1.1 Course Introduction

This course is designed to prepare you to pass the TestOut PC Pro and CompTIA A+ certifications. The TestOut PC Pro certification is the first exam of the TestOut Pro certifications. This certification measures not just what you know, but what you can do. It measures your ability to install, manage, repair, and troubleshoot PC hardware and Windows, Linux, and Mac operating systems.

Before you take this course, you should have a basic understanding of computers. You should be familiar with how to:

* Use a mouse and keyboard
* Install and run programs
* Use basic productivity software, including word processing applications
* Save files created by common applications
* Browse the internet

The PC Pro certification addresses the following knowledge domains:

* Hardware
* Software
* Security
* Troubleshooting

In addition to covering everything you need to know to become certified, this course is designed to help you gain real-world skills that you will use every day as a PC technician. By the time you are done with this course, you should be able to do the following:

* Set up a new computer.
* Identify system requirements when purchasing a new computer.
* Understand the technology and specifications used to describe computer components.
* Make informed choices about which device characteristics are required for your situation.
* Install or upgrade the operating system.
* Manage external devices.
* Troubleshoot common computer problems that can be resolved without replacing internal components.
* Connect to a small home network.

1.1.1 PC Pro Introduction

## PC Pro Introduction **0:00-0:11**

Welcome to the PC Pro course. In this course, we're going to talk about computer systems—how they work, how to maintain them, and how to repair them.

## Course Audience **0:12-0:30**

This course is designed for anyone who wants to increase their computer skills and knowledge, even if you're just starting out. Employers search for IT professionals with valid real-world skills, so we'll teach you the knowledge and skills they look for so that you can begin your career in computers.

## Course Prerequisites **0:31-1:11**

Before we go any further, it's important that you understand the prerequisites for this course. We're assuming that you already know a few basic things about computers. First, we'll assume that you know how to turn a computer on.

You should know how to interact with the computer using a mouse and a keyboard. And we expect that you know how to run basic applications on a computer system. For example, you should be able to turn on a PC,open Microsoft Word, open a particular document, make changes to the document, and save the changes. We're also going to assume that you understand how to use a web browser and an email client to access information on the internet. Those are all the prerequisites for this course.

## Course Purpose and Topics **1:12-4:14**

The purpose of this course is to provide you with the equivalent knowledge of an entry-level computer technician with about 12 months of on-the-job experience. To do that, we're going to cover these topics:

First, we'll discuss how computers and operating systems work. We'll review a computer technician's job role, how they spend their time, and how should they act on the job.

We'll discuss the components that comprise a computer system. We'll take a look at storage, motherboards, processors, memory, and so on. We'll also discuss how to manage computer storage, how to make sure data is stored safely and securely, and how to make it accessible.

We'll also discuss some computer networking basics. We won't discuss them in much depth, though. If you want to learn more about computer networking, you should take the Network Pro course and get your Network Pro certification. We'll just give you a brief introduction.

We'll also discuss how to manage printing and mobile devices, a very important aspect of managing computer systems, and we'll introduce you to virtualization and cloud computing.

Then we'll move away from hardware and discuss the software that runs on computer systems. We'll discuss how to manage desktop operating systems. We'll talk about how to implement a computer system from a hardware and software perspective and how to manage files in the file system. Then we'll look at how to secure desktop systems. Specifically, we'll discuss how to make sure that the right people are able to access the right information.

And throughout the course, you'll learn how to troubleshoot common computer problems.

LabSim provides several features designed to help you learn and retain basic computing concepts. Each section provides you with videos and demonstrations that teach you how to perform necessary tasks. Fact sheets help reinforce the concepts taught in the videos, and interactive hands-on labs let you practice the skills you've learned. Within each section, you'll find practice questions to test your knowledge.

At the end of the course, you'll find both a PC Pro certification practice exam and A+ practice exams. These exams will help you prepare for certification. Consider using the exams as a pretest at the beginning of the course to determine how much you already know about computing. Then, as a post-test, retake the exams at the end of the course to see how much you've learned. You can also test your knowledge by taking the domain tests. The domain tests divide test questions up according to the domain objectives in the certification exams. It's another way to practice and reinforce basic computing concepts.

Now, let's talk about your certification, because that's really the goal of this course, to provide you with the information you need to become industry certified as a PC technician.

Certification is important if you plan to have a career in the IT industry. Certification provides two benefits. First, it gives employers critical information they need to make hiring decisions. Second, it gives you an edge in the job application process because employers look for certification.

## Certifications **4:15-4:24**

This course meets the specifications for two different industry certification programs: the TestOut PC Pro certification and the CompTIA A+ certification.

## TestOut PC Pro Certification **4:25-5:03**

The TestOut PC Pro certification measures how much you know and what you can do. The PC Pro cert validates that you have the equivalent knowledge of a computer technician with about one year of work experience.

It demonstrates that you know the basics of how computers work, how to install, configure, and troubleshoot computer hardware, and how to install, configure, and troubleshoot networking connections. In addition to that, PC Pro takes things a step further by emphasizing real-world job skills. In order to get your PC Pro certification, you won't answer a whole bunch of multiple-choice questions—you'll perform real-world tasks.

## CompTIA A+ Certification **5:04-6:08**

The A+ certification is an international certification program created by the Computing Technology Industry Association, or CompTIA. The CompTIA A+ certification covers generic PC concepts. It's not focused on one particular vendor's hardware or software. The A+ certification program tests how much you know—it doesn't focus on what you can do. The online exam is composed of multiple-choice questions.

The A+ certification is composed of two different exams. The first exam is 220-1001, which tests your knowledge of mobile devices, networking, computer hardware, virtualization and cloud computing, and hardware and network troubleshooting. The 220-1002 exam tests your knowledge of operating systems, security, software troubleshooting, and operational procedures.

So, as you can see, the A+ certification works hand in hand with the PC Pro certification to verify that you know what a computer technician should know and can do what a computer technician needs to in their job.

## Summary **6:09-6:23**

With this introduction in mind, it's time for you to start learning about how computers work. In this video, we introduced you to the PC Procourse, the course audience and prerequisites, the topics covered in this course, and the certifications that this course will help you achieve.

Chapter 1: Computing Overview

1.2 Hardware Basics

As you study this section, answer the following questions:

* What is the difference between hardware, software, and firmware?
* Which types of devices use USB ports?
* What are common input and output devices?
* What is the definition of processing?
* What are the most common types of storage devices?
* Why is it important to increase componentization and standardization?

In this section, you will learn to:

* Identify common I/O ports by sight
* Connect common peripherals to standard ports

Key terms for this section include the following:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Hardware | The physical components that compose a computer system or network. |
| Software | Instructions or data that are stored electronically, either on a hard drive or a special chip. |
| Input | The movement of data or commands to the internal computer hardware. |
| Processing | The flow of data through a series of procedures as defined by a set of instructions. |
| Storage devices | Devices that contain non-volatile memory for saving or maintaining data. |
| Output | The process of the computer presenting, displaying, or otherwise giving data. |
| Networking and communications | The practice of connecting two or more computers in order to transfer data. |

This section helps you prepare for the following certification exam objectives:

|  |  |
| --- | --- |
| **Exam** | **Objective** |
| CompTIA 220-1001 | 1.1 Given a scenario, install components within the display of a laptop.   * Microphone   3.1 Explain basic cable types, features, and their purposes.   * Multipurpose cables   + Thunderbolt    Peripheral cables   * Serial    Hard drive cables   * SATA * IDE    Adapters   * DVI to HDMI * USB to Ethernet * DVI to VGA   3.2 Identify common connector types.   * RJ-11 * RJ-45 * RS-232 * DB-9 * SCSI   3.6 Explain the purposes and uses of various peripheral types.   * ADF/flatbed scanner * Barcode scanner/QR scanner * Mouse * Keyboard * Touchpad * Game controllers * Camera/webcam * Microphone |

1.2.1 Computing Basics

## Computing Basics **0:00-0:18**

As a PC technician, it's very important that you understand the basic components that make up a computer. Computers are made up of constituent parts that work together to create a functional computer.These parts can be divided into two main categories, hardware and software.

## Hardware vs. Software **0:19-1:09**

Hardware refers to the physical components that are installed inside or connected to a computer system. By itself hardware can't do much. It needs instructions to tell it what to do. These instructions come from the software. Software refers to instructions, or data, that are storedelectronically either on a hard drive or on a special chip.

Hardware without software is like a car without a driver. A car has the potential to drive but it needs a driver in order to see the potential.Without a driver the car can't do anything. The same is true with hardware. Hardware has a lot of potential but it needs software to instruct it to use that potential. The main thing to remember is that hardware is the potential and software is the instructions.

In this lesson, we're going to take a look at the different types of hardware devices that compose a computer system. The first type of hardware we'll look at is input devices.

## Input Devices **1:10-3:36**

An input device is any piece of hardware that takes information from outside the computer and transfers it inside where the computer hardware can use it. The most common input device is a keyboard. A keyboard takes user inputs and sends them as electrical signals to the internal computer hardware where they are processed. When a key on a keyboard is pressed, an internal chip called the scanning chip, identifies which key was pressed and then sends the appropriate code to the computer.

The code could generate a letter in a Word document, a number in a spreadsheet or a command for the computer. Another very common input device is a mouse. A mouse also uses inputs and sends them as electrical signals to the computer, but it does so a bit differently. A mouse tracks movements as x,y-coordinates. The coordinates sent to the computer cause the mouse pointer to move in the same manner.

The way a mouse tracks movement depends on the type of mouse being used. The most common type is an optical mouse. An optical mouse uses a light source and a sensor to track movement. A less-common type is a mechanical mouse. A mechanical mouse uses a trackball that the user rolls to move the mouse pointer. The trackball has sensors to identifywhich direction the ball rolls.

Chances are you are very familiar with using these two input devices.Another input device you are also probably familiar with is a touchscreen.If you've used a smartphone, tablet, or a computer kiosk, you've used a touchscreen. Instead of key presses or movement tracking, a touchscreen takes user input from screen taps.

There are two main touchscreen technologies, resistive and capacitive.Resistive touchscreens use two flexible layers that are separated by a gap.Inside the gap is an electrical current. When the screen is tapped, the outer layer depresses and contacts the inner layer creating an electrical signal that identifies x,y-coordinates. The coordinates are then sent to the computer.

Capacitive touchscreens use a screen that is coated with a conductive material. An electrical current is then run through the material. When something conductive touches the screen, such as a finger, small sensors identify the touch and generate x,y-coordinates. Capacitive touchscreens are used on smartphones, tablets, and some laptops.

