A+ Guide to Hardware, 9th Edition

Chapter 5

Supporting the Power System and Troubleshooting Computers

Objectives

- Describe the methods and devices for keeping a system cool
- Select a power supply to meet the power needs of a system
- Demonstrate an organized approach to solving any computer problem, especially hardware problems occurring during the boot
- Troubleshoot problems with the electrical system

Objectives

- Troubleshoot problems with the motherboard, processor, and RAM
- Troubleshoot hardware problems with mobile devices

Cooling Methods and Devices

- If processor, expansion cards, and other components overheat:
  - System can get unstable
  - Components can fail or be damaged
- Devices used to cool a system:
  - CPU and case fans
  - Coolers
  - Heat sinks
  - Liquid cooling systems

Processor Coolers, Fans, and Heat Sinks

- Computer systems use a cooling assembly designed for a specific processor to keep temperatures below the processor maximum temperature
- Good processor coolers maintain a temperature of:
  - 90-110 degrees F (32-43 degrees C)
- **Cooler**: sits on top of processor
  - Consists of a fan and heat sink
  - **Heat sink**: uses fins that draw heat away from processor
  - **Fan**: blows drawn heat away from CPU unit

Processor Coolers, Fans, and Heat Sinks

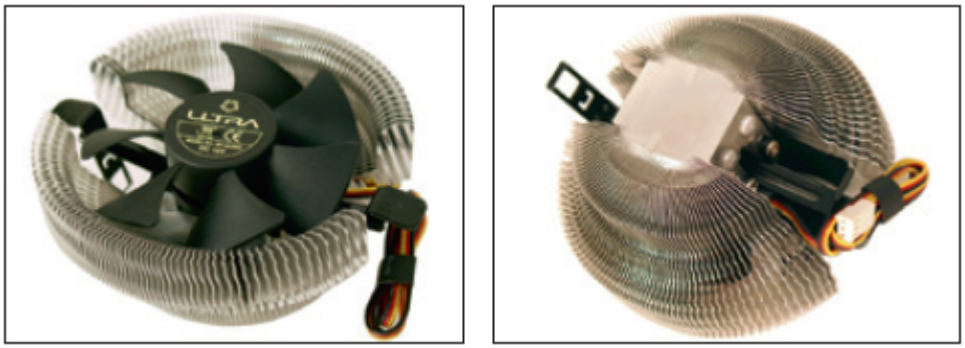

Figure 5-1 A cooler sits on top of a processor to help keep it cool

Processor Coolers, Fans, and Heat Sinks

- Cooler (cont'd):
  - Made of aluminum, copper or combination of both
  - Bracketed to motherboard using a wire or plastic clip
  - A creamlike thermal compound eliminates air pockets, helping to draw heat off the processor
  - Gets power by using a 4-pin fan header on the motherboard
  - Fanless CPU cooler (passive CPU cooler) contain heat pipes, which contain liquid that becomes vapor when heated
    - Vapor draws heat away from the CPU

Case Fans and Other Fans and Heat Sinks

- Case fans: help draw air out of the case to prevent overheating
  - Most cases have one or more positions on the case to hold a case fan
  - Large fans tend to perform better than small fans
- Other fans:
  - Some graphics (video) cards come with a fan
  - Fan cards can be mounted next to graphics cards
    - Be sure to select a fan card that fits the expansion slot you plan to use

Case Fans and Other Fans and Heat Sinks

- Other fans (cont'd):
  - RAM cooler – clips over a DIMM memory module
    - May be powered by a SATA or 4-pin Molex power connector

