# Lesson 3: Introduction to Internet Technology

## *Objectives*

By the end of this lesson, you will be able to:

✐ 1.2.1: Distinguish between a client and a server.

✐ 1.2.2: Explain Internet history, define current protocols (e.g., IPv4, IPv6, related protocols), and identify timelines and models for technology adoption curves (e.g., Moore's Law, Geoffrey Moore's technology adoption life cycle, Kuhn's concept of paradigm shifts).

✐ 1.2.3: Identify the infrastructure needed to support an Internet client, including TCP/IP stack software, operating system, network connection, Web browser, e-mail, hardware platform (PC, laptop, tablet, smartphone, smart TV).

✐ 1.2.4: Identify hardware and software connection devices and their uses, including various types of modems (e.g., analog, ISDN, DSL/ADSL, cable), and connect systems to the Internet and other networks using basic cable/ADSL and wireless equipment.

✐ 1.2.5: List elements, benefits and drawbacks of cloud computing, including Software as a Service (SaaS), grid computing, offline computing features.

✐ 1.3.1: Define the purpose of remote access protocols, including Point-to-Point Protocol (PPP), Point-to-Point Protocol over Ethernet (PPPoE).

✐ 1.3.2: Identify various types of Internet bandwidth technologies (link types), including T and E carriers, fractional T and E lines, and common DSL/ADSL, wireless and cable speeds.

✐ 1.3.3: Map protocols to specific business services (e.g., SMTP, IMAP and POP3 to e-mail; HTTP and HTTPS to Web browsers; FTP to file transfer).

✐ 1.4.1: Define the purpose of the Domain Name System (DNS).

✐ 1.4.2: Identify Internet domain names, including top-level or original domains (edu, com, net, gov, org), country-level domains (e.g., uk, ch, tv) and newer domains (e.g., biz, info).

✐ 1.4.3: Describe the hierarchical structure of DNS.

✐ 1.4.4: Identify basic domain name server roles.

⇗   1.4.5: Describe Internet addresses.

⇗   1.4.6: Define shared domains.

⇗   1.19.6: Define essential social networking terms, including crowdsourcing, social tagging (e.g., Delicious) and semantic Web, and identify social networking sites and resources (e.g., Facebook, MySpace).

# Pre-Assessment Questions

1. What is the purpose of Transmission Control Protocol/Internet Protocol (TCP/IP)?

   a. It maps hosts on the Internet.
   b. It directs a packet along a prescribed route.
   c. It passes information from one computer to another.
   d. It downloads incoming messages.

2. A domain name server performs which function?

   a. It resolves machine addresses to domain names.
   b. It resolves domain names to machine names.
   c. It resolves IP addresses to Web URLs.
   d. It resolves domain names to IP addresses.

3. What is the main difference between Internet Protocol version 4 (IPv4) and Internet Protocol version 6 (IPv6)?

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# Internet Technology

You have already been introduced to the field of Information Technology (IT), and the many job roles and career opportunities it offers. While it is clear that skills such as project management, communication, teamwork and business administration are all vital to this field, the world of IT is still dependent on the complex foundation of computer network and Internet technology. Any jobs in the IT field (and some that are not) require a solid understanding of how machines, protocols and applications work together to make the Internet a reality.

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# Overview of Networks

**network**
A group of two or more computers connected so they can communicate with one another.

**node**
Any entity on a network that can be managed, such as a system, repeater, router, gateway, switch or firewall. A computer or other addressable device attached to a network; a host.

**OBJECTIVE**
1.2.1: Client vs. server

**client**
An individual computer connected to a network. Also, a system or application (such as a Web browser or user agent) that requests a service from another computer (the server) and is used to access files or documents.

**server**
A computer in a network that manages the network resources and provides, or serves, information to clients.

A **network** is a group of two or more computers connected so they can communicate, share resources and exchange information with one another. In a networked environment, computers are connected to a network server, which acts as the central repository of programs and data to which all users connected to the network have access. Networks allow users to:

- Simultaneously access the same programs and data.

- Transfer data from one computer to another.

- Share peripheral devices, such as printers.

- Share data storage devices for backup.

- Use programs to communicate with other users, such as texting, e-mail, instant messaging, and social networking.

- Access the Internet.

## The client/server model

Many networks are structured using the client/server model, in which individual computers and devices, called **nodes**, interact with one another through a central server to which they are all connected. The client/server model divides processing and storage tasks between the **client** and the **server**. The server is more powerful than the individual computers, or clients, connected to it. The server is responsible for storing and providing information. The client/server model processes information as follows:

1. A client requests information from a shared file stored on the server.

2. The server processes the request, locates the requested information and sends the information to the client.

3. The client uses or processes the data as needed.

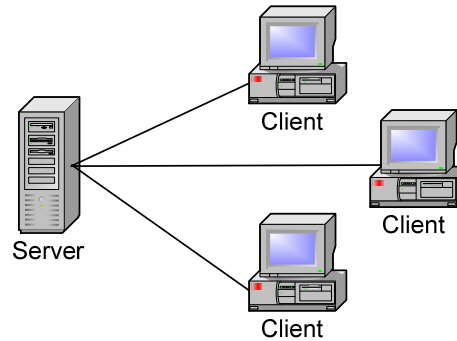Figure 3-1 illustrates the client/server relationship.

*Figure 3-1: Client/server model*

In a client/server environment, client programs run on the computer nodes and interact with a server program running on the server. The client software is the interface that enables users to communicate with and request information from the server. The client and server are able to communicate because they follow the same rules, or protocols, established for the client/server model. Therefore, a client can access information from any server if both the client and server understand the protocol.

A network can accommodate more than one server. Specific servers can be dedicated to making certain resources available to clients. These resources can include printers, applications and documents. Types of servers include:

- Application servers that provide user services for social networking and streaming audio and video.

- Network servers that manage the flow of data between them and client nodes.

- Print servers that manage network printers.

- File servers that store shared data.

- Web servers that manage access to the World Wide Web.

- E-mail servers that manage electronic mail.

### Client/server model example

E-mail is a technology that uses the client/server model. If you want to use e-mail, you must install and configure an e-mail client program on your computer. You can type an e-mail message, edit it repeatedly before sending it, and work offline until you are ready to access the network (or Internet) connection to send the message. When you send the message, the e-mail client computer connects to the network or Internet, transmits the message to an e-mail server, and closes the connection. The message recipient can connect to his or her e-mail server through a network or the Internet to retrieve the message.

## LANs and WANs

The two main types of network structures are local area networks (LANs) and wide area networks (WANs).

**local area network (LAN)**
A group of computers connected within a confined geographic area.

### *Local area networks (LANs)*

A **local area network (LAN)** is a group of computers connected within a confined geographic area. A LAN can consist of as few as two computers, or any number up to hundreds of computers and various types of servers. LANs are commonly used for intraoffice communication and home networks. They can extend over several yards or several miles, but are generally confined to one building or a group of buildings, such as a corporate office in Tempe, Arizona, United States, for example.

It is often useful to connect one LAN to other LANs if different divisions or departments within a large business have their own LANs. By connecting the LANs to one another, the divisions or departments can communicate with each other to share data and resources.

**wide area network (WAN)**
A group of computers connected over an expansive geographic area so their users can share files and services.

### *Wide area networks (WANs)*

A **wide area network (WAN)** consists of two or more LANs that span a wide geographic area. For example, a large business may have offices in several locations across the country or around the world. Each site has its own LAN with which to share resources and data locally, but it also needs to communicate with the other sites. By connecting the LANs via public networks (such as high-speed telephone lines, leased lines such as T1 lines, or satellites), the company creates a WAN. The largest WAN is the Internet.

In addition to geographic distance, the main difference between LANs and WANs is data transmission cost. In a LAN, the organization owns all components. In a WAN, an organization typically leases some of the necessary components needed to transmit data, such as high-speed telephone lines or wireless transmissions via microwave antennas and satellites.

**NOTE:**
Generally, a LAN becomes a WAN when two or more LANs are connected via public carriers.

**OBJECTIVE**
1.2.2: Internet history, protocols and technology adoption models

# Overview of the Internet

**Internet**
A worldwide network of interconnected networks.

The **Internet** is a vast network of LANs and WANs that electronically connects millions of people worldwide. Every computer that connects to the Internet is (for the time that it is connected) part of the Internet. These LANs and WANs are able to communicate with each other because of standardized Internet guidelines and procedures, such as the use of Internet protocols and standard Internet addresses. Using the Internet, it is possible to "surf" the World Wide Web, use e-mail, and send real-time messages to friends using instant messaging (IM) and Voice over IP (VoIP) applications. All of these various technologies are part of the Internet.

**NOTE:**
Internet protocols and addresses will be presented later in this lesson.

**Advanced Research Projects Agency (ARPA)**
A U.S. Department of Defense agency that created the first global computer network.

The Internet was formed in 1969 when the U.S. Department of Defense's **Advanced Research Projects Agency (ARPA)** funded what would become the first global computer network, the **Advanced Research Projects Agency Network (ARPANET)**. The ARPANET allowed university and government engineers to research and work from any location on the network. ARPANET's design featured multiple servers, or hosts, and multiple connections — in the form of telephone lines — among those servers. If one part of the network became incapacitated, other parts would remain functional, thereby reducing the chances of total network failure. Figure 3-2 illustrates ARPANET's decentralized design.

**Advanced Research Projects Agency Network (ARPANET)**
A computer network, funded by ARPA, that served as the basis for early networking research and was the backbone during the development of the Internet.
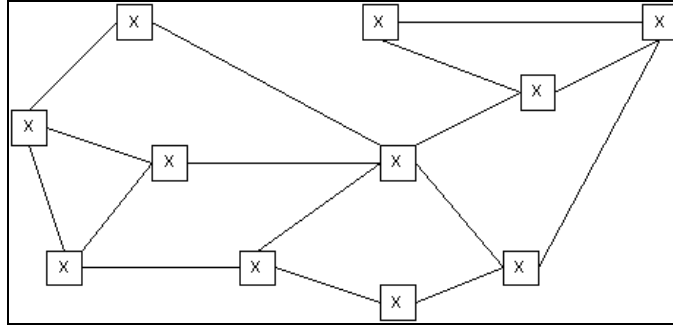
*Figure 3-2: Multiple connections among servers*

**National Science Foundation (NSF)**
An independent agency of the U.S. government that promotes the advancement of science and engineering.

**backbone**
The highest level in the computer network hierarchy, to which smaller networks typically connect.

**gateway**
A node on a network that serves as a portal to other networks.

In the late 1980s, the Department of Defense decommissioned the ARPANET, and all sites switched over to the **National Science Foundation (NSF)** network, called NSFnet. The NSF added access to more networks, expanding the range of sites to businesses, universities, and government and military installations. The connections among ARPANET, NSFnet and the other networks became what is now known as the Internet.

