Lesson 5

Data Communications

Introduction

In this lesson, we are going to learn about the fundamental concepts and the terminologies used for data communication and Internet technology (Chapter 6).

In particular, you need to understand the following terminologies well:
- Local Area Network (LAN)
- Wide Area Network (WAN)
- Internet – IP, TCP/UDP, TCP Applications
- Virtual Private Network (VPN)
- Web Technology – HTML

Study the following slides along with the textbook reading. As before, click any hyper link to learn more about the keywords and concepts.

At the end of the lesson, the second project description will be presented. This project is to design your homepage using HTML presented in this lesson. The project is due by midnight on Sunday, November 10.

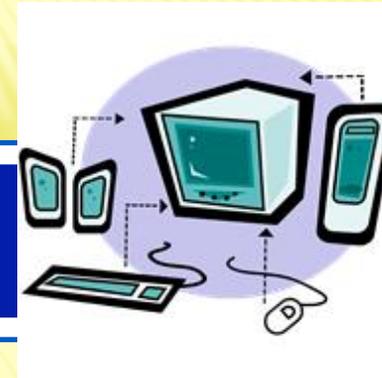Let's first watch the scenario video and think about the following questions.

This Could Happen to You: "$175,000 to Hook Up a Computer?"

Wired vs. Wireless?

What devices are needed?

How much will it cost?

Where to start?

Scenario Video

Study Questions

Q1   What is a computer network?

Q2   What are the components of a LAN?

Q3   What are the alternatives for connecting to a WAN?

Q4   What are the fundamental concepts you should know about the Internet?

Q5   What happens on a typical web server?

Q6   How do organizations benefit from Virtual Private Networks (VPNs)

Q1: What Is a Computer Network?

Network

- Collection of computers
- Communicate with one another over transmission line

Major types of network topologies

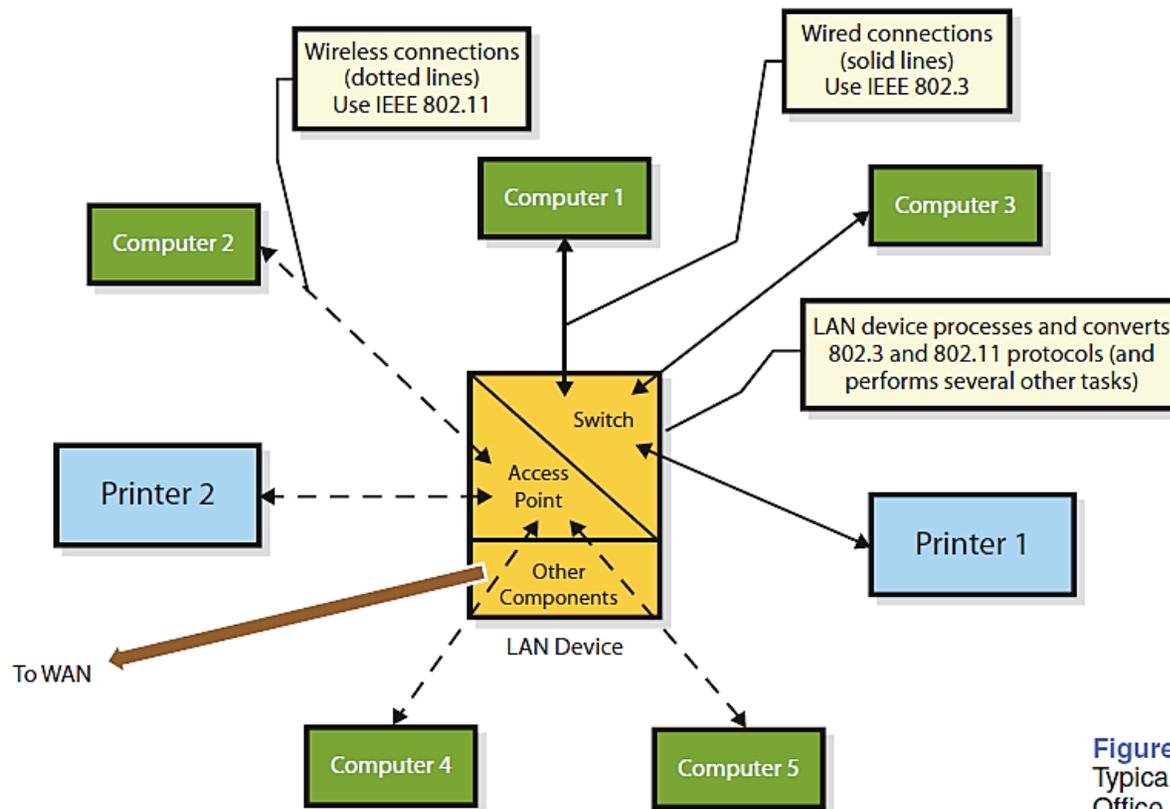| Type	Characteristic
Local area network (LAN)	Computers connected at a single physical site
Wide area network (WAN)	Computers connected between two or more separated sites
The Internet and internets	Networks of networks

Q2: What Are the Components of a LAN?

