

# CompTIA® A+ Certification: Essentials

## 2009 Edition



### A+ CERTIFICATION

#### What's New?

##### RAID levels

Identify characteristics of the various RAID levels. **See page 3.**

##### Portable computers

Describe the three power states used on notebook computers. **See page 5.**

##### Wireless networks

Take steps to protect your wireless network. **See page 6.**

#### Other Important Information

##### CPU components

Identify the components of a CPU. **See page 2.**

##### Memory

Recognize the various types of RAM and memory packages. **See page 2.**

##### Hard drives

Describe various types of hard drives. Prepare a hard drive for use by the operating system. **See page 3.**

##### Directories

View and work with directories in Windows Vista or Windows XP or at the command prompt. **See page 4.**

##### File systems

Describe FAT, FAT32, and NTFS file systems. Understand and configure NTFS file and folder permissions. **See page 4.**

##### Addressing

Recognize the four methods used to identify devices and programs on a network. **See page 5.**

##### Troubleshooting

Be methodical in your troubleshooting and check the most common items. **See page 6.**

### GETTING HELP

#### CompTIA A+ certification information

- For current test objectives and certification information for the CompTIA A+ Certification: Essentials exam, visit [www.comptia.org](http://www.comptia.org).
- To order the “CompTIA A+ Certification: Practical Application” CourseCard, which covers additional content that you might find on the Essentials exam, visit [www.axzopress.com](http://www.axzopress.com).

#### Get more help with Windows

To get more help with Windows operating systems, visit the following Microsoft Web sites:

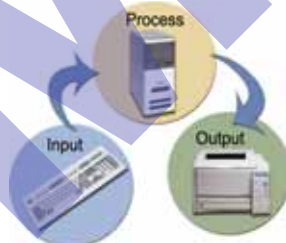
- [www.microsoft.com/windows/windows-xp](http://www.microsoft.com/windows/windows-xp)
- [www.microsoft.com/windows/windows-vista](http://www.microsoft.com/windows/windows-vista)

A personal computer (PC) consists of hardware, software, and firmware.

#### A Hardware

A computer's physical components and the peripheral equipment used with the computer. Each hardware device in a computer system corresponds to one of four basic functions: input, output, processing, or storage (temporary or permanent).

- **Input**—Input devices are used to send data or instructions to a computer. The most common input devices are the keyboard and the mouse.
- **Output**—Output devices are used to display the results of the processing being performed by the computer. Typical output devices are monitors and printers.
- **Processing**—The operating system communicates with hardware devices—such as hard drives, RAM (random access memory), and printers—through the CPU (central processing unit). The CPU receives data from input devices and stores it in temporary or permanent storage. The CPU then processes the data, executes the instructions, and sends data to various output devices.
- **Storage**—Temporary storage (RAM) is located on the system board (motherboard) and is used by the CPU to process data and instructions. Permanent storage devices hold data even when the computer is turned off. Four popular types of permanent storage devices are hard drives, USB flash drives, CD-ROMs, and DVDs.



#### B Software

The set of instructions processed by the CPU. There are two main types of software:

- **Operating system (OS)**—A program that controls a computer's hardware components and provides an interface for users and applications. Common operating systems include Windows®, UNIX®, Linux®, and Mac® OS.
- **Applications**—Software that enables the computer to perform specific tasks. Examples include word processing programs, spreadsheets, and image editing programs.

#### C Firmware

A type of software written permanently or semi-permanently to a computer chip. Firmware chips retain information without power and provide the computer's basic startup instructions.

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## POWER SUPPLIES, CPUS, AND MOTHERBOARDS

## Power supplies

A PC power supply is the internal component that converts wall voltage (110 V or 220 V) to the various DC voltages used by the computer's other components.

## CPU components

- **Control unit**—Component that manages the flow of a program. The control unit retrieves the next instruction to be acted upon or the data to be processed.
- **One or more execution units (cores)**—Components that process instructions and data. A dual-core processor has two execution units, a triple-core processor has three, and a quad-core processor has four.
- **Registers**—Very small, yet very fast, memory locations that hold instructions or units of data.