NSF did not permit users to conduct private (i.e., commercial) business over the NSFnet. As a result, private telecommunications companies developed their own high-speed data lines, called **backbones**, which used the same protocols as NSFnet and connected to it through **gateways**. These private networks did not restrict network use, so the Internet became usable for commercial purposes.

In the early 1990s, the Internet began to expand rapidly. Today it connects thousands of networks and hundreds of millions of users around the world. The Internet has no centralized control or ownership, which makes it available for anyone to access and use. Through the Internet, any computer can exchange data, e-mail and programs with potentially any other computer anywhere in the world.

## The World Wide Web

**World Wide Web (WWW)**
A set of software programs that enables users to access resources on the Internet via hypertext documents.

**hypertext link**
Highlighted or underlined text in a Web page that, when clicked, links the user to another location or Web page.

**Web page**
An HTML document containing one or more elements (text, images, hyperlinks) that can be linked to or from other HTML pages.

**Web site**
A World Wide Web server and its content; includes multiple Web pages.

The **World Wide Web (WWW)**, also called the Web for short, was created in 1989 at the European Particle Physics Laboratory in Geneva, Switzerland. The Web was designed to enable scientists studying high-energy physics to share information more efficiently by using hypertext documents. A hypertext document is created using Hypertext Markup Language (HTML), a system of code that enables the author to include **hypertext links** (also called hyperlinks or links) in documents.

Hyperlinks show as highlighted or underlined text in a hypertext document, or **Web page**. You can click a hyperlink and immediately move to another location in the same Web page or to another Web page that can reside anywhere on the Internet. Any Web page is a potential destination for a hyperlink. A collection of related Web pages is called a **Web site**. Web sites are located on Web servers, which are host computers on the Internet.

Unlike the Internet, the World Wide Web is not a network. The Web is a set of software programs that enables users to access resources on the Internet. However, the Web was used almost exclusively by scientific researchers until the introduction of Web browsers, whose graphical user interfaces (GUIs) made them easy to use.

## Web browsers

**Web browsers** (or browsers) are software applications that enable users to easily access, view and navigate Web pages on the Internet. Examples of Web browsers are Google Chrome, Windows Internet Explorer, Mozilla Firefox, Lynx and Opera. Browsers are found on traditional desktop computers, as well as on mobile devices such as smartphones and tablet computers.

A browser displays the elements of a Web page according to the HTML code used to create the page. The HTML code provides the browser with information, such as:

- The structure of the Web page, such as the placement of navigation bars, the body of the Web page, headers and footers.

- The location of graphical, animated, audio or video content.

- The location of hyperlinks.

A Web page may not appear the same in different browsers because each browser interprets HTML somewhat differently. For example, different browsers may use different default fonts and layouts, or support different table formatting commands.

Web browsers often have more capabilities than simply reading HTML pages and downloading files. Web browsers often support additional Internet protocols, which are discussed in the following section.

## How the Internet works

**Transmission Control Protocol/Internet Protocol (TCP/IP)**
A suite of protocols that turns data into blocks of information called packets, which are then sent across the Internet. The standard protocol used by the Internet.

**packet**
Data processed by protocols so it can be sent across a network.

Every computer connected to the Internet uses a protocol suite called **Transmission Control Protocol/Internet Protocol (TCP/IP)**, which enables computers to communicate with one another. TCP enables two computers to establish a communication link and exchange **packets** of data; IP specifies the format and addressing scheme of the packets. Dissimilar systems can then communicate and exchange data provided that both use TCP/IP.

Most client computers are connected to the Internet through gateways, which connect their LANs to the Internet backbone. Thus, computers access information from the Internet in the following sequence:

1. You request data through your LAN from a server connected to the Internet.

2. The request is divided into packets of data.

3. The packets are routed through your LAN, and potentially through other networks, to the Internet backbone.

4. The packets are routed from the Internet backbone through one or more networks until they reach the destination server containing the requested information.

5. The destination server sends information in response to your request using the same process, although possibly following a different route.

**router**
A device that routes packets between networks based on network-layer addresses; determines the best path across a network. Also used to connect separate LANs to form a WAN.

Thus, your original request and the subsequent response may travel through several networks and servers, each forwarding the packets toward their final destination. Your software does not have a map of the entire Internet and does not know the route your transmission will take. In essence, all paths through the Internet lead to your destination. A network device called a **router** determines the best path across a network.

TCP/IP ensures that your information is transferred quickly and reliably. If a packet is lost, all your data is not re-sent; TCP/IP re-sends only the missing packet. The destination computer collects the packets and reassembles them into your original data.

If one of the connections, or routes, between two computers is not working, the nearby computers simply stop using that route until the connection is repaired. Routers recognize damaged connections and send data through other routes. The routing flexibility of TCP/IP software ensures an accurate and steady flow of information.

## Visual history of the Web

As you can imagine, since the inception of the Internet and World Wide Web, the development of Web documents and Web sites has changed dramatically to keep pace with emerging Web technologies.

In the following lab, you will use the Internet Archive's Wayback Machine see how Web sites have changed over the years. Suppose you are writing a paper about the history of the World Wide Web, and you want to include descriptions and samples of Web sites "then and now." A site such as the Wayback Machine provides real examples of current and historic Web site designs.

### Lab 3-1: Sampling current and historic Web site designs

In this lab, you will use the Internet Archive's Wayback Machine to compare the look of Web pages today with how they looked in the past.

1. Open your browser.

2. Go to *www.google.com*, then press **ENTER**. The Google home page will appear. Note the appearance of the page.

3. Go to *http://archive.org/web/web.php*, then press **ENTER**. The Internet Archive's Wayback Machine page will appear, as shown in Figure 3-3.
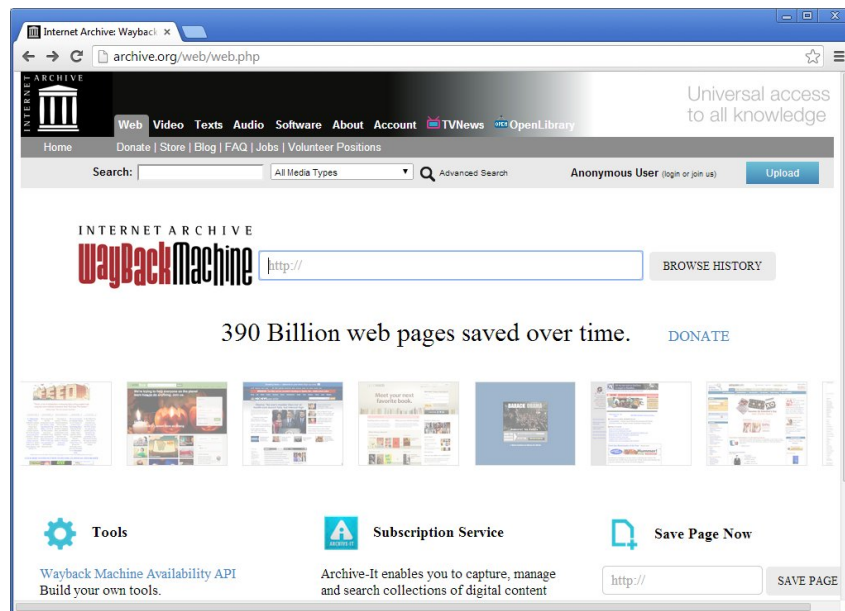


*Figure 3-3: Internet Archive's Wayback Machine page*

4.  Click in the "http://" text box, type ***www.google.com***, then click the **Browse History** button. A Search Results page will appear containing a timeline and links to the archived dates available for the selected Web site.

5.  Click the **November 11, 1998** link and notice the difference between the current Google home page and the home page as it looked on November 11, 1998.

6.  The Wayback Machine's timeline for Google appears at the top of the page. Click different points on the timeline to view the Web page on various dates.

7.  Click the **Wayback Machine logo** to return to the Wayback Machine home page.

8.  Click in the "http://" text box, type the address of a site that you know has been in existence for a number of years (e.g., ***www.ibm.com***), then press **ENTER**. Click the most recent link to view the page as it appears today.

9.  Click on the timeline link to view the site at least 10 years ago, and note the appearance of the page compared to the current version of the site.

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**NOTE:**
Take time to view and compare several sites, particularly those in which you have a personal interest.
</div>

10. Go to additional sites and use The Wayback Machine to view how Web design has progressed. Notice how the look and feel of each site has changed over time. Some features may no longer render as they once did. You can see how technologies have changed and improved in past years.

11. Close the browser.

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**OBJECTIVE**
1.2.3: Internet client infrastructure
</div>

# Connecting to the Internet

Six elements are required to connect to the Internet:

- **Computer** — PC, smartphone, smart TV, tablet, etc.

- **Operating system** — Windows, Linux/UNIX, Apple OS X, etc.

- **TCP/IP** — protocol software used to communicate with the Internet

- **Client software** — Web browser, mobile app, e-mail, etc.

- **Internet connection** — direct connection to an Internet Service Provider (ISP)

- **Internet address** — Web address (e.g., *www.CIWcertified.com*), e-mail address (e.g., *student1@class.com*), server address (e.g., *ss1.ciwcertified.com*), etc.

The first three items are generally acquired when you buy a computer. When you arrange to connect your computer to the Internet, you must install client software, implement a connection method and identify the addresses of servers you can use. Within the business environment, the corporate IT department may set up your system for you. Because of the high cost of connecting directly to the Internet backbone, most businesses and individuals obtain access through ISPs, which provide the backbone connection. The ISP, in effect, acts as the gateway connecting your LAN to the Internet backbone.

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**NOTE:**
Current Windows-family operating systems automatically install Internet client software.
</div>

If you are connecting your computer yourself, ISPs provide instructions for connecting to the Internet, and any necessary Internet addresses for configuring your client software. In most cases, the ISP provides a modem for your residence. The modem provides a direct connection to the ISPs network and the Internet.

The following sections will discuss ISPs and dial-up and direct Internet connections, as well as cloud computing.

## Internet Service Providers (ISPs)

**Internet Service Provider (ISP)**
An organization that maintains a gateway to the Internet and rents access to customers on a per-use or subscription basis.

