

# Chapter 11: Advanced Personal Computers



## IT Essentials: PC Hardware and Software v4.1

# Chapter 11 Objectives

- 11.1 Give an overview of field, remote, and bench technician jobs
- 11.2 Explain safe lab procedure and tool use
- 11.3 Describe situations requiring replacement of computer components
- 11.4 Upgrade and configure personal computer components and peripherals
- 11.5 Identify and apply common preventive maintenance techniques for personal computer components
- 11.6 Troubleshoot personal computer components and peripherals

# Personal Computers



- A technician should be able to determine if a component for a customer's computer should be upgraded or replaced.
- A technician should develop advanced skills in these areas:
  - Installation procedures
  - Troubleshooting techniques
  - Diagnostic methods for computers.

# Computer Technicians

When training to become a computer technician, develop the following skills:

- Building and upgrading computers
- Performing installations
- Installing, configuring, and optimizing software
- Performing preventive maintenance
- Troubleshooting and repairing computers
- Communicating clearly with the customer
- Documenting customer feedback and the steps involved in finding the solution to a problem

# Field, Remote, and Bench Technicians



- A **field technician** needs troubleshooting skills and customer service skills, because they work on-site, are in regular contact with customers and work on a wide variety of hardware and software.

- A **remote technician** may work at a help desk answering calls or e-mails from customers who have computer problems and need good communication skills.



- A **bench technician** may not work directly with customers. Bench technicians are often hired to perform computer warranty service in a central depot or work facility.

## Safety Rules

- Keep work area clean and free of clutter.
- Keep food and drinks out of work area.
- Never open a computer monitor without proper training.
- Remove all your jewelry and watches.
- Make sure the power is off and the power plug has been removed.
- Do not look into laser beams located in equipment.
- Make sure there is a fire extinguisher and first aid kit available.
- Cover sharp edges with tape when working inside computer case.

# Safe Working Environments

Always follow these basic rules:

- Use antistatic mats and pads to reduce the chance of ESD damaging your equipment.
- Store hazardous or toxic materials in a secured cabinet.
- Keep the floor clear of anything that might trip someone.
- Clean work areas on a regular basis.
- Follow local codes and government rules whenever disposing of batteries, solvents, computers, and monitors.

## Proper Tools

- Use proper tools to work safely and prevent damage to the computer equipment.
  - Various screwdrivers
  - TORX screwdriver
  - Tweezers or part retriever
  - Needle-nosed pliers
  - Wire cutters
  - Chip extractor
  - Hex wrench set
  - Nut driver, large and small
  - Three-claw component holder
  - Digital multimeter
  - Wrap plugs
  - Small mirror
  - Small dust brush
  - Soft, lint-free cloth
  - Cable ties
  - Scissors
  - Small flashlight
  - Electric tape
  - Pencil or pen
  - Compressed air
  - Antistatic wrist strap
  - Antistatic mat
  - Antistatic bag
  - Cleaning products



# Specialized Testing Devices

- Specialized testing devices are used to diagnose computer and cable problems
  - **Multimeter** – Measures AC/DC voltage, electric current, and other cable and electrical characteristics.
  - **Power supply tester** – Checks whether the computer power supply is working properly.
  - **Cable tester** – Checks for wiring shorts or faults, such as wires connected to the wrong pin.
  - **Loopback plug** – Connects to a computer, hub, switch, or router port to perform a diagnostic procedure to test the integrity of the data transmission.



# High Voltage Computer Components

The following dangerous, high-voltage computer components should only be serviced by authorized personnel:

- **Power supplies** - Most broken or used power supplies are replaced.
- **Display monitors** - The internal electronic parts of a display monitor cannot be repaired, but they can be replaced.
- **Laser printers** - It is more cost effective to fix broken printers by repairing or replacing broken parts. Laser printers use high voltages and may have very hot surfaces inside.



# Environmental Issues



- A **computer recycling warehouse** is a place where discarded computer equipment can be taken apart.
- Computer parts that are still usable can be recycled for repairing other equipment.
- Many organizations have policies that define disposal methods for the hazardous components found in electronic equipment.