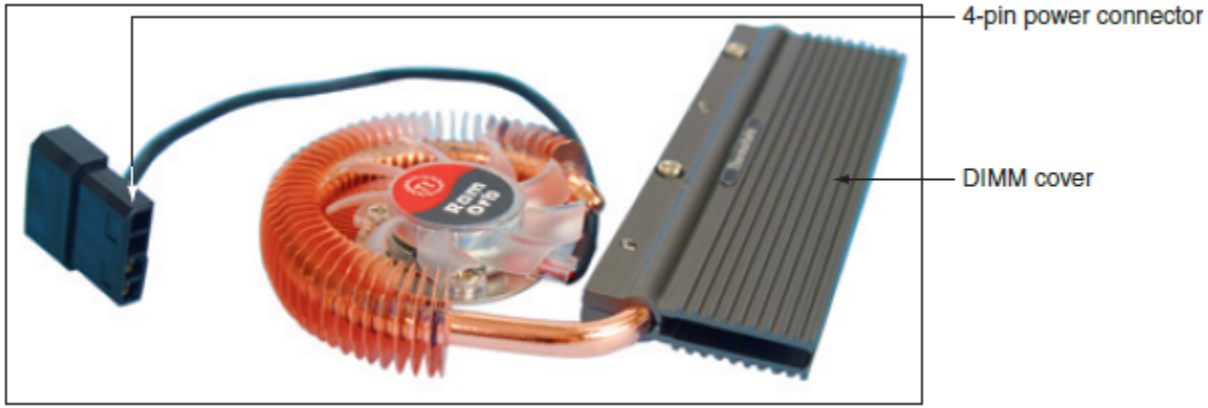

Figure 5-7 A RAM cooler keeps memory modules cool

Liquid Cooling Systems

- Liquid cooling system
  - A small pump sits inside the case and tubes moves liquid around components and then away from them to a place where fans cool the liquid

Courtesy of Thermaltake (USA) Inc.

Figure 5-8 A liquid cooling system pumps liquid outside and away from components where fans can then cool the liquid

Selecting a Power Supply

- Reasons to replace a power supply:
  - Power supply in existing system fails
  - Power supply in existing system is not adequate
- When building from scratch, some cases come with power supply already installed

Types and Characteristics of Power Supplies

- Important power supply feature considerations:
  - Form factor determines power supply size
  - Wattage ratings (listed in documentation)
  - Number and type of connectors
  - Fans inside the PSU
  - Dual voltage options
  - Warranty and overall quality

How to Calculate Wattage Capacity

- Determining wattage capacity
  - Consider all components inside case
  - Consider USB and FireWire devices
    - Get power from ports connected to the motherboard
- Points to keep in mind
  - Video cards draw the most power
  - The power supply should be rated 30 percent higher than expected needs
- What size Power Supply?
  - Add up wattage requirements and add 30 percent

How to Calculate Wattage Capacity

Devices	Approximate Wattage
Motherboard, processor, memory, keyboard, and mouse	200–300 W
Fan	5 W
SATA hard drive	15–30 W
DVD/CD drive	20–30 W
PCI video card	50 W
PCI card (network card, FireWire card, or other PCI card)	20 W
PCIe ×16 video card	150–300 W
PCIe ×16 card other than a video card	100 W

Table 5-2 To calculate the power supply rating you need, add up total wattage

How to Approach a Hardware Problem

- Troubleshooting resources:
  - The web (Internet)
  - Chat forums or email technical support
  - Manufacturer's diagnostic software
  - User manuals
  - Technical associates in your organization

Step 1: Interview the User

- Include these questions:
  - Can you describe the problem, when did it first start, and when does it occur?
  - Was the computer recently moved?
  - Was any new hardware or software recently installed?
  - Was any software recently reconfigured or upgraded?
  - Did someone else use your computer recently?