An **Internet Service Provider (ISP)** is an organization that provides access to the Internet, such as cable providers (Time Warner, Comcast, Cox, etc.), major phone carriers (AT&T, Verizon, Sprint, etc.), America Online (AOL) (*www.aol.com*) and many others. Many ISPs offer other online services in addition to Internet access and e-mail. For instance, when users log on to AOL, they access the self-contained network of AOL servers. AOL servers provide content exclusively to their users so users need not navigate the entire Internet. AOL can also filter Internet content to make it safer and more relevant for the intended audience. Most ISPs charge a flat monthly rate. Some basic-service ISPs offer free Internet connectivity plans, such as NetZero (*www.netzero.net*) and Juno (*www.juno.com*) in the United States.

ISPs offer two principal options for connecting to the Internet:

- Dial-up connection
- Direct connection

## Dial-up Internet connections

**modem**
Abbreviation for modulator/ demodulator. An analog device that enables computers to communicate over telephone lines by translating digital data into audio/ analog signals (on the sending computer) and then back into digital form (on the receiving computer).

Dial-up connections are very slow, outdated and rarely used anymore. However, some individual users may still use this method because it is the least expensive method of obtaining access to the Internet. Dial-up connections use a **modem**, which is a device that enables computers to transmit data over standard analog telephone lines. A modem converts digital data from a computer into an analog signal to be transmitted through the telephone line to another modem. The receiving modem converts the analog signal back into digital code and transmits it to the receiving computer.

*The term modem is widely used, but does not always assume an analog-to-digital translation. For instance, DSL and ISDN modems (presented later in this lesson) are used on all-digital networks — no translation to analog is required. In this sense, DSL and ISDN modems are not actually modems. In many cases, the term modem has been used to describe any device that adapts a computer to a phone line or cable TV network, whether it is digital or analog. The term analog modem is often used to indicate a traditional modem.*

You gain access to the Internet by dialing a phone number that connects your computer with an ISP, which in turn connects your computer to the Internet. When finished, you disconnect from the ISP. The speed with which you can access the Internet is determined primarily by the speed capability of the modem.

**Integrated Services Digital Network (ISDN)**
A communication standard for sending voice, video or data over digital telephone lines.

To gain faster dial-up connections, individuals would also go through a local phone company to install an **Integrated Services Digital Network (ISDN)** line, which is a digital telephone line. The advent of cable and DSL services has mostly superseded ISDN. An ISDN "modem," which is technically not a modem but a digital terminal adapter, is attached to a computer that transfers data over the digital phone line. With an ISDN line, you can connect a computer, telephone and fax machine into a single line and use them simultaneously.

## Direct Internet connections

Direct connections provide continuous access to the Internet through permanent network connections. Unlike dial-up connections, direct connections do not require activation for each usage period. Direct connections are convenient and fast because permanent network connections are generally capable of handling high **bandwidth**.

**bandwidth**
The amount of information, sometimes called traffic, that can be carried on a network at one time. The total capacity of a line. Also, the rate of data transfer over a network connection; measured in bits per second.

Direct connections can be obtained in a number of ways, including:

- High-speed data links, including fiber-optic.

- Wireless connections, including 802.11 standards and satellite.

- T and E carriers, including fractional T and E lines.

- LAN connections.

- Cable modems.

- Digital Subscriber Lines (DSLs).

If your company's network is connected to the Internet, or you have a cable or DSL modem installed, then your computer has a direct connection to the Internet.

### High-speed data links

Analog modem capacity is limited to a data transfer rate of 56 kilobits per second (Kbps), the maximum theoretical data transfer rate of a standard telephone line. Although analog modems are sufficient to transmit text, they are impractical for transmitting large audio and video files. Telephone companies, cable TV services and other suppliers provide high-speed data links, such as fiber-optic cables and wireless connections, that offer faster Internet connections than those provided by analog modems.

### Wireless connections

Wireless network connections are usually implemented in a hybrid environment, in which wireless components communicate with a network that uses cables. For example, a laptop computer or tablet may use its wireless capabilities to connect with a corporate LAN that uses standard cabling.

**network interface card (NIC)**
A circuit board within a computer's central processing unit that serves as the interface enabling the computer to connect to a network.

The only difference between a wireless network and a cabled network is the medium itself; wireless systems use wireless signals (high-frequency radio waves) instead of a network cable. A standard system that uses a wireless **network interface card (NIC)** is called an end point. Two types of wireless modes exist:

- **Ad-hoc** — wireless mode in which systems use only their NICs to connect with each other

- **Infrastructure** — wireless mode in which systems connect via a centralized access point, called a wireless access point (AP)

A **wireless access point (AP)** is a device that enables wireless systems to communicate with each other, provided that they are on the same network.

**wireless access point (AP)**
A device that enables wireless systems to communicate with each other, provided that they are on the same network.

### 802.11 wireless standards

The 802.11 **standard**, developed by the Institute of Electrical and Electronics Engineers (IEEE), refers to a family of specifications for wireless network technology. The 802.11 standard includes:

**standard**
A definition or format that has been approved by a recognized standards organization.

- **802.11a** — capable of reaching speeds up to 54 megabits per second (Mbps). Although the 802.11a standard also uses Ethernet, it is not compatible with the 802.11b standard because 802.11a operates in the range of 5 gigahertz (GHz) to 6 GHz. The 802.11a wireless networks are often used to connect municipal networks and large campuses.

- **802.11b** —operates at speeds between 5.5 Mbps and 11 Mbps, although some can reach speeds of up to 20 Mbps. The 802.11b networks support common Ethernet networks (Ethernet is a LAN standard that allows computers in a network to communicate). The 802.11b networks operate at the 2-GHz range, the same level as common wireless 2-GHz phones and other devices, and are subject to interference.

- **802.11g** — also operates at 54 Mbps, but is compatible with 802.11b networks, making 802.11g a popular alternative to 802.11b in home and office networks. The 802.11g standard was ratified by the IEEE in 2003 but is becoming less adequate as applications become more complex and require more bandwidth. For example, the use of streaming video is difficult with 802.11g products, because although they have a theoretical maximum throughput speed of 54 Mbps, real-world speeds are generally in the 22 Mbps to 24 Mbps range, which is inadequate for video.

- **802.11n** — the most current wireless standard. Compared to the previous wireless standards, 802.11n enables you to build bigger, faster wireless networks that deliver better reliability and capacity with more built-in security.

### T and E carriers

T carriers refer to T1 and T3 lines, which are dedicated digital telephone lines that have much greater bandwidths than ISDN lines. T1 lines can transmit data at 1.544 megabits per second (Mbps), and T3 lines can transmit data at 44.736 Mbps. Many businesses lease T1 lines from phone companies to connect to ISPs. The ISPs use T3 lines to connect to the Internet backbone, which is composed of T3 lines. T5 lines are currently under development and will offer speeds of 400.352 Mbps.

E carriers refer to E1 and E3 lines, which are the European equivalents of T1 and T3 lines, respectively. E1 lines can transmit data at 2.048 Mbps, and E3 lines can transmit data at 34.368 Mbps. E5 lines are currently under development and will offer speeds of 565.148 Mbps.

### Fractional T and E lines

T and E carriers consist of channels, or transmission paths. Each channel is capable of supporting 64 kilobits per second (Kbps). A T1 line consists of 24 channels, and a T3 line consists of 672 channels. Most telephone companies will allow you to purchase one or a number of these individual channels, rather than the entire T1 or T3 line. The resulting line is known as a fractional T1 or fractional T3 line. Likewise, in Europe, you can purchase fractional E1 and E3 lines.

Fractional T and E lines provide less bandwidth than their undivided counterparts, but are much less expensive to purchase.

### LAN connections

A LAN can be connected to the Internet by a router, provided that the LAN uses TCP/IP. The LAN router is connected to another router at the ISP by a high-speed data link. The line between the LAN and the ISP is leased monthly, and can cost from US$250 or less per month for a small-business connection to $40,000 or more per month for a large corporation, depending on the speed and the amount of traffic. If LANs do not use TCP/IP, they can be connected to the Internet by gateways, which convert the protocol used by a LAN to and from TCP/IP.

### Cable modems

Cable television systems use coaxial cables, which can transmit data and streaming audio and video images at much faster speeds than are possible using standard telephone lines. You can connect to the Internet through your cable TV system by

attaching a cable modem to the computer's NIC and to a cable television outlet. By so doing, the computer becomes connected to the cable TV system's Internet server, which is in turn connected to the Internet backbone.

### Digital Subscriber Line (DSL)

**Digital Subscriber Line (DSL)**
A high-speed direct Internet connection that uses all-digital networks.

**xDSL**
Collectively, the variations of Digital Subscriber Line (DSL), which include ADSL, RADSL and HDSL.

Another direct connection method is **Digital Subscriber Line (DSL)**, a high-speed connection that uses digital phone lines and an xDSL modem. Several variations of the DSL modem exist, hence the term **xDSL**. Some of the more popular versions include Asymmetric Digital Subscriber Line (ADSL), which is used primarily in homes and small businesses. Rate-Adaptive DSL (RADSL) is a version of ADSL that allows the transmission rate to vary depending on your phone line capabilities. High-bit-rate Digital Subscriber Line (HDSL) was the original version of DSL. It was used for wideband digital transmissions between the phone company and customers, as well as within large corporations. DSL is similar to but much faster than ISDN, with speeds up to 10 Mbps.

You must check whether your local phone company supports xDSL. If so, its technicians may need to visit your location to install xDSL, depending on the type it offers. You will also need an xDSL modem and possibly a NIC to attach your computer to the xDSL modem. xDSL competes directly with cable modems.

### Cable modem and DSL limitations

Both cable modem and DSL connections are subject to various limitations, as follows:

- **Service limitations** — Your connection speed may be limited, depending upon the type of plan you purchased. With cable modems, connection speeds often become slower when many people are online. For example, some cable customers perceive a significant slowdown in access during peak hours (for example, between 5 and 8 p.m.).

- **Upload and download limitations** — DSL and cable modems often have different upload and download speeds. Upload speeds are generally slower than download speeds. Typically, download speeds range from 512 Kbps to 18 Mbps, and upload speeds from 128 Kbps to 2 Mbps. Only ISPs can obtain the maximum speeds of 52 Mbps. Providers of high-speed Internet service assume that most home and small-business users download far more than they upload. Usually, uploading is used only to establish and maintain connections. Therefore, larger businesses may need to upload files more often.

**Tech Tip**    *Upload connections are often called upstream connections, and download connections are often called downstream connections.*

### 4G mobile hotspot

**4G (fourth generation)**
Wireless phone network capable of delivering high-speed broadband Internet access to mobile devices.

**4G mobile hotspot**
A device that connects a wireless local area network to a wireless phone network at broadband speeds.