# Select a Case and Power Supply

- Determine the customer's needs before making any purchases or performing upgrades.
  - A power supply should support 25 percent more wattage than all the attached components require.
- The computer case holds the power supply, motherboard, memory, and other components.
- When purchasing a new computer case and power supply separately, ensure that all of the components will fit into the new case and that the power supply is powerful enough to operate all of the components.



# Select a Motherboard

- When you select a replacement motherboard, make sure it supports the CPU, RAM, video adapter, and other adapter cards.
- The socket and chip set on the motherboard must be compatible with the CPU.
- The motherboard must accommodate the existing heat sink/fan assembly.
- The existing power supply must have connections that fit the new motherboard.
- The number and type of expansion slots must match the existing adapter cards.
- The new motherboard must physically fit into the current computer case.



# Select CPU

- Replace the CPU when it fails or is no longer adequate for the current applications.
- Make sure the CPU is compatible with the existing motherboard:
  - The new CPU must use the same socket type or slot type and chip set.
  - The BIOS must support the new CPU.
  - The new CPU may require a different heat sink/fan assembly.
  - Make sure the correct voltage is maintained.
  - Use manufacturers' websites to investigate the compatibility between CPUs and other devices.

# CPU Features and Classification

- Multi-core processors - RAM is shared between the processors
- Cache memory - L1, L2 and L3
- Speed of a processor - Maximum speed without errors
- Front Side Bus (FSB) - Path between the CPU and chip set, expansion cards, and RAM
- 32-bit and 64-bit - number of instructions handled by the processor at one time

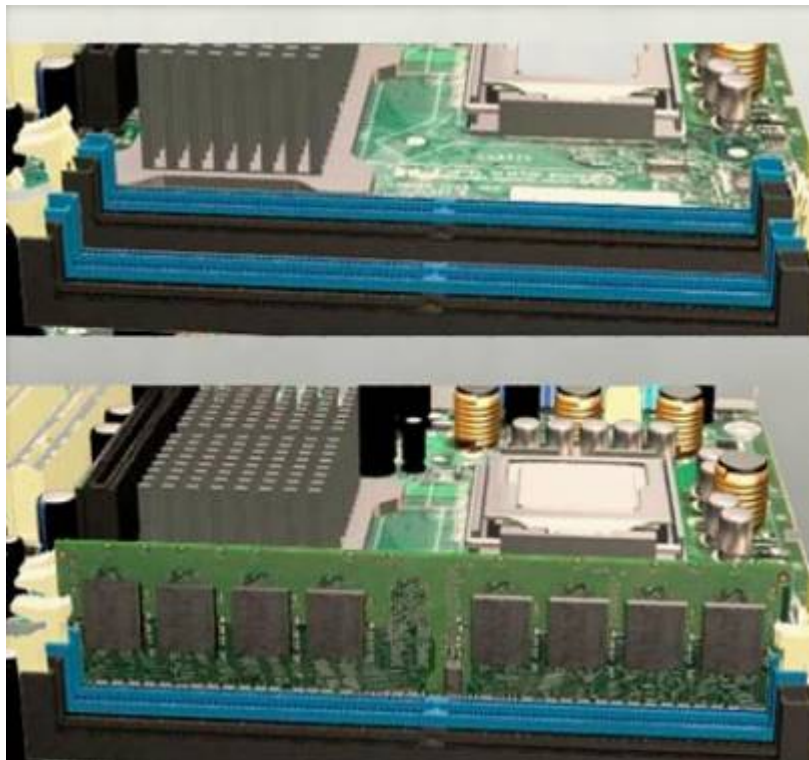
# Select a Heat Sink/Fan and Case Fan

- Heat sink/fan assembly considerations:
  - Socket type
  - Motherboard physical specifications
  - Case size
  - Physical Environment
- Case fan considerations:
  - Case size
  - Fan speed
  - Number of components in the case
  - Physical environment
  - Number of mounting places available
  - Location of mounting places available
  - Electrical connections