## CPU technologies

- **SMT** (simultaneous multi-threading technology)—Code that enables parallel multi-threading. Without SMT, the software can recognize only one core.
- **Hyperthreading**—An Intel® technology that enables a single processor to execute two streams of instructions at the same time, as if it were two processors.
- **VRM** (voltage regulator module)—A small module that regulates the voltage sent to the CPU. The VRM gets the exact voltage requirements from Voltage ID (VID) pins on the motherboard.
- **32-bit vs. 64-bit processors**—The terms “32-bit” and “64-bit” refer to how the CPU processes information. A 32-bit processor can process 32 bits of data at one time. A 64-bit processor can process 64 bits of data at one time. A 64-bit processor can handle more data-intensive programs than a 32-bit processor can, because the 64-bit CPU processes more data per clock cycle.

## Cache memory

Cache memory is fast SRAM that buffers access between the CPU and main memory. There are two types:

- **Primary cache memory**—Also called *Level 1* or *L1* cache. This is 32 to 64 KB of very fast memory on the same chip as the CPU.
- **Secondary cache memory**—Also called *Level 2*, *L2*, or *external* cache. This cache bridges the speed disparity between the CPU and main memory. L2 cache sizes range from 256 KB to 2 MB.

## BASIC INPUT/OUTPUT SYSTEM (BIOS)

The *BIOS* is a set of software instructions stored on a chip on the motherboard. The BIOS instructions control basic computer functions, such as getting input from the keyboard and mouse. *CMOS* is an area of memory that stores BIOS configuration information.

## Configure the BIOS

1. From a powered-off state, boot your PC.
2. At the appropriate time in the boot sequence, press the key combination that opens the BIOS setup utility on your system.
3. Follow the on-screen prompts or menu to configure your system.
4. Follow the on-screen prompts or menu to save the new configuration data in CMOS memory.

## Power-on self test (POST)

The POST is a series of basic checks that a system performs to make sure its components are working properly. There are four basic steps:

1. The BIOS tests the core hardware, including itself, the processor, CMOS, and the input/output system. Any errors detected at this stage are reported as a series of beeps.
2. The BIOS tests the video subsystem.
3. The BIOS identifies itself, including its version and manufacturer.
4. The BIOS tests main system memory.

## MEMORY

## RAM types

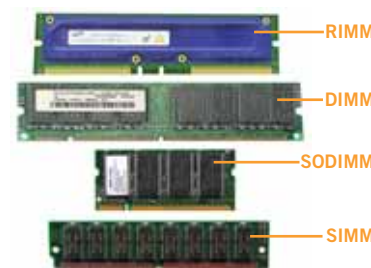
RAM is where PCs store programs and data currently in use. There are several types of RAM:

- **SRAM** (static RAM)—Retains information without the need for refreshing, as long as the computer's power is on.
- **DRAM** (dynamic RAM)—Stores data for only a fraction of a second before losing it. To maintain stored data, the system must constantly refresh DRAM. This reduces performance. DRAM is packaged as SIMMS or DIMMS.
- **SDRAM** (synchronous DRAM)—Designed to operate at clock speed; if the system bus is 100 MHz, then SDRAM matches that frequency. SDRAM is referred to with a “PCXXX,” where XXX is the bus speed.
  - **DDR** (double data rate)—SDRAM that doubles the amount of data transferred per clock cycle, effectively doubling the memory bandwidth. Its data transfer range is 200–400 MHz, based on a 100–200 MHz I/O clock. Uses a 184-pin connector.
  - **DDR2**—Transfers data at a rate of 400–1066 MHz, using a 200–533 MHz I/O clock on both the rise and fall of the clock signal. Uses a new 232-pin connector and provides increased performance and bandwidth.
  - **DDR3**—Transfers data at a rate of 800–1600 MHz, using both the rise and fall of a 400–800 MHz I/O clock signal. DDR3 allows for chip capacities of 512 MB to 8 GB, enabling a maximum memory module size of 16 GB.
- **RDRAM** (Rambus DRAM)—Uses a 16-bit data bus running at up to 800 MHz, transferring data on both the rise and fall of the clock signal. RDRAMs are packaged as 184-pin modules called RIMMs.

## Memory slots

The memory package type you use must match the memory slots on your motherboard.