Wireless connections (dotted lines) Use IEEE 802.11

Wired connections (solid lines) Use IEEE 802.3

Computer 1

Computer 2

Computer 3

LAN device processes and converts 802.3 and 802.11 protocols (and performs several other tasks)

Switch

Access Point

Printer 2

Printer 1

Other Components

LAN Device

To WAN

Computer 4

Computer 5

Figure 6-2
Typical Small Office/Home Office (SOHO) LAN

WANs

Connects computers across metropolitan, state, regional, national areas

Uses communication networks from vendors

Licensed by government

ICN Network Topology

MSA	City
01	Chicago
02	Rockford
03	Moline
04	DeKalb
05	Normal
06	Peoria
07	Chmpgn/Urb.
08	Charleston
09	Springfield
10	Quincy
11	Olney
12	Carbondale
14	Paris
15	Collinsville
17	Macomb

ILLINOIS CENTURY NETWORK
Central Management Services
WWW.ILLINOIS.NET

Wired Connectivity

Switch

- *Special purpose computer that receives and transmits messages*

Gateway

Network interface card (NIC)

UTP (unshielded twisted pair)

Optical fiber cable

LAN Protocol

IEEE 802.3 Protocol

Wired LAN

10/100/1000 Mbps Ethernet

Protocol specifies hardware characteristics, cables, and how messages are packaged and processed

IEEE 802.11 Protocol

Wireless LAN

Most popular 802.11g (2010)

Bluetooth

Common wireless protocol for transmitting data over short distances—wireless mice and keyboards, cell phones

Summary of LAN and WAN Networks

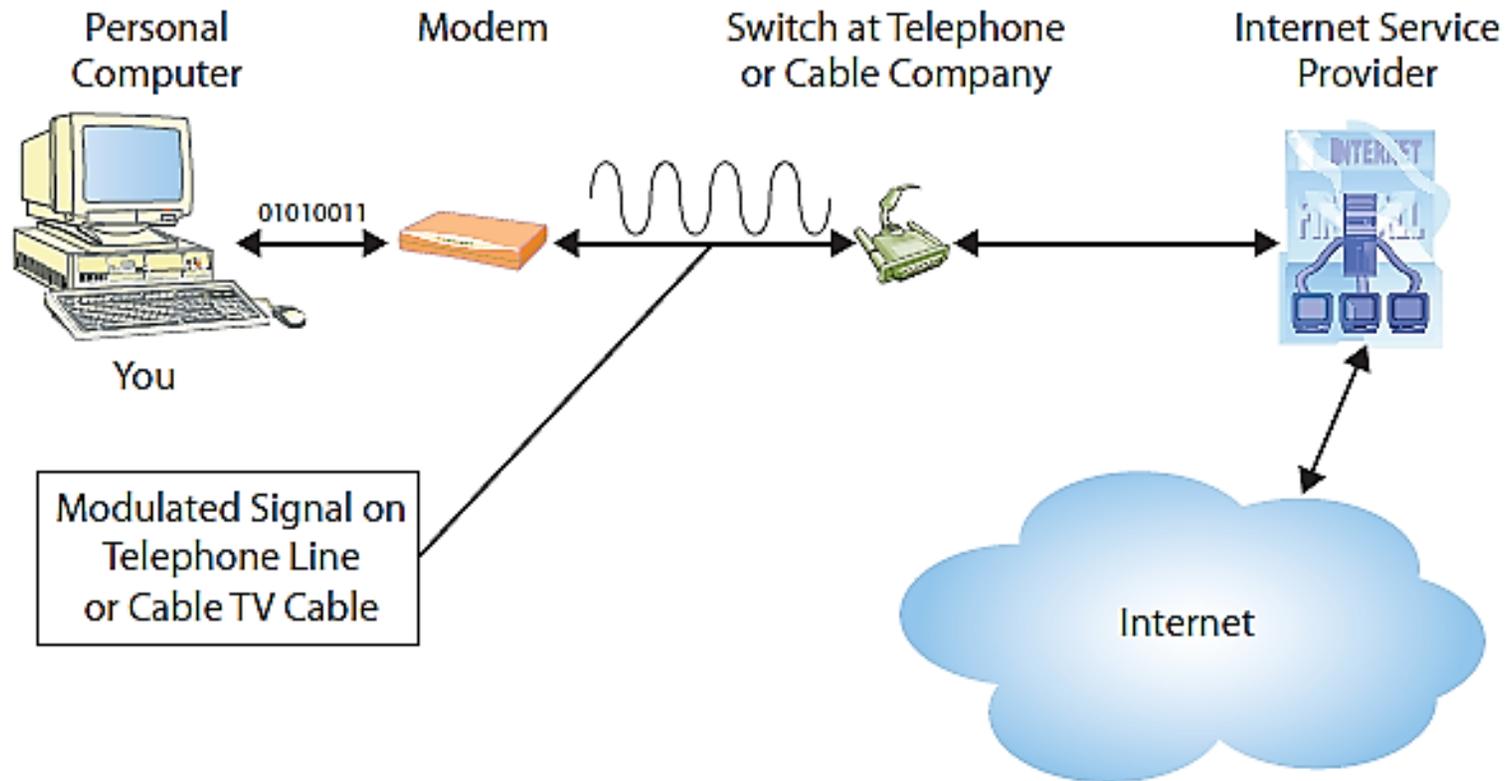| Type	Topology	Transmission Line	Transmission Speed	Equipment Used	Protocol Commonly Used	Remarks
Local area network	Local area network	UTP or optical fiber	10,100, or 1,000 Mbps	Switch NIC UTP or optical	IEEE 802.3 (Ethernet)	Switches connect devices, multiple switches on all but small LANs.
	Local area network with wireless	UTP or optical for non-wireless connections	Up to 54 Mbps	Wireless access point Wireless NIC	IEEE 802.11g	Access point transforms wired LAN (802.3) to wireless LAN (802.11).
Wide area network connections	DSL modem to ISP	DSL telephone	Upstream to 256 kbps Downstream to 1.544 Mbps	DSL modem DSL-capable telephone line	DSL	Can have computer and phone use simultaneously. Always connected.
	Cable modem to ISP	Cable TV lines to optical cable	Upstream to 256 kbps Downstream 300–600 kbps (10 Mbps in theory)	Cable modem Cable TV cable	Cable	Capacity is shared with other sites; performance varies depending on others' use.
	WAN wireless	Wireless connection to WAN	500 kbps to 1 Mbps	Wireless WAN modem	EVDO, HSDPA, WiMax	Sophisticated protocol enables several devices to use the same wireless frequency.