# Select RAM

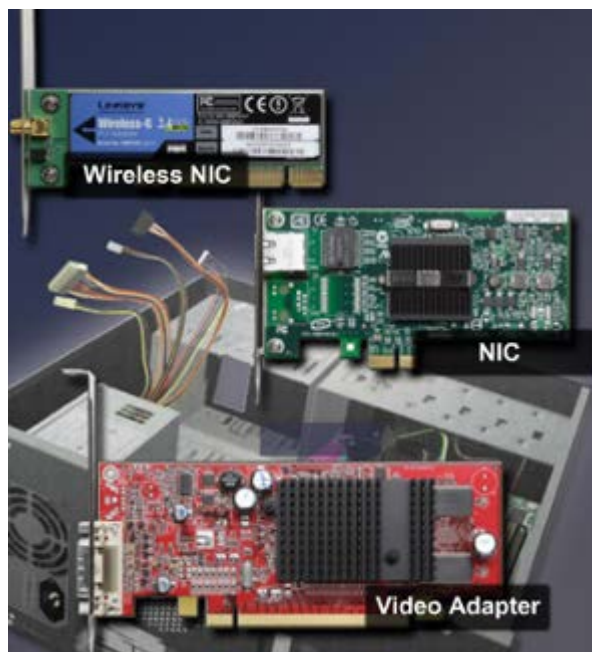
- New RAM may be needed when an application locks up or the computer displays frequent error messages.



- When selecting new RAM, check the compatibility with the current motherboard.
- The speed of the new RAM must be the same or faster than the existing RAM.

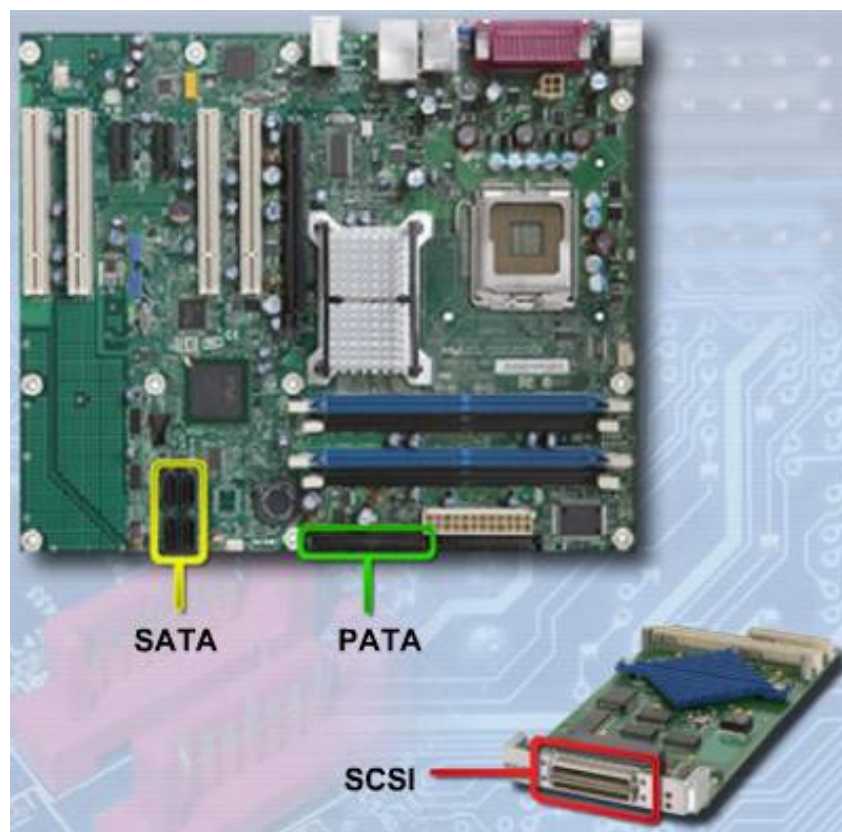
# Select Adapter Cards

- Adapter (or expansion) cards, add extra functionality to a computer. Before purchasing an adapter card, check:
  - Is there an open expansion slot?
  - Is the adapter card compatible with the open slot?
  - What are the customer's current and future needs?
  - What are the possible configuration options?
  - What are the reasons for the best choice?
  
- If the motherboard does not have compatible expansion slots, external devices are an option:
  - Are USB or FireWire versions of the external device available?
  - Does the computer have an open USB or FireWire port?