With the advent of **4G (fourth generation)** phone networks, mobile devices can receive high-speed broadband Internet access from anywhere 4G phone networks are provided. 4G has the potential to deliver speeds of 100 Mbps while a user is physically moving and a 1 Gbps data rate when stationary. At the time of this writing, speeds ranged from 3 Mbps to 12 Mbps.

Phone carriers are now offering **4G mobile hotspot** devices for businesses and residences to take advantage of these higher speeds. They are wireless-enabled devices that connect multiple users to the carrier's 4G network. The network users connect to a mobile hotspot device at their location, similar to any local wireless network.

The difference is that the mobile hotspot device is connected directly to the ISP's wireless phone network, and therefore to the Internet. No cables are required at the location and the network is completely mobile. The ease and simplicity of this solution may cause it to eventually replace cable and xDSL modems.

Mobile hotspots are limited in the number of users that connect to them. Many devices only allow five users at a time, but as adoption of these devices grows, user connections should increase.

### Direct connection speeds

Transmission speeds can vary greatly for direct connections based on distance, wire and equipment type, ISP capabilities, and so forth. Table 3-1 lists the connection speeds associated with direct connections.

**NOTE:**
T1/E1 and T3/E3 connections are typically used for wide area network (WAN) links and high-volume applications, such as high-volume Web sites. Many smaller companies can be supported through mobile hotspots, xDSL or cable modems.

Table 3-1: Common speeds for direct Internet connections

| Connection Type | Speed |
|---|---|
| **Fiber-optic cable** | Up to 100 gigabits per second (Gbps). |
| **T5 and E5 lines** | Currently under development. Will offer speeds of 400.352 Mbps (T5) and 565.148 Mbps (E5) |
| **T3 line** | 44.736 megabits per second (Mbps). <br> Commonly used by North American ISPs to connect to the Internet backbone. Extremely fast and one of the most costly types of access. |
| **E3 line** | 34.368 Mbps. <br> European equivalent of T3. |
| **T1 line** | 1.544 Mbps. <br> Commonly used by North American corporate LANs to connect to ISPs. |
| **E1 line** | 2.048 Mbps. <br> European equivalent of T1. |
| **Cable modem** | 512 kilobits per second (Kbps) to 52 Mbps. |
| **xDSL modem** | 512 Kbps to 32 Mbps. |
| **4G mobile hotspot** | Potential for 100 Mbps (moving) and 1 Gbps (stationary). Current speeds are 3 Mbps to 12 Mbps. |

*Cable and xDSL modems are usually limited to 10 Mbps because of the NIC. Only ISPs are capable of achieving the maximum rates. Also, many cable modems must share the cable network with other users in their neighborhoods. The speed of the cable modem depends on how many users are online at a given time. Likewise, the speed of an xDSL modem depends on the distance between the xDSL modem and the phone company's main distribution frame. Speeds less than 512 Kbps are common on both cable and xDSL modems.*

### CIW Online Resources – Online Exercise

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to complete an interactive exercise that will reinforce what you have learned about this topic.

*Exercise 3-1: Direct connection speeds*

### *Connecting cable and DSL modems*

When connecting a home office or small business to the Internet using a cable or DSL modem, you will need the following equipment:

- **A modem** — This modem is actually a router that connects your home computer or network to the Internet. The ISP offering digital access to the Internet often supplies this modem. You can purchase or rent the modem from the ISP. You can also purchase your own router at a store. However, make sure that this router is compatible with your ISP's network.

- **Network cables** — If you are using a DSL modem, you will use two standard Ethernet cables (for example, a Category 5, 5e or 6 cable) with RJ-45 connectors. An RJ-45 connector is similar to a standard North American telephone cable connector (an RJ-11), but the RJ-45 is larger. You will attach one cable from the wall of your home to the modem, and attach another cable from the modem to your computer. If you are using a cable modem, you will attach a coaxial cable from the wall to the modem, then connect a computer to the modem using a standard networking cable (e.g., a Category 5 cable).

It is also possible to obtain equipment that combines wireless connections with modems that are compatible with your ISP. In these cases, you must also equip each of your computers with a wireless NIC, or connect your wireless router to a hub.

### *Connecting 4G mobile hotspot devices*

When connecting a home office or small business to the Internet using a 4G mobile hotspot device, you will need the 4G mobile hotspot device and wireless adapters for all computers that connect to it.

The 4G mobile hotspot can be purchased from your phone carrier, such as Verizon, AT&T, or Sprint. The device is activated by the phone company, similar to a mobile phone. Place the device at your location and connect your local wireless computers to it, such as laptops, tablets, desktops, and servers with wireless cards. The local computers simply locate the hotspot's wireless network, enter the wireless passphrase, and they are connected to the Internet.

The mobile hotspot device functions like a wireless network router to the local computers, similar to a 802.11n Linksys, NETGEAR, or D-Link wireless router you would purchase from a consumer electronics store: users discover the wireless network and connect to it. The difference is that the mobile hotspot device is not connected to a physical modem, such as a DSL or cable modem. Instead, it communicates to the phone carrier (ISP) over the 4G wireless phone network.

### CIW Online Resources – Course Mastery

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to take the Course Mastery review of this lesson or lesson segment.

*IBA Lesson 3 - Part A*

# Internet Protocols

**Internet Protocol (IP)**
The data transmission standard for the Internet. Every computer connected to the Internet has its own IP address, which enables a packet of data to be delivered to a specific computer.

Protocols are the rules that describe how clients and servers communicate across a network. Protocols are similar in concept to the rules of diplomatic interaction that dictate who speaks first, who bows to whom, and so forth. **Internet Protocol (IP)** is the protocol by which data is sent from one computer to another on the Internet. Each computer on the Internet has at least one IP address that uniquely identifies it from all other computers on the Internet. When you send or receive data on the Internet (for example, when you send or receive a message or retrieve information from a Web site), the Internet gateways route the packets of information from your source address to the destination address.

In the following sections, you will examine the standard protocols used in network and Internet communication.

## Internet Protocol version 4 (IPv4)

The creators of the Internet recognized the need for a flexible addressing system powerful enough to accommodate the enormous number of current and future users. They decided that every device on the Internet would be given an IP address, just as every house and business is given a street address. Instead of a street address format, such as 123 Main Street, a 32-bit address format is used, such as the following:

72.44.192.233

This IP address format is also referred to as a "dotted quad" because the series of numbers is divided into four segments, each separated by a period, or dot. Each segment is a number between 0 and 255. Some number values are reserved, but roughly 256 x 256 x 256 x 256 different IP addresses are possible — approximately 4 billion.

In an IP address, the first set of numbers on the left represents the largest network. As you move from left to right, the networks get smaller and more specific. The last number in the address (on the far right) identifies the specific computer.

Using your computer to connect to others on the Internet is similar to using your telephone to connect to other telephones through the phone system. You need not know how a signal goes through switching systems in order to connect to the person you want to reach; you need only dial the correct set of numbers. Similarly, when you use the Internet, you need not know how the networks connect; you only need a computer's IP address to connect to it.

**Internet Assigned Numbers Authority (IANA)**
The international organization responsible for allocation of IP addresses. Part of the Internet Corporation for Assigned Names and Numbers (ICANN).

The **Internet Assigned Numbers Authority (IANA)** depleted its IPv4 addresses on January 31, 2011, and the remaining five regional Internet registries will be depleted in the next several years.

## Internet Protocol version 6 (IPv6)

With the depletion of IPv4 addresses, work has been completed to improve TCP/IP so it can handle the phenomenal growth that the Internet is experiencing. Internet Protocol version 6 (IPv6) meets the increasing demand for IP addresses, and is supported by every major operating system and application.

**hexadecimal**
A base-16 number system that allows large numbers to be displayed by fewer characters than if the number were displayed in the regular base-10 system. In hexadecimal, the number 10 is represented as the letter A, 15 is represented as F, and 16 is represented as 10.

IPv6 supports approximately 340 undecillion (340 times $10^{36}$) IP addresses by using a 128-bit address format. This format uses **hexadecimal** numbers instead of decimals. Following is an example of an IPv6 address:

> 2E22:4F00:000E:00D0:A267:97FF:FE6B:FE34

In addition to solving IP address shortages, IPv6 is more efficient and requires less overhead than IPv4 because it uses routers more efficiently.

IPv6 is now included as part of IP support in many products, including major computer operating systems such as Microsoft Windows XP and higher. IPv6 is gradually replacing IPv4, with the two coexisting for many years into the future. Any server that can support IPv6 packets can also support IPv4 packets.

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### CIW Online Resources – Online Exercise

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to complete an interactive exercise that will reinforce what you have learned about this topic.

*Exercise 3-2: Differences between IPv4 and IPv6*

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**OBJECTIVE**
1.3.1: Remote access protocols

## Remote access protocols

Remote access protocols refer to dial-up and direct Internet connections that you can establish from a remote computer, such as your laptop, and that can operate independently of a network or the Internet.

**Point-to-Point Protocol (PPP)**
A protocol that allows a computer to connect to the Internet over a phone line.

When you use a phone line and modem to connect to the Internet, you are using a dial-up connection. Most dial-up connections use **Point-to-Point Protocol (PPP)**. Multilink Point-to-Point Protocol (MLPPP) can be used to combine two PPP connections into one, thereby enabling a higher transmission speed.

**Point-to-Point Protocol over Ethernet (PPPoE)**
A protocol that implements PPP on top of the Ethernet architecture to connect an entire network to the Internet.

Many direct Internet connections, such as LAN, cable modem and DSL connections, as well connections made through 4G mobile hotspot devices, are established using **Point-to-Point Protocol over Ethernet (PPPoE)**. PPPoE uses the PPP that is commonly used for dial-up networks and implements it over Ethernet. Ethernet is a LAN standard that allows computers in a network to communicate. Therefore, PPPoE can connect an entire network to the Internet. PPPoE is also used by cable modem, wireless phone carrier and DSL ISPs. The protocol uses the same methods as PPP; however, it allows the point-to-point connection to establish itself on the Ethernet architecture, allowing much faster connection speeds.

**OBJECTIVE**
1.3.3: Protocols for business services

## Hypertext Transfer Protocol (HTTP)

**Hypertext Transfer Protocol (HTTP)**
The protocol for transporting HTML documents across the Internet.

**Hypertext Transfer Protocol (HTTP)** is the protocol used to transfer Web pages from a Web server to a Web client, usually a Web browser. Specifically, HTTP is the set of rules required to exchange files, such as text, images, video and multimedia content, across the Web. An essential concept of HTTP is that files contain references to other files, so they are linked to one another. HTTP transfers HTML files and other file formats that it can serve. Web servers are often called HTTP servers. HTTP requires a client program (a browser) on one end and a server on the other, both running TCP/IP.

