

Level 1

Fundamental Concepts and Essential Components



Lesson 1: Technology Basics

Lesson Objectives

In this lesson you will explore the following concepts:

- ☐ 1.1 Access and navigate between digital environments
- ☐ 1.2 Identify digital devices and connections
- ☐ 1.3 Explain fundamental software concepts
- ☐ 1.4 Explain fundamental hardware concepts
- ☐ 1.5 Explain fundamental operating system concepts
- ☐ 1.6 Explain fundamental networking concepts

What is an Operating System?

Objective 1.1.1

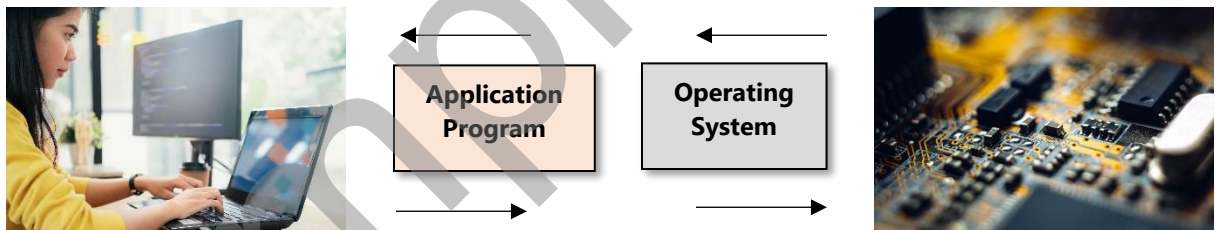
A computer is essentially a collection of electrical and mechanical parts referred to as *hardware*. Each hardware part performs its own function, and in order for all the parts to work together, they must be able to communicate. Instead of communicating directly with one another, the various components communicate via an operating system.

- The *operating system* (or OS) is a computer program.
- A *program* is a sequence of instructions that guides the computer through the performance of a specific task or sequence of tasks.
- The individual lines of instruction are referred to as *code*.
- The term *software* refers to any program that makes a computer run – including operating systems and application programs.

Every computer requires an operating system in order to function. Think of an operating system as the central manager of communication, coordination, and control.

Application programs, on the other hand, allow you to be productive – to create documents or complete specific tasks such as creating a budget, removing red-eye from a photograph, searching the Internet or scheduling a meeting.

Application programs use the operating system to control the hardware functions of the computer, and you, as a computer user, interact with the operating system whenever you log on to the computer, or type on the keyboard, tap on a touchscreen, or use an application program such as an email program or a word processor.



It works like this:

As you work in an application program, the program interacts with the operating system behind the scenes.

The operating system:

- manages hardware devices, and
- controls communication among hardware devices, and
- controls communication between application programs and hardware devices, and
- manages files stored on the computer.

Desktop Operating Systems

There are many types of operating systems in wide use today because there are many types of devices. In this course, you will focus on desktop operating systems and mobile operating systems.

A desktop operating system is used on desktop and laptop computers. A desktop operating system is a large and robust program. It offers many features, and provides a great deal of power and control over how the computer runs.

- **Operating system version** – refers to the specific code-base used to develop the operating system, such as Windows 7 and Windows 10 are different versions of the Windows operating system.
- **Operating system edition** – determines which features are available, such as Windows Home, Professional, or Enterprise.

Today, you can choose from several operating systems. You might like Windows, while your friend or classmate prefers Mac OS X, and your teacher or colleague likes Linux.

Almost all operating systems include a *Desktop* which is the screen that opens once you log on and are ready to begin using the device. Operating systems usually include colorful backgrounds, icons or buttons for accessing commands, and a status bar to show which programs are open and running. The Desktop is the central place from which a user interacts with the computer.

Mobile Operating Systems

These operating systems are used on smart phones, and other handheld (or mobile) devices; the options for each system vary depending on the type of handheld device. Popular handheld operating systems include Android, iOS, and Blackberry.