Because they require a conductive touch, a non-conductive object, such as gloves or plastic, can't be used to tap the screen. Resistive touchscreens are typically used for airport or library kiosks. Because they require only pressure, any rigid object can be used to tap the screen.

## Processing **3:37-4:40**

Signals generated by input devices need to be analyzed. This is done using a processing device. A processing device is any hardware component that can analyze and interpret input. The most common processing device is the central processing unit (CPU). The CPU is like the brains of the computer. It processes data according to a set of instructions or software.

For example, when the "A" key on the keyboard is pressed, the keystroke information is sent to the CPU where it is processed based on the software that is currently running. If you were running word processing software, the letter "A" would appear at the cursor location in the open document. If you were running a game, it might make the character move to the left.

Another processing device is random-access memory (RAM). RAM is used to store processed information so it can be quickly accessed at a later time. For example, if a CPU were to process data from a spreadsheet but still needed to access that data at a later time, the data could be stored in RAM for quick access. RAM is also used to store running software.

## Storage **4:41-7:26**

RAM can also be considered a hardware component called a storage device. A storage device is any hardware component that stores data, either temporarily or permanently. When data is stored temporarily,short-term storage such as RAM is used. It's important to know that RAM is considered volatile memory, that means it's not persistent. For example, if the computer is turned off or loses power, all the data that was stored in RAM is lost. It's gone forever.

You might wonder why you would use a storage device that is erased every time it loses power. You use RAM because it's extremely fast.Information can be accessed from RAM faster than any other type of storage hardware.

But sometimes you need to store information permanently. This is done using long-term storage. Remember, short-term storage is lost every time the computer is shutdown. Long-term storage is considered non-volatile memory. In other words, it's persistent. This means that even when the computer is turned off, the data stored on the hardware will still be there when you turn the computer back on.

There are a variety of long-term storage media. The most common one is a hard-disk drive. Hard-disk drives store information on rotating disks called platters. Another common medium is a solid-state drive (SSD). SSDs use memory chips that are a lot like RAM. However, the information stored on these chips is persistent.

Hard disk drives and SSDs can store a lot of data and access it relatively fast but not nearly as fast as RAM. This is why you use both hard drives and RAM to store data.

You also have optical-storage media such as CDs, DVDs, and Blue-ray disks (BDs or BRDs). Optical-storage media can be read-only or writable. If a disk is read-only, the information it contains is fixed and can't be modified or erased. It can only be viewed. An example, a read-only disk isa software CD-ROM or DVD-ROM. The ROM at the end stands for read-only memory.

Writable disks on the other hand can be modified. Disks that are writable have an R or an RW. For CD-R, DVD-RW, and BD-R, the R stands for recordable. Unlike their ROM counterparts, these types of disks can have information saved to them.

There are two more long-term storage devices to talk about. The first is a flash drive. Flash drives are small, portable devices that use memory chips to store information. These memory chips are very similar to RAM chips.However, the information is persistent.

The second device is a secure digital card (SD card). You might be familiar with these. SD cards are used in smartphones, tablets, and digital cameras to store information. They use non-volatile memory.

## Output Devices **7:27-8:25**

All the information that is being input, processed, and stored on a computer is useless unless there is a way to access and view it. This is done by using an output device. An output device is any device that receives data from a computer and outputs it in a physical medium.

The most common output device is a monitor. Monitors visually depict the data that is processed by the CPU, whether it's numbers being calculated in a spreadsheet or aliens running around in a video game. A monitor displays a visual representation of the information being processed.

Another very common output device is a printer. Printers take information that is processed by the CPU and prints it on a piece of paper.Both monitors and printers output visual information.

There are more than just visual output devices. Another output device is a sound card. Sound cards take digital information and output it as audible signals. Almost all computers have some sort of audio output device.

## Networking Devices **8:26-9:16**

All the devices talked about so far communicate information within a single computer. However there are other hardware components that allow information to be communicated between multiple computers.These are known as networking devices. Networking devices are used to create networks.

A network is a group of two or more computers that are connected together. To create a network, a special interface is installed in a computer. A connecting medium is used to connect the computers together. This connecting medium can be a physical wire or even radio signals.

With this connection established, two or more computers can take information being processed by the CPU and send it to each other. This makes networking hardware both input and output devices. When one computer is outputting information, the other is inputting information and vice versa.

## Modular Design **9:17-10:18**

There's one more aspect of computer hardware, it's called modular design. Modular design is a design approach that standardizes hardware interfaces in order to create modular hardware components. This means that when a monitor that works on one computer is connected to a different computer and still works, the monitor is modular.

While this may seem commonplace today, it wasn't always the case. In the early days of computers, hardware components were proprietary. This meant that if a piece of hardware in your computer died you couldn't just go to the store and buy a replacement. You had to ship the component, sometimes the entire computer, back to the manufacturer in order to get it fixed or replaced.

Luckily this isn't the case anymore. Because computer hardware is modular and standardized, you aren't limited to a specific manufacturer or brand when buying and replacing hardware components. For example, if you want to install another hard-disk drive in your computer, you don't have to buy it from the same company that built your computer.

## Summary **10:19-10:42**

Any brand of hard-disk drive will work.

Those are the basic hardware components of a computer system.Remember, there are two main computer component categories.Hardware and software. Hardware's the potential. Software is the instructions. In this lesson, we looked at the various hardwarecomponents that comprise a computer based on the five main functions they perform, input, processing, storage, output, and networking.

1.2.2 Computing Facts

Computers are made up of several constituent components. These components can be divided into two main categories:

|  |  |
| --- | --- |
| **Category** | **Description** |
| Hardware | The physical components that compose a computer system or network. Common hardware components include the following:   * Keyboard, mouse, monitor, printer * Connectors and cables * Hard disk drives * Circuit boards |
| Software | Instructions or data that are stored electronically, either on a hard drive or a special chip. Software components include the following:   * Operating systems. * Program applications. * Hardware drivers (special programs that tell the operating system how to use the hardware.)   *Firmware* is a special type of software that is embedded in the read-only memory of a hardware component. A BIOS chip is an example of firmware. |

Computer hardware can be categorized based on the function it performs.

|  |  |
| --- | --- |
| **Function** | **Description** |
| Input | The movement of data or commands to the internal computer hardware. Input devices include:   * Standard input devices:   + Mouse   + Keyboard   + Touchscreen * Gaming input devices:   + Game controller   + Joystick * Media input devices:   + Scanner   + Digital camera   + Webcam * Audio input devices:   + Microphone   + MIDI controller |
| Processing | The flow of data through a series of procedures as defined by a set of instructions. Major processing components include:   * CPU (central processing unit) * RAM (random-access memory) * RAM is a temporary short-term type of storage used to store processed information for quick access. RAM is considered volatile memory because it is not persistent. When the computer is turned off, all the data that was stored in RAM is lost. |
| Storage Devices | Devices that contain non-volatile memory for saving or maintaining data. Storage devices include:   * Hard disk drives * Solid-state drives * Optical drives (CD-ROM, DVD-ROM, and Blu-ray) * Flash drives |
| Output | The process of the computer presenting, displaying, or otherwise giving data. Output devices include:   * Video * Audio * Printing |
| Networking and Communications | The practice of connecting two or more computers in order to transfer data. Networking components include:   * Connecting media:   + Copper cables   + Radio signals * Connection devices:   + Routers   + Switches |

Modern hardware components use modular design that implements both componentization and standardization.

* Componentization: a functional PC is a combination of several constituent parts. Each part is considered a field-replaceable unit (FRU), meaning it can be quickly replaced when faulty or easily upgraded when needed. Componentization keeps maintenance costs low and reduces downtime.
* Standardization: specifications that allow components from different manufacturers to be interchangeable. If a component meets the specified standards, it will work in the computer regardless of manufacturer.

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1.2.3 External Components

## External Components **0:00-0:13**

Computers use a variety of ports in order to connect external input and output devices. In this lesson, we're going to look at some of the more common ports used by computers.

## PS/2 Ports **0:14-1:12**

If you looked at the back of a desktop computer, you would notice many different ports. Let's take a look at each of these.

PS/2 ports are used to connect a keyboard and a mouse. PS/2 ports are part of a family of connectors called mini-DIN connectors. Their technical name is a mini-DIN 6 port, but they are typically called PS/2 ports.

You may notice how these ports are different colors. The majority of desktop computers use colors to denote the type of device that connects to the port. For example, a purple PS/2 port means it is the keyboard port.A green means it is the mouse port.

Occasionally, you might encounter a PS/2 port that is half purple, half green. This means that the port can be used for either a keyboard or a mouse. Know that not all computers use color-coded ports. Sometimes ports will be black with small icons to identify the port. Sometimes, the ports won't have any identifiers.

## Video Ports **1:13-2:14**

Next to the PS/2 ports, we have a few ports we'll talk about as a group.These ports are all different types of video ports and are used to output display information.

A VGA port on a PC is a DE-15, female connector. It has three rows with five pins each. It sends an analog video signal to an external display.

Next is a Digital Video Interface (DVI) port. Unlike VGA ports, DVI ports are able to send a digital signal to an external display, resulting in a much higher quality image. The DVI port is also a female port and it has 28 pins.It has three rows of eight pins with a square of four pins to the side of the three rows. DVI ports send a digital video signal but analog audio.

The next two video ports also send a digital signal. One port is an High Definition Multimedia Interface (HDMI) port. The other port is a DisplayPort. The cool thing about these ports is that in addition to a digital video signal, they can also send a digital audio signal. This is great for connecting a computer to a TV.

You can identify HDMI ports and DisplayPorts by their shape. HDMI ports are symmetrical. Both bottom corners are beveled. DisplayPorts are asymmetrical.

## USB Ports **2:15-2:56**

Only one corner is beveled.

You are most likely familiar with these next ports, Universal Serial Bus (USB) ports. USB ports are extremely versatile. They can be used to connect a mouse, keyboard, printer, digital camera, external hard drive, and the list goes on and on.

USB ports can be identified by their rectangular shape and the inside tab.This tab prevents a USB plug from being inserted incorrectly. You may notice different colors of USB ports. There are currently two versions of the USB standard. A blue port identifies ports that are USB 3.0 ports.These ports are able to transfer information at a much faster rate than the USB 2.0 ports indicated as black.

## FireWire (IEEE 1394) **2:57-3:15**

Another port you will see is a FireWire port. It is also called an IEEE 1394 port. FireWire ports can connect many of the same devices that USB ports connect. However, USB ports are used much more often. FireWire ports can be identified by the rectangular shape that has one beveled side.