- **RIMM**—Has 184 edge connector pads with 1 mm pad spacing. Used with RDRAM chips and trademarked by Rambus.
- **DIMM** (dual inline memory module)—Contains 100 pins (printers), 168 pins (Pentium and Athlon systems), 184 pins (DDR SDRAM in desktops), or 240 pins (DDR2 or DDR3 SDRAM in desktops) on a double-sided module. Two notches, one centered and the other off-center, ensure correct installation.
- **SODIMM** (small outline dual inline memory module)—Contains 144 pins, 200 pins (DDR and DDR2), or 204 pins (DDR3) on a double-sided module. Used in laptop and notebook computers. A single off-center notch ensures correct installation.
- **SIMM** (single inline memory module)—Contains 30 or 72 pins. Used in early Pentium and Macintosh desktop computers. A notch on one end ensures that you insert this module in the correct orientation.



## Additional memory terms

- **Volatile memory**—Loses its contents when power is turned off.
- **Non-volatile memory**—Retains its contents when power is turned off.
- **Unbuffered memory**—Deals directly with the chipset controller.
- **Buffered memory**—Contains a buffer to help the chipset handle a large electrical load if the system has a lot of memory.
- **Parity**—Enables the detection of an error by using a parity bit that is used to detect whether the bit in one chip has gone bad.
- **ECC memory** (Error Correcting Code memory)—Detects single- and multiple-bit errors and corrects all single-bit and some multibit errors.
- **Dual-channel architecture**—Doubles data throughput from memory to the memory controller by using two 64-bit data channels, providing a 128-bit data path. Dual-channel architecture requires both a dual-channel-capable motherboard and two or more DDR, DDR2, or DDR3 memory modules.

## BUS TYPES

The bus provides the data path to and from computer components, such as the processor and memory on the motherboard. You'll need to understand the following types of bus architectures:

- **PCI** (Peripheral Component Interconnect)—Designed to isolate the processor electronically from the PCI expansion slots.
- **AGP** (Accelerated Graphics Port)—Designed to provide faster video performance in a dedicated slot.
- **PCIe** (PCI Express)—Designed to use a dedicated, bi-directional, serial, point-to-point connection called a *lane*. Each lane can simultaneously transfer 250 MBps of data in each direction.
- **Riser bus**—Brings the basic wiring and control of a function to a motherboard without using the PCI interface. There are three main riser standards: ACR (Advanced Communication Riser), AMR (Audio/Modem Riser), and CNR (Communication and Networking Riser).

BUS TYPE	WIDTH (BITS)	SPEED (MHz)	BITS PER LINE PER CYCLE	THROUGHPUT (MBps)
PCI	32	33	1	133
PCI (64-bit)	34	66	1	533
AGP 1X, 2X, 4X, 8X	32	66	1, 2, 4, 8	266, 533, 1067, 2133

## SYSTEM RESOURCES

- **DMA (Direct Memory Access) channels**—Numbers designating channels on which an I/O device can send data directly to memory without involving the CPU.
- **I/O addresses**—Hexadecimal numbers assigned to hardware devices and used by software to send commands to those devices.
- **IRQ (Interrupt Request) number**—On a system bus, a line that's assigned to a device and used to signal the CPU for servicing. When multiple devices send their interrupts to the CPU at the same time, Windows processes the device request with the lowest IRQ value first. In Windows, you can use Device Manager to view assigned IRQ numbers.
  1. Click **Start**, right-click **Computer**, and choose **Manage**. If necessary, click **Continue**.
  2. Under System Tools, select **Device Manager**.
  3. Choose **View, Resources by type**.
  4. In the details pane, expand **Interrupt request (IRQ)**.

### CERTBLASTER® PRACTICE TEST

The purchase of this CourseCard entitles you to one copy of the CertBlaster® test preparation software for the CompTIA A+ Essentials exam. To help you pass your exam, CertBlaster provides hundreds of practice questions, exam simulations containing the same number of questions as an actual exam, and a personalized study path.

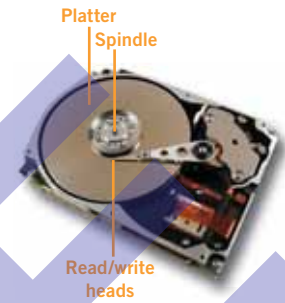
To install your CertBlaster:

1. Go to <http://www.axzopress.com>.
2. Under Downloads, click **CertBlaster**.
3. Click the link for **CompTIA A+ Essentials**.
4. Save the .EXE file to your hard drive.
5. Double-click the .EXE file.
6. Click **OK** and follow the on-screen instructions.
7. When prompted for a password, enter **c\_a+ess09**.