Step 1: Interview the User

- Include these questions (cont'd):
  - Does the computer have a history of similar problems?
  - Is there important data on the drive that is not backed up?
  - Can you show me how to reproduce the problem?
- After gathering information:
  - Prioritize what to do and begin diagnosing and addressing the problem

Step 2: Back Up Data As Needed

- Three options for backing up data:
  - Move the hard drive to another system
  - Use file recovery software
  - Hire a professional file recovery service
    - Before selecting a service, read reviews, understand the warranty and guarantees, and get a customer recommendation

Step 3: Examine the System and Establish a Theory

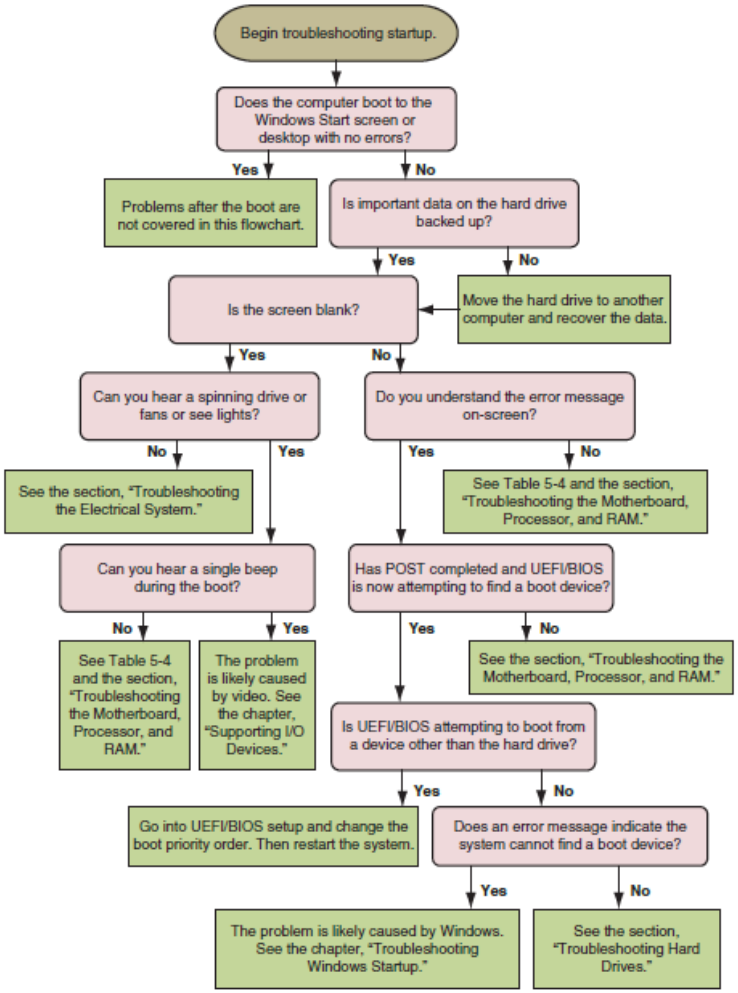

Figure 5-16 Use this flowchart when first facing a computer problem

Step 3: Examine the System and Establish a Theory

Beeps During POST	Description
1 short beep or no beep	The computer passed all POST tests
1 long and 2 short beeps	Award BIOS: A video problem, no video card, bad video memory Intel BIOS: A video problem
Continuous short beeps	Award BIOS: A memory error Intel BIOS: A loose card or short
1 long and 1 short beep	Intel BIOS: Motherboard problem
1 long and 3 short beeps	Intel BIOS: A video problem
3 long beeps	Intel BIOS: A keyboard controller problem
Continuous 2 short beeps and then a pause	Intel BIOS: A video card problem
Continuous 3 short beeps and then a pause	Intel BIOS: A memory error
8 beeps followed by a system shutdown	Intel BIOS: The system has overheated
Continuous high and low beeps	Intel BIOS: CPU problem

Table 5-5 Common beep codes and their meanings for Intel and Aware BIOS

Steps 4, 5, and 6: Fix the Problem, Verify the Fix, and Document the Outcome

- After understanding the problem
  - Plan steps to resolve the problem
- After the fix
  - Verify the system works by performing one last hard boot and making sure everything works as expected
  - Ask if anything could have been done to prevent the problem, if so, take preventative action
- Most organization require documentation in a call tracking or helpdesk application
  - Record findings