Q3: What Are the Alternatives for a WAN?

WANs connect computers at separate sites

- Use routers and public communications links between sites
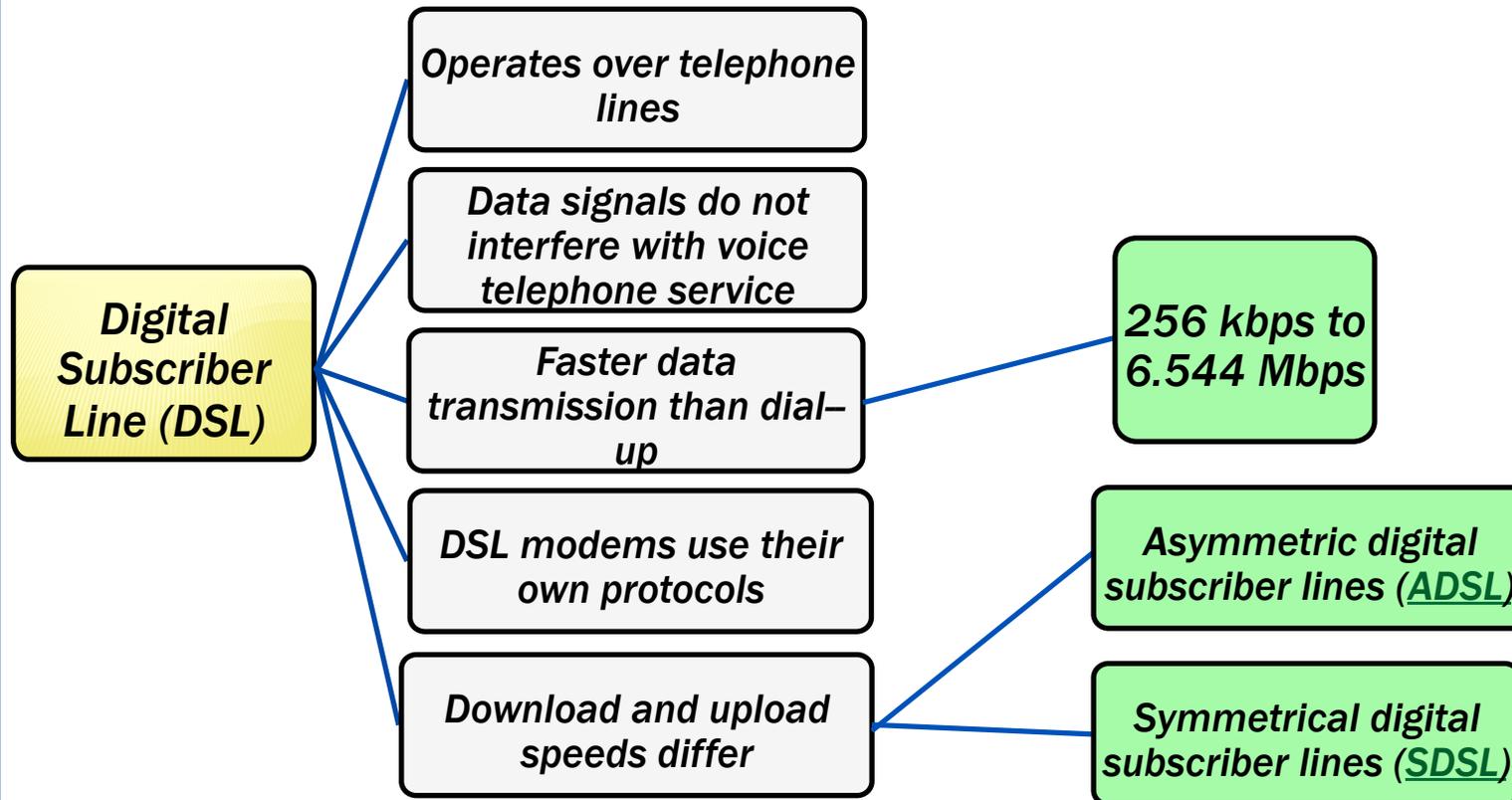- Cable connections made through licensed public telecommunications companies

Internet service provider (ISP)

- A company that provides customers access to the Internet
- Provides legitimate Internet address
- Serves as gateway to Internet
- You pay for Internet access

DSL and Cable Internet Access

Personal Computer — You

01010011

Modem

Modulated Signal on Telephone Line or Cable TV Cable

Switch at Telephone or Cable Company

Internet Service Provider

Internet

DSL Modems

Digital Subscriber Line (DSL)

- Operates over telephone lines
- Data signals do not interfere with voice telephone service
- Faster data transmission than dial–up
  - 256 kbps to 6.544 Mbps
- DSL modems use their own protocols
- Download and upload speeds differ
  - Asymmetric digital subscriber lines (*ADSL*)
  - Symmetrical digital subscriber lines (*SDSL*)

Cable Modems

Provide high-speed data transmission

Use cable television lines

- High-capacity optical fiber cable to neighborhood
- Optical fiber cable connects to regular cable-television cables run to subscribers home or business. Does not interfere with television transmission.
- Up to 500 users share facility
  - Performance varies based on number of people connected
- Download speed up to 50 Mbps, upload up to 512 kbps

WAN Wireless Connection

Amazon's Kindle uses a Sprint wireless network to provide wireless data connections

Variety of WAN wireless protocols exist. Sprint and Verizon use EVDO; AT&T supports iPhone and T-Mobile use HSDPA; WiMax by Clearwire

WAN wireless provides average performance of 500 kbps, with peaks of up to 1.7 Mbps, as opposed to the typical 50 Mbps for LAN wireless

Narrowband lines transmission speeds less than 56 kbps

Broadband lines speeds in excess of 256 kbps

Q4: What Are the Fundamental Concepts You Should Know About the Internet?