## HARD DRIVES

Hard drives are components that store data. Magnetic hard drives are made of the following parts:

- **Platters**—Metal or plastic disks where the data is recorded.
- **Spindle**—The axis around which the platters spin.
- **Read/write heads**—The magnetic devices that both read and write data on the platters.



### new Solid-state drives (SSDs)

Solid-state drives use memory chips (DDR RAM or flash memory) to read and write data, instead of using a rotating disk. SSDs have no moving parts. Therefore, they are less fragile than magnetic hard drives and are silent.

### Drive technologies

- **IDE/ATA** (Integrated Device Electronics/Advanced Technology Attachment)—A hard drive whose disk controller is integrated into the drive, eliminating the need for a controller cable. With IDE/ATA drives, you can install one or two drives per channel.
- **PATA** (Parallel ATA)—An older ATA technology that has almost been replaced by SATA. PATA continues to be used in CompactFlash storage applications.
- **SATA** (Serial ATA)—An IDE/ATA hard drive that uses a thinner 7-pin cable with faster throughputs.
- **SCSI** (Small Computer System Interface)—A faster system-level interface with a host adapter and a bus that can daisy-chain as many as seven devices. SCSI 2 can support up to 15 devices.

### Partition and format a hard drive

After you have physically installed a hard drive, you must prepare it for use by the operating system.

1. **Perform a low-level format**—Formats the hard drive, creating the tracks and sectors.
2. **Partition the hard drive**—Divides the hard drive into one or more logical drives, also called *volumes*.
  - DOS and Windows 9x—Use FDISK.
  - Windows NT/2000/XP/Vista—Use DISKPART at the command prompt, or use Disk Management from within Windows.
3. **Perform a high-level format**—You must do this for each logical drive on the hard drive.
  - DOS and Windows 9x—Use FORMAT.COM.
  - Windows NT/2000/XP/Vista—Use DISKPART or Disk Management.

### new RAID levels

RAID is a set of standards for lengthening disk life, preventing data loss, and enabling relatively uninterrupted access to data. There are six basic levels of RAID:

- **RAID level 0**—Striping with no other redundancy features. Striping works by spreading data equally over two or more drives.
- **RAID level 1**—Simple disk mirroring, which provides a way to duplicate the operating system files if a disk fails.
- **RAID level 2**—An array of disks in which the data is striped across all disks in the array. In this method, all disks store error correction information that enables the array to reconstruct data from a failed disk.
- **RAID level 3**—Uses disk striping and stores error correcting information, but writes the information to only one disk in the array.
- **RAID level 4**—Stripes data and stores error correcting information on all drives, similar to level 2. Also uses *checksum verification* to compare a checksum previously stored for a file against a re-created file's checksum. If the two do not match, the file might be corrupted. Windows server and client OSs don't support RAID levels 2 through 4.
- **RAID level 5**—Combines the best features of RAID, including striping, error correction, and checksum verification. The Windows operating systems that support dynamic disks also support RAID level 5.

## OPERATING SYSTEMS

## Client operating systems

- **Windows**—Released by Microsoft®. Windows can run on just about any personal computer (PC). Windows has a graphical user interface (GUI). The current versions of Windows are Windows Vista and Windows XP. Windows 7 is slated for release by the end of 2009.
- **Mac OS**—Released by Apple®. The Mac OS runs only on Apple computers. Like Windows, Mac OS has a graphical user interface. The current version of the Mac OS is Mac OS X Leopard.
- **Linux**—Based on the UNIX OS, most versions of Linux, known as *distributions*, are available to download free of charge ([www.linux.org/dist/](http://www.linux.org/dist/)). The most popular distribution at the time of this writing was Ubuntu, by the U.K.-based company Canonical Ltd. You can also buy distributions from vendors such as Novell and Red Hat®. Although many Linux distributions have a GUI, many administrative tasks are performed at the command line.


## DIRECTORIES

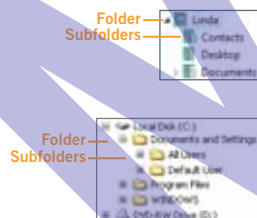
Most PC operating systems use a directory tree to organize files. In a directory tree, a disk or partition contains one or more directories (folders). The *root directory* is the highest-level folder on the disk or partition.