Special Concerns when Troubleshooting Mobile Device Hardware

- Factors to consider before starting repair project:
  - Warranty
  - Time the repair will take
  - Alternatives to repairing (upgrading)
    - Return notebook to manufacturer or service center
    - Substitute external component for internal device
    - Replace the internal device

Troubleshooting the Electrical System

- Electrical problems can:
  - Occur before or after the boot
  - Be consistent or intermittent
- Possible symptoms of electrical problem:
  - Computer appears to be “dead”
  - Computer sometimes locks up during booting
  - Error codes or beeps occur during booting
  - Smell burnt parts or odors
  - Computer powers down at unexpected times
  - Computer appears dead except you hear a whine coming from the power supply

Troubleshooting the Electrical System

- Try these simple things first:
  - If you small any burnt part, don't turn system on
    - Find fried part and replace
  - If power supply is whining, don't turn system on
    - Open case and look for short or consider upgrading
    - Test power supply with a power supply tester
  - Check power cord connection and power bar it may be plugged into
  - Is power outlet controlled by wall switch? If so, turn it on
  - Are any cable connections loose?

Troubleshooting the Electrical System

- Try these simple things first (cont'd):
  - Is the circuit breaker blown? Is the house circuit overloaded?
  - Are all switches on the system turned on?
  - Is it possible the system has overheated? If so, wait awhile and try again
  - Older computers might be affected by electromagnetic interference (EMI)
    - Check for sources of EMI such as fluorescent lighting or an electric fan or copier sitting near PC

Troubleshooting the Electrical System

- Problem still not solved, look inside the case:
  - Check all power connections from the power supply to the motherboard and drives
  - If you smell burnt parts, search for shorts and frayed and burnt wires
  - If you suspect the power supply is bad, test it with a power supply tester

Problems That Come and Go

- Generally, intermittent problems are more difficult to solve
- Symptoms of what may be an intermittent problem:
  - Computer stops or hangs for no reason
  - Memory errors appear intermittently
  - Data is written incorrectly to the hard drive
  - Keyboard stops working at odd times
  - Motherboard fails or is damaged
  - Power supply overheats and becomes hot to touch
  - Power supply fan whines and becomes noisy

Problems That Come and Go

- Eliminate the electrical system as the source of an intermittent problem:
  - Consider the power supply is inadequate
  - Suspect the power supply is faulty
  - The power supply fan might not work

Power Problems With the Motherboard

- Short might occur if a motherboard component makes improper contact with the chassis
  - Can seriously damage the motherboard
  - Check for missing/loose standoffs or loose screws
- Shorts in motherboard circuits might also cause problems
  - Look for damage on the bottom of the motherboard
  - Look for burned-out capacitors that are spotted brown or corroded

Problems With Overheating

- Symptoms of overheating:
  - System hangs or freezes at odd times or after the boot starts
  - Windows BSOD (blue screen of death) error occurs during the boot
  - You cannot hear a fan running or the fan makes a whining sound
  - You cannot feel air being pulled into or out of the case
- You can purchase a temperature sensor that will sound an alarm when the inside of the case is too hot

Problems With Overheating

- Things to do to solve overheating:
  - If system hangs, go into UEFI/BIOS setup and find the CPU screen that reports temperature (should not exceed that recommended by the CPU manufacturer)
  - Use compressed air, a blower, or antistatic vacuum to remove dust from the power supply and vents
  - Check airflow inside the case to see if fans are running (may need to replace a fan)
  - Install extra fans if case will hold them
  - Can the side of the case hold a chassis air guide that guides air to the processor? If so, install one

Problems With Overheating

Figure 5-20 Dust in the cooler fan can cause the fan to fail and the processor to overheat