Using the Internet for a Hotel Reservation
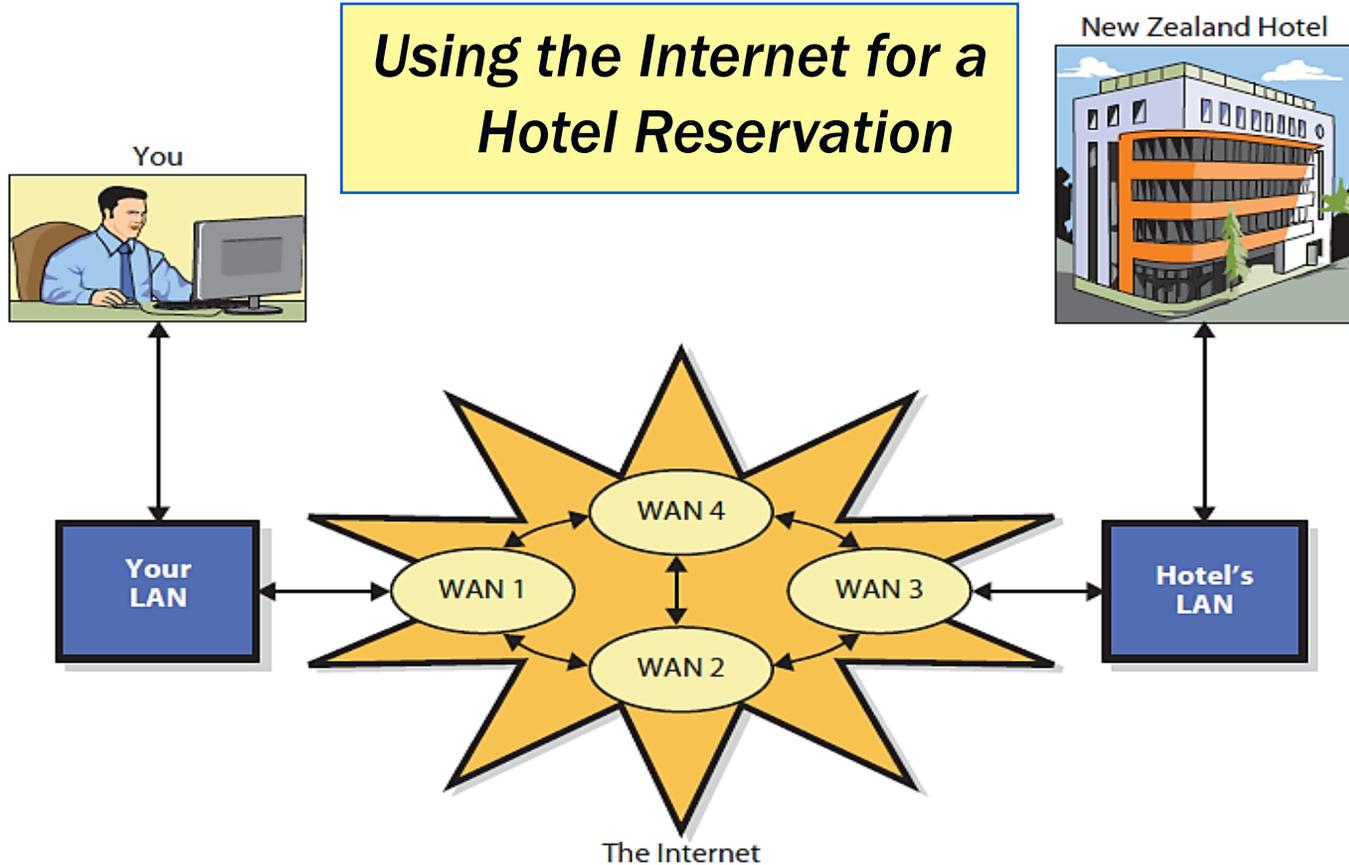
TCP/IP Architecture

Layer	Name	Scope	Purpose	Example Protocol
5	Application	Program to program	Enable communication among programs	HTTP; HTTPS; SMTP; FTP
4	Transport	Internets	Reliable internet transport	TCP
3	Internet	Internets	Internet routing	IP
2	Data Link	Network	Flow among switches and access points	IEEE 802.3 IEEE 802.11
1	Physical	Two devices	Hardware specifications	IEEE 802.3 IEEE 802.11

Application Layer Protocols

Hyper Text Transport Protocol (HTTP)

- **Protocol used between browsers and web servers.**

Simple Mail Transfer Protocol (SMTP)

- **Used for email transmissions.**

File Transfer Protocol (FTP)

- **Used to move files over Internet.**
- **Web-Internet-based network of browsers and servers that process http or https. When you use ftp or smtp, you are using Internet, not web.**

TCP and IP Protocols

TCP or Transmission Control Protocol

- Breaks traffic up into pieces and send each piece along its way

IP (Internet Protocol)

- Specifies routing of pieces of data communication through networks that comprise any Internet
- *Packet* is a piece of a message that is handled by programs that implement IP
- *Router* is a special purpose computer that moves packet traffic according to rules of IP protocol

IP Addressing

Public IP Addresses

- Identify a particular device on public Internet
- Public IP Addresses must be unique, worldwide
- Assignment controlled by *ICANN* (Internet Corporation for Assigned Names and Numbers)