## Audio Ports **3:16-4:34**

We'll talk about the next ports as a group. These are different types of audio ports. Two of the ports are Sony/Phillips Digital Interface Format (S/PDIF) ports. S/PDIF ports transmit a high quality digital audio signal.Notice the different connector types. One port is a Coaxial S/PDIF portand uses a coaxial connector. The other port is a Fiber S/PDIF port. It uses a fiber optic connector.

Other audio ports transmit analog audio signals. The ports themselves are called audio jacks. Audio jacks are typically color coded. The blue jack is the line-in port. The line-in port is used to transmit an audio signal into the computer where it can be played by the computer's speakers. For example, you could plug in radio output and play it through your computer.

The green jack is the line-out port. This is used to connect speakers to the computer.

The pink jack is the microphone port. It is used to connect a microphone in order to record audio. Most of the time you'll encounter only these three types of audio jacks.

However, higher-end motherboards will also have two jacks that are used with surround sound devices. The black jack is for connecting rear speakers.

## Ethernet Port **4:35-4:50**

The orange jack is for the subwoofer.

The next connector we'll look at is the Ethernet port. Ethernet ports are used to connect a computer to a network. Ethernet ports use RJ45 connectors to connect to the network. Most new motherboards have oneor more built-in Ethernet ports.

## Serial Port **4:51-5:21**

The last port we'll talk about isn't used as much as it used to be. It's been replaced by most of the ports we've already talked about. It's the serial port. The serial port, also called a DB9 connector, has nine pins. The D in DB comes from the characteristic D-shape of the port. Serial ports are used to connect serial devices, such as a barcode scanner. They look similar to VGA ports, but they have only two pin rows, not three.

## Summary **5:22-5:45**

Those are some of the most common ports used by computers.Remember, ports can use either colors or icons to help you identify them, but this isn't always the case. It's very important that you are able to identify the various ports used by computers by their look. By spending time memorizing these ports, you'll easily be able to identify a DVI port or line-out port at a quick glance. This is an invaluable skill.

1.2.4 Port and Connector Facts

You should be familiar with the following ports and connectors, where they are located, and which devices they support.

|  |  |
| --- | --- |
| **Port/Cable** | **Description** |
| VGA (DE-15) | The video graphics array (VGA) port is used to connect external display devices such as projectors and some monitors. VGA ports:   * Transmit an analog video signal. * Have three rows of five pins. * Use a DE-15 connector.   DE-15 connectors are often called DB-15 connectors, which is a misnomer. |
| DVI | A digital visual interface (DVI) port is used to connect display devices. DVI ports:   * Carry either an analog signal, a digital signal, or both. * Support one of two cable and connector types, single link or dual link. |
| HDMI   DisplayPort | The High-Definition Multimedia Interface (HDMI) port and DisplayPort are used to send high-quality digital video and audio signals. The following devices use the HDMI and DisplayPort:   * LCD monitors * HDTVs   HDMI has a smaller form factor connector called an HDMI-mini connector. This connector is half the size of a standard HDMI connector and is used to connect smart phones, tablets, and digital cameras to external displays. |
| Thunderbolt | The Thunderbolt port combines PCI Express (PCIe) and DisplayPort signals into a single interface. The Thunderbolt port can also provide DC power. Thunderbolt ports are mainly used for external displays. |
| S-Video (miniDin-4) | The separated video (s-video) port is used for connecting external displays. It has slightly better picture quality than an RCA video port. |
| USB | The USB port is one of the most common computer ports. USB ports are used to connect a variety of devices.   * Mouse and keyboard devices * External storage devices * Digital cameras * Printers * Scanners * Microphones * Webcams |
| Audio Jack | Audio jacks are used to send or receive analog audio signals. Audio jacks use 3.5 mm TRS connectors to connect audio devices such as:   * Speakers * Headphones * Microphones * Audio output devices   Audio jacks use a common color code to denote the port type:   * Green: line out * Pink: mic in * Blue: line in * Orange: subwoofer * Black: rear speakers |
| Coaxial S/PDIF   Fiber S/PDIF | The S/PDIF port is used to send a digital audio signal to high-end audio devices such as home theatre systems or Dolby Digital surround sound systems.   * Coaxial S/PDIF ports use a copper coaxial cable to transmit signals. * Fiber S/PDIF ports use fiber optic cables to transmit signals. |
| RJ45 | RJ45 ports are used to create Ethernet networks by connecting multiple computers and networking devices. RJ45 ports have eight connector pins. |
| RJ11 | RJ11 ports are used by telephones and modems to send analog signals. RJ11 ports have four connector pins. |

Computer ports that have been replaced by newer technology are considered legacy ports. Legacy ports are still widely used and provide functionality, but are neither as fast nor as efficient as the ports that have replaced them. The following table explains some common legacy ports.

|  |  |
| --- | --- |
| **Port/Cable** | **Description** |
| PS/2 (Mini-DIN-6) | The PS/2 port, also called mini-DIN-6, is used to connect older PS/2 keyboard or mouse devices. PS/2 ports are color coded. Purple denotes the keyboard port, and green denotes the mouse port.  The PS/2 port has been superseded by the USB port. |
| Serial (DB-9) | The serial port is used to connect serial devices, such as a barcode scanner, dial-up modem, or serial mouse. Serial ports are also used to configure and manage some networking devices.  *RS-232* is a standard for serial communication transmission of data. It defines the signals connecting computer equipment like a computer and a modem. The RS-232 standard was commonly used in computer serial ports. USB has replaced RS-232 for most of its peripheral interface roles. Many computers no longer come equipped with RS-232 ports. |
| Parallel (DB-25) | The parallel port connects older devices that use a parallel interface, such as printers, hard drives, and gamepads.  The parallel port was superseded by the USB and RJ45 port. |
| DB-15 | The DB-15 port is used by legacy gamepads, joysticks, and MIDI devices.  These ports are typically found on older sound cards. |

1.2.5 Adapter and Converter Facts

Connector adapters and converters are used to convert a particular connector type into one that can be used by a computer or component. Adapters are typically used with displays to convert a display connector into one the display device can use.

The following table describes the most commonly used adapters and converters.

|  |  |
| --- | --- |
| **Adapter** | **Description** |
| HDMI to DVI | Used to connect an HDMI cable to a DVI port. |
| VGA to DVI | Used to connect a VGA cable to a DVI port. |
| VGA to HDMI | Used to connect a VGA cable to an HDMI port. |
| Ethernet to USB | Used to connect an RJ45 connector to a USB port. |

The way an adapter or converter looks depends entirely on the manufacturer. Because of this, it is important to make sure that the adapter has not only the correct connection type, but also the correct connection end (e.g., a DVI [female] to an HDMI [male]).

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1.2.5 Adapter and Converter Facts

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1.2.6 Internal Components

## Internal Components **0:00-0:17**

Computers are made up of a lot of different parts. Some connect to the outside of a computer. Some connect to the inside. In this lesson we're going to look inside a desktop computer and identify some of the key internal components that allow a computer to function.

## Power Supply **0:18-0:34**

If you look inside a computer, you will see there are a lot of different components inside.

The first one you might notice is a big square. It is the power supply. The power supply converts AC power from the wall into DC power that can be used by the computer.

## CPU **0:35-1:01**

Next you might notice a big fan in the middle of the computer. This is the CPU fan and heat sink. It sits directly on top of the CPU. CPUs generate a lot of heat. The CPU fan and heat sink pull heat away from the CPU and dissipate it, cooling the CPU. Without this, the CPU would overheat.

If you remove the heat sink, you can see the CPU it is behind the CPU fan and heat sink.

## Motherboard **1:02-1:20**

You'll notice that everything in the computer, including the CPU, is connected to the same component at the bottom of the computer case.This component is called the motherboard.

The motherboard is kind of like the heart of the computer. It contains all of the wiring and circuitry that is necessary for the different components to communicate with each other.

## Memory **1:21-1:38**

Memory modules, also known as Random Access Memory (RAM) are inserted into memory slots on the motherboard. RAM is where data that the CPU is currently working on is stored. Remember, this memory is short-term storage. When the power supply is turned off, the data in these modules are erased.

## Storage Devices **1:39-2:21**

To store data long term, you use a hard disk drive. Hard disk drives can be easily identified by their size, appearance, and the cables used to connect them to the motherboard. Most hard disk drives use a thin cable called a SATA cable.

Another storage device in the computer is an optical disc drive. Optical drives are larger than hard disk drives and typically use an IDE cable toconnect them to the motherboard. However, some newer optical drives use SATA cables.

Storage devices have two cables connected to them. One cable connects the device to the motherboard. The other connects the device to the power supply to provide power.

## Expansion Card **2:22-2:46**

The last component to talk about is called an expansion card. An expansion card is inserted into one of the motherboard's expansion slots.Expansion cards are used to customize a computer to perform a desired function. For example, a common expansion card is a high-end graphicscard that allows a computer to play the latest PC games.

## Summary **2:47-3:03**

Other types of expansion cards include audio expansion cards and networking expansion cards.

These are the key internal components of a desktop computer. Take time to memorize these components. As a PC technician, you should be able to open up any computer system and immediately point out the components we covered in this lesson.

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Chapter 1: Computing Overview

1.3 Windows Basics

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As you study this section, answer the following questions:

* What are the kernel's functions?
* What is the difference between a GUI and a CLI?
* What type of information is shown on the taskbar?
* Which Windows interface components would you use to switch from one running program to another?
* How does an index improve searching on your computer?

In this lesson, you will learn to:

* Navigate the Windows 10 interface

Key terms for this section include the following:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Operating system | A set of programs that acts as an interface between the applications that are running on a computer and the computer's hardware. |
| Multiprocessing | The ability to use multiple processing devices. |
| Multitasking | The ability to run multiple applications simultaneously. |
| Multithreading | The ability to run multiple parts of an application simultaneously. |
| Kernel | The core of the operating system that is loaded into memory when the system boots up. |
| Driver | A type of computer program that enables the operating system to interact with hardware devices. |
| Interface | What allows the user to interact with the kernel and the utilities. |
| Utilities | The features or programs included with an operating system that perform system-related tasks. |
| Application | A subclass computer program that is designed for end users. |

This section helps you prepare for the following certification exam objectives:

|  |  |
| --- | --- |
| **Exam** | **Objective** |
| CompTIA 220-1002 | 1.1 Compare and contrast common operating system types and their purposes.   * Workstation operating systems   + Microsoft Windows |

1.3.1 Windows Operating Systems

## Windows Operating Systems **0:00-0:05**

In this lesson, we're going to talk about operating systems.