Embedded operating systems manage and control operations on the specific type of equipment for which they are designed, such as a vehicle, a machine that controls robotic manufacturing, or a piece of medical equipment. When the equipment is turned on, the embedded operating system loads into memory. Embedded operating systems are designed to be compact and are highly specialized; they include only the functions that are required by the specific devices for which they are developed.

Case Study 1

An operating system is the most important software on a computer. It is often referred to as “the brain” of the computer. All computers must have an operating system.

Which of the following options is NOT a responsibility of the operating system?

- Providing access to the Internet and web sites.
- Managing the activity between the software and hardware on the computer.
- Providing a user interface to communicate with the computer.
- Managing access to programs and data through user authentication.

Meet the Web Browser

Objective 1.1.2

Web browsers (or simply, browsers) are software applications that enable users to easily access, view and navigate web pages on the Internet. Browsers allow you to interact with websites and to experience the amazing rich media that is available on the World Wide Web.

You may be familiar with several browsers, such as Microsoft Edge, Mozilla Firefox, Google Chrome, Apple Safari and Opera.

While a browser's primary function is to retrieve pages from a web server and display them on your screen, you should understand that browsers are complex software applications that provide a number of services. They can be configured to suit your working style and keep you safe while you are online.

Using the Address Bar

To visit a web page, you enter its URL into the browser address bar and press ENTER. The browser requests the page from the web server, and when it is received, the browser displays the page within the browser window. The address bar displays the URL of the page currently displayed in the browser window. If the webpage includes a title, it is displayed in the window tab.



You can visit any web page by typing its URL into the address bar and pressing ENTER.

As you navigate to other pages within a website (or as you visit pages on other websites), the URL shown in the address field updates to show the address of the current page. Most browsers maintain a history of URLs that you can access from the address bar. Clicking a URL displayed in the address bar history list has the same effect as entering the URL directly into the address bar.

In addition to displaying the URL, the address bar often includes several buttons. The Microsoft Edge address bar is shown in the previous screen.

Browser Scroll Bars

Browser windows (like other windows you may be used to seeing on a computer screen) support horizontal and vertical scroll bars that display when a window is too small to display all the contents of a web page. The following figure shows a browser window with a vertical scroll bar.

Identifying Devices

Users interact with a computer through input and output devices.

- **Input** devices allow you to send information to the computer
- **Output** devices display (or otherwise send) information from the computer to you.

Keyboards and pointing devices are basic input devices. Monitors, printers, and speakers are basic output devices. Touch screens serve as both input and output devices because you can touch the screen to input information, and the screen displays the output.

Input Devices

Objective 1.2.1

Keyboards

The keyboard is the primary tool for sending information to the computer. You use it to enter data or to run commands in an application. Keyboards can be physical or virtual. In computing, a *virtual* device is one that does not physically exist, but is made to appear and act as if it exists by software. Virtual keyboards (and dial pads) are presented on screen in touch screen devices; the user “types” or dials by tapping the virtual keys that appear on the screen.

Keyboards come in many sizes and configurations. Some are ergonomically designed to protect against repetitive strain injuries such as carpal tunnel syndrome. Many include buttons for enhancing your multimedia experience.



The preceding figure shows a standard Windows keyboard, which includes the following types of keys:

- **Typewriter keys** – use these keys to type text and enter commands.

- Version 3.1 Generation 1 is almost identical to USB 3.0, except that it supports new connectors. The usual color coding for USB 3.0 ports and connectors is blue. Version 3.1 Generation 2 promises speeds of up to 10Gbps. The usual color coding for USB 3.1 ports and connectors is teal blue.

Most desktop systems sold today include several USB 2.0 and 3.0 ports.

Laptops generally include only 2 or 3 USB ports. If you want to connect several USB devices to a laptop, you can increase the number of available ports by connecting a USB hub. The hub uses one USB port on the computer, and provides, four, six, or eight open ports for connecting devices.