## Work with folders and files in Windows

Windows Explorer is a GUI tool that can be used to manage directories (folders) and files. To open Windows Explorer in Windows Vista, XP, or 2000, click **Start** and choose **All Programs, Accessories, Windows Explorer**. The left pane is the navigation pane; the right pane is the details pane. In Windows Vista, Window Explorer is also called the Documents folder, and the navigation pane is divided into two sections: Favorite Links and Folders.

Do any of the following in Windows Explorer:

- **Navigate a directory tree**—In Windows Vista, in the Folders pane, click the arrow  next to a drive or folder to expand the tree and view the subfolders in that drive or folder. In Windows XP and Windows 2000, in the navigation pane, click the plus sign (+) next to a drive or folder to expand the tree and view the subfolders. Select a drive or folder in the Folders pane or the navigation pane to view its contents in the details pane.
- **Create a folder**—In the navigation pane, select the drive or folder where you want to create a folder. In Windows Vista, click **Organize** and choose **New Folder**. In Windows XP and Windows 2000, choose **File, New, Folder**. In all versions of Windows, type a folder name and press **ENTER**.
- **Copy a folder**—Select the folder you want to copy. To select multiple folders, hold down **CTRL** and select each folder. In Windows Vista, Windows XP, and Windows 2000, right-click the selection and choose **Copy**. In the navigation pane, right-click the location that you want the folder and its contents to be copied to, and choose **Paste**.
- **Remove a folder**—Right-click the folder you want to remove, and choose **Delete**. Click **Yes** to confirm that you're moving the folder and all of its contents to the Recycle Bin.



## Work with a directory tree at the command line

To open a command line in Windows Vista or Windows XP, click **Start** and choose **All Programs, Accessories, Command Prompt**. Then use the following commands:

- **cd**—Switches to a different directory. Syntax: `cd drive:\path`
- **dir**—Displays the contents of the current directory.
- **md**—Creates a directory or subdirectory. Syntax: `md drive:\path`
- **rd**—Removes a directory. Syntax: `rd drive:\path`
- **del**—Deletes the specified file. Syntax: `del drive:\path\filename`
- **copy**—Copies files from one disk or directory to another. Syntax: `copy drive:\path\filename drive:\path\filename`

## WINDOWS COMPATIBILITY AND UPGRADE PATHS

## Check hardware and application compatibility

- To verify that a PC's hardware is compatible with Windows Vista or Windows XP, visit [store.microsoft.com](http://store.microsoft.com).
- To verify that a computer's applications are compatible with Windows XP, run Setup in check-upgrade-only mode.
  1. Insert the Windows XP CD-ROM. Click **Start** and choose **Run**.
  2. Enter the following, where x: is your CD-ROM drive letter:  
`x:\i386\Winnt32 /checkupgradeonly`
  3. Examine the report for potential problems.

## Upgrade paths

- You can upgrade to Windows Vista from Windows XP or Windows 2000. The upgrade from Windows XP is a direct one, but the upgrade from Windows 2000 requires a clean installation.
- You can upgrade directly to Windows XP from Windows 98/Me, Windows NT Workstation 4.0 with Service Pack (SP) 6, and Windows 2000 Professional.
- To upgrade all versions of Windows NT 4.0 prior to SP6, upgrade to SP6 and then upgrade to Windows XP.
- To upgrade from Windows 95, you'll need to upgrade to Windows 98 and then upgrade to Windows XP.

## FILE SYSTEMS

Windows Vista, Windows XP, Windows 2000, Windows Server 2008, and Windows Server 2003 support three main file systems:

- **FAT**—A 16-bit file system that supports partitions of up to 2 GB with a maximum cluster size of 64 KB.
- **FAT32**—A 32-bit file system that supports partitions of up to 32 GB with a maximum cluster size of 16 KB.
- **NTFS**—A 32-bit file system that supports partitions of up to 32 GB with a maximum cluster size of 4 KB. Supports encryption, compression, file and folder permissions, and disk quotas.

## NTFS file and folder permissions

- **Full Control**—The user can perform any task on a particular file or on any file in a particular folder.
- **Modify**—The user can change a file or its attributes, view a folder and its files, create folders and files, run program files, and read folder permissions.
- **Read & Execute**—The user can view a file or a folder and its files, read file attributes, and run program files.
- **List Folder Contents**—The user can view a folder and all file attributes.
- **Read**—The user can view the contents of a file or folder.
- **Write**—The user can change the contents of a particular file or of any file in a particular folder, and create files and folders.