## Operating System **0:06-0:40**

The operating system serves as an interface between the applications running on the computer and the computer hardware. If you drew a picture of a computer system, you would have the computer's hardware, an operating system on top of it, and applications on top of the operating system.

The hardware is the motherboard, the CPU, the memory, the hard drive, the DVD drive, and the video card.

On top of the hardware, you install an operating system (OS). Because the operating system and the hardware are independent of each other, you can install any operating system, like Windows, Mac, or Linux, onto your choice of hardware.

On top of the operating system, you install applications.

## Provides Application Platform **0:41-0:53**

The first job of the operating system is to provide a platform for your applications. Applications need a place to run. They can't run directly on the hardware, so there has to be an operating system sitting in between to allow this to happen.

## Moderates Hardware **0:54-1:45**

The operating system accesses the hardware for the applications. Not only does the operating system provide a platform for the application to run on, but it also provides a way for the applications to access the hardware in the computer. The operating system software includes special routines that allow an application programmer to access certain pieces of hardware in the computer without having to do a lot of work.

Let's say that you have an application that you're writing and you want to be able to send a print job through a USB port on the PC system. Without an operating system, you would have to write the exact instructions foraccessing the USB port on the hardware.

But with an operating system, you don't have to worry about that because the person who wrote the operating system included the instructions for accessing the USB port. All you have to do is send the print job to the USB port and the operating system formats the job and gets it to the USB port.

## Provides Security **1:46-2:09**

The operating system also provides security. Any operating system you use may require you to provide some kind of credentials like logging inwith a username and a password to use the computer. The operating system checks its database of valid users and their passwords. Based on the information you enter, the operating system decides whether or not you can use that computer. This is an important feature because it helps prevent the loss of important data.

## Manages the File System **2:10-2:38**

--Manages the File System

The operating system also manages the file system. The file system encompasses all the different storage devices that are installed on the computer. The operating system organizes and stores the data on one of these storage devices whether it's the hard disk, a flash drive, or other storage media.

Managing the file system also relates to moderating hardware. The file system works with specific pieces of hardware like the hard disk drive, a CD drive, a DVD drive, or a flash drive.

## Kernel **2:39-3:05**

Operating System Components

Operating system components perform various functions of the operating system. The three components covered in this lesson are the kernel, utilities, and interfaces.

The first component of the operating system is called the kernel. The kernel is the core of the operating system. It's what's loaded into memory when the system boots up. The kernel performs most of the criticaloperating system jobs just mentioned. It's responsible for managing the file system. It's responsible for managing security, for working with the hardware, and for providing a platform for applications to run on.

The kernel runs behind the scenes and does the bulk of the work, so you won't work directly with it.

## Utilities **3:06-3:42**

Utilities are another component of a typical operating system. The utilities are the parts you work with on a daily basis. For example, if you're using Windows and you open My Computer, browse your hard drive, and open a file, you're using a utility. You're not actually using the kernel but you're using a utility that's part of the operating system that's interacting with the kernel to do a particular job. Most operating systems come with many utilities.

Today's operating systems are very large, in part because of the utilities that are packed around the kernel. The kernel forms the center of the operating system and all around the kernel are the many different utilities.

## Interfaces **3:43-4:47**

Another key component of the operating system is called an interface.The interface allows the user to interact with the kernel and the utilities.There are two different types of interfaces.

The first type of interface is a command line interface. An example of a command line interface is Linux. If you want to run a program or a utility,you type the command at the prompt, hit Enter and the program or utility runs. Command line interfaces are very powerful.

The second type of interface is called a graphical user interface, or GUI, as it's known in the industry. Instead of using a command line, a GUIrepresents things graphically on the screen. If you've used Windows and you've clicked on the icons or the Start button with a mouse, you've used a graphical user interface. Linux also includes a graphical user interface.

The command line interface and the graphical user interface are both fantastic for their different purposes. Sometimes you need the power and flexibility offered by a command line interface. However, when you're just doing day-to-day work, it's nice to be able to double click on something and have it work.

## Summary **4:48-5:10**

Summary

That's it for this lesson. In this lesson, you learned that the role of the operating system is to act as an interface for applications, access the hardware, provide security, and manage the file system. One component of the operating system is the kernel. The kernel manages the file system and security. It works with the hardware and provides a platform for applications to run on. You use an interface to run utilities andapplications that run on the kernel itself.

**Actions**

1.3.2 Windows Operating System Facts

An *operating system* is a set of programs that acts as an interface between the applications that are running on a computer and the computer's hardware. Operating systems perform actions such as:

* Receiving user input from input hardware devices such as the keyboard or mouse
* Sending user output to output hardware devices such as the monitor or a printer
* Controlling the use of processing devices by applications
* Serving as a platform for applications
* Moderating hardware
* Providing security
* Managing the file system

Some operating systems also have attributes such as the following:

* *Multiprocessing* is the ability to use multiple processing devices.
* *Multitasking* is the ability to run multiple applications simultaneously. Two common variations are:
  + Cooperative multitasking means that multiple processes must work together for the operating system to work effectively.
  + Preemptive multitasking forces applications to share the CPU.
* *Multithreading* is the ability to run multiple parts of an application simultaneously.

The following table explains important operating system components.

|  |  |
| --- | --- |
| **Part** | **Description** |
| Kernel | The *kernel* is the core of the operating system that is loaded into memory when the system boots up. It is responsible for controlling security, managing the file system, and providing a platform for applications to run on. The user rarely interacts directly with the kernel. |
| Driver | A *driver* is a type of computer program that enables the operating system to interact with hardware devices. |
| Interface | An *interface* is what allows the user to interact with the kernel and the utilities. There are two main types of interfaces, command line and GUI. In command line interfaces, commands are executed through instructions written into a command line. Examples of command line-based interfaces are MS-DOS and aspects of Linux. In a Graphical User Interface (GUI), the user executes commands by clicking on graphics and symbols. Windows is an example of graphical user interface. |
| Utilities | *Utilities* are the features or programs included with an operating system that perform system-related tasks. Common Windows utilities are Control Panel and This PC. Common Linux utilities are cd, cp, grep, and Is. |
| Application | An *application* is a subclass computer program that is designed for end users. Examples are database, spreadsheet, and word processing programs. Applications frequently come in suites. |

In this course, you will learn about the following operating systems:

* Windows 7
* Windows 8.*x*
* Windows 10
* Linux
* Mac

1.3.4 Windows Interface Facts

You should be familiar with the following components of the Windows interface.

|  |  |
| --- | --- |
| **Component** | **Purpose** |
| Desktop | The *desktop* is the working surface that contains icons that access programs, files, applications, and file systems. The desktop is what is seen when all programs and open folders are minimized. Installing an application often adds an icon to the desktop. |
| Start | The *Start* is the easiest way to access the most useful things on your computer.   * The list of programs in the Start is divided by a separator line into two sections, pinned default programs and the most used programs. * The Start can be customized for each user. * The Start's appearance is different with each Windows version.   The Start is found in Windows 7 and 10. |
| Taskbar | The *taskbar* is the bar displayed at the bottom of a Windows desktop (although its position can be changed). The taskbar:   * Contains icons that represent each program or application currently running or pinned to the taskbar for quick access. You launch a pinned program by selecting the icon on the taskbar. * Can be configured to display different types of toolbars. For instance, Quick Launch is a toolbar that contains shortcuts to designated programs. |
| Notification Area | The *notification area* is a part of the taskbar located on the right side of the taskbar. The notification area:   * Displays the time and date. * Displays icons that represent the applications and processes running behind the scenes on your computer, such as audio volume and security programs. * Displays connectivity to the internet or a workgroup. |
| Windows Explorer | *Windows Explorer* is a graphical user interface (GUI) for viewing and managing the file system. |
| Control Panel | *Control Panel* is a compilation of various utilities that change how a computer looks and behaves. Use the Control Panel to configure settings for hardware devices, manage printers and networks, configure personal settings, and manage the system. |
| Aero | *Aero* is a set of features that improves the visual appearance of Windows. Features of Aero include:   * Glass effects on window borders that make borders semi-transparent (translucent). You can view objects behind windows through the window borders. * Window animations when windows are opened or closed. * Taskbar thumbnails that show the contents of an open window when you move the mouse over items on the taskbar. * Windows Flip shows thumbnails of running programs when you use the **Alt** + **Tab** keys to switch between running programs. * Aero Flip 3D is activated with the  **+ Tab** key and shows an expanded 3D view of running programs. * The Show Desktop button (on the right side of the taskbar) hides all open windows. Hovering over the button makes the content of all open windows disappear (called Peek). * Snap is a new feature that maximizes a window as you drag its border to the edge of the screen. Snapping multiple windows on the screen tiles them side-by-side. In Windows 10, Snap is limited to four apps on the desktop and two apps on a tablet. * Shake lets you hide all but the current window. Select the top window border and shake the mouse to hide or unhide all other open windows.   Aero is not available in the Windows 7 Home Basic version. In addition, features depend on the graphics card in the system. For example, you might not be able to use Flip 3D if the graphics card does not have the necessary features. |
| Search | *Search* is a feature to help you find documents on your computer.   * Windows includes a new indexing service that catalogs objects and files on your computer to improve the speed of searches on your computer. The search is typically fast because it does not search the complete hard drive but, instead, searches the index. * Instant Search provides a box for typing keywords and phrases. As you type, matching results are displayed. Instant Search boxes are available on the taskbar and in other applications such as Internet Explorer, Photo Gallery, and Media Player. * Custom properties are tags or descriptions that you can add to files as attributes that can be easily searched or indexed. * Search Folders lets you save a search as a folder. When you open the folder again, the search is performed, and the results are displayed. |
| User Account Control (UAC) | *User Account Control* (UAC) is a feature that helps minimize the dangers of unwanted actions or unintended software installations.   * UAC differentiates between standard user privileges and administrative privileges. * Icons next to some tasks identify tasks that require administrative privileges. In addition, performing other tasks, such as installing applications or hardware devices, require administrative privileges. * If standard user privileges are not sufficient to perform a task, the system requests privilege elevation.   + If you are logged on as a standard user, you are prompted to supply the username and password for an administrator user.   + If you are logged on as an administrator, you are prompted for permission before the action is performed. |

Features new to Windows 10 include:

* Customizable Start lets you organize your apps and shortcuts.
* Microsoft Store allows you to purchase music, videos, games, and apps
* Cortana provides you with a personal assistant for web searching. This feature is only available in the United States, United Kingdom, China, France, Italy, Germany, and Spain. This feature is hardware-dependent.
* Microsoft Edge lets you write and highlight web pages in the Edge web browser. This feature is hardware-dependent.
* Windows Hello uses face and fingerprint sign in. This feature is hardware-dependent.
* Photos app organizes photos and videos in one location.
* Cloud storage provides integrated access to OneDrive, which provides free storage space in the cloud.
* Continuum allows you to switch between PC, tablet, and phones modes. This feature is hardware-dependent.