Problems With Overheating

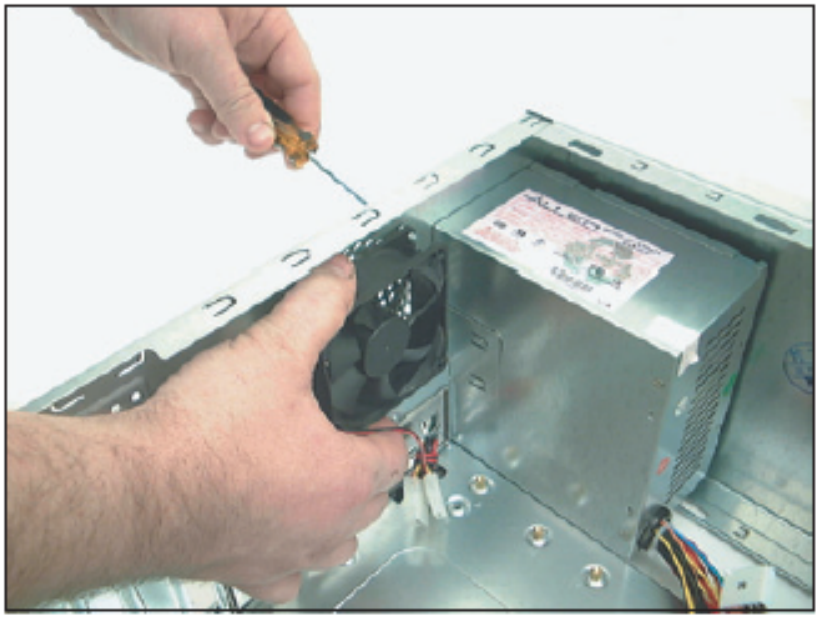

Figure 5-21 Install one exhaust fan on the rear of the case to help pull air through the case

Problems With Overheating

- Things to do to solve overheating (cont'd):
  - To improve airflow, replace missing faceplates and expansion slot covers
  - Ensure cables are not in the way of airflow
  - Place case so that there are a few inches of space on both sides and the top of the case
  - Verify the cooler is connected properly to the processor
  - After closing the case, leave system off for at least 30 minutes

Problems With Overheating

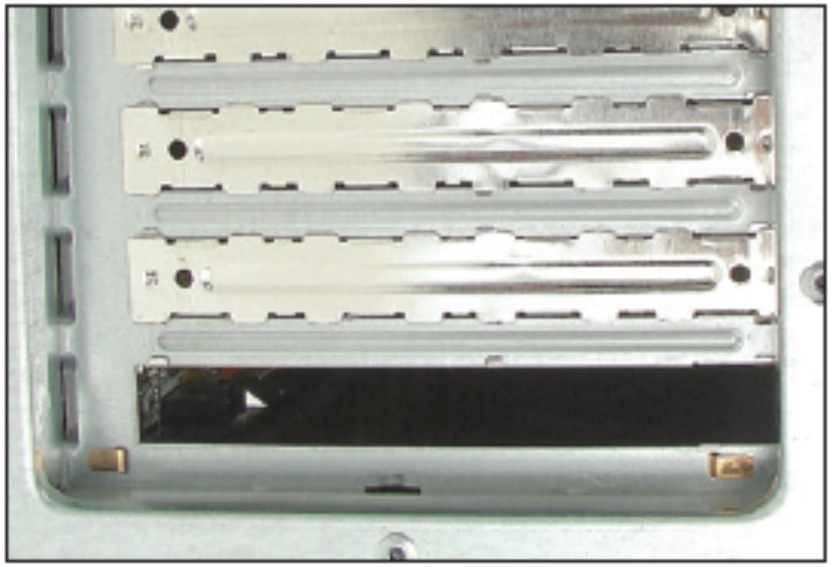

Figure 5-22 For optimum airflow, don't leave empty expansion slots and bays uncovered

Problems With Overheating

Figure 5-23 Use cable ties to hold cables out of the way of fans and airflow

Problems With Overheating

- Things to do to solve overheating (cont'd):
  - Check UEFI/BIOS setup to see if the processor is being overclocked (can cause system to overheat)
  - Have too many peripherals been installed inside the case? Try to leave an empty slot between each card
  - Flash UEFI/BIOS to update firmware on motherboard
  - Replace thermal compound if it has hardened