Private IP Addresses

- Identify a particular device on a private network, usually on a LAN

Use of Private IP Addresses

Network: 192.168.1.x
Subnet: 255.255.255.0
Default Gateway: 192.168.1.254

The Internet
Public
Network
(WAN)

Host "A"
(192.168.1.1)

Host "B"
(192.168.1.2)

Router
(192.168.1.254)

TCP/IP

TCP/IP

Private
Network
(LAN)

Host "C"
(192.168.1.3)

Host "D"
(192.168.1.4)

Source: http://www.broadband-help.com/articles/networking/networking-guide-part2-tcpip-explained#b10
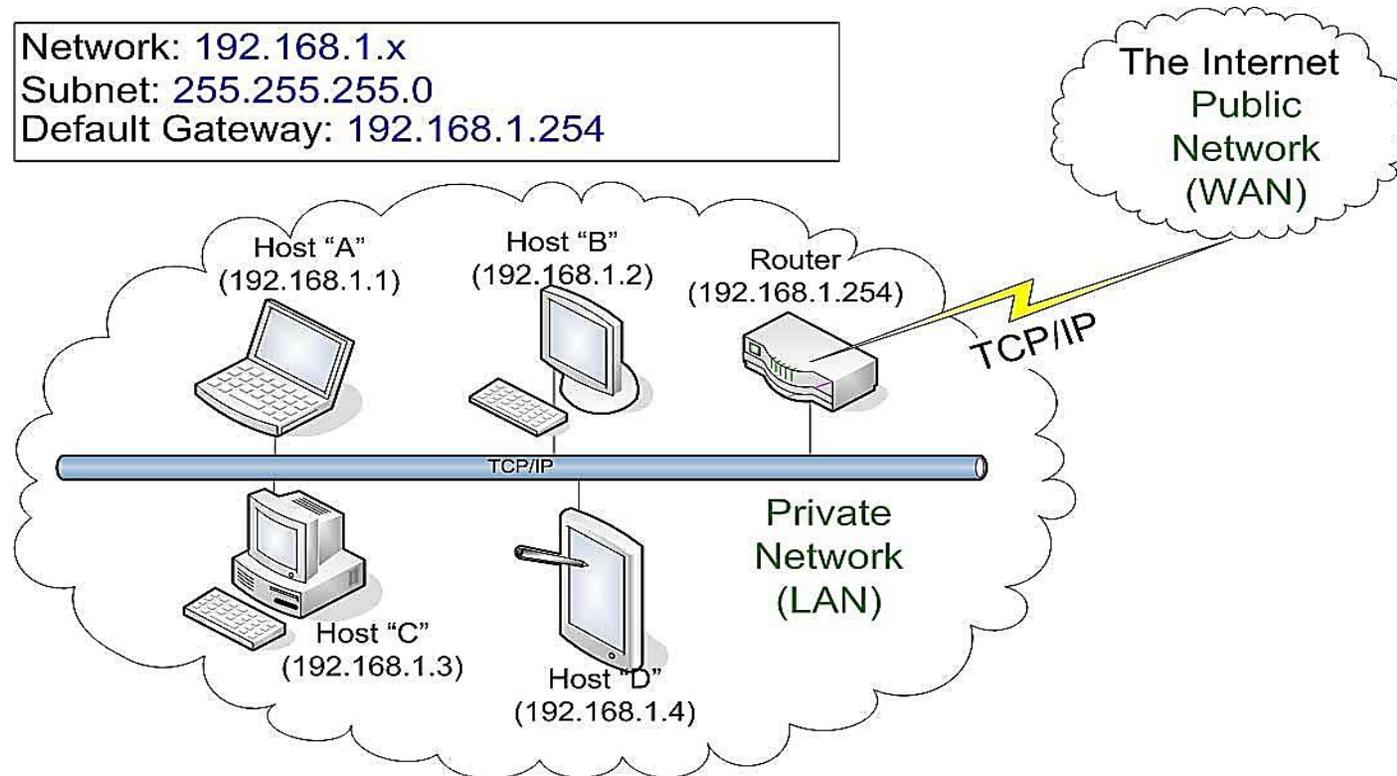
Public IP Addresses and Domain Names

IPv4 Supports (2^{32}) or 4,294,967,296 addresses

- Four decimal dotted notation like 165.193.123.253

IPv6 - Supports 2^{128} addresses

Domain name

- Unique name affiliated with public IP address

URL (Uniform Resource Locator)

Q5 What Happens on a Typical Web Server?