As portable devices have become smaller, the USB standard has adopted different sized connectors.

- USB 2.0 and 3.0 connectors are the flat rectangular connectors you are probably most familiar with.
- Mini-USB and Micro-USB connectors are commonly found on devices with a slim profile, with USB-C being the preferred connector on more recent devices.
- Lightning connectors were introduced for use with Apple products such as the iPhone, iPod, or iPad. If your device ships with a USB cable, it will include the correct connector type.



Bluetooth



Bluetooth is a wireless technology used to allow devices (such as computers and phones) to work with Bluetooth-enabled accessories (such as headsets, mice, keyboards, and so on).

Bluetooth devices and accessories must be “paired” with each other before they can communicate.

Bluetooth is also commonly used to enable hands-free phone calling by using a car’s stereo system to make or receive calls without touching the phone, and to transfer files between devices that are in close proximity to each other.

Compatibility Considerations

It is important to understand that devices and accessories must be compatible. In other words, just because a device and an accessory are Bluetooth-enabled, it does not necessarily mean that they will work together.

For example, prior to iOS 13.4, iPads and iPhones supported an array of Bluetooth accessories such as headsets, remote controls, and keyboards; however, they did not support Bluetooth mice.

Case Study 3

The physical parts of a computer are called *hardware*. Hardware can be found connected to or inside the computer. Hardware that is connected to a computer is called a *peripheral device*. Devices that send information to the computer are *input* devices; those that receive output from the computer are *output* devices. Which of the following peripheral devices are input devices? Select the three options that apply.

- Scanner
- Monitor
- Keyboard
- Microphone
- Headphones
- Projector
- Speakers

Software

Objectives 1.3.1, 1.3.3

While hardware is what makes our computers powerful and capable machines, it is software (programs) that makes our computing devices useful. The operating system provides an interface with the hardware itself, and software programs are what we use to get work done.

Software programs enable us to produce documents and charts; solve complex equations; calculate rocket trajectory; make online purchases; edit digital movies; decode the human genome; and many other menial or extraordinary things. Additionally, light-weight apps can keep us on schedule, remind us of appointments, or help us find our way to a location when construction crews block our familiar path. Software and apps keep us productive and empowered.

Locally-installed software is installed on a device and runs directly on that device. These programs are designed to work with specific operating systems and with hardware that meets certain minimum requirements.

Cloud-based software on the other hand runs on a dedicated server (not on your computer) and is designed to be accessed over the Internet. You will learn about cloud-based software in upcoming lessons.

Application Programs

An application program must be compatible with your hardware and operating system, and programs have specific requirements for processor power, video resolution, and memory. But how do you decide which application programs you should use?

Application programs vary in price from free to very expensive for those with large budgets. Deciding where to invest your money is not always an easy task, and understanding the different types of application programs available can help you get a clear grasp on what is available to fit your needs and your budget.

A productivity program is one that is dedicated to producing information, such as documents, presentations, worksheets, databases, charts, graphs, digital images, websites, electronic music or digital video. Different types of programs are suited for different types of tasks.

It is important to select the appropriate software program for the task at hand. Many programs share a number of features; to choose the one that best suits your needs, you must look closely at what you want to accomplish. It is recommended to make a list of all the tasks you need to perform, and check off items as you compare.

Word Processing

A *word processing* application enables you to create, edit, save, format and print documents. Most word processing programs also allow you to insert pictures and other digital objects. You can use a word processing application to create letters, memos, invoices, faxes, articles, and sometimes basic Web pages, newsletters, forms, brochures, or flyers.

The following examples of documents you can produce with word processing programs include a letter, a newsletter, and a flyer.



Popular word processing applications include:

Microsoft Word – by Microsoft. Word is a popular word processing application that you can use to type and format text and images for a variety of documents. Advanced features help you create tables, indices, and outlines. It is often installed on Apple devices as well, and is available in a web version.