Problems With Overheating

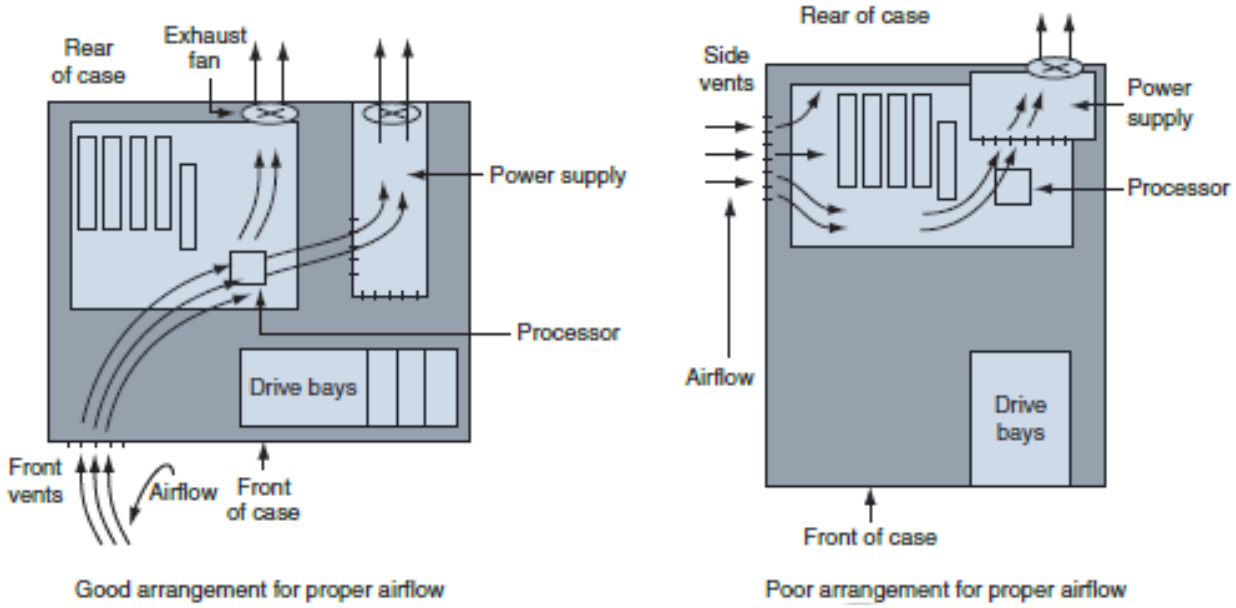

Figure 5-25 Vents and fans need to be arranged for best airflow

Problems With Overheating

- Use a power supply that has vents on the bottom and front for better ventilation