# Storage Device Failures

- The signs that a hard drive is failing and should be replaced as soon as possible:
  - Unusual noises
  - Error messages
  - Corrupt data or applications
- Replacement options:
  - Floppy Disk Drive
  - Media Reader
  - Solid State Drives
  - Optical Drives
  - External Storage
  - Hard Drive

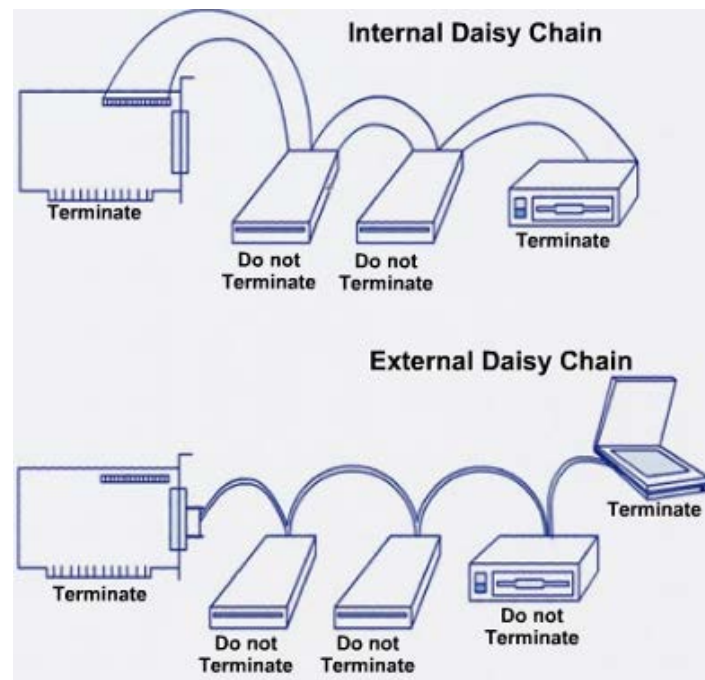


# Hard Drive Connectors

- **PATA** (Parallel ATA) hard drives
  - Originally, called **ATA** (Advanced Technology Attachment).
  - With the introduction of SATA, ATA was renamed to PATA.
  - Can use a 40-pin / 80-conductor cable or a 40-pin / 40-conductor cable.
  
- **SATA** (Serial ATA) hard drives
  - Connect to the motherboard using a serial interface.
  - Have a higher data-transfer rate than PATA drives.
  - Smaller data cable allows for improved airflow.
  
- **SCSI** (Small Computer Systems Interface) hard drives
  - More advanced interface controller than PATA or SATA.

# Small Computer Systems Interface (SCSI)

- Usually used for hard drives and for tape storage
- Ideal for high-end computers, including network servers that require high transfer speeds and reliability
- SCSI devices are connected in a series, forming a chain that is called a **daisy chain**.
- Each end of the daisy chain is terminated to prevent signal reflections and interference.
- Most SCSI buses can handle a total of seven devices and a SCSI controller.
- Each device must have a unique SCSI ID.



# SCSI Types

SCSI Type	Also Called	Connector	Maximum Throughput
SCSI-1		50-pin Centronics 50-pin	5 MBps
Fast SCSI	Plain SCSI	50-pin Centronics 50-pin	10 MBps
Fast Wide SCSI		50-pin 68-pin	20 MBps
Ultra SCSI	Fast-20	50-pin	20 MBps
Ultra Wide SCSI		68-pin	40 MBps
Ultra2 SCSI	Fast-40	50-pin	40 MBps
Ultra2 Wide SCSI		68-pin 80-pin	80 MBps
Ultra3 SCSI	Ultra-160	68-pin 80-pin	160 MBps
Ultra320 SCSI		68-pin 80-pin	320 MBps

# Select Input and Output (I/O) Devices

- An input device transfers information into a computer:
  - Mouse
  - Keyboard
  - Scanner
  - Camera
  - Process control sensor
  - MIDI interface
  - Microphone
- An output device transfers information out of a computer:
  - Display monitor
  - Projector
  - Printer
  - Process-control equipment
  - Speaker

# Types of I/O Device Interfaces

- **USB 1.1** - Transfers data up to 12 Mbps
- **USB 2.0** - Transfers data up to 480 Mbps
- **IEEE 1394 (FireWire)** - Transfers data at 100, 200, or 400 Mbps
- **Parallel (IEEE 1284)** - Transfers data up to 3 MBps
- **Serial (RS-232)** - Early versions: less than 20 Kbps. Now: up to 1.5 Mbps
- **SCSI (Ultra-320 SCSI)** - Connects as many as 15 devices at 320 MBps