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HTTPS is a secured version of HTTP used to transfer Web pages from a secure Web server to a Web client. When you use HTTPS, your Web session is managed by a security protocol, which encrypts and decrypts your requests as well as the information that is returned by the Web server. You will learn more about HTTPS later in this course.

## File Transfer Protocol (FTP)

**File Transfer Protocol (FTP)**
An Internet protocol used to transfer files between computers; allows file transfer without corruption or alteration.

**File Transfer Protocol (FTP)** is a TCP/IP suite protocol that enables the transfer of files between two computers on the Internet. Some sites allow guests to transfer files without an account on the remote site. These sites are called anonymous FTP sites and are available to the public. To obtain access to files through an anonymous FTP server, you use the general user ID "anonymous" and provide your e-mail address as the password. Many major universities have reliable anonymous FTP servers on the Internet. Most business FTP servers require user names and passwords because the data is confidential.

Businesses have discovered many uses for FTP servers as efficient information access and distribution points. For instance, when you download software programs and documents from Web sites, you are usually transferred to FTP sites for the download. This process takes place transparently (that is, the user is unaware of the protocol that is downloading the program). FTP is also used to publish Web pages to a Web server. You simply upload your Web page files to an FTP server. After the upload is complete, Web browsers using HTTP can access your Web pages.

Files on FTP sites can include text, graphics or software. Often, a site index lists the site's available files. Unlike the Web, where you browse for information as you move from one Web page to another, FTP sites are organized by topic. Navigating an FTP site is similar to navigating a hard drive's directory structure. You start at the top by selecting a directory name close to your general topic. You then continue to select directory names that are more specific to the topic you are seeking, until you find the file you want. This navigation process may take you many levels into an FTP server's hard drive. Most FTP servers are structured similarly, and when you become familiar with FTP servers, navigating their contents becomes easy.

## Electronic mail (e-mail) protocols

**Simple Mail Transfer Protocol (SMTP)**
The Internet standard protocol for transferring e-mail messages from one computer to another.

E-mail involves two mail servers: outgoing and incoming. The outgoing and incoming servers use various protocols to handle sending, receiving and storing e-mail messages.

You send e-mail to others with an outgoing server using **Simple Mail Transfer Protocol (SMTP)**. SMTP is the Internet standard protocol for transferring e-mail messages from one computer to another. It specifies how two e-mail systems interact. SMTP is responsible solely for sending e-mail messages, and is part of the TCP/IP suite.

**Post Office Protocol (POP)**
A protocol that resides on an incoming mail server. The current version is POP3.

**Internet Message Access Protocol (IMAP)**
A protocol that resides on an incoming mail server. Similar to POP, but is more powerful. Allows sharing of mailboxes and multiple mail server access. The current version is IMAP4.

You receive mail from an incoming mail server using **Post Office Protocol (POP)** or **Internet Message Access Protocol (IMAP)**. POP and IMAP are used to store and access e-mail messages.

The current version of POP is version 3 (POP3). POP3 stores incoming e-mail until users authenticate and download it. POP3 is the more accepted and widely used protocol for receiving and managing e-mail. POP3 servers store and forward e-mail messages to the host. For example, if you were to send an e-mail message, the message would be stored in the appropriate mail server until the recipient downloaded it from the server. The POP3 server responds to a request, asks for a password, then forwards the messages immediately.

The current version of IMAP is version 4 (IMAP4). IMAP4 handles messages in a more sophisticated manner than POP3 because it allows you to browse and manage e-mail messages while they reside on the server. A POP3 server forces you to download e-mail messages before reading, deleting or otherwise managing them.

You can use separate servers for outgoing and incoming e-mail, or a single server for both tasks. You need an account and password to receive e-mail, and tightened Internet security measures now require an account and password to send it as well. Internet creators thought that e-mail would be a minor tool and were amazed that it immediately became the primary source of Internet traffic.

**OBJECTIVE**
1.3.3: Protocols for business services

**Usenet (User Network)**
A collection of thousands of Internet computers, newsgroups and newsgroup members using Network News Transfer Protocol (NNTP) to exchange information.

**newsgroup**
On Usenet, a subject or other topical interest group whose members exchange ideas and opinions. Participants post and receive messages via a news server.

**Network News Transfer Protocol (NNTP)**
The Internet protocol used by news servers that enables the exchange of newsgroup (Usenet) articles.

## Network News Transfer Protocol (NNTP)

**Usenet (User Network)** is a public-access worldwide network to which users can submit messages or notes about any conceivable subject. It is considered a legacy service now, and many ISPs no longer support newsgroup access. However, it is still worth understanding.

Usenet consists of newsgroups and mailing lists, which are organized into topics. Usenet can be accessed from various Internet sources such as Web pages or Usenet readers. Usenet has no central moderator; it is a cooperative environment.

A **newsgroup** is a group of messages about a particular subject that is posted to a central Internet site (a news server) and redistributed through Usenet. A news server uses the **Network News Transfer Protocol (NNTP)**. Like an e-mail server, a news server provides text output that users can access at their convenience. However, like a conference call, it has multi-person input, allowing users to post information in an easily accessible location. Web browsers such as Mozilla Firefox, Windows Internet Explorer and Opera include an NNTP client. You may also use a separate client program called a news reader, such as Knews, to access a news server.

Newsgroup articles are generally unofficial, rapidly updated and informal. They tend to provide timely, significant and often spirited information. They do not usually discuss current news events. They tend to be focused on goods and services, events, people, pets, topics, concepts, ideas and so forth. Newsgroups are usually excellent informal sources of information. Because users participate by choice, newsgroups tend to be tightly focused and the data tends to be reliable.

You can think of a newsgroup as a vast e-mail system in which everyone has access to all messages. Unlike e-mail, which sends messages to your computer from a server, newsgroup messages remain on the server so everyone can see them. Newsgroup participants exchange views and ideas by writing messages that are transmitted automatically to news servers in the network. Articles posted to news servers can be read by anyone who can access the network.

> ## CIW Online Resources – Online Exercise
>
> Visit CIW Online at *http://education.Certification-Partners.com/CIW* to complete an interactive exercise that will reinforce what you have learned about this topic.
>
> *Exercise 3-3: The importance of Internet protocols*

**OBJECTIVE**
1.4.1: Purpose of DNS

1.4.5: Internet addresses

**Domain Name System (DNS)**
A system that maps uniquely hierarchical names to specific Internet addresses.

# Domain Name System (DNS)

To access any resource on the Internet (for example, a Web or FTP server), you must enter its address in the client (for example, a Web browser or FTP application). One way to do this is to provide the IP address. However, IP addresses can be difficult to remember because they consist of a series of numbers separated by periods. The **Domain Name System (DNS)** remedies this problem.

DNS resolves IP addresses into easily recognizable text-based names. For example, you can access the CIW Web server at IP address 72.44.192.233 by typing *www.CIWcertified.com* in your browser's Address box. In other words:

> 72.44.192.233 = *www.CIWcertified.com*

**domain name**
An IP address represented in words.

Both the **domain name** and the IP address refer to the same resource (for example, an FTP or Web server), but the domain name is much easier to remember. Without DNS, users would be forced to enter numerical IP addresses every time they need access to any resource on the Internet.

One way to remember a domain name is to understand its structure, which can reveal information about the site. Businesses choose their domain names carefully so other businesses and users will be able to recall them.

**NOTE:**
DNS applies to all services, not just the World Wide Web.

*Tech Note*

*We will reference the CIW Web site often in this and subsequent lessons because it contains information pertinent to the course you are taking. The CIW Web site's domain name is www.CIWcertified.com.*

Each domain name is unique and registered with the Internet Corporation for Assigned Names and Numbers (ICANN). When a name within a domain category (i.e., .com) is assigned, no other organization or individual can use that name within that category. For example, no other Web server can use *CIWcertified.com*. However, *CIWcertified.org* is still available, as is *CIWcertified.net*.

**NOTE:**
Top-level domains will be presented in greater detail in a later section.

Review some well-known domain names and identify their components.

Figure 3-4 shows a domain name, which consists of letters (and sometimes numbers) separated by periods. A domain name usually indicates the server name, the registered company domain name and the domain category, also called a top-level domain.
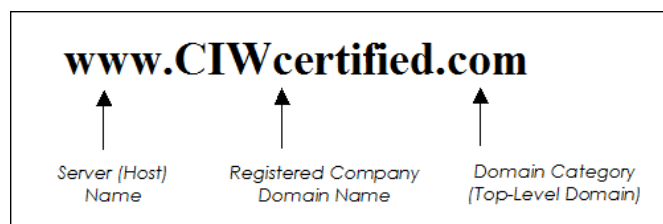


*Figure 3-4: Typical domain name*

*It is possible for DNS to use protocols other than TCP/IP. Additional protocols include IPX/SPX. However, DNS is most often used with TCP/IP.*

### CIW Online Resources – Movie Clips

Visit CIW Online at http://education.Certification-Partners.com/CIW to watch a movie clip about this topic.

*Lesson 3: What's in a Name? A closer look at DNS*

**OBJECTIVE**
1.4.3: Hierarchical DNS structure

## Domain name syntax

A domain name, read right to left, signifies general divisions, then specific companies, then departments within the company and even individual computers (such as a Web server or an e-mail server). For example, reading right to left, the domain name *www.CIWcertified.com* can be interpreted as follows:

- **com** — a commercial site

- **CIWcertified** — the name registered by the company that manages the CIW program, chosen because it accurately represents the purpose of the Web site

- **www** — the name of the Web server at the company, also called the Web site **host**

**host**
A computer that other computers can use to gain information. In network architecture, a host is a client or workstation.

Some companies further subdivide their domain names into departments or individual computers. For example, if a company wants to divide the domain *companyname.com* by department, it might use *finance.companyname.com* and *sales.companyname.com*. Or it might use *tokyo.companyname.com* and *london.companyname.com*, dividing by geography. For example, *www.research.microsoft.com* can be interpreted as follows:

**NOTE:**
The term host is most commonly used when referring to TCP/IP network clients.

- **com** — a commercial site

- **microsoft** — Microsoft Corporation

- **research** — the research division of Microsoft

- **www** — Web site host for the research division

Some sites name each computer on the LAN and give each a unique domain name, such as *sales1.companyname.com*, *sales2.companyname.com*, and so forth.

### CIW Online Resources – Online Exercise

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to complete an interactive exercise that will reinforce what you have learned about this topic.