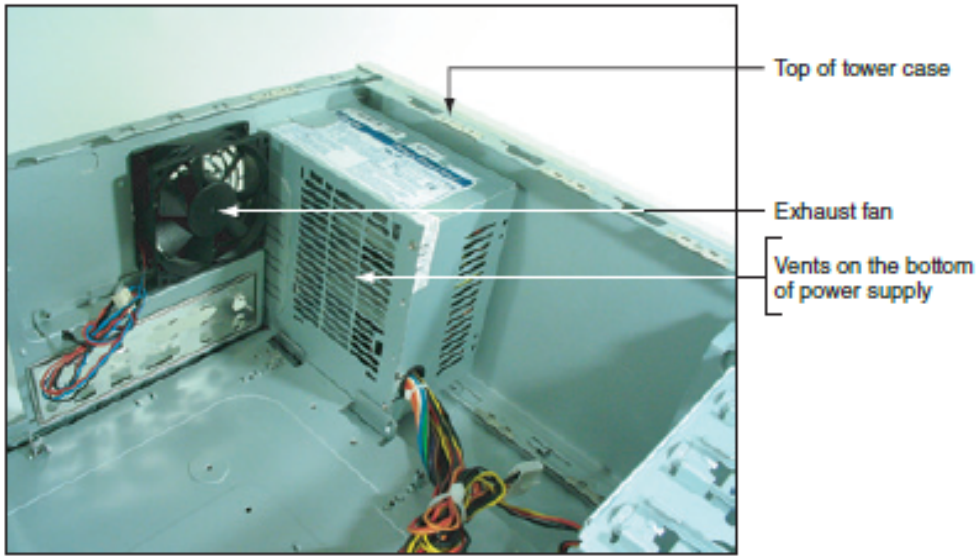

Figure 5-26 This power supply has vents on the bottom to provide better airflow inside the case

Problems With Overheating

- An intake fan on the front of the case might help pull air into the case
- Check with processor and case manufacturers
  - For specific instructions as to the placement of fans and what type of fan and heat sink to use
- Intel and AMD recommend a chassis air guide (CAG) as part of the case design
  - A round air duct that helps pull and direct fresh air from outside the case to the cooler and processor

Problems with Laptop Power Systems

- Laptop power sources
  - AC adapter or a battery pack
  - Today's batteries use lithium ion technology
- Auto-switching AC adapter feature
  - Device automatically switches from 110 V to 220 V AC power
- Some laptops use two batteries
  - Second battery is known as a sheet battery

Problems with Laptop Power Systems

- If power is not getting to the system or battery indicator light is lit:
  - Verify the AC adapter is plugged into an outlet
  - Check if AC adapter's plug is secure outlet
  - Check connections on both sides of AC adapter transformer
  - Check connection at notebook
- If battery is not charging when AC adapter is plugged in, problem might be with battery or motherboard

Troubleshooting the Motherboard, Processor, and RAM

- Symptoms that a motherboard, processor, or memory is failing:
  - System begins to boot but then powers down
  - Error message is displayed during the boot
  - System reports less memory than installed
  - System becomes unstable, hangs, or freezes
  - Intermittent Windows or hard drive errors occur
  - Components on the motherboard or devices connected to it don't work
- Check simple things first

Troubleshooting the Motherboard, Processor, and RAM

- Follow these steps to find source of problem:
  - 1. Search the Internet for the error message
  - 2. Run antivirus software to check for viruses
  - 3. A memory module might be failing
    - Use Memory Diagnostics tool to test memory
  - 4. Check for potential hardware problems using Device Manager
  - 5. Download and install any Windows updates or patches
  - 6. If problem began after a change or new install, uninstall device or application

Troubleshooting the Motherboard, Processor, and RAM

- Follow these steps to find source of problem (cont'd):
  - 7. Use System window to find out how much RAM is installed (consider upgrading if not enough)
  - 8. Check UEFI/BIOS setup to ensure proper settings
  - 9. Disable any quick booting features in BIOS
    - Then look for errors reported during the boot
  - 10. Flash BIOS to update firmware on the board
  - 11. Check CD that came with motherboard
    - May have diagnostic tests
  - 12. Update all drivers of motherboard components that are not working

Troubleshooting the Motherboard, Processor, and RAM

- Follow these steps to find source of problem (cont'd):
  - 13. If an onboard port is not working:
    - Verify the problem is not with the device using the port
    - Go into UEFI/BIOS setup and verify the port is enabled
    - Check Device Manager and verify Windows recognizes port with no errors
    - Update motherboard drivers for this port from manufacturer's web site
    - Use a loop-back plug to test the port
    - Disable the port in BIOS setup and install an expansion card

Troubleshooting the Motherboard, Processor, and RAM

- Follow these steps to find source of problem (cont'd):
  - 14. Suspect the problem is a failing hard drive
  - 15. Suspect the problem is caused by overheating
  - 16. Verify the installed processor is supported by the motherboard