# Upgrade Components and Peripherals

- Computer systems need periodic upgrades:
  - User requirements change
  - Upgraded software packages require new hardware
  - New hardware offers enhanced performance
  - Research the effectiveness and cost for both upgrading and replacing



# Upgrade and Configure Motherboards

1. Work on an antistatic mat and wear a wrist strap.
2. Note where and how everything is connected before you upgrade.
3. Move the CPU and heat sink/fan assembly to the new motherboard.
4. Use thermal compound between the CPU and the heat sink.
5. Connect jumper setting to support motherboard options
  - CPU voltage, CPU speed, Bus speed, Cache size and type, Flash BIOS enabled, Clear CMOS, Size of system memory
6. If new RAM is required, install it at this time.
7. If the CMOS battery needs to be replaced, ensure that it is the correct model required by the motherboard.
8. Remove the cables from the old motherboard that attach to the case LEDs and buttons, then remove the motherboard.
9. Replace the old I/O shield if the new motherboard has different I/O ports or port locations.

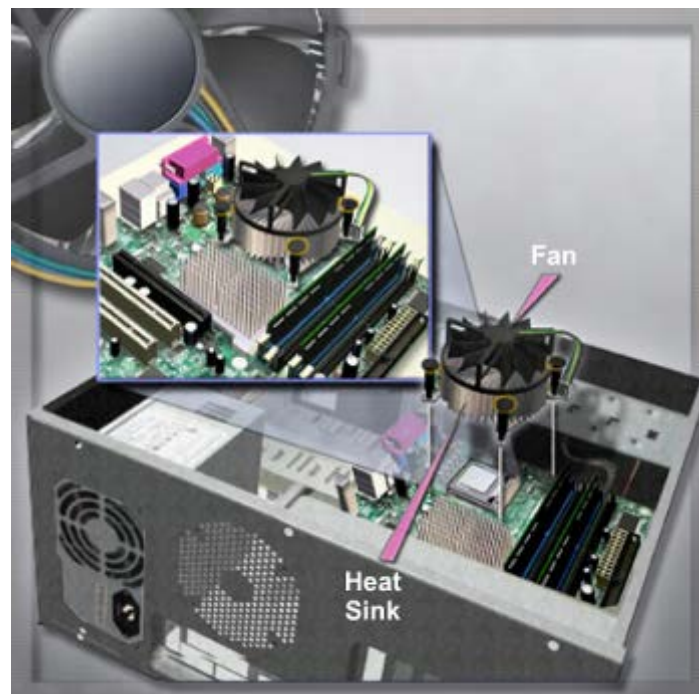
# Upgrade and Configure Motherboards (Continued)

10. Install the new motherboard, make sure to use the correct screws.
11. Connect the power supply cables.
12. Connect the cables for the case LEDs and buttons.
13. Install and secure all expansion cards.
14. Make sure there are no loose parts or leftover wires.
15. Connect the keyboard, mouse, monitor, and power.
16. Use the documentation that came with the motherboard to learn what BIOS adjustments may be required.

**CAUTION:** If there is any sign of trouble, shut the power supply off immediately.

# Upgrade and Configure CPU

- **CAUTION:** Always work on an antistatic mat and wear a wrist strap when installing and removing CPUs.
- Remove the existing CPU by releasing it from the socket using the zero insertion force lever.
- Insert the new CPU into place.
  - Single-Edge Connector (SEC)
  - Low-Insertion Force (LIF)
  - Zero-Insertion Force (ZIF)
  - Land Grid Array (LGA) socket
- Excessive force may damage the CPU or its socket.