WordPerfect – by Corel. WordPerfect was one of the first highly successful word processors for DOS and Windows based systems, and it has also been available for a wide variety of operating systems.

Pages for Mac – by Apple. Pages for Mac is a powerful word processor that you can use to create documents on Mac and on iOS devices. Design tools allow you to create charts, tables, bi-directional text and more.

Spreadsheets

Spreadsheet programs perform functions and mathematical calculations, help you analyze data, and produce graphs, charts, and diagrams. If you need to track numbers or analyze information for trends or patterns, a spreadsheet is a good choice.

Spreadsheets provide the ability to sort, find or filter information, and are very useful for managing and manipulating large amounts of data. You can use spreadsheets to analyze and present information such as expenses, assignment or report marks, financial forecasts, cash flow and so on, as shown in the above image.

	A	B	C	D	E	F	G	H	I	J	K
1	Today's date:	27-Apr-16	Month	Payment in £	Exchange	Payment in \$				Month	Exchange Rate
2	Amount to invest:	\$500,000	1	£26,666.67	1.57	\$41,866.67				0	1.59
3	Amount to invest:	£314,860.10	2	£26,666.67	1.5	\$40,000.00				1	1.57
4	Annual interest rate:	3.00%	3	£26,666.67	1.52	\$40,533.33				2	1.50
5	Monthly payment										
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Popular spreadsheet programs include:

Microsoft Excel – by Microsoft. Excel is part of the Microsoft 365 suite. It is a spreadsheet application that runs on Windows, Mac OS X, Android, and iOS. It features calculation, graphing tools, pivot tables, and a macro programming language called Visual Basic for Applications.

Google Sheets – by Google. Sheets is a web-based spreadsheet program that is a part of the larger Google Workspace (formerly known as G Suite or Google Docs Editor Suite). Being web-based, Google Sheets facilitates collaborative work by 'inviting' or sharing with others to view and/or edit the spreadsheets in real-time (more on collaborative work programs in later lessons).

EULA and Registration

Once the installation process begins, you will be asked to agree to an End User License Agreement (EULA); depending on the vendor, this may appear in a separate screen or it may be a link you should click in order to read the contents of the agreement. Typically, you agree not to make illegal copies of the software to distribute to others, and you agree not to hold the software vendor liable for any damage or expenses that may occur from misuse or improper use of the software, such as putting incorrect entries into an income tax preparation program which results in an audit by the tax collector.

When the installation is complete, you will usually be asked to register or activate your copy of the program. Performing this last step ensures that you will be notified of any updates to the program. It also usually provides the option to call technical support should you require technical assistance.

Case Study 4

Software applications are programs that tell the computer what to do, when to do it, and how to do it. Most software is available for download from the Internet.

Which statements below are TRUE about downloading? Select the two options that apply.

- a. Downloading is the same as streaming.
- b. Downloading requires an Internet connection.
- c. Downloading is when you receive files or data to your computer using the Internet.
- d. Downloading is when you send files or data from your computer using the Internet.

Recognizing Basic Hardware

Objective 1.4.1

Desktop Computers

Desktop computers are designed to sit on or beneath a desk. They are fairly large, although many are available in compact configurations so that they require less space.

Desktop computers come in two basic designs:

- **Macintosh or Macs** – produced by Apple. These machines feature a sleek design in which the monitor and processing unit are housed within the same case. Only Apple produces the Mac. Macs are designed to run the Mac OS X operating system.
- **Personal Computer or PC** – produced originally by IBM, and later produced by several manufacturers. Traditionally, in a desktop PC, the processing unit is housed within a case, and an external monitor, keyboard, and mouse are attached with cables. The fully assembled combination is sometimes referred to as a *work station*. Today, there are also some all-in-one units available. You can use a wide variety of operating systems on a PC, but by far the one most commonly installed on a PC is the Windows operating system.