*Exercise 3-4: Domain name syntax*

## Fully qualified domain names (FQDN)

**fully qualified domain name (FQDN)**
The complete domain name of an Internet computer, such as *www.CIWcertified.com*.

A **fully qualified domain name (FQDN)** is the complete domain name of an Internet computer. The FQDN provides enough information to convert the domain name to an IP address. For instance, *www.CIWcertified.com* is an FQDN. The FQDN must include the server (host) name, the registered domain name and the top-level domain.

## Root-level servers

The Domain Name System is hierarchical. **Root-level servers** are at the highest level of DNS. They provide foundational naming services; if these servers were to become unavailable, then name resolution would no longer occur. To learn more about root-level servers, visit *www.ripe.net*.

## Top-level domains

The right-side component of a domain name categorizes domains into groups by common type (company, educational institution) or geography (country, state). These categories are called **top-level domains**. The original top-level domains categorize domains by common type and signify the type of site you are visiting. These original top-level domains are as follows:

- **com** — commercial or company sites

- **edu** — educational institutions, typically universities

- **org** — organizations; originally clubs, associations and non-profit groups; currently various types of organizations

- **mil** — U.S. military

- **gov** — U.S. civilian government

- **net** — network sites, including ISPs

- **int** — international organizations (rarely used)

Other top-level domain names use a two-letter abbreviation to indicate states and countries. These domain names often correspond to postal codes. Examples of geographic domain names include the following:

- **au** — Australia

- **ca** — Canada

- **ch** — Switzerland (Confédération Helvétique)

- **dk** — Denmark

- **fr** — France

- **gr** — Greece

- **jp** — Japan

- **mx** — Mexico

- **uk** — United Kingdom

- **us** — United States

Domain names that end with country codes may feature categories or further geographical divisions before the company or organization name. For example, commercial sites in Australia all have domain names that end with *.com.au*, and university sites use *.edu.au* for their domain names.

Other countries use other abbreviations. In the United Kingdom, names ending with *.ac.uk* are universities (ac stands for academic), and names ending in *.co.uk* are companies. In Canada, many names feature province abbreviations such as *.on.ca* or *.mb.ca* (for Ontario and Manitoba, respectively). Reading from right to left, you will eventually reach the organization name.

Additional domain categories were selected in the year 2000. They are categorized by topic and include the following:

- **aero** — travel industry

- **biz** — businesses

- **coop** — cooperatives

- **info** — content and research-related sites

- **museum** — museums

- **name** — personal Web addresses

- **pro** — professional

In the following lab, you will use IP addresses and DNS to access different hosts on the Internet. Suppose that you are a help desk technician and you have been asked to teach new sales interns some techniques they can use to access Web sites. You show the interns how to access Web sites using various protocols, IP addresses and domain names. Note the differences in domain name syntax as you visit different servers and server types.

### Lab 3-2: Using Internet protocols in a Web browser

In this lab, you will use Internet protocols in your browser.

1. Open your browser and go to **www.CIWcertified.com**. The prefix *http://* is assumed when entering a URL into a Web browser. This step accesses the CIW Web site and displays its home page in the browser window, as shown in Figure 3-5.



*Figure 3-5: CIW Web site home page*

2. In the browser toolbar, click the **Home** button to display the browser's default Web site.

*Note: The Home button in the browser toolbar will display the browser's specified default Web site, not the home page of the site you are visiting.*

3.  Type **72.44.192.233** in your browser's address field (where you typed *www.CIWcertified.com*), then press **ENTER**. This step accesses the CIW Web site using the IPv4 address, instead of the URL, and displays its home page in the browser window.

4.  Type **ftp://ss1.ciwcertified.com** in your browser's address bar, then press **ENTER**. This step accesses the CIW FTP site, which you can use to transfer files between it and your computer. You will use FTP later in this course. The Internet protocol must be specified in a Web browser when it is not the default HTTP.

5.  Type **ftp://64.128.206.143** in your browser's address bar, then press **ENTER**. This step also accesses the FTP site, but uses the IPv4 address instead. Notice that the Internet protocol "ftp://" is still required.

6.  To learn more about Internet protocol and technology topics, form teams of two people each with your classmates and pair up the teams.

    *   **Team A:** Go to **www.ripe.net/internet-coordination/ipv4-exhaustion** to read about IPv4-address depletion. View the "RIPE NCC IPv4 Available Pool Graph" to determine how many IPv4 addresses remain. Should we be worried?

    *   **Team B:** Go to **http://mobileoffice.about.com/od/glossary/g/mobile-hotspot.htm** to learn about the brief history of 4G mobile hotspot devices. Find another source with information on how 4G mobile hotspots are deployed. Based on your Web site visits, do you think 4G mobile hotspots could eventually replace cable and xDSL Internet access?

7.  **Both teams:** After you have completed the research, discuss your findings with the other team. Explain what you discovered and provide your own ideas and thoughts about these protocols and technologies. How will these changes impact businesses and residential Internet users?

8.  Close the browser.

## Domain name servers

**Domain name servers** are servers on the Internet whose sole function is to resolve human-readable domain names into their computer-readable IP addresses. These servers help to implement the domain name system (DNS). For example, when you enter *www.CIWcertified.com* into your browser's Address box, the browser contacts a domain name server to obtain the IP address related to this domain name. When the browser receives the IP address 72.44.192.233 from the domain name server, the CIW Web site displays on your screen.

## Reverse DNS

Domain name servers can also be programmed to resolve IP addresses into domain names. This function is called reverse Domain Name System (reverse DNS).

## Virtual and shared domains

**virtual domain**
A hosting service that allows a company to host its domain name on a third-party ISP server.

A **virtual domain** is a hosting service in which one domain name server hosts multiple domain names. For example, if you register your domain name *yourcompany.com*, users can enter *www.yourcompany.com* to access your site, even if your Web site is hosted by a third-party ISP whose domain name is *webserver.com*. Users enter only your domain name, not the domain name of the third party.

If you hosted your Web site with a third-party ISP using a non-virtual domain, you would not need to register your company's domain name. Instead, users might access your site at *www.webserver.com/yourcompany*.

**OBJECTIVE**
1.4.6: Shared domains

A virtual domain allows your Web address to be shorter. It also gives your company the prestige of its own Web address for branding purposes, even though a third party is hosting your Web site.

**shared domain**
A hosting service that allows multiple entities to share portions of the same domain name.

Rather than a single domain name server hosting multiple domain names, a **shared domain** occurs when multiple companies, organizations or people share portions of the same domain name. Multiple entities can use your registered domain name *yourcompany.com* as their domain name as long as you elect to sell the domain name and make it available to others. For example, you could sell the domain name *company1.yourcompany.com* to Company1, the domain name *company2.yourcompany.com* to Company2, and so forth. The Web sites for each respective company would then be hosted by the *yourcompany.com* domain.

# Cloud Computing

**OBJECTIVE**
1.2.5: Cloud computing

You were introduced to the concept of cloud computing in a previous lesson. The network of servers and connections that make up the Internet is collectively known as "the cloud." The term "cloud" derives from the practice of representing the Internet as a cloud in network diagrams.

Cloud computing refers to hosted applications and services offered by a third party and run almost entirely from one or more servers that reside on the Internet. A Web browser is the only locally installed application necessary for the user to access these applications; no other software needs to be installed. Because users can access Internet resources as they need them, cloud computing has also been described as on-demand computing and hosted computing.

Although the applications reside on remote servers, end users can choose to store files on a local drive or on a remote system. Even though only a Web browser is used, the cloud-based applications are nevertheless meant to be as robust and as sophisticated as those you would install on your local system.

The remote, cloud-based applications do the majority of the processing work. The local browser is responsible for rendering the applications, and acts as a 21st-century equivalent of a "dumb terminal." However, the Web browser and the cloud computing solution are far more capable than the old terminal-based systems.

Common cloud computing services include:

**NOTE:**
The business model of cloud computing, and additional ideas can be found at: *www.ciwcommunity.org/drupal5/?q=node/94*.

*   Document creation and conversion.

*   File storage and management services.

- Instant messaging (IM).

- Customer relationship management (CRM).

Table 3-2 compares installed and cloud computing-based services.

*Table 3-2: Installed vs. cloud computing-based services*

| Type of software/ service | Examples of Installed Software | Examples of Cloud Computing-Based Services |
|---|---|---|
| **E-mail software** | Microsoft Outlook (*http://office. microsoft.com/outlook*)<br><br>Mozilla Thunderbird (*www.mozilla.org/ thunderbird*) | Gmail (*www.gmail.com*)<br><br>Rackspace (*www.rackspace.com/apps/email_ hosting/*)<br><br>Outlook.com (*www.outlook.com*) (formerly Windows Live Hotmail) |
| **Word processing, slide show and spreadsheet creation** | Microsoft Office (*http://office. microsoft.com*)<br><br>Apache OpenOffice (*www.openoffice.org*) | Google Apps (*www.google.com/enterprise/apps /business/*)<br><br>Zoho (*www.zoho.com*) |
| **File backup and management** | File servers | Amazon S3 (aws.amazon.com/s3)<br><br>Microsoft OneDrive (*https://onedrive.live.com/*)<br><br>Google Drive (*http://drive.google.com*) |
| **File sharing, extranet creation and project management** | Microsoft SharePoint (*http://sharepoint.microsoft.com*) | Google Sites (*http://sites.google.com*)<br><br>Basecamp (*http://basecamp.com*) |
| **Customer Relationship Management (CRM) software** | GoldMine (*www.goldmine.com*) | Salesforce.com (*www.salesforce.com*)<br><br>SugarCRM (*www.sugarcrm.com/crm*) |

## CIW Online Resources – Movie Clips

Visit CIW Online at http://education.Certification-Partners.com/CIW to watch a movie clip about this topic.

*Lesson 3: Looking to the Clouds*

## Crowdsourcing

Some cloud computing applications use crowdsourcing (also known as collaborative filtering) to help you define and refine choices you make in a cloud computing application to personalize its content. As you learned in a previous lesson, crowdsourcing occurs when a task ordinarily performed by one person is outsourced to a large group or community in order to obtain and analyze large amounts of data.

Pandora (*www.pandora.com*) is an example of a cloud computing application that uses crowdsourcing. Pandora is an automated Internet radio service that you can use to build a collection of songs you like. When you select certain songs or artists, Pandora will play selections that are musically similar and you can approve or disapprove the selections. The selections are determined by other Pandora users who have selected the same or similar songs/artists and categorized them together based on their own

approval/disapproval decisions. This crowdsourcing technique allows Pandora to tailor its future selections to coincide with your initial selections.

## Cloud computing characteristics

Following are general characteristics of cloud computing:

- **Reliance on only a Web browser to access services** — Cloud computing sites ask the user for a browser, nothing else. It is possible for services to require minor add-ons, such as Flash.