# Upgrade and Configure Heat Sink/Fan Assembly

- The heat sink/fan assembly must:
  - Physically fit the CPU
  - Be compatible with the CPU socket.
  - Be adequate to remove the heat of the faster CPU

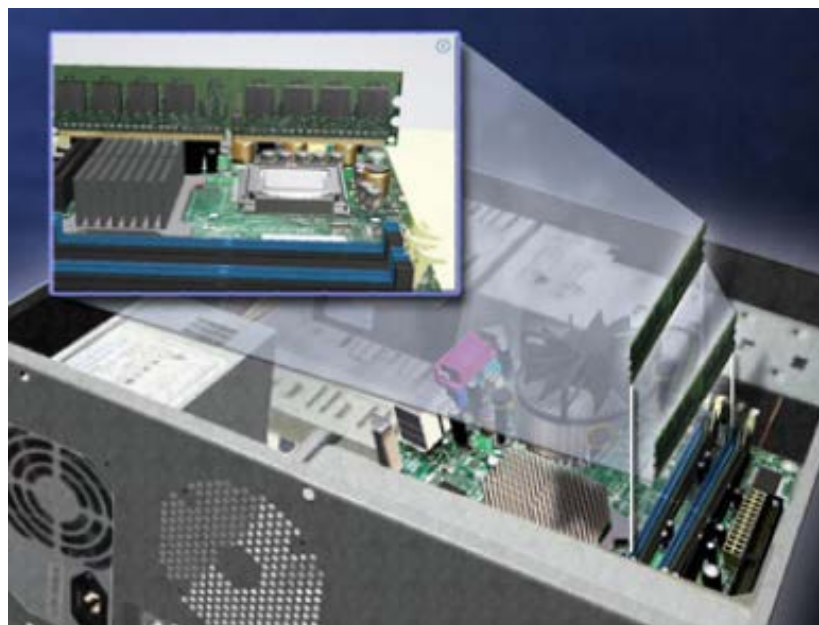
**CAUTION:** You must apply thermal compound between the new CPU and the heat sink/fan assembly.

- With some types of BIOS, you can view thermal settings to determine if there are any problems with the CPU and the heat sink/fan assembly.
- Third-party software applications can report CPU temperature information in an easy to read format.

# Upgrade and Configure RAM

**CAUTION:** Work on an antistatic mat. Wear a wrist strap.

1. Remove the existing RAM by freeing the retaining clips that secure it. Pull it from the socket.
2. Insert the new RAM, and lock it into place with the retaining clips.
3. The RAM should be discovered by the system.
4. If the BIOS does not indicate the presence of the correct amount of RAM, troubleshoot.



# Upgrade and Configure BIOS

- Motherboard manufacturers periodically release updates for their BIOS. Read release notes for description of upgrade.
  - **“Flashing the BIOS”** is upgrading the BIOS with new EEPROM, or flash memory.
  - To view the current BIOS settings, enter the BIOS setup program.
  - Press the setup sequence keys (possibly F1, F2, or Del key) while the computer is performing the power-on self test (POST).
  - If you are unsure about changing a BIOS setting, then research the problem in depth.
  - To download a new BIOS, go to the manufacturer's website and follow the installation procedures.

**CAUTION:** An improperly installed or aborted BIOS update can cause the computer to become unusable.

# Upgrade and Configure Storage Devices and Hard Drives

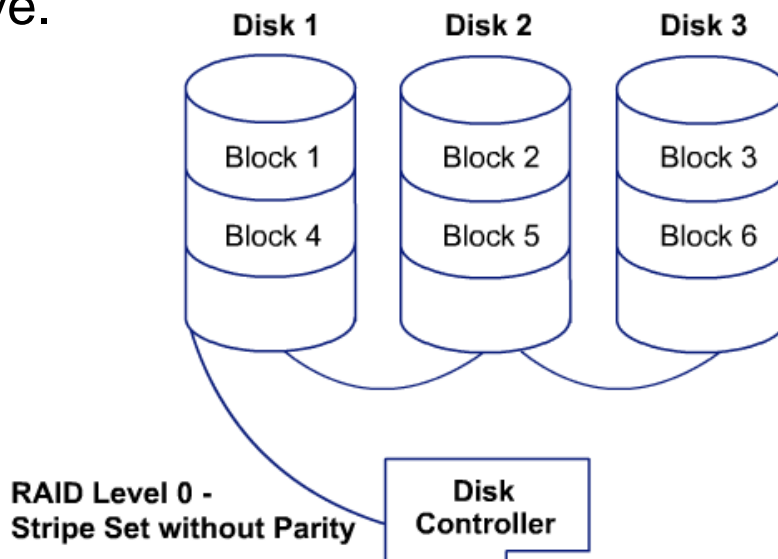
- Reasons for installing an additional drive:
  - To install a second operating system
  - To provide additional storage space
  - To provide a faster hard drive
  - To hold the system swap file
  - To provide a backup for the original hard drive
  - To increase fault tolerance
  
- New partitions or drive letter assignments should be well-planned. The boot order in BIOS may need to be adjusted.