## Set NTFS permissions

*NOTE: If a Windows XP Professional computer is not a member of a domain, you must disable Simple File Sharing. In Windows Explorer, choose **Tools, Folder Options**. Activate the **View** tab. In the **Advanced settings** list, clear **Use simple file sharing (Recommended)**. Click **OK**.*

1. In Windows Explorer, navigate to the folder for which you want to set permissions.
2. If the computer is in a workgroup, you must enable the Security tab. To do this, choose **Tools, Folder Options** and activate the **View** tab. Under **Advanced Settings**, clear **Use simple file sharing**. Click **OK**.
3. Right-click the folder and choose **Sharing and Security**. Activate the **Security** tab.
4. Under "Group or user names," select the group or user for whom you want to set permissions.
5. Under "Permissions for <user>," check **Allow** for each permission you want to assign. Repeat steps 4 and 5 as needed. Then click **OK**.

## USB CONNECTIONS

new

Universal Serial Bus (USB) is a standardized peripheral specification that defines a bus architecture to which you can connect one or more expansion devices. There are three versions of USB: 1.1, 2.0 (current), and 3.0 (due to be released in 2010). USB offers these features:

- **Hot-swapping and self-configuration**—You can plug a device into or unplug a device from the bus while the computer is running. Devices identify themselves to the bus controller, which informs the operating system that a new device is present. If the necessary drivers are on the system where Windows can find them, Windows loads the drivers and enables the USB device for immediate use.
- **Multiple-device support**—Typical PCs include two or more USB ports. You can connect a maximum of 127 devices to the bus.
- **High-speed data transfer**—Depending on the version of USB supported by your system and peripherals, the USB specification enables data transfer rates of up to 480 Mbps.
- **Power**—USB can deliver electrical power through the port.

## PORTABLE COMPUTERS

new

Notebook computers are small computers with all the necessary input and output components contained in a portable unit. Notebooks use standard client operating systems, such as Microsoft Windows, Mac OS, or Linux.

### Power states

You're likely to encounter three power states on notebook computers:

- **Sleep**—In Sleep mode, the system enters a low-power state. System configuration information, open applications, and files are stored in RAM, but the screen and hard disk and most of the other notebook components are turned off. The computer draws just enough power to preserve the contents of RAM. Lift the cover or press the Sleep or Suspend key again to “wake up” the computer.
- **Hibernate**—The computer takes all current applications running in RAM, saves them in the swap partition on the hard disk, and then turns the notebook's power off. As a result, the Hibernate power state requires no power. When the computer is turned back on, information stored on the hard disk is loaded back into RAM and appears in the same state as before the hibernation.
- **Standby**—Standby is a user-configurable power-saving mode that's activated in order to conserve the battery. To take a computer out of Standby, you move the mouse, press any key on the keyboard, or press the power button. Unlike Suspend and Hibernate modes, nothing is saved in memory or on the hard disk in Standby mode.

### Configure Sleep or Hibernate modes on a notebook computer

1. Click **Start** and choose **Control Panel**. Then click **Hardware and Sound**.
2. Under Power Options, click **Choose what the power buttons do**.
3. Select one of the following actions to be taken when you close the lid or press the power button: **Do nothing**, **Sleep**, **Hibernate**, or **Shut down**.
4. Click **Save changes**.

### PC Cards

The expansion cards used in notebook computers are PC Cards. These are roughly the size of a credit card, with varying thicknesses based on the type of card. There are three types of PC Cards. They all have a 68-pin female connector that plugs into a connector in the PC Card slot on the side of the computer. The three types of PC Card adapters are:

- **Type I**—3.3 mm thick, typically used for memory.
- **Type II**—5 mm thick, typically used for network adapters and modems.
- **Type III**—10.5 mm thick, typically used for additional storage.

### Mini PCI card

A mini PCI card has the same functionality as a standard PCI card used in desktop computers, but in a smaller format. It's typically used for communications that are integrated into the notebook, including modems and network cards. These cards are installed inside the notebook case, rather than being installed externally.