Three-Tier Architecture
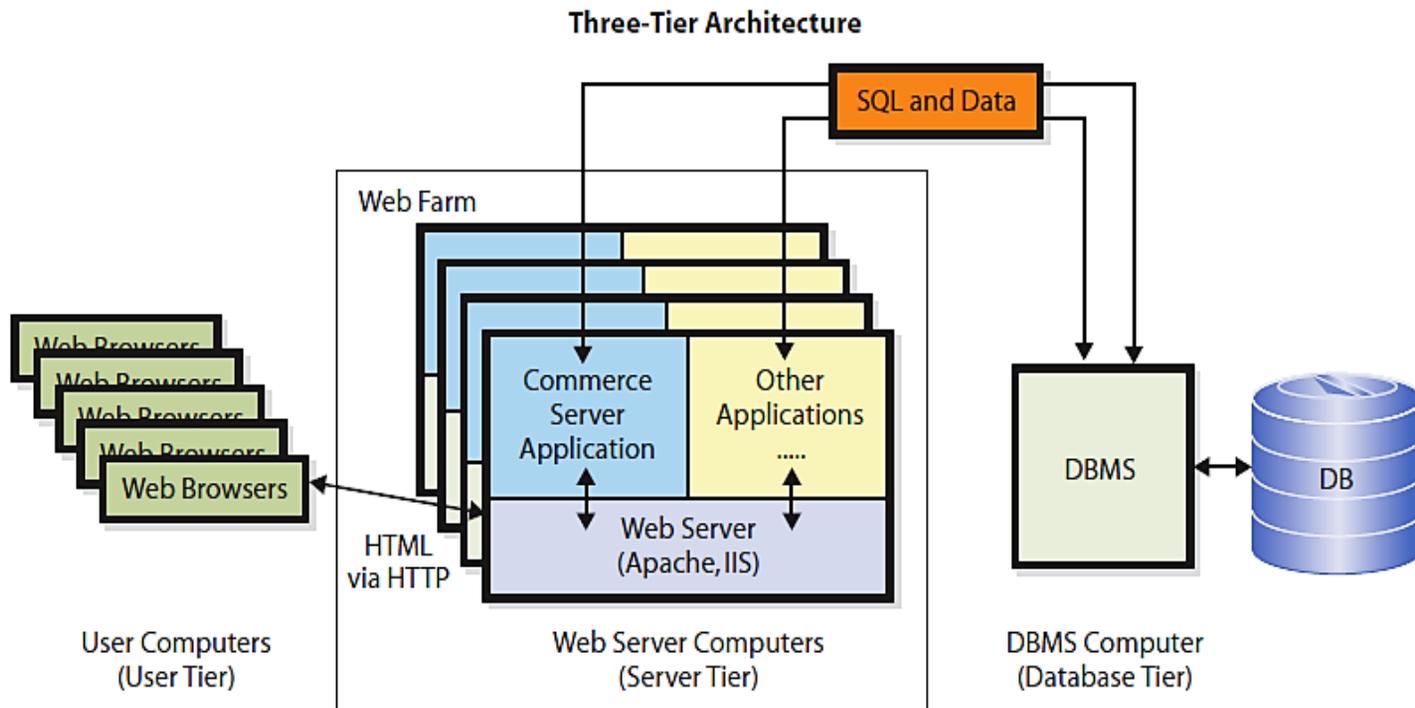
Web Farm Servers

Web servers
- Programs that run on a server tier computer
- Manage HTTP traffic by sending and receiving web pages to and from clients

Commerce servers
- Application programs that run on a server tier computer
- Receives requests from users via web server, takes some action, and returns a response to users via the web server

Hypertext Markup Language (HTML)

```
<title>UMIS Example HTML</title>
<style type="text/css">
.style1 {
    font-size: xx-large;
    text-align: center;
    font-family: Arial, Helvetica, sans-serif;
}
.style2 {
    color: #FF00FF;
}
.style3 {
    font-size: medium;
    text-align: center;
    font-family: Arial, Helvetica, sans-serif;
}
.style5 {
    font-size: medium;
    text-align: left;
    font-family: Arial, Helvetica, sans-serif;
}
</style>
</head>

<body>

<p class="style1">
    <span class="style2"><strong>Using</strong></span>
    <strong>MIS</strong></p>
<p class="style1"> </p>
<p class="style3"><em>Fourth Edition</em></p>
<p class="style3"> </p>
<p class="style5">Example HTML Document</p>
<p class="style5"> </p>
<p class="style5"> </p>
<p class="style5">Click <a href="http://www.PearsonHigherEd.com/kroenke">here</a>
for the textbook&#39;s web site at Pearson Education.</p>

</body>
```

EMIS Example HTML - Windows Internet Explorer

C:\Users\David\Documents\My

Bing

Windows Live   Bing   What's New   Profile   Sign in

Favorites   Suggested Sites   Web Slice Gallery   Advanced Search

EMIS Example HTML   Page ▾   Safety ▾   Tools ▾

Experiencing MIS

Third Edition

Example HTML Document

Click here for the textbook's web site at Pearson Education.

Done   Computer | Protected Mode: Off   100%
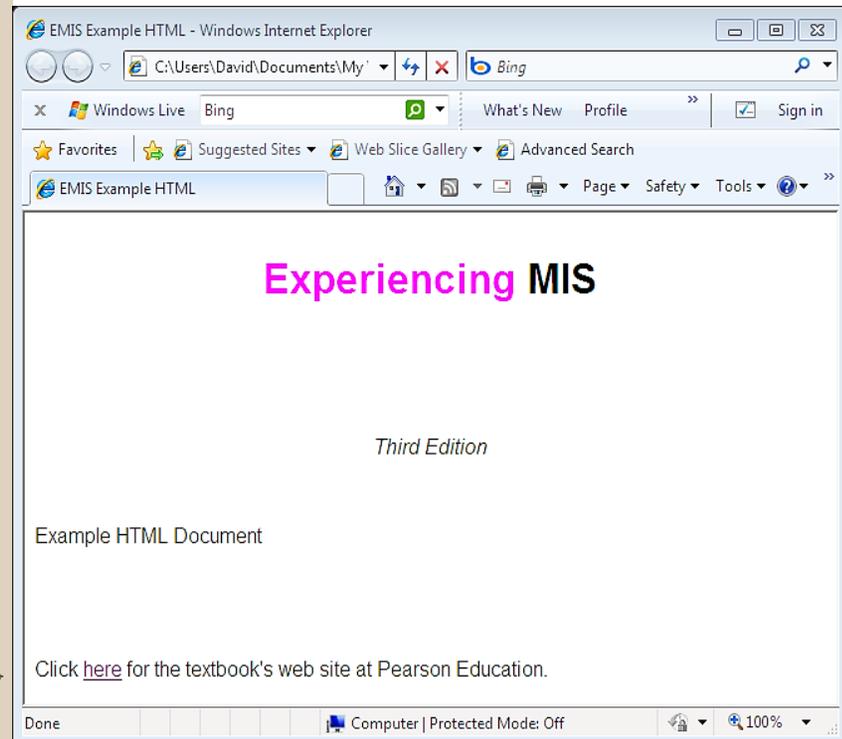
HTML Online Tutorial

First, watch the HTML tutorial video to understand how it works (click here).