# Types of RAID

- Arrays, such as a redundant array of independent disks (RAID), improve fault tolerance when connecting multiple hard drives.
- Install RAID using hardware or software.

Hardware installations are usually more dependable, but more expensive.



# Upgrade and Configure I/O Devices

- Reasons for installing new I/O devices:
  - Replace a device that stopped operating properly
  - Increase performance and/or productivity
  - Add ergonomically designed devices
  - Accommodate users with disabilities
  
- When upgrading and configuring I/O devices, install new drivers, if necessary.



# Clean Internal Components

- To remove dust, use compressed air to blow the dust away.
- When using a can of compressed air, keep the can upright to prevent the fluid from leaking onto computer components.
- While cleaning, inspect components for loose screws and connectors.
- Keep these internal parts as clean as possible:
  - Heat sink/fan assembly
  - RAM
  - Adapter cards
  - Motherboard
  - Case fan
  - Power supply
  - Internal drives

# Clean the Computer Case

- Dust buildup inside a computer can prevent the flow of air and affect cooling.
- Use a cloth or duster to clean the outside of the computer case.
- If using a cleaning product, put a small amount onto a cleaning cloth or duster and wipe the outside of the case.
- Also, look for and fix these issues:
  - Missing expansion slot covers that let dust, dirt, or living pests into the computer
  - Loose or missing screws that secure adapter cards
  - Missing or tangled cables that can pull free from the case

# Inspect Computer Components

- CPU and cooling system

- Examine for dust buildup.
- Check that the fan power cable is secure.
- Check the fan while the power is on to see the fan turn.
- Inspect the CPU to be sure that it is seated securely in the socket.
- Make sure that the heat sink is well attached.

**CAUTION:** Do not remove the CPU for cleaning.

- RAM connections

- Ensure RAM chips are seated securely in the RAM slots. Sometimes the retaining clips can loosen.
- Use compressed air to remove any dust.

# Inspect Computer Components (Continued)

- Storage devices
  - Ensure all cables are firmly connected.
  - Check for loose, missing, or incorrectly set jumpers.
  - A drive should not produce rattling, knocking, or grinding sounds.
  - Read the manufacturer's manual to learn how to clean optical drive and tape heads by using cotton swabs and compressed air.
  - Clean floppy drives with a drive cleaning kit.
  
- Adapter cards
  - Ensure cards are seated properly.
  - Secure cards with the retaining screw to avoid the cards coming loose in their expansion slots.
  - Use compressed air to remove any dirt or dust on the adapter cards or the expansion slots.

# Inspect Computer Components (Continued)

- Power devices, including power strips, surge suppressors (surge protectors), and UPS devices
  - Ensure proper ventilation.
  - Replace power strips if there have been electrical problems or excessive thunderstorms in the area.
- Loose screws
  - Can cause problems if not immediately fixed or removed.
- Keyboard and mouse
  - Use compressed air or a small vacuum cleaner to clean the keyboard and mouse.
  - If the mouse is the mechanical type, remove the ball and clean off any dirt.
- Cables
  - Look for broken and bent pins.
  - Ensure that all connector retaining screws are finger tight.

# Troubleshooting Process

- Step 1** Identify the problem
- Step 2** Establish a theory of probable causes
- Step 3** Determine an exact cause
- Step 4** Implement a solution
- Step 5** Verify solution and full system functionality
- Step 6** Document findings



# Step 1 - Identify the Problem

## ■ System information

Manufacturer, model, OS, network environment, connection type

## ■ Open-ended questions

- Can you describe precisely what happens when the computer boots?
- How often does the computer fail to start?
- What is the first screen you see when you turn on your computer?
- What sounds does the computer make as it starts?
- Is there a pause, or does the computer restart instantly?