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Chapter 2: PC Technician Responsibilities

2.1 Protection and Safety

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As you study this section, answer the following questions:

* Which specific computer components require special care that will protect your safety when handling them?
* What is the proper way to lift heavy objects?
* How can ESD be a hazard to electronic computer components?
* What is the difference between a static shielding bag and a static-resistant bag?
* What steps can you take to reduce ESD if you do not have the proper equipment handy?
* What is the MSDS? When would the information that it provides be important?

In this section, you will learn to:

* Use an anti-static mat and strap to protect yourself from ESD
* Implement appropriate grounding procedures

Key terms for this section include the following:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Capacitor | A device that stores an electric charge. |
| Cathode Ray Tube (CRT) | A vacuum tube used to display images that is commonly used in computer monitors. |
| Electrostatic Discharge (ESD) | The flow of electricity from one electrically charged object to another. |
| Material Safety Data Sheet (MSDS) | A document that contains safe handling and disposal processes for dangerous materials. |
| Peripheral device | A device that connects to a computer, such as a monitor or printer. |

This section helps you prepare for the following certification exam objectives:

|  |  |
| --- | --- |
| **Exam** | **Objective** |
| CompTIA 220-1002 | 4.4 Explain common safety procedures.   * Equipment grounding * Proper component handling and storage   + Antistatic bags   + ESD straps   + ESD mats   + Self-grounding * Toxic waste handling   + Batteries   + Toner   + CRT   + Cell phones   + Tablets * Personal safety   + Disconnect power before repairing PC   + Remove jewelry   + Lifting techniques   + Weight limitations   + Electrical fire safety   + Cable management   + Safety goggles   + Air filter mask * Compliance with government regulation   4.5 Explain environmental impacts and appropriate controls.   * MSDS documentation for handling and disposal * Temperature, humidity level awareness, and proper ventilation * Protection from airborne particles   + Enclosures   + Air filters/mask * Dust and debris * Compliance to government regulations |

2.1.1 Safety

## Safety **0:00-0:15**

In this lesson, we're going to talk about the most important part of your job, safety. Your primary responsibility is to ensure the personal safety of yourself and your coworkers around electronic equipment.

## Power Hazards **0:16-0:58**

Any time you work around a computer or any electrical device, remove jewelry to prevent it from getting caught in equipment or fromtransferring an electrical charge to your body.

Be certain that the grounding pin of a 110 volt plug is intact. Power that comes from the wall is AC, or alternating current. It comes through at between 110 and 120 volts at 60 cycles per second. An alternating current coming out of a wall socket can be enough to stop your heart.

Never work on device until you've powered it down and unplugged it from the wall.

If you're working on a portable computer, you must first make sure that the battery is removed from the system.

## Capacitor Hazards **0:59-1:32**

A capacitor's ability to store a charge raises a safety concern that other electrical components don't share. Power coming out of a wall is stored ina capacitor in the power supply unit. Even after the power supply unit is unplugged from the wall, a capacitor can hold a charge for up to whole seconds instead of milliseconds.

It's important to use caution when working with the power supply. If you're not a trained technician, consider the power supply a field-replaceable unit (FRU). Do not service it. Just replace it with a new one.

## ESD and High Voltage Hazards **1:33-1:50**

Another good rule of thumb is to avoid servicing anything with high voltage. Do not wear an EST wrist strap around high voltage. If you are grounded, you become the path of least resistance for the current. If the current is high voltage, you are the path through which the high voltage current will flow.

## Peripheral Hazards **1:51-2:52**

Some peripherals can also present a safety hazard.

First is laser printers. Some laser printers use laser light that can damage your eyes. They also use toner, which is toxic if inhaled. Toner is fused, or melted, onto the paper by fuser rollers. During the process, the fuser rollers get very hot and are definitely a safety hazard. The parts of a laser printer that manage the paper path can be complicated and fast. Those parts present another safety hazard within a laser printer.

Impact dot matrix printers can also present a hazard. The solenoids, the little coils in the print head, get hot enough to burn you.

Next, DVD and CD drives write data with laser light that can damage your eyes.

Fiber optic cables also use light that can damage your eyes. Never look down the end of a fiber optic cable. Shine the light into your hand or look for a red dot.

## Thermal Hazards **2:53-3:21**

Do not look into the cable.

Another safety consideration is thermal radiation or heat. Devices inside a computer generate heat, in particular, the CPU and memory. Allow a system to cool down before you work on it. Some components can get hot enough to cause a severe burn.

A heat sink or a heat spreader in a device indicates you should let that device cool down before you touch it. These devices present a definite safety hazard.

## Physical Hazards **3:22-3:39**

Your physical surroundings are another component of safety. Arrange the room that you work in to eliminate physical hazards. Use proper cable management and don't leave wires on the floor. Don't leave components in places where coworkers can trip over them. Be aware of personal safety for yourself and those around you.

## Lifting Hazards **3:40-3:51**

You can also ensure your personal safety by lifting with your legs, not with your back. If you're lifting extremely heavy pieces of equipment, wear a back brace, use a cart, or ask for help.

## Fire Extinguishers **3:52-4:04**

Every room in which you work should be fire suppressed. At a minimum, you should have a Class C fire extinguisher available to you. Class C fire extinguishers are made for electrical fires.

## Materials Safety Data Sheet **4:05-4:30**

Any component that presents a potential hazard ships with its own Materials Safety Data Sheet (MSDS). An MSDS explains, among other things, what you should do if you come in contact with an electricalcomponent that's potentially dangerous to you. An MSDS also explains how to properly dispose of equipment. For example, an alkaline battery can be disposed of in the trash a NiCad battery cannot.

## Summary **4:31-4:46**

In this lesson, we talked about safety. Safety is your number one priority.Any time you see a hazardous situation that falls within your responsibility, you should fix it. If it does not fall within your responsibility, report it to your safety officer and have it taken care of.

2.1.2 Safety Measures

Personal safety is your top priority when working with computer components. Keep in mind the following issues that can be hazardous:

|  |  |
| --- | --- |
| **Hazards** | **Description** |
| Power | Power hazards can cause electrical shock and burns.   * Before handling a system component, make sure that it is powered off and that the main power cord is unplugged from the wall socket. * Ensure that the grounding pin on a PC power plug is intact. * Unplug the system before working on internal components. Newer power supplies constantly pull power from the socket. * Be aware that the power inverter (power supply) converts AC current to DC current. Also be aware that the power supply can retain an electrical charge, even when not plugged in. Replace faulty power supplies instead of trying to repair them. * Avoid opening the power supply which houses a capacitor (stores a large charge of electricity). |
| Capacitor | Be sure to discharge capacitors or turn the equipment over to qualified personnel for servicing. Similarly, exercise caution when working with the DC converter in a laptop display. |
| ESD and High Voltage | Exercise great care when working with electricity.   * Use ESD wrist straps not only protect components, but to reduce the chance of accidental electrical shock. Properly ground yourself before working with components. * Do not use an ESD wrist strap when working with monitors, power supplies, laptop LCD panels, or other high-voltage components. * Exercise caution when wearing jewelry, because it readily conducts electricity and could cause burns or even electrocution. |
| Peripherals | Peripherals can present a safety hazard to you.   * Do not use a regular multimeter or other electrical testing equipment to measure charge inside a monitor. * Never clean the monitor's glass with a liquid solvent while the monitor is powered on. * Some studies suggest that laser printers emit tiny particles which could be dangerous when inhaled. As a precaution, do not locate laser printers immediately next to desks, and keep the area ventilated. * Avoid handling leaky batteries. The leaking electrolytes can be harmful if they get into your eyes. * Never look into the end of a fiber optic networking cable. Laser light can damage your eyes. |
| Thermal | Components such as the CPU heat sink and fan, the printing head of a dot matrix printer, or components inside a laser printer can be hot. After turning off a computer or printer, allow components to cool sufficiently before servicing to prevent burns. |
| Physical | Make sure the room and the building are properly set up to ensure your safety.   * Keep work areas and floors clear of clutter to help prevent accidents. * Do not route cables across the floor in pathways. This can lead to tripping accidents, and could also result in worn cables. * Provide adequate ventilation in any enclosure to remove toxic fumes. * Protect yourself from airborne particles by using an air filter mask. * Wear safety goggles. * Replace worn or frayed power cords. |
| Lifting | Be careful when lifting heavy objects.   * Bend your knees and keep your back straight, using your legs to lift objects. * Wear a back brace for added protection if your job requires frequent lifting. * Use carts and other tools when moving heavy objects for any significant distance. * Ask for help, if necessary, when lifting or moving heavier objects. * Follow the weight limitation guidelines defined by your employer. |
| Cleanliness | Clean hardware regularly to avoid problems caused by built-up dust.   * Use compressed air to clean delicate components. * Use a specialized vacuum to clean dust from other hardware. * Avoid blowing dust into other hardware or all over your office. |
| Fire | Every room in which you work should be fire suppressed.   * Have at least a Class C fire extinguisher available. A Class C fire extinguisher is made for electrical fires. * Make sure fire extinguishers and fire suppression methods (e.g., sprinklers) are properly implemented and maintained. * Promptly report any potentially hazardous situations. * Make the safety of others your top priority in responding to any incident. In the event of a hazardous situation, clear people from the area or remove the danger before attempting other actions such as preventing or repairing damage to components. |

Also periodically review and update your Material Safety Data Sheets (MSDSs). An MSDS describes safe handling and disposal procedures for dangerous materials and can provide you with the knowledge to resolve an uncertain situation.

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2.1.2 Safety Measures

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Also periodically review and update your Material Safety Data Sheets (MSDSs). An MSDS describes safe handling and disposal procedures for dangerous materials and can provide you with the knowledge to resolve an uncertain situation.

2.1.3 Electrostatic Discharge

## Electrostatic Discharge **0:00-0:14**

In this lesson, we're going to talk about electrostatic discharge (ESD). As a PC technician, ESD is your worst enemy. You need to know what it is and how to mitigate its effects.