Both Macs and PCs are available in a wide variety of types and configurations (including desktop models, laptops, servers, and touch screen devices).

**PC****Mac**

Desktop computers are stable and powerful and most include ample storage space (500GB – 1TB on average), a fair amount of installed memory (8GB - 16GB on average), the ability to read data stored on a wide variety of storage media, and the ability to play music and video. They include several USB ports for connecting external devices, and may include one or more slots for reading and writing to SD cards. Many are equipped with powerful video and sound cards. They usually include a network port for a wired network connection, and most include built-in wireless networking ability as well.

They are also easily upgradeable – you can open the case to access the internal components and there is generally enough “working room” to easily replace or upgrade components such as a video, audio, or network card. You can also easily add more storage space.

Laptop (or Notebook) Computers

Laptop (or notebook) computers are designed to be portable. They are small and light enough to sit on your lap. They are also self-contained with everything you need included in one unit - display, keyboard, camera, speakers, pointing device.

Laptops run the same operating systems as their desktop counterparts, and include the same internal components such as a hard drive and installed memory. Laptops also include a rechargeable battery that is charged from an AC adapter – these can range greatly in power.



Laptops are very popular with students and business people alike because of their portability. For example, students can bring a laptop to class and take notes, then take it home to do homework and other assignments.

Recently discontinued, but still available (no longer supported, or updated) mobile operating systems include:

- **Windows 10 Mobile** (formerly called Windows Phone) – is from Microsoft. It is closed-source and proprietary and it is integrated with Microsoft services such as OneDrive and Office, Xbox Music, Xbox Video, Xbox Live and Bing.
- **BlackBerry 10** – is from BlackBerry and is closed-source and proprietary. It runs only on phones and tablets manufactured by BlackBerry.

Popular Operating Systems

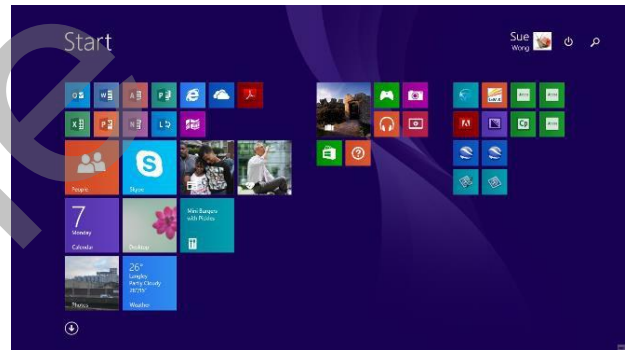
Objective 1.5.2

While there have been several versions of computer operating systems available, the most commonly used ones include the following:

Windows

Windows operating systems are designed by Microsoft. The current version is Windows 10 although there may be some home systems with Windows 8 installed.

The Windows 10 and Windows 8 Desktops are shown here:



Mac OS X

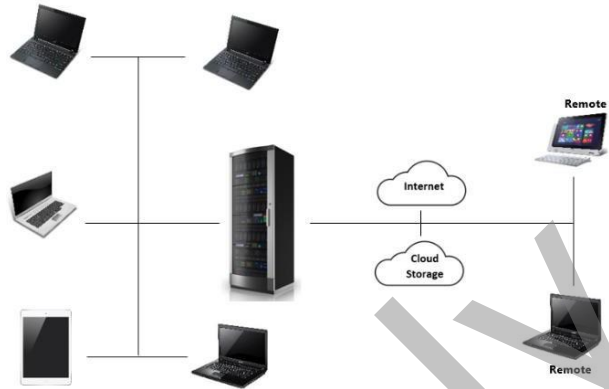
Mac OS X is designed by Apple for Macintosh computers. Recent versions are:

- Version 10.13 – High Sierra
- Version 10.14 – Mojave
- Version 10.15 – Catalina

The Mac OS X Catalina and Mojave desktops are shown here:

In computing, a network is simply an arrangement of computers (and additional computing devices) that are connected in such a way that they can communicate and share information. Individual networks can also be connected to other networks, and this practice is referred to as *internetworking*.