## NETWORKING

### Ethernet architectures, cable types, length, and speed

NETWORK	MEDIA TYPE	MAXIMUM CABLE LENGTH	MAXIMUM TRANSFER SPEED
10-Mbps Ethernet (Twisted-Pair Ethernet)	CAT3 or coaxial	100 to 500 meters	10 Mbps
100-Mbps Ethernet (Fast Ethernet)	CAT5	100 meters	100 Mbps
1000-Mbps Ethernet (Gigabit Ethernet)	CAT5 or fiber optic	100 to 5000 meters	1 Gbps
10 Gigabit Ethernet (or 10GbE)	Multi-mode fiber optic	30 to 80 meters	10 Gbps
10 Gigabit Ethernet (or 10GbE)	Single-mode fiber optic	10 to 40 kilometers	10 Gbps

### Addressing

Every device on a network has a unique address. On a network, four methods are used to identify devices and programs:

- **MAC address**—A unique address permanently embedded in a NIC. The MAC address is used only to identify devices inside the LAN.
- **IP address**—An address that identifies a computer, printer, or other device on a TCP/IP network. There are two versions of IP addresses: IPv4 and IPv6. IPv4 addresses are 32 bits, written as four octets or bytes, separated by periods as follows: 208.206.88.56. IPv6 addresses are 128 bits, written as eight bytes, separated by colons as follows: 0:0:0:128:34:52:7.
- **Character-based names**—Domain names, host names, and NetBIOS names used to identify computers on a network with easy-to-remember letters rather than numbers.
- **Port address**—A number between 0 and 65,535 that identifies a program running on a computer.

### Connection technologies

TECHNOLOGY	ACCESS	ATTAINABLE SPEEDS
Standard phone line	Dial-up	Up to 56 Kbps
ISDN	Dial-up	64 Kbps to 128 Kbps
DSL	Direct	512 Kbps upstream and up to 32 Mbps downstream
Cable modem	Direct	512 Kbps to 5 Mbps
Wireless 802.11a/b/g	Direct	1 Mbps to 54 Mbps
Satellite	Direct	400 Kbps
T carriers (N. America)	Direct	1.544 Mbps to 44.736 Mbps
Fiber optic cable	Direct	Up to 100 Gbps

new

### Wireless network protocols

- **Wi-Fi** (Wireless Fidelity)—The most widely used wireless technology at present. IEEE wireless standards 802.11b and 802.11g are collectively referred to as Wi-Fi.
- **802.11a**—An improved version of the original Wi-Fi technology, based on the same IEEE 802 standard. Devices supporting 802.11a aren't compatible with 802.11b.
- **Bluetooth**—A short-range wireless technology. Its limited transmission distance (10 meters) generally confines it to connecting nodes in a single room or adjacent rooms. Newer devices have a higher transmitting power that increases the range to 100 meters.
- **WiMAX** (IEEE 802.16 Air Interface Standard)—A point-to-multipoint broadband wireless access standard. It's an emerging wireless connection standard for long distances.

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## TROUBLESHOOTING

### The CompTIA A+ troubleshooting model

1. **Identify the problem.** Question the user and determine if changes were made on the computer. Perform a backup before making any changes.
2. **Establish a theory of probable cause.** Analyze the problem and potential causes so you can identify a likely cause and determine whether it's hardware or software related.
3. **Test the theory to determine the actual cause.** Test components related to the problem. Look for proper connections, proper hardware and software configurations, and indications of conflicts in Device Manager.
4. **Create a plan of action.** Then implement the solution you've chosen.
5. **Verify the results.** Then, if necessary, take additional steps to correct the problem. Once you've established full system functionality, implement applicable measures to prevent the problem from happening again.
6. **Document the solution.** Document the actions you took to correct the problem, as well as the outcomes of those actions.

### The ASID troubleshooting model

The ASID troubleshooting model offers a four-stage process you can apply to many types of problems. Its stages are:

1. **Acquire**—Acquire information about the problem.
2. **Simplify**—Remove any non-critical components.
3. **Implement**—Identify and implement potential solutions, one at a time.
4. **Document**—Document the problem and its resolution.