## Static Charge **0:15-0:59**

A static charge is created whenever two objects come into contact with each other and then separate. When the objects separate, one of theobjects can steal electrons from the other object, negatively charging the first object. The object that lost electrons becomes positively charged.These two objects now have different charge levels.

An electrostatic discharge occurs when two objects with the different charge levels come together. If an object that has a high positive chargecomes into contact with another object that has a high negative charge, the charge from the object with the higher electrical potential flows orjumps to the object with the lower potential. The result is an electrostatic shock.

## Component Damage **1:00-1:50**

As a technician, you need to understand that a computer component, such as a memory chip or a CPU, can be damaged by an electrostatic discharge as small as 100 volts or less. When you hear 100 volts, it sounds like a lot. We're used to dealing with 110 volts from our wall outlets, so smaller DC voltages of 12, 5, or 3.3 volts, inside the PC makes 100 volts sounds like a lot.

When we're talking about ESD, an ESD discharge must be about 3,000 volts before you can see it or feel it. When you touch a doorknob and you get a shock, you're dealing with at least 3,000 volts.

This means that you could be working on a PC system and be shocking the daylights out of the components and not even know it because the discharge is so small that you can't see or feel it. However, it's enough to hurt the components.

## ESD Prevention **1:51-1:58**

ESD is bad, but there are a number of steps that you can take to reduce the risk of ESD when you're working on a PC system.

## Discharge Yourself **1:59-2:17**

First, discharge yourself before you touch any PC component. There's a lot of different ways you can do this, but the easiest way is to simplytouch the case frame of the PC system. When you do that, any electrical potential or difference in potential that may have existed between you and the case is immediately discharged.

## Use Static Mats **2:18-2:53**

The next thing you can do is use a static mat that allows you to equalize the electrical potential between you and the PC system. You can also use static floor mats or static floor materials. A static floor mat is designed to keep you in balance with the electrical potential of everything around you.

If you've ever walked through a carpeted room in socks, you know that you will build up an electrical charge. When you use static floor mats or static flooring material, that charge never builds up. Any charge that you may have is immediately dissipated through the mat or through the floor.

## Follow Safe Handling Guidelines **2:54-3:19**

When you're handling an electrical component out of the computer, like a memory chip or a CPU, don't touch the gold or silver leads on the bottom of the component. On the expansion board card, don't touch the little tab connectors. The reason is that any static discharge goes through these leads traveling right into the heart of that component and probably shorting circuits. So don't touch the leads.

## Use Static Shielding Bags **3:20-4:02**

You should store your components in static shielding bags. If you've ever bought a computer part from a computer store before, then you've probably noticed that the part came in a gray bag. That's a static shielding bag. It has an additional layer built into it underneath the plastic that absorbs electrical discharges as they occur. It dissipates the discharges around the component instead of letting them go through and hurting the component.

If you ever purchase a part and it comes in a pink, blue, green, or clear bag, those are static resistant bags. If you see this kind of bag, be extra careful because those bags don't provide the same level of protectionagainst ESD that a static shielding bag does.

## Remove Static Producing Materials **4:03-4:21**

Watch out for static producing materials in your work area. These include plastic and Styrofoam. Plastic and Styrofoam can build up a great deal of electrical charge in you that can subsequently shock your components.Keep plastic and Styrofoam away from your work area as much as possible.

## Humidity **4:22-4:42**

Remember that humidity is your friend when you're dealing with electrostatic discharge. The higher the humidity, the less likely that an electrostatic discharge will occur. Dry air acts as a resistor and allowsstatic electricity to build up. To keep static down, you should keep thehumidity in your work area relatively high.

## Summary **4:43-5:08**

So let's review. Electrostatic discharge can be a really bad problem because when it happens, you may not even know it has occurred. It takes only a small amount of voltage to ruin a PC component. To keep electrostatic discharges from happening, make sure you use static prevention measures like using a static mat and a static floor mat. Keep substances that cause static charges, like Styrofoam and plastic, away from your work area and increase the humidity in the room to keep the static down.

2.1.4 ESD Protection

## ESD Protection **0:00-0:30**

In this lesson, we're going to talk about how to prevent electrostatic discharge (ESD) while working on a PC system. Remember, an ESD occurs when there's a difference in electrical potential built up between two objects due to a static charge. When you're working on a PC system, this could be a bad thing because a discharge can damage PC components.Make sure that the static charges between you and the case are equalized.

## Use a Static Mat **0:31-1:05**

To equalize charges, use a static mat. A static mat equalizes a static charge. A static mat is composed of a conductive surface. This surface is designed to conduct electricity. Taking an electrical component, such as a piece of memory or a CPU, and setting it on a static mat establishes connectivity between that device and the mat. That way, there's no charge being built up. Any charge that does get built up dissipates between the computer part and the mat and whatever the mat is connected to.

## Ground the Computer **1:06-1:31**

When you're working on a PC system, you need to establish connectivity between the case, the mat, and you. First, take the case and use an alligator clip to connect or ground the case to the mat. Now we've got connectivity established between the mat and the case. No difference in static charge can be built up between the mat and the case itself.

## Ground Yourself **1:32-2:01**

The next thing you need to do is to ground yourself so you don't build up a static charge either. To ground yourself, use a wristband that has a littlemetal plate and connect the wristband to your wrist. This establishes connectivity between you and the case and between the case and the mat.

Now when you set things up this way, there can be no static charge built up between you, the case or the mat. Everything is equalized because any current that does build up immediately gets dissipated through the system.

## Unplug the System **2:02-3:42**

Everything stays in equilibrium.

Now this brings up a very important point. You need to make sure that the case is unplugged before you start attaching these clips. I'm going to say that again. Before you start attaching the clips, unplug the case because we've got connectivity going on here. You don't want to be connected to 110 volts.

Some people in the industry will tell you that it's a good idea to leave the system plugged in while you work on it. They say that because it creates a perfect ground. It may be a perfect ground and I don't know about you,but I don't like the idea of being connected electrically to something that's plugged into the wall. If the power supply were to have a fault or a problem that allowed current to go through the components to which you are grounded, you could get a nasty shock. If you can't get this wrist strap off fast enough, you're going to have some problems.

So I'll say it again. Please unplug the system before you attach these grounding cables. Old power supplies had a physical switch that broke thecurrent between the wall and the power supply when shut off. New supplies don't do that. Even when the system is turned off, it still supplies a continuous current to the motherboard. If you have a case with a power supply that is plugged in but the system is off, you might think you're safe, but you're not. There is still a current going through the system.

Granted, on the motherboard side of the power supply it is DC current and it probably won't hurt you that much. But if the power supply were to have a fault and was leaking AC current to the system, you would still be in trouble. So as a general rule of thumb, unplug the system before you start using a static mat.

## Summary **3:43-4:03**

That's it for this lesson. Remember that when you're working on a PC system, you need to prevent electrostatic discharge damage. The best way to do that is to invest in a good static mat and to use it properly. Also remember to unplug the system while you're working on it. You don't want to be hooked up to 110 volts through a static mat.

2.1.5 ESD Facts

*Static electricity* is the accumulation of a friction-caused electric charge on a non-grounded object. The static charge on the surface of a non-grounded object can jump when it contacts the surface of any grounded object. This electric discharge is known as *electrostatic discharge* (ESD). ESD can be very destructive to a computer.

The threat of ESD begins when the fragile components (including the processor, hard drives, memory, motherboard, and expansion cards) inside the computer are exposed. You can cause damage simply by placing a fingertip too close to a component inside an open computer case. ESD charges can travel through wires and into components, where the wires can explode or fuse together, causing the components to fail. ESD can cause immediate failure of components or could gradually degrade components, causing only intermittent problems. It takes very little ESD to damage a component. A discharge of as little as 10 volts can damage a component, but 3,000 volts or more of ESD must occur before you can even feel it.

Implement the following measures to defend components from ESD:

* Keep the relative humidity in the room high, ideally around 70%, and temperature between 72-77 degrees. The key is to avoid dry air in the computer repair location to prevent ESD.
* Use antistatic mats under the PC and on the floor.
* Discharge yourself before touching any computer component.
* When touching anything inside the computer, wear an antistatic wrist strap that is attached to the metal PC chassis with an alligator clip .
* Ground both yourself and the computer to the same ground. This provides a single path for the flow of electrical potential.
* Use static-resistant materials to handle computer components.
* Never touch the metal connectors on a circuit board.
* Keep the computer repair location free of materials that accumulate electric charges, such as plastic and Styrofoam.
* Store sensitive components in static shielding bags, which are usually grey. Static-resistant bags are not nearly as effective. They are usually tinted pink or blue.
* If a wrist strap is unavailable, keep your body in constant contact with the metal frame when working inside the computer.

Unplug the system before working on internal components. Do not rely on the power cord for an electrical ground.

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Chapter 2: PC Technician Responsibilities

2.4 PC Tools

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As you study this section, answer the following questions:

* When working with computer hardware, what is the advantage of having a ratcheting handle on a screwdriver?
* What is a good tool to use to retrieve a screw that has fallen into a computer case?
* What types of electrical properties can a multimeter measure?
* How is a power supply tester used to test the output from a PC power supply?
* How does a loopback plug verify that a device can both send and receive signals?
* How can ESD damage computer components?
* What measures should you take to protect hardware against ESD damage?
* When a wrist strap is unavailable, how can you still protect the computer from ESD while working in it?

In this section, you will learn to:

* Use a PC toolkit

Key terms for this section include the following:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Antistatic pad | An insulated covering that prevents static electricity from moving between objects and damaging computer components. |
| Antistatic wrist strap | A strap that connects you to an antistatic pad to prevent static electricity from damaging computer components. |
| Cable tester | A tool that verifies that network signals can travel throughout a network. |
| Combination ratchet/screwdriver | A multi-tool with interchangeable bits. |
| Extension magnet | A small magnet on a collapsible rod used to retrieve parts that fall into a computer case or another area that hands cannot reach. |
| IC insertion and extraction tool | A plastic and metal tool used to add and remove integrated circuit chips. |
| Loopback plug | A small tool used to test network communications. |
| Multimeter | A handheld device with a digital readout used to test electrical properties. |
| Power supply tester | A special multimeter used to test output from a PC power supply. |
| POST card | An expansion board used to troubleshoot computer system startup. |
| Three-pronged parts retriever | A small tool used to grasp and retrieve small parts that fall into places difficult to reach with hands. |

2.4.1 PC Toolkit

## PC Toolkit **0:00-0:11**

In this lesson, we're going to introduce you to some of the tools you'll need in order to do your job as an IT technician. We'll go through each of the tools in a sample starter tool kit.