A network can consist of two or three computers in a single room, while an *internetwork* can consist of millions of computers connected across the globe.



Infrastructure Is Everything

Networking technologies have been in a state of constant development and improvement since the late 1960s. However, networking becomes practical and desirable and adopted into widespread use only when the proper infrastructure is in place.

Infrastructure is the basic underlying physical structure or framework needed for the operation of a service or an enterprise. In the case of networking, infrastructure is the hardware that supports high-speed communications and data transfer. Infrastructure is millions of miles of fiber-optic cable, high-powered cell relay towers dotting the landscape, thousands of communication satellites in Earth's orbit, high-speed routers and servers and exchange points strategically positioned along the Internet, and consumer devices capable of participating in modern networks.

It has taken over fifty years and billions of dollars to build the infrastructure that our modern networks rely on today. Modern networking technologies and networks evolve and expand at an exponential rate because finally there is now sufficient infrastructure to support that type of growth.

Connectedness is Key

You will learn about different types of networks in this course. Even though these networks are distinct from one another, they also inter-connect with each other. Cellular networks, the telephone network, and the Internet all *interconnect*. Since our private home, school, or businesses networks and devices tap into these large networks, we are all interconnected.

Why Network?

Networks are in wide use today because they are practical and useful. They enable users to share many things, including:

- **Files** – for example, Betty can create and store a file on her computer, and her fellow network user Barney can open and work with Betty's file without having to obtain a copy of the file.
- **Resources** – printers and scanners are commonly shared on a network. An entire office can share one or two printers, eliminating the need to purchase and attach a printer to each computer.
- **Internet connections** – networks within a home or office allow several users to share an Internet connection.

Network Interface Card (NIC)

In order to make an Ethernet connection between your computer and your home, school, or company wired LAN, your computer must include a network interface card (NIC). A NIC sends and receives data back and forth between your computer and the network, and includes its own Ethernet port.

NICs are manufactured to support various data transfer rates, such as 10Mbps, 100Mbps, and 1Gbps. The faster NICs are backward-compatible meaning that they can slow down to match the speed of other equipment on the network.

Note: The speed of a single network connection is only as fast as its slowest link. This means that if you have 50Mbps Internet service, a high-speed router and Cat 5e cable, but your NIC is an old 10Mbps version, your connection speed will be 10Mbps.

A NIC may be built into a device (as it is in most desktop computers and some laptops), or it can be added to a device (either internally or externally).

- You can add an internal NIC to a desktop system by opening the case and inserting the NIC into a slot on the system board.
- You can add an external NIC to a computer by connecting one to an available USB port.
- Connecting to the wired network is as easy as plugging in the cable. Most devices you connect via Ethernet automatically detect the network connection and will perform any necessary configuration (such as obtaining an IP address) automatically.



When you use a wired connection, a wired network icon  will display in the Windows taskbar.

Wireless Connections (Wi-Fi)

Wireless networking systems use their Wi-Fi capability to send and receive radio transmissions over the air instead of over cables. Wireless networking occurs in two distinct modes:

- **Ad-hoc** – systems communicate with one another directly using their Wi-Fi capability. This mode is highly insecure, and it does not provide access to the Internet.
- **Infrastructure** – systems connect to the network through a wireless router (or access point), and communicate with each other and with other systems on a wired Ethernet network through the router. This mode of communication can be secured, and it provides Internet access.



Most modern broadband routers include wireless capability, which means they can be used to create wireless networks. These are infrastructure mode networks: all wireless devices that join the network communicate with the router, not directly with one another.