- **No browser preference** — More "pure" cloud computing services work with any browser, whereas those with more traditional approaches or desire for vendor lock-in are browser-specific.

- **No operating system preference** — Because cloud-based solutions require only a browser, many services do not favor any particular operating system.

## Software as a Service (SaaS)

Cloud computing is also known as Software as a Service (SaaS) for the following reasons:

- **The software responsible for providing the service cannot be downloaded and owned by the end user** — It is available as a solution only on a remote basis.

- **The software becomes available as a service either for free or for a fee** — Often, the service is available free for a certain period of time. Sometimes two versions of a service are made available: The first version is usually a free service that is limited in some way or contains advertisements. The second version is an enhanced or "professional" service that contains no advertisements and is generally full-featured. In some cases, the full-featured version is available either for a fee or in exchange for user profile information.

## Grid computing

Grid computing is similar to cloud computing in that a cluster of multiple, remote systems are used to create a single solution. However, grid computing generally relates to the use of multiple systems dedicated to processing a vast amount of data or solving a particular mathematical or scientific problem. Examples of grid computing include systems that engage in economic forecasting or analyze seismic data.

Grid computing solutions create a group of systems that share CPU cycles in a particular pool. The process of sharing these cycles is often referred to as "CPU scavenging," because the system captures available cycles from computers whenever it can.

## Advantages to cloud computing

Cloud computing is attractive for the following reasons:

- **Flexibility** — Using powerful cloud computing software, a single person can run a sophisticated business. Yet a large enterprise can use a very similar product as well.

- **Scalability** — As an enterprise grows, it can simply rely on its cloud computing partner to increase capability instead of hiring additional employees and obtaining new hardware.

- **Cost reduction** — Companies that use cloud computing can hire fewer employees and purchase less hardware.

## Problems with cloud computing

Drawbacks to cloud computing include:

- **Connectivity** — If Internet access is cut off to a particular company or division for some reason, then the cloud-based service will no longer be available. Workers are entirely dependent upon accessing remote applications. Furthermore, if the company or end user tends to store information only on the remote servers (i.e., "in the cloud"), then this information is no longer available as well.

- **Speed** — If Internet access slows down or somehow becomes impaired, then users' ability to access or use information is slowed down or disabled until Internet access is restored.

- **Lockout** — If the cloud-based organization decides to limit access to its services, you may no longer be able to access information stored remotely.

### CIW Online Resources – Online Exercise

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to complete an interactive exercise that will reinforce what you have learned about this topic.

*Exercise 3-5: Cloud computing concepts*

In the following lab, you will learn how to access cloud computing services. Suppose you have just purchased a new personal computer and you want to be able to access as many applications as possible, yet keep your costs to a minimum. Would you be forced to purchase the applications you need and load them on your hard drive, or is there another alternative?

### Lab 3-3: Exploring iGoogle Portal's cloud computing capabilities

In this lab, you will configure iGoogle Portal to explore online services that use cloud computing.

**NOTE:**
HTTP is the default Web browser protocol. You do not need to enter "http://" when you type Web site addresses.

1. Open your browser and go to *www.igoogleportal.com*.

2. Click the **Login** link in the upper-right corner of the screen to create a new account.

3. Click the **Create Your Account** link to display the Create Your Account dialog box.

4. Enter the e-mail, password and name information you specified when you created your Google account in the previous lesson. Click the **Create Account** button.

5. A message box will appear prompting you to validate your account. Click the provided link and the iGoogle Portal login screen will appear. Enter your e-mail address and password, then click the **Login** button.

6. The iGoogle Portal home page should appear, as shown in Figure 3-6. You can use iGoogle Portal to add widgets (mini-applications that can deliver e-mail, Web feeds, photos and personalized news) anywhere on a Web page.
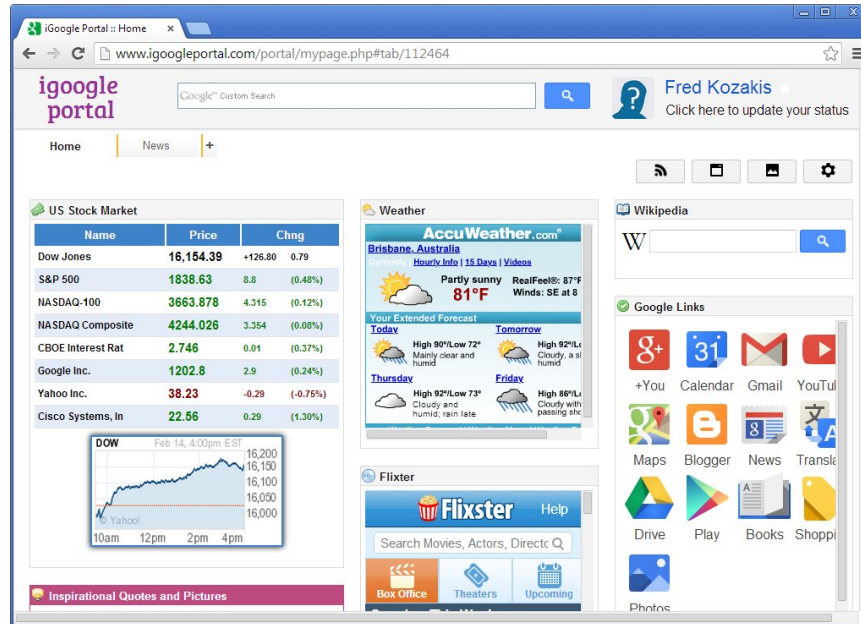
*Figure 3-6: iGoogle Portal home page*

7. Scroll through the page and notice the default widgets: US Stock Market, Weather, Wikipedia, Google Links, and so on.

8. Click the **Add Widgets** button (the second button in the toolbar near the top-right portion of the screen) to display a list of widgets you can add to your iGoogle Portal home page. Scroll through the list of widgets to familiarize yourself with the available applications. If you wish to add a widget, click the **Add It Now** button for the widget.

9. Click your browser's **Back** button as many times as necessary to redisplay the iGoogle Portal home page.

10. Click the **Change Theme** button (the third button in the toolbar near the top-right portion of the screen) to display the Change Theme window, which displays a list of available themes. Scroll through the list of themes to familiarize yourself with them. If you wish to specify a theme, click the **Add It Now** button for the theme.

11. When you are finished exploring the themes, click the **Close** link in the upper-right corner of the Change Theme window to return to your iGoogle Portal home page. Depending on the widget(s) and theme you selected, your iGoogle Portal home page may resemble Figure 3-7.
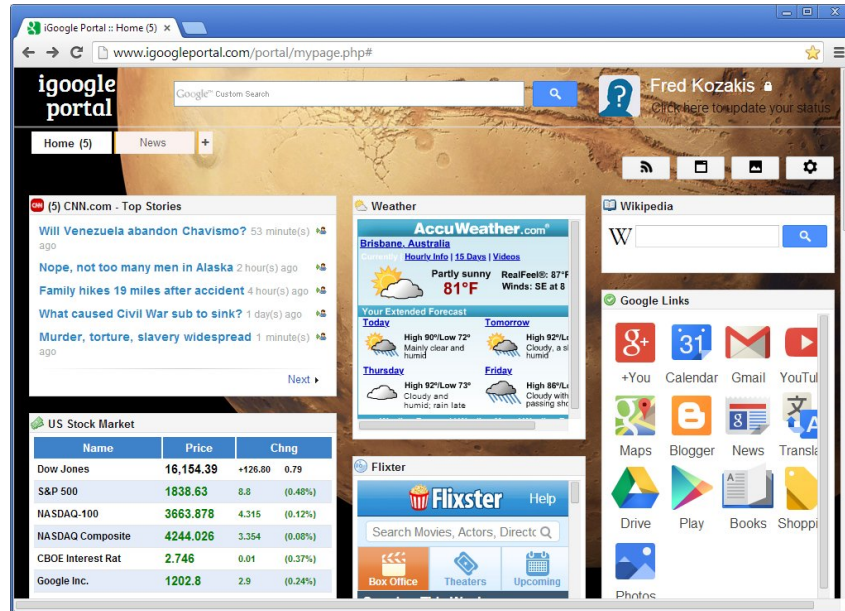
*Figure 3-7: Personalized iGoogle Portal home page*

**12.** Scroll through the page and observe the widgets that were added based on your selections.

**13.** In the iGoogle Portal home page, place the mouse pointer on the title bar of the **Weather** widget, then click the **Configure** link. Enter your ZIP code or city name to specify your location, then click the **Submit** button. Notice that you now have weather information for your locale.

**14.** In the **Google Links** widget, click the **Maps** link. The Google Maps page will open, as shown in Figure 3-8. You can use Google Maps to view maps, satellite images and street-level images of many locations around the world. You can also obtain directions, check live traffic conditions and perform many other useful tasks without leaving the interface.
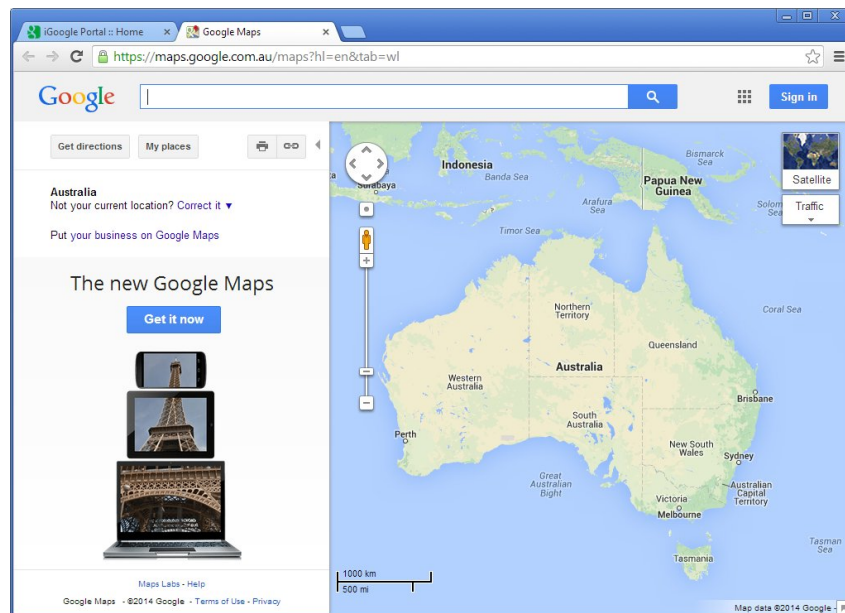


*Figure 3-8: Google Maps page*

**15.** Click in the Search text box near the top of the screen, enter an address of your choice, then press **ENTER**. Notice that a map of the area surrounding the location you specified appears.