## ESD Wrist Strap **0:12-0:51**

The first tool you'll use out of your tool kit is the ESD wrist strap. An ESD wrist strap is a safety device used to prevent electrostatic discharge (ESD) by safely grounding you while you're working with electronic equipment.

ESD damage occurs when stored static electricity is released and travels from your body into a conductor, such as the computer being repaired.The ESD wrist strap safely channels the static electricity to a proper ground, usually the computer's case.

An ESD wrist strap is typically used with an ESD table mat on the workbench or a static dissipating plastic laminate on the workbench.

## Screwdrivers **0:52-1:08**

The next tool you'll need is a screwdriver. You'll need one screwdriver with interchangeable bits or several screwdrivers of different sizes. You might want to purchase a jeweler's screwdriver kit. Many internal components require very small screwdrivers, especially in laptops.

## Pliers **1:09-1:26**

You'll use pliers to grab those little screws that fall into the bottom of your computer case. This is probably the handiest tool of all.

Extension Magnet

You'll also want an extension magnet to retrieve those little screws that inevitably fall into the system case as you're working on it. Just be careful as you work with any magnetized tool, because they can damage computer parts.

## 3-Prong Holder **1:27-2:22**

You'll need a three-prong holder. This is a tweezer-like tool with three prongs used for grabbing and lifting small objects.

Multimeter

You'll need a multimeter.

Some multimeters include a voltmeter feature. A voltmeter is an instrument you can use for measuring electrical potential differencebetween two points in an electric circuit. Analog voltmeters move a pointer across a scale to show the voltage of the circuit. Digital voltmeters display a numerical value of the voltage by using an analog-to-digital converter.

A multimeter is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter includes features like the ability to measure voltage. It can also test resistance and current flow. Some multimeters also test for capacitance, which is the ability of a component to retain a charge when the power is off.Multimeters also measure simple continuity, which is the connection made between one end of the cable and the other.

## Power Supply Tester **2:23-2:52**

Another way to test a power supply is to use a power supply tester. A power supply tester is a version of a multimeter. You can use either instrument to test your equipment. You use a power supply tester to make sure the correct voltage is coming out of your computer system's power supply. It is specifically designed to test DC voltage on most connections coming from a PC power supply.

To test a power supply using the power supply tester, connect the power cable to the tester.

## Tone Generator and Probe **2:53-3:29**

Turn on the tester. You then read the screen for the results.

A tone generator and a probe lets you trace a wire from a wall drop, which is an RJ-45 network jack, to a wiring closet. The tone generator emits a tone as it goes along the wire and is picked up by the probe.That's how you know which wire you are looking for.

To use a tone generator and a probe, insert the tone generator RJ-45 connector into your data wall jack.

Then go to your wiring closet. Move the probe over each wire in a bundleor over the patch panel until you hear the tone generated by the tone generator.

## Cable Tester **3:30-4:11**

You use a cable tester to test cables to make sure they are in good working order. You'll mainly use this on cables you've made or repaired.The numbers on the tester correlate to the one through eight pins of the cable.

A cable tester can be a very simple, inexpensive device which tests for continuity within your network cable. It can also be a very expensive device, like a time domain reflectometer (TDR). A TDR is an electronic instrument that uses time domain reflectometry to characterize and locate faults on metallic cables like twisted pair wire or coaxial cable. It can also be used to locate discontinuities in a connector, a printed circuit board, or any other electrical path.

If you're working with optical fiber, use an optical time domain reflectometer (OTDR).

## Loopback Plugs **4:12-4:40**

You'll also want a number of loopback plugs. You use loopback plugs to test ports to identify if any network or NIC issues exist. To test a port, you insert a loopback plug into the port. If the light goes on, your port is good.

Also, a loopback plug can be attached to a physical connection on the back plane of your computer. It sends any data that comes out of the connection back in. If the data sent is identical to the data returned, then you know the device is working properly.

## Known Good Spares **4:41-4:57**

It is important to keep extra good working computer equipment available.This equipment is referred to as known good spares. A valid troubleshooting method is to replace the suspected bad equipment with equipment that you know is good. Replacing parts can help you narrowdown problems on your system.

## Summary **4:58-5:15**

That's it for this lesson. We discussed important tools that should be included in your starter tool kit. Make sure you label your personal tools with your initials and keep them in a place you can always find. And one final recommendation, don't skimp on tools. Buy quality tools that can last for your career as an IT technician.

2.4.2 Tool Facts

The following devices and components are used for computer repair and maintenance.

|  |  |
| --- | --- |
| **Tool** | **Description** |
| Combination Ratchet/Screwdriver | A *combination ratchet* is a ratcheting handle with interchangeable bits that provides multiple features in a single tool.   * Bit ends can be replaced with Phillips and flat-head screwdrivers, hex sockets, and torx (star-shaped) bits. * The ratcheting handle allows you to drive the screw without repositioning the driver.   Most computer components use Phillips head screws. |
| IC Insertion and Extraction Tool | An IC insertion and extraction tool is used to add or remove integrated circuit chips that are used on motherboards and some computer components. For example, on some motherboards, you can use the IC insertion and extraction tool to change the BIOS chip. |
| Antistatic Pad/Wrist Strap | An antistatic pad provides an insulated covering to prevent static electricity from moving between objects and damaging computer components. When working with computer components, use a wrist strap connected to the antistatic pad and connect the pad to a ground. |
| Extension Magnet | An *extension magnet* is a small magnet on a collapsible rod. Use the extension magnet to retrieve screws that have fallen into a computer case or other areas you cannot reach.  As an alternative to a magnet, use an extension tool with retractable prongs. |
| Three-Pronged Parts Retriever | A three-pronged parts retriever is used to grasp and retrieve small parts that have fallen into areas that are difficult to reach. |
| Multimeter | A *multimeter* is a device that tests various electrical properties. For example, most multimeters can measure:   * AC and DC voltage * Current (amps) * Resistance (ohms) * Capacitance * Frequency |
| Power Supply Tester | A *power supply tester* is a custom multimeter used to test output from a PC power supply. The power supply tester has multiple connectors to test the output for each connector type. |
| Cable Tester | A *cable tester* verifies that a network can carry a signal from one end to the other and that all wires within the connector are in the correct positions. Most testers have a single unit that tests both ends of the cable at once. Many testers come with a second unit that you can plug into one end of a long cable run to test the entire cable. |
| Loopback Plug | A *loopback plug* is used to test network communications by redirecting a signal from the transmit port on a device to the receive port on the same device. Use the loopback plug to verify that a device can both send and receive signals. |
| Known Good Spares | *Known good spares* are a set of components that you know are in proper functioning order. If you suspect a problem in a component, swap it with the known good component. If the problem is not resolved, troubleshoot other components. Examples of using this strategy are:   * Changing the cable connecting a computer to the network * Connecting a different monitor to a computer * Replacing an expansion card |
| POST Card | A *POST card* is an expansion board that you insert into an expansion slot. It is typically used to troubleshoot a computer system that doesn't start up correctly. The POST card displays output from the BIOS during the Power-On Self-Test (POST). |

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Chapter 2: PC Technician Responsibilities

2.5 PC Maintenance

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As you study this section, answer the following questions:

* Why is dust an enemy to a computer?
* What will too much or too little humidity do to a computer?
* When considering HVAC, what is the difference between a positive pressure system and a negative pressure system?
* What causes EMI? What can you do to prevent EMI problems?
* What types of materials can you use to clean internal PC components?
* When is it important to use an anti-static vacuum?
* How are backups related to preventive maintenance?
* What is the difference between a surge and a spike?
* Which type of device protects equipment from over-voltages?
* What is the difference between the way an online UPS provides power to a system and the way an offline UPS provides power?

In this section, you will learn to:

* Install a UPS
* Configure UPS settings

Key terms for this section include the following:

|  |  |
| --- | --- |
| **Term** | **Definition** |
| Blackout | Complete power failure. |
| Brownout | An under-voltage that lasts seconds. |
| Electromagnetic interference (EMI) | A signal caused by motors, heavy machinery, and fluorescent lights that interferes with wired networking signals. |
| Heating, ventilation, and air conditioning (HVAC) | The system installed within buildings to control temperature by supplying heat and air conditioning. |
| Line conditioner | A device that modifies power signals to remove noise and create a smooth AC electrical signal. |
| Radio frequency interference (RFI) | Signals caused by cordless phones, microwave ovens, and wireless devices that interfere with wireless networking. |
| Sag | An under-voltage that lasts milliseconds. |
| Spike | An over-voltage that lasts milliseconds. |
| Standby power supply (SPS) | An offline devices that provides power when an under-voltage occurs. |
| Surge | An over-voltage that lasts seconds. |
| Surge suppressor | A device that conditions under-voltages and over-voltages before they reach devices and damage them. |
| Surge protector | A device that protects systems from under-voltages by switching the system off. |
| Uninterruptible power supply (UPS) | A device that provides battery power to a computer in case of an under-voltage. |

This section helps you prepare for the following certification exam objectives:

|  |  |
| --- | --- |
| **Exam** | **Objective** |
| TestOut PC Pro | 2.5 Given a scenario, implement disaster prevention and recovery methods  2.5.3 Install surge protection and a UPS |
| CompTIA 220-1002 | 4.3 Given a scenario, implement basic disaster prevention and recovery methods.   * UPS * Surge protector   4.5 Explain environmental impacts and appropriate controls.   * Power surges, brownouts, and blackouts   + Battery backup   + Surge suppressor |

2.5.1 PC Maintenance Best Practices

## PC Maintenance **0:00-0:10**

In this lesson, we'll discuss PC maintenance. Maintaining your computer equipment will help extend the life of the components.

## Create Proper Environment **0:11-0:16**

The first thing you need to look at is creating the proper environment for your computer hardware. This will help your hardware last longer.

## Physical Environment **0:17-0:40**

Some considerations include keeping the temperature between 70 and 74 degrees and the humidity levels between 40 and 70%. Make sure the computer rooms have separate and redundant cooling systems. Use a positive pressure system in your computer rooms and wire ways to ensure a supply of clean filtered air. Frequently clean systems that operate in a dirty, dusty, or smoky environment.