Because the router is also a central connection point in the LAN, this type of network is called a Wireless LAN (WLAN). Devices connected to the WLAN can communicate (through the router) with one another and with systems that are connected to the LAN via Ethernet.

Additionally, because the router is connected to the broadband modem, the WLAN has access to the Internet.

- If you do call your ISP, be prepared to provide information to the technical specialist such as your current IP address, and your connection speed. Remember that you view your network connections in the Network and Sharing Center, and that you can click your connection to view necessary details.
- If you have trouble connecting to your Wi-Fi network, check the following:
 - Is your wireless adapter turned on? Sometimes, wireless adapters are turned off by a device in order to save battery power.
 - Has the Wi-Fi network password changed? Network administrators sometimes change the Wi-Fi password if they suspect that the previous one has been compromised or if they conduct scheduled password changes.
 - Are you close enough to the Wi-Fi hotspot? WLAN devices have a limited range, especially if they are using older WLAN standards such as 802.11b or 802.11g.

Trouble shooting is a process that takes practice - the more you do it, the better you will become.

Lesson Summary

In this lesson, you explored the following concepts:

1	Technology Basics – Level 1		
	1.1	Access and navigate between digital environments	
	1.1.1	Recognize operating system terms and concepts	
	1.1.2	Explain basic functions of web browsers	
	1.1.3	Explain processes and requirements for accessing digital	
	1.1.4	Explain methods of navigating between digital environments	
	1.2	Identify digital devices and connections	
	1.2.1	Identify input devices	
	1.2.2	Identify output devices	
	1.2.3	Identify cables, connectors, and connections	
	1.3	Explain fundamental software concepts	
	1.3.1	Explain basic software application concepts	
	1.3.2	Compare and contrast proprietary and open-source software	
	1.3.3	Describe processes for installing software from online sources	
	1.4	Explain fundamental hardware concepts	
	1.4.1	Describe concepts related to computing devices	
	1.4.2	Describe concepts related to memory	
	1.4.3	Describe concepts related to data storage	
	1.5	Explain fundamental operating system concepts	
	1.5.1	Compare and contrast features of mobile device operating systems	
	1.5.2	Compare and contrast features of computer operating systems	

23. If you are uncertain as to whether your device has a working Internet connection, which one of the following actions can you take to quickly check it?
- Check the connections on the network router to ensure they are connected.
 - Contact your ISP to request them to verify your connection.
 - Check your email send/receive option.
 - Open your browser to see if you are able to access a web site.
24. Which of the following statements about Bluetooth technology are TRUE? Select the four options that apply.
- Bluetooth technology permits enabled devices to communicate directly with each other.
 - Bluetooth only needs to be enabled on one of the two devices.
 - In order to be paired, both Bluetooth devices must be in discovery mode.
 - Bluetooth accessories include headsets, mice, keyboards, and automobile media devices.
 - Bluetooth accessories sometimes require a PIN to be entered to ensure secure communication.
 - Bluetooth devices must be paired in order to communicate.
 - Once paired, Bluetooth devices automatically connect when powered up and within range.
25. Computer networks and the Internet use both private and public IP addresses to know where information is coming from and where it should be sent.

From the statements below, select those that are TRUE for *Private* IP addresses. Select the four options that apply.

- IP address obtained from a DHCP server.
 - Reserved for internal use behind a router.
 - Used by DNS to locate data destinations
 - Identifies each device on the local network.
 - Translates to a common URL
 - Static IP address and does not change.
 - 198.162.x.1 identifies the default gateway.
36. Computer networks and the Internet use both private and public IP addresses to know where information is coming from and where it should be sent.

From the statements below, select those that are TRUE for *Public* IP addresses. Select the three options that apply.

- IP address obtained from a DHCP server.
- Reserved for internal use behind a router.
- Used by DNS to locate data destinations
- Identifies each device on the local network.
- Translates to a common URL
- Static IP address and does not change.
- 198.162.x.1 identifies the default gateway.