## ■ Closed-ended questions

- Has anyone done any repair work on the computer recently?
- Has anyone else used the computer?
- Does this computer have a floppy drive?
- Does this computer have a USB drive installed?
- Is there a wireless NIC in this computer?
- Is the computer turned off at night?
- Is the computer secured in a locked room at night?
- Do you have a Windows XP installation CD on hand?

## Step 2 - Establish a Theory of Probable Causes

- Problem may be simpler than the customer thinks.
- Create a list of the most common reasons why the error would occur.
  - Computer power problems
  - Loose external cable connection
  - Loose data cable connection
  - Loose RAM
  - Loose adapter card
  - Incorrect device driver
  - Incorrect RAM module
  - Fans are dirty
  - Incorrect jumper settings
  - CMOS battery problem
  - Incorrect firmware

## Step 3 - Determine the Exact Cause

- Test your theories of probable causes one at a time, starting with the quickest and easiest.
  - Restart the computer.
  - Disconnect and reconnect the external cables.
  - Disconnect and reconnect the internal cables.
  - Secure the adapter card.
  - Secure the RAM.
  - Roll back or reinstall the device driver.
  - Replace the RAM.
  - Clean the fans.
  - Reset the jumpers.
  - Secure or replace the CMOS battery.
  - Update the firmware.
  
- If the exact cause of the problem has not been determined after you have tested all your theories, establish a new theory of probable causes and test it.

## Step 4 - Implement a Solution

- If a quick procedure does not correct the problem, you might need to research the problem further to establish the exact cause.
- Divide larger problems into smaller problems that can be analyzed and solved individually.
- Create a list of possible solutions and implement them one at a time. If you implement a possible solution and it does not work, reverse the solution and try another.

# Step 5 - Verify Solution and System Functionality

- Verifying full system functionality and implementing any preventive measures if needed. This ensures that you have not created another problem while repairing the computer.
  - Reboot the computer.
  - Restart external drives.
  - Access all drives and shared resources.
  - Print a document.
  - Read and write to all storage devices.
  - Validate the amount of RAM, the CPU, speed, and the date and time.
  
- Have the customer verify the solution and system functionality.

## Step 6 - Document Findings

- Discuss the solution with the customer
- Have the customer confirm that the problem has been solved
- Give the customer all appropriate paperwork
- Document the process in the work order and in your technician's journal:
  - Problem description
  - Solution
  - Components used
  - Amount of time spent in solving the problem

# Common Problems and Solutions

- Computer problems can be attributed to hardware, software, networks, or some combination of the three. You will resolve some types of computer problems more often than others.

# Apply Troubleshooting Skills

- It is time to apply your listening and diagnostic skills.





# Chapter 11 Summary

Some of the important concepts to remember from this module:

- You learned about the roles of the field, remote, and bench technicians and the job possibilities that are available to those who enter the workforce with some knowledge of advanced troubleshooting skills.
- You are able to explain and perform safe lab procedures and tool use. You can describe basic electrical safety, especially as it applies to monitors and laser printers. You understand the purpose and enforcement of worker safety standards.
- You know the safe disposal procedures for various types of computer batteries and types of hardware, such as monitors.
- You have the ability to advise customers of ways to protect their computers by using good preventive maintenance practices.
- You can describe ways to clean the external components of a computer, including the monitor, case, printer, and peripherals. You can describe how to clean internal components of a computer, such as the motherboard, CPU and cooling system, RAM, and adapter cards.

# Chapter 11 Summary (Continued)

Some of the important concepts to remember from this module:

- You know how to advise customers when it is best to upgrade a computer and components and when it is best to buy new products.
- You can explain the steps involved in adding and configuring a second hard drive. You can describe the steps involved in updating various computer components, such as cases, power supplies, the CPU and cooling system, RAM, hard drives, and adapter cards.
- You are able to demonstrate the use of open- and closed-ended questions that are appropriate for a level-two technician to determine the problem.
- You can describe the troubleshooting steps, including gathering data from the customer, verifying obvious issues, trying quick solutions first, evaluating problems, and implementing solutions until the problem is fixed.
- You have an understanding of the role of the level-two technician, and how to build on the troubleshooting efforts of a level-one technician.

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