Troubleshooting the Motherboard, Processor, and RAM

- For Windows 8, many continuous restart errors can be solved by performing a Startup Repair process
- For Windows 7/Vista, error messages disappear before they can be read as the system reboots
  - Disable automatic restarts by using the Advanced Boot Options menu (press F8 as Windows starts)

Troubleshooting the Motherboard, Processor, and RAM

- If you have checked Windows and UEFI/BIOS settings and have not identified the source of the problem, open the case and check inside
- With the case open, follow these steps:
  - 1. Check that all power and data cables are securely connected
  - 2. Look for physical damage on the motherboard
  - 3. Reduce the system to essentials
  - 4. Try using a POST diagnostic card
  - 5. Suspect the problem is caused by a failing power supply

Troubleshooting the Motherboard, Processor, and RAM

- With the case open, follow these steps (cont'd):
  - 6. Exchange the processor
  - 7. Exchange the motherboard
    - Before you do this, measure the voltage output of the power supply or replace it (in case it damaged the motherboard)

Troubleshooting Mobile Devices

- Solutions for a cell phone that is overheating:
  - Check if heat is coming from the bottom of cell phone, where battery is located
    - Use different AC adapter to charge battery
    - Examine battery for damage (if no longer under warranty)
  - If heat is coming from other areas of the phone:
    - Too many apps might be open
    - Follow troubleshooting steps for phone's OS
    - Phone processor might be overworked (allow to cool)
    - Remove phone from case

Troubleshooting Mobile Devices

- Other problems and solutions:
  - For a frozen system:
    - For iPhone or iPad, reset the device
    - For Android device, reboot the system by following manufacturer directions for a reboot
    - For Windows Phone, hold down the Power button and then swipe Slide down to power off
  - Battery charge lasts a short time
    - Try exchanging the AC adapter
    - If that doesn't work, exchange battery unless device is under warranty

Troubleshooting Mobile Devices

- Other problems and solutions:
  - When installing apps that don't load or load slowly
    - A hot or failing battery might be the problem
  - For slow performance, close apps you're not using, clean Android cached data, and disable live wallpapers
  - If device is unable to decrypt email, may need to generate a new public key and private key and distribute your new public key to those who send encrypted email

Summary

- Devices used to keep a processor and system cool include CPU coolers, fans, heat sinks, and liquid cooling
- Liquid cooling system use liquids pumped through system to keep it cool
- Important features of a power supply to consider when purchasing it are: form factor, wattage capacity, number and type of connectors, fan size, support dual video cards, and warranty
- To decide on the wattage capacity of a power supply, add up the wattage requirements for all components and add 30 percent

Summary

- Always begin troubleshooting by interviewing the user
- When troubleshooting, check the simple things first
- Decide if problem occurs before or after a successful boot and if it is caused by hardware or software
- When troubleshooting mobile devices, consider the warranty and that replacing a component might cost more than replacing the device
- Listen for spinning fans or drives and look for indicator lights to ensure a system is getting power

Summary

- Use a power supply tester to test the power supply
- Intermittent problems that come and go are the most difficult to solve
- Removing dust from a system, providing for proper ventilation, and installing extra fans can help keep a system from overheating
- The battery and DC jack are considered field replaceable units in a laptop that pertain to the power system
- Use a multimeter to check the voltage output of an AC adapter

Summary

- UEFI/BIOS gives beep codes when a POST error occurs during the boot before it tests video
- Error messages on a black screen during the boot are usually put there by startup UEFI/BIOS during the POST
- An unstable system that freezes or hangs at odd times can be caused by a faulty power supply, RAM, hard drive, motherboard, processor, Windows error, or overheating
- A POST diagnostic card can troubleshoot problems with the motherboard

Summary

- A mobile device battery that overheats or quickly loses its charge might need replacing, but first try replacing the AC adapter
- For a frozen system, try resetting an iPhone or iPad, rebooting an Android device, or resetting a Windows Phone