**16.** At the top of the map image, click the **Traffic** button. Notice that the major routes are outlined with a color denoting the level of real-time traffic, ranging from slow (black) to fast (green).

**17.** Click the **Satellite** button. Notice that the map is replaced by a satellite image of the same area.

**18.** Position the mouse pointer anywhere on the image and drag it in any direction. Notice that you can move the image around to view different geographical areas.

**19.** Use the slider on the left side of the image to zoom in or out of the image. Experiment with other options to familiarize yourself with the different features of Google Maps.

**20.** Redisplay your **iGoogle Portal** home page.

**21.** In the **Google Links** widget, click the **Drive** link. Your Google login page appears. Sign in using your Google account.

**22.** The Google Drive page appears. Google Drive provides cloud file storage for your files. You can create files to store on the Google Drive servers using the Create button. You can create folders, documents, slide presentations, spreadsheets, forms and drawings. All of the software is hosted by Google's servers, and any files created are stored in your Google Drive by default.

**23.** To create a word-processing document, click the **Create** button and select **Document** from the drop-down menu. An Untitled Document page will appear, as shown in Figure 3-9.
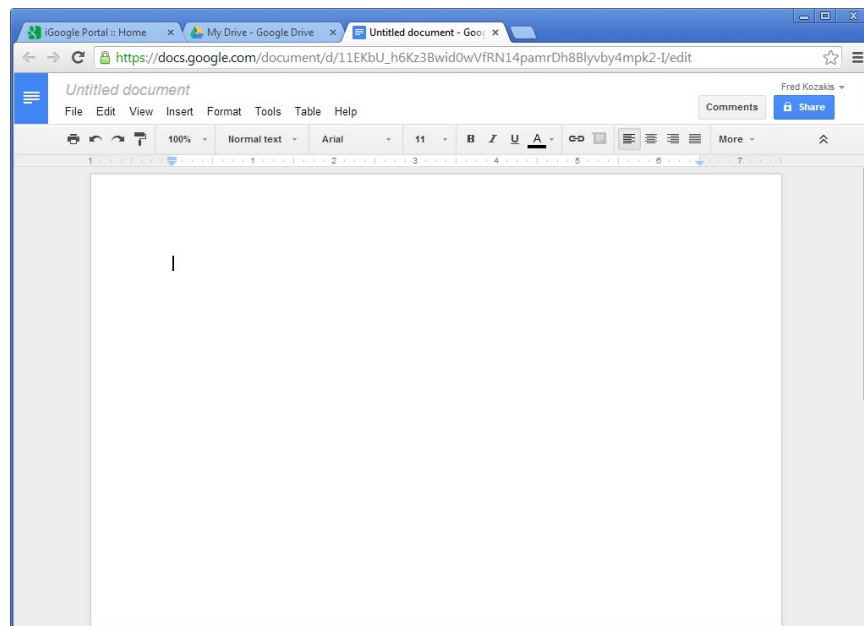


*Figure 3-9: Google Drive – Untitled Document page*

**24.** Type a few words into your document, such as ***This document is a test.*** Rename the document by clicking **Untitled document**. Enter a new document name, such as

*Test*, and click **OK**. The document is automatically saved in Google Drive in the cloud. No Save button is needed.

**25.** Close the document tab or window and return to the Google Drive page. Click **My Drive**. Your word-processing document will appear. It has been stored in Google Drive, as shown in Figure 3-10.
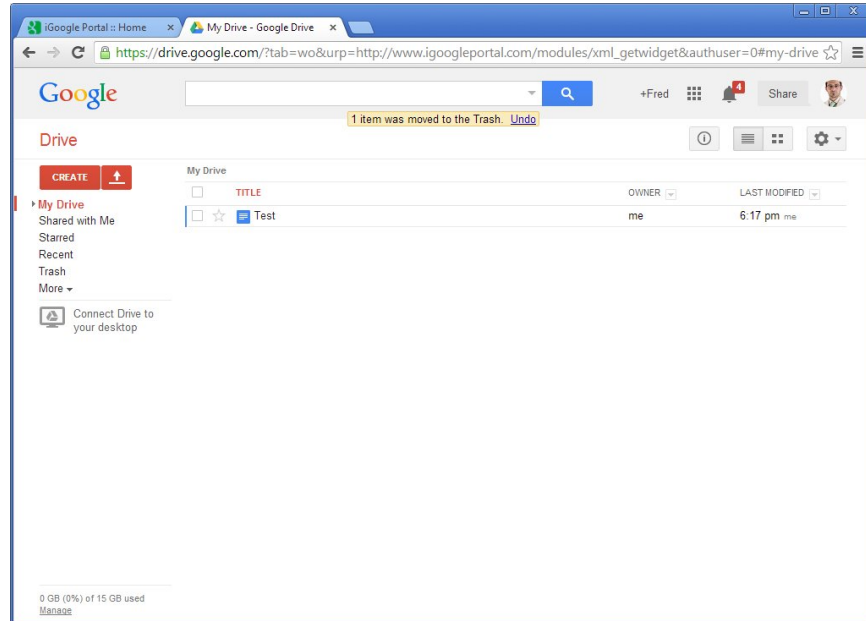


*Figure 3-10: Google Drive document saved in the cloud*

**26.** Sign out of **Google**, then close the **iGoogle Portal** window. You need not disconnect from iGoogle Portal. Close your **browser**, if necessary.

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### CIW Online Resources – Course Mastery

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to take the Course Mastery review of this lesson or lesson segment.

*IBA Lesson 3 - Part B*

## Case Study

# Computing in the Cloud

Salim has accepted the position as the one-man IT department for the small catalog business that his brother Jamal is starting up. Jamal is leaving all decisions up to Salim about the computer systems and software applications that the company will use to do business.

Resources are tight, so Salim decides to use several cloud computing applications for the business. Rather than purchase applications and servers that he will need to configure and continuously maintain, he contracts with service providers for the following services:

- Word-processing

- File storage and management

- E-mail

- Customer relationship management (CRM)

<p align="center">*       *       *</p>

As a class, discuss this case study and answer the following questions:

- What are some advantages of using cloud computing for the services listed?

- What are some disadvantages of using cloud computing for the services listed?

- What hardware and software will Salim still need to purchase, configure and maintain for the company's computing needs?

- As Jamal's company grows, how will the decision to use cloud-computing applications be affected? How might the cloud computing decision affect the company's productivity as it grows?

## *Lesson Summary*

### Application project

Consider the following situations, and compare your solutions to those of your classmates.

- The Internet is composed of many systems that are connected using the client/server architecture. What other computer interactions occur during your business day that might use client/server architecture?

- You are hired by a non-profit organization that promotes cultural exchanges among youths from countries that are politically estranged from one another. The organization wants you to establish a domain name and create a Web site. Determine a domain name and the domain name category that will best suit your customer.

- A friend wants to create her own home page but is not familiar with any cloud computing applications. Review with her the capabilities of iGoogle and suggest appropriate Gadgets she should include that will reflect her interests.

### Skills review

In this lesson, you learned about networks, the client/server network model, and the differences between LANs and WANs. You also learned about the history of the Internet, the difference between the Internet and the World Wide Web, and the way the Internet works. You studied the elements required to connect to the Internet, the purpose of Internet Service Providers (ISPs) and the ways to connect to the Internet. You learned about Internet protocols and about the business services to which they refer. You also learned about the Domain Name System (DNS), the hierarchical structure of DNS, top-level domains, domain name servers, and virtual and shared domains. Finally, you studied cloud computing.

Now that you have completed this lesson, you should be able to:

✓ 1.2.1: Distinguish between a client and a server.

✓ 1.2.2: Explain Internet history, define current protocols (e.g., IPv4, IPv6, related protocols), and identify timelines and models for technology adoption curves (e.g., Moore's Law, Geoffrey Moore's technology adoption life cycle, Kuhn's concept of paradigm shifts).

✓ 1.2.3: Identify the infrastructure needed to support an Internet client, including TCP/IP stack software, operating system, network connection, Web browser, e-mail, hardware platform (PC, laptop, tablet, smartphone, smart TV).

✓ 1.2.4: Identify hardware and software connection devices and their uses, including various types of modems (e.g., analog, ISDN, DSL/ADSL, cable), and connect systems to the Internet and other networks using basic cable/ADSL and wireless equipment.

✓ 1.2.5: List elements, benefits and drawbacks of cloud computing, including Software as a Service (SaaS), grid computing, offline computing features.

✓ 1.3.1: Define the purpose of remote access protocols, including Point-to-Point Protocol (PPP), Point-to-Point Protocol over Ethernet (PPPoE).

✓ 1.3.2: Identify various types of Internet bandwidth technologies (link types), including T and E carriers, fractional T and E lines, and common DSL/ADSL, wireless and cable speeds.

✓ 1.3.3: Map protocols to specific business services (e.g., SMTP, IMAP and POP3 to e-mail; HTTP and HTTPS to Web browsers; FTP to file transfer).

✓ 1.4.1: Define the purpose of the Domain Name System (DNS).

✓ 1.4.2: Identify Internet domain names, including top-level or original domains (edu, com, net, gov, org), country-level domains (e.g., uk, ch, tv) and newer domains (e.g., biz, info).

✓ 1.4.3: Describe the hierarchical structure of DNS.

✓ 1.4.4: Identify basic domain name server roles.

✓ 1.4.5: Describe Internet addresses.

✓ 1.4.6: Define shared domains.

✓ 1.19.6: Identify social networking sites and resources (e.g., Facebook, Google+), and define essential social networking terms, including crowdsourcing, social tagging (e.g., Delicious), semantic Web.

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### CIW Practice Exams

Visit CIW Online at *http://education.Certification-Partners.com/CIW* to take the Practice Exams assessment covering the objectives in this lesson.

*IBA Objective 1.02 Review*

*IBA Objective 1.03 Review*

*IBA Objective 1.04 Review*

*IBA Objective 1.19 Review*

*Note that some objectives may be only partially covered in this lesson.*

# Lesson 3 Review

1. What term describes a group of two or more computers connected so that they can communicate, share resources and exchange information?

   _____

2. Briefly describe the client/server model.

   _____

   _____

3. What is the difference between a local area network (LAN) and a wide area network (WAN)?

   _____

   _____

4. What is the difference between the Internet and the World Wide Web?

   _____

   _____

5. Why are IPv4 addresses also called dotted quads?

   _____

   _____

   _____

6. What is the function of Hypertext Transfer Protocol (HTTP)?

   _____

   _____

7. How are domain names structured?

   _____

   _____

8. How are domain names resolved to IP addresses?

   _____

   _____

   _____