For those of you want to learn more about HTML and how a webpage is designed by it, visit http://www.w3schools.com/html/html_intro.asp and take the online lessons.

We will summarize what you learned about HTML in the next couple of slides.

HTML Page Format

```
<HTML>

    <HEAD>
        <TITLE> MIS Project! </TITLE>

    </HEAD>

    <BODY>

        <H1> Hello World </H1>

        <! Rest of page goes here. This is a comment. >

    </BODY>

</HTML>
```
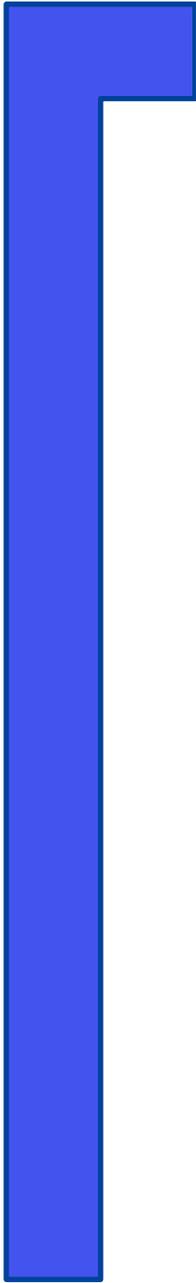
BODY Element

<BODY attributename="attributevalue">

- **Deprecated attributes (but still used)**
  - BACKGROUND="*Sunset.jpg*" (can be tiled)
  - BGCOLOR=color
  - TEXT=*color*
  - LINK=*color* (unvisited links)
  - VLINK=*color* (visited links)
  - ALINK=*color* (when selected)

<P> Paragraph

- **<P> defines a paragraph**
- **Add ALIGN=*"position"* (left, center, right)**
- **Multiple <P>'s do not create blank lines**
- **Use <BR> for blank line**
- **Fully-specified text uses <P> and </P>**
- **But </P> is optional**

```
<BODY>
<P>Here is some text </P>
<P ALIGN="center"> Centered text </P>
<P><P><P>
<P ALIGN="right"> Right-justified text
<! Note: no closing /P tag is not a problem>
</BODY>
```

Colors

- **Values for BGCOLOR and COLOR**
  - many are predefined (red, blue, green, ...)
  - all colors can be specified as a six character hexadecimal value: RRGGBB
  - FF0000 – red
  - 888888 – gray
  - 004400 – dark green
  - FFFF00 – yellow

XML, Flash, Silverlight, HTML 5
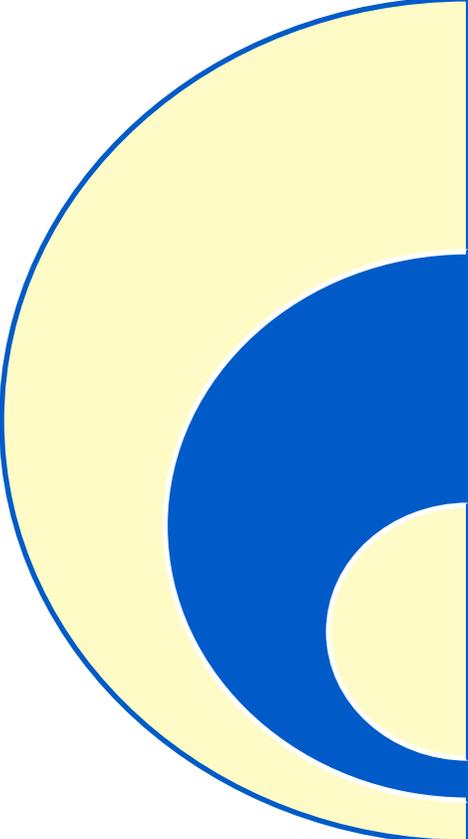
XML (eXtensible Markup Language)	• Fixes several HTML deficiencies • Program-to-program interaction over web
Flash and Silverlight	• Add-ons to browsers • Provides animation, movies, other advanced graphics inside a browser
HTML 5.0	• New version of HTML supports animation, movies, and graphics

Q6 How Do Organizations Benefit From Virtual Private Networks (VPNs)

Virtual private network

- Uses Internet or private network to create appearance of point-to-point connections
- Uses public Internet to create appearance of private network
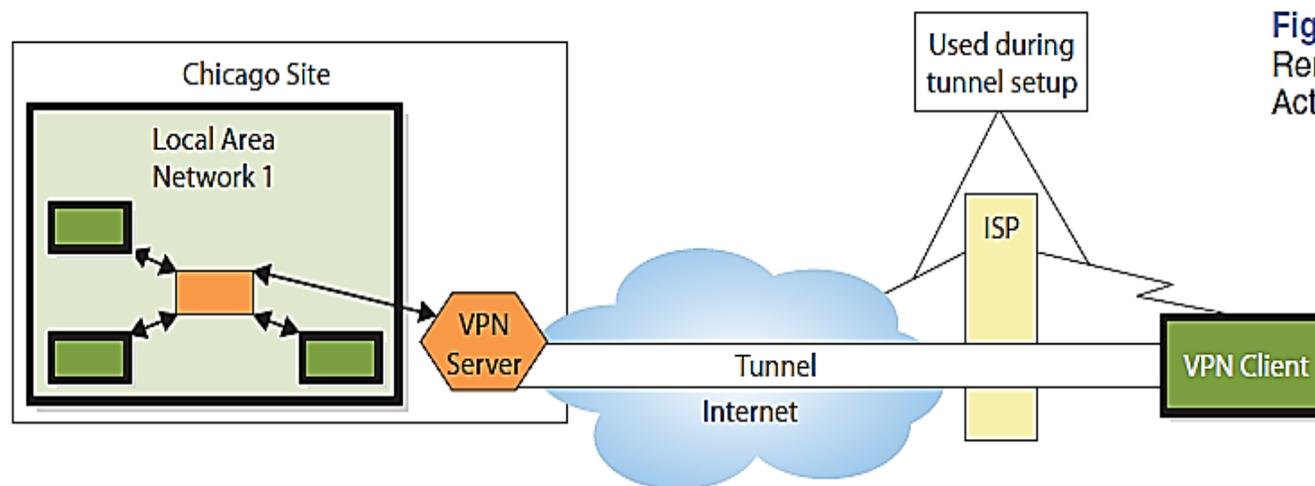
Figure 6-14
Remote Access Using VPN;
Actual Connections

