particular segment. TRACERT /? returns the switch options.
- **WHOIS** and **FINGER** - returns user info on domains and email addresses, respectively.

### Domain Names

#### **IP Addresses**

Every computer on the Internet has a 32-bit unique [IP address](#), which looks like this:  
206.112.74.27

But all those numbers are hard to remember, much less type properly. So, an alternative addressing method called FQDN (Fully Qualified Domain Names) is used.

Domain names are user-friendly versions of the IP address:  
[www.brainbuzz.com](http://www.brainbuzz.com) = 206.112.74.27

#### **Domains**

Top-level domain - .com, .org, .net, edu, .ca, .au ...

Sub-domains - identify the company (brainbuzz, ebay, amazon, etc)

Local domains - specify a division within the company (eg, cramsession.brainbuzz.com)

Host - www, www2...



## URLs

URLs are made up of a:

- Protocol – http:, ftp:, mailto:, irc: etc
- Host name (domain + sub-domain + local domain [if any] + host) – cramsession.brainbuzz.com
- File path – to the exact web page - /cramsession/comptia/default.asp  
e.g. <http://cramsession.brainbuzz.com/cramsession/comptia/default.asp>

Email addresses are made up of a:

- Protocol – mailto:
- Identifier – e.g. whomever@wherever.com

## Additional Notes:

This exam also covers any questions on installing, configuring, troubleshooting and upgrading **Hardware**, too. It is recommended that you take the A+ Core Hardware Exam first, before attempting this exam.

Don't think that **Windows NT** isn't a factor in this exam. Just because it is barely mentioned in the Exam Objectives, doesn't mean you don't need to know about it. Many questions require knowledge of NT's legacy, and many questions apply to both NT and 2000. We *strongly* suggest having at least some knowledge of upgrading to/from NT, the features/differences of NT, and the NT File system, NTFS.

Most of this exam is on **Diagnosing and Troubleshooting**. So, make sure you know what to do if you get a particular error, or have a certain situation where you need to know what to do next. Know common errors and problems with Windows *and users*. Know where to find things, how to do particular tasks, what particular system tools do, and know multiple ways to achieve the same results (usually 3 ways of doing things in Windows).

Good Luck!



Special thanks to [Cherina Sparks](#) & [sc0rp10n](#) for contributing this Cramsession. For feedback from the authors, please post a message labelled "Attention Cramsession Authors" here: [A+ Operating Systems Forum](#)