## Electromagnetic Interference (EMI) **0:41-0:58**

Protect your systems and network cabling from EMI. EMI is generated by motors, machinery, and even fluorescent lights. You can use shielded cables or run your network cabling in conduit to prevent EMI. Fiber optic cable is not susceptible to EMI.

## Radio frequency interference (RFI) **0:59-1:18**

RFI can disrupt wireless network traffic. RFI can be generated by cordless phones and other home automation hardware. Wireless networks that operate within the 2.4 gigahertz (GHz) range are particularly susceptible to RFI. This can be overcome by moving to a wireless solution that operates in the five GHz range.

## Magnetic Fields **1:19-1:33**

Data stored on magnetic media, such as disks and tape, is at risk from any source of a magnetic field such as speakers, motors, fans, and even space heaters. Solid state and flash storage devices are not susceptible to this kind of data loss.

## Clean Computers **1:34-2:35**

Proper computer maintenance includes periodic cleaning. Dust and dirt will insulate PC components, trapping heat and shortening the life of your computer. Some common cleaning supplies include a lint-free cloth; compressed air; an antistatic and micro filtering vacuum cleaner; and denatured or isopropyl alcohol. Always power down the system before cleaning. Use caution with liquid-based cleaners. Never apply a liquid directly to a PC component.

When cleaning PC systems:

\* Use denatured alcohol to clean electrical contacts.

\* Use a dry lint-free cloth or a special LCD cleaning solution to clean LCD screens.

\* Clean keyboards with a small PC vacuum cleaner, or compressed air.

\* Clean Inkjet print heads with a manufacturer's supplied utility.

\* Remove excess toner from a laser printer with an antistatic and micro filtering vacuum.

\* Use only a special cleaning disk and its related software to clean CD or DVD drives. CD and DVD disks can be cleaned with a soft dry cloth.

## Maintain Computers **2:36-3:04**

Here are a few more considerations to help you ensure a long life for your PC components. When you receive a component that has been shipped to you, allow it to sit at room temperature for at least six hours. This will dissipate any condensation that caused by a rapid change in temperature or humidity. Use covers and cases to protect equipment when it's not in use. Use cable ties and anchors to keep cabling organized. Always perform regular backups of important data.

## Summary **3:05-3:15**

That's it for this lesson. We discussed several things you can do to extendthe life of your computer equipment such as maintaining proper temperature and humidity; protecting your systems from interference and magnetic fields; and cleaning your PC components.

2.5.2 PC Maintenance Facts

One of the most important things you can do to keep computer systems running is create a proper environment. This lesson cover the following topics:

* HVAC, interference, and magnetic fields
* Computer cleaning
* Management tips

**HVAC, Interference, and Magnetic Fields**

|  |  |  |
| --- | --- | --- |
| **Consideration** | **Description** | |
| Heating, Ventilation, and Air Conditioning (HVAC) | For computer components, design HVAC systems with the following in mind:   * Keep temperature between 70 and 74 degrees to prevent components from overheating. * Keep humidity between 40 and 70 percent to prevent electrostatic discharge (ESD). * Make sure server rooms have separate ducting or HVAC systems from the rest of the building for better temperature control. * Use *positive pressure* systems. Positive pressure systems protect the air quality in the facility by causing air to be forced out through doors, windows, and other openings. *Negative pressure* systems draw air in, potentially bringing in airborne particles such as dust or smoke. Positive pressure systems are more energy effective. * In areas with heavy smoke or dust, add filters to air intake systems to filter out airborne particulates. | |
| Interference | *Interference* is a signal that corrupts or destroys regular signals. Interference affects signals used by two devices to communicate on a network. Listed below are two types of interference that affect computer networks: | |
| Electromagnetic Interference (EMI) | EMI is interference that affects wired networking signals.   * EMI is caused by motors, heavy machinery, and fluorescent lights. * Use shielded twisted pair cable to protect signals sent on Ethernet twisted pair cabling. If necessary, use fiber optic cables to eliminate the effects of interference. |
| Radio Frequency Interference (RFI) | RFI is interference on the radio channel used by wireless networking devices.   * RFI can be caused by nearby wireless devices using the same channel, cordless phones, or microwave ovens. * Wireless networks that use the 2.4 GHz frequency range (801.11b and 802.11g) are susceptible to RFI. * You can reduce RFI by using a wireless networking standard that operates in the 5.75 GHz range or using a different channel for wireless devices. |
| Magnetic Fields | Magnetic fields located close to a computer can cause undesired effects or even data loss.   * Hard drives use magnetic charges to store data. While hard disks are shielded and protected from all but the strongest magnets, getting a magnet too close to these components could erase data. * Speakers, motors, and generators contain magnets (keep sensitive components away from these devices). * Solid state storage devices (such as RAM or flash drives) are not affected by magnetic fields. | |

**Computer Cleaning**

One of the best things you can do to keep your system running efficiently is to keep it clean. Be aware of the following facts about cleaning your computer:

* Common computer cleaning supplies include:
  + Lint-free cloth
  + Compressed air or an air compressor
  + Small anti-static vacuum
  + Denatured or isopropyl alcohol
* Regular cleaning gives you the chance to inspect all components. Look for worn or failed components. On electrical components, dark areas might indicate a burned-out component.
* Prior to cleaning computer components, power down and unplug components and let them sit for at least 30 minutes to cool.
* Use caution with liquid-based cleansers. Use small amounts and always apply cleaning solutions to cloths and cleaning instruments, never directly to component surfaces.
* Dust buildup inside a computer acts as an insulator for internal components, trapping heat and preventing adequate cooling of components. Use:
  + Compressed air to blow dust off.
  + A non-static vacuum to remove dust.
  + A natural bristle paintbrush to wipe components off.
* Use a small amount of denatured alcohol on a cotton swab to clean electrical connectors (such as those on expansion cards).
* For LCD screens, use a lint-free dry cloth or a small amount of isopropyl alcohol (do not use window cleaner, ammonium-based cleaners, paper towels). You can also use special monitor-cleaning solutions or pre-packaged wipes with monitor-safe solution.
* For a mouse with a roller ball, clean the ball and the roller contacts on a regular basis.
* For keyboards, use a vacuum or compressed air. For keys that stick, use a lint-free cloth and/or cleaning swabs, lightly dampened, to gently wipe each key.
* To clean a printer, use a damp or dry cloth.
  + On inkjet printers, use the printer's cleaning function to clean the print heads.
  + For laser printers, use an anti-static vacuum to remove excess toner.

A regular vacuum will build up an electrostatic charge from the toner.

* On removable media devices, use:
  + Compressed air to blow dust and debris off of CD-ROM and DVD disc surfaces, out of drive bays, and off of drive heads.
  + Soft, dry lint-free cloths to wipe smudges off of CD-ROM and DVD disc media surfaces.

**Management Tips**

Be aware of the following tips for maintaining your computer:

* When receiving a new computer or component that has been shipped, let it sit for at least six hours (24 hours if it arrives in outside freezing conditions) before applying power. The rapid change in temperature can cause damage to components or can result in condensation within the computer.
* Perform regular backups. Backups protect your data if a hard disk fails.
* You can use covers and cases to protect some equipment from dust and liquid spills. Be sure to remove covers before use and replace after use.
* Keep cables organized. Route cables to prevent them from being kinked or stepped on. For best results, use cable ties to bind and organize cables.
* Verify that your system's cooling fans are blowing air through the system case in the correct directions. A fan blowing in the wrong direction can negate the airflow through the case and cause the system to overheat.

2.5.5 Power Protection Facts

The following table lists power conditions you should be familiar with:

|  |  |
| --- | --- |
| **Problem** | **Description** |
| Surge | Overvoltage that lasts seconds |
| Spike | Overvoltage that lasts milliseconds |
| Sag | Undervoltage that lasts milliseconds |
| Brownout | Undervoltage that lasts seconds (lights dim) |
| Blackout | Complete power failure |

The following is a description of devices used to prevent power problems:

|  |  |
| --- | --- |
| **Device** | **Description** |
| Surge Suppressor | A surge suppressor conditions power so that overvoltages don't reach devices. |
| Surge Protector | A surge protector protects against overvoltages by switching a device off before an overvoltage can damage it.   * A power strip provides multiple power outlets from a single plug-in, but is not necessarily a surge protector. * Surge protectors can be destroyed by surges and lose their ability to protect. * Consider using a surge protector with an indicator light to show whether it is working correctly. |
| Line Conditioner | A *line conditioner* modifies the power signal to remove noise and create a smooth alternating current (AC) signal. |
| Standby Power Supply (SPS) | A *standby power supply* is an offline device that switches over to provide power when an undervoltage occurs. If the switchover is not fast enough, the computer loses power. |
| Uninterruptible Power Supply (UPS) | An *uninterruptible power supply* is an online device that is constantly providing battery power to the computer and being recharged by the wall outlet.   * There are two types of UPS systems:   + An *online* UPS constantly powers the computer from the battery.   + An *offline* UPS powers the computer from the wall power. When the power fails, a switch inside the UPS switches to power the computer from the battery. This is the most common form of UPS. * UPS size is measured by the volt-amp (VA) rating. The capacity of the UPS determines the number of devices and how long the devices can run when power is interrupted. * When purchasing a UPS, purchase one with enough battery power to power only critical devices such as the computer and a single monitor.   + To reduce the amount of power required by the UPS, do not plug non-critical devices in to the UPS.   + Laser printers require more power than most UPS systems are capable of providing. For this reason, you should not connect a laser printer to a UPS. If you must provide power to a laser printer, get a dedicated UPS for that device. * A UPS is designed to provide enough power to shut a system down safely during an extended power outage. Most are not intended as long-term power solutions. * The UPS connects to the power source (usually a wall socket), the computer plugs into the UPS, and the UPS is connected through a serial or USB port to the computer. Software on the computer uses this connection to monitor battery life and to detect when the regular power is lost. You can configure the software to shut the system down automatically when the battery charge reaches a certain level. You usually need to configure the following settings when working with UPS software:   + Time to wait before sending a warning to clients   + Time to wait before beginning a shutdown   + Name of programs or commands to run during shutdown * In addition to providing power when the power is lost, most UPS systems also condition the line and remove power spikes and sags. * Most UPS devices sound an alarm when the AC power is lost. This alarm continues until AC power is restored, although many UPS devices have a switch to mute the alarm. |

During certain conditions, such as an electrical storm or when the power supply is constantly going up or down, you might need to unplug the computer to protect it. Simply turning it off might still damage the components because some power remains supplied to the system. In the case of an electrical storm, keeping the system plugged in leaves it susceptible to power spikes.