WAN Using VPN Remote Access Using VPN; Actual Connections
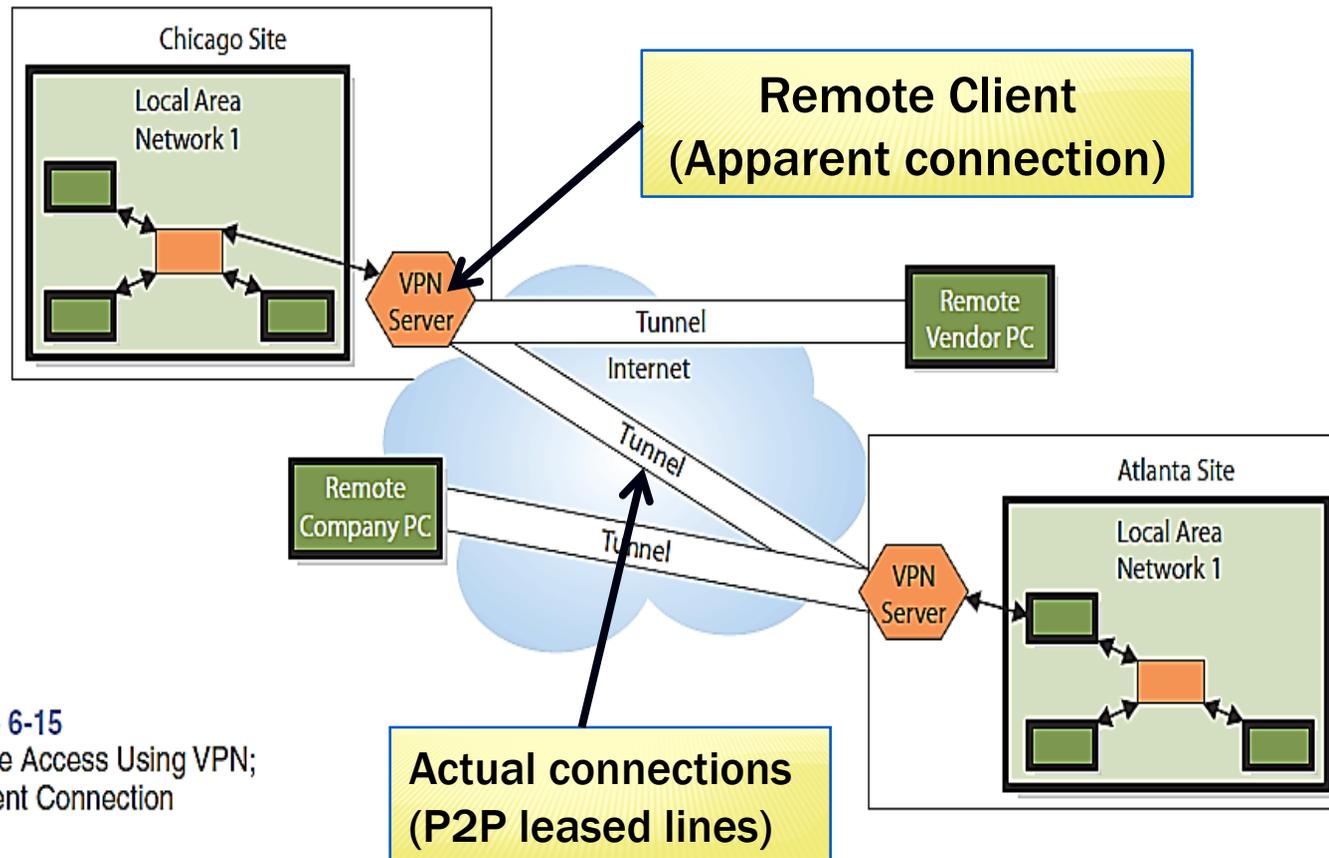
Figure 6-15
Remote Access Using VPN;
Apparent Connection

Chicago Site

Local Area Network 1

VPN Server

Remote Client (Apparent connection)

Internet

Tunnel

Remote Vendor PC

Remote Company PC

Tunnel

Tunnel

VPN Server

Atlanta Site

Local Area Network 1

Actual connections (P2P leased lines)

Webpage Design Project using HTML

- This project is to create a simple homepage using HTML to introduce yourself.

- The full description about this project is available on a separate link under the lesson main menu.

- This project will be counted 5% toward your final grade.

Requirements

1. Introduce yourself (i.e., name, year in college, major, etc.);

2. Insert your picture.

3. Save the final HTML document as "P2.html".

4. Submit both P2.html and your picture file into DropBox provided