### Common items to look for when troubleshooting a PC

- Loose or damaged wires or cables, or circuit boards not properly seated
- Signs of overheating
- Improper jumper-switch settings
- Incorrect configurations, or incompatible hardware or software

### Use Windows troubleshooting tools

- **Safe Mode**—Boots the computer when it can't boot normally.
- **Last Known Good Configuration**—Restores the system to the configuration used during its last normal boot. Useful if the installation of a driver is causing a problem.
- **Automated System Recovery (ASR)**—Recovers a failed system. Use this only as a last resort because the logical drive on which Windows is installed will be reformatted and restored from the most recent backup.
- **Emergency Repair Disk (ERD)**—Contains basic system configuration files that you can use to restore your computer to a bootable state if your Registry is damaged or if the OS is on an NTFS partition that isn't booting.
- **Performance Monitor (Perfmon.msc)**—Reports information about performance problems.
- **Recovery Console**—Provides a command line for performing troubleshooting tasks when the desktop will not load.
- **System Restore**—Restores the system to a previously working condition.
- **Task Manager**—Shows running applications and processes and allows you to adjust their priority or terminate them.

### Use these network diagnostic tools

- **ping**—Tests connectivity between two computers.  
Syntax: `ping IP address` or `ping host name`
- **ipconfig**—Displays the computer's IP address, subnet mask, default gateway, DNS servers, WINS servers, and host name. Syntax: `ipconfig` (to display the IP address, subnet mask, and default gateway) or `ipconfig /all` (to display all of your IP configuration settings).
- **tracert**—Traces a packet's route to determine if routers are functioning correctly. Syntax: `tracert IP address` or `tracert host name`

## SOLUTIONS

### Manage device drivers

First, open Device Manager. Click **Start**, right-click **My Computer**, and choose **Properties**. Activate the Hardware tab and click **Device Manager**. Then, do any of the following:

- To view a device's status, expand its category. The following symbols indicate a device's status:
  - A red "X" through the device name indicates that the device is disabled.
  - A yellow exclamation point (!) indicates a problem with the device. Right-click the device and choose **Properties** for more information and troubleshooting options.
  - A blue "i" on a white field indicates that automatic settings were not used and resources have been assigned manually. This does not indicate a problem with the device.
- To disable a device, right-click it and choose **Disable**.
- To update a device's driver, right-click the device and choose **Update Driver**. Follow the steps in the Hardware Update Wizard.
- To roll back a driver, right-click the device and choose **Properties**. Activate the Driver tab and click **Roll Back Driver**. Click **Yes** and then click **OK**.

### Check a disk for errors

To check a disk for errors in Windows Vista, Windows XP, or Windows 2000 Professional:

1. Click **Start** and choose **Computer** (or **My Computer** in Windows XP/2000).
2. Right-click the drive you want to check for errors and choose **Properties**.
3. Activate the Tools tab and click **Check Now**.
4. In Windows Vista, click **Continue**.
5. Check **Automatically fix file system errors** and/or **Scan for and attempt recovery of bad sectors**.
6. Click **Start**. When the scan is finished, click **OK**.

### Defragment a disk in Windows Vista

Click **Start** and choose **All Programs, Accessories, System Tools, Disk Defragmenter**. Click **Continue**. Then click **Defragment now**. Select the disk or disks you want to defragment and click **OK**. Windows Vista analyzes the disk first, and then begins defragmenting if it's necessary. Click **OK**.

Volume	Session Status	File System	Capacity	Free Space	% Free Space
HPNOTEBOOK (C:)	Analysed	NTFS	37.21 GB	22.87 GB	61 %

Estimated disk usage before defragmentation:

### new Protect a wireless network

- **Enable WEP**—WEP encryption uses a shared secret key and the RC4 encryption algorithm. The access point and all stations that connect to it must use the same shared key.
- **Alter the wireless access point's factory settings**—By default, WAPs broadcast their SSIDs, the names designated for specific wireless LANs. To protect your wireless network, change the default SSID and disable SSID broadcasts.
- **Use MAC filters**—Use MAC filters to allow or deny computers access to the network based on their MAC addresses.
- **Enable 802.1x**—The 802.1x standard is the recommended method of authentication and encryption for enhanced security.
- **Use Wi-Fi Protected Access (WPA) mode**—WPA authorizes and identifies users based on a secret key that automatically changes at a regular intervals.
- **Disable the use of DHCP on WAPs**—Wireless access points can hand out DHCP addresses for your network. Disable DHCP, and assign authorized static IP addresses to your wireless clients.