

Part 2: Using Information Technology

Chapter 6

Networks and Collaboration

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Running Case

- Marlo thought the biggest technical issue was a low toner light on one of the printers
- However, a guest told Marlo that she could access a complete list of The 1881 files which is a security issue
- Security has always been taken seriously by the owners, and a quick response is necessary to fix this bug
- Marlo wished she had used her MIS lecture to create a checklist on security problems
- A couple of questions ran through her mind on fixing and preventing similar problems

Study Questions

1. Why should I care about Networks?
2. What is a computer network?
3. What are the components of a LAN?
4. Why is mobile computing important?
5. What do I need to know about connecting to the Internet?
6. How does e-mail actually work?
7. What are firewalls, encryption, and VPNs?
8. How does a search engine work?

Why should I care about Networks?

- Computers are more useful to people when they are connected to networks
- When connected to the Internet, you are part of a functioning network of networks containing millions of computers
- Networks allow you to send and receive email, browse web pages stored across the globe, download audio and video files, and even talk to friends using the telephone

Networks and Collaboration

- **Collaboration:** when two or more people work together to achieve a common goal, result, or product
- Effective collaboration produces results greater than those that could be produced by any of the individuals working alone
- Collaboration involves coordination and communication and often makes use of computer networks

Networks and Collaboration

- The effectiveness of a collaborative effort is driven by four critical factors:
 - Communication skills and culture
 - Communication systems
 - Content management
 - Workflow control
- Sometimes these four collaboration drivers are not equally important for all collaborations

Networks and Collaboration

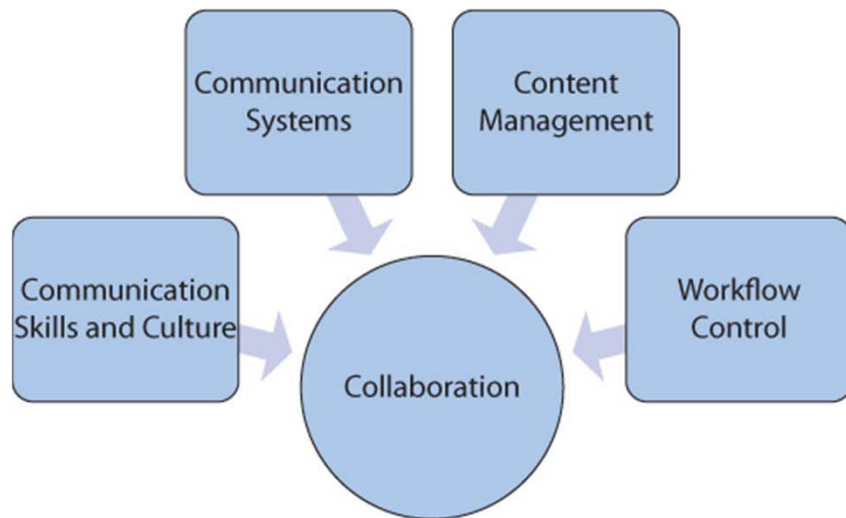


Figure 6-1

Critical Factors in Collaboration

Networks Externalities

- **Network externality:** the larger the number of people using a network, the more valuable that network becomes
- It is also called “network effect”
- When networks are first started, people often look for the critical mass
- When networks hit critical mass, they usually grow at a faster rate
- Network growth leads to congestion problems or the market may become saturated

What is a Computer Network?

- A **computer network** is a collection of computers that communicate with one another over transmission media
- Transmission media might be physical media, such as copper cable and optical fibre or wireless media transmitting light or radio frequencies
- Three basic types:
 - Local Area Network (LAN)
 - Wide Area Network (WAN)
 - Internet

Major Network Types

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

Figure 6-2

Major Network Types

LAN

- Connects computers within a relatively small, single geographic location
 - Two to several hundred computers
 - One geographic area only
 - Communication lines can be placed where the organization wants
- The distinguishing characteristic of a LAN is that it is in *a single location*

WAN

- Connect computers at *different geographical locations*
 - Two or more separated sites
- Uses communication networks from vendors
 - Licensed by government

The Internet and internets

- Network of networks
- Connect LANs, WANs, and other internets
- The Internet (with an upper-case letter I) is used for emailing and web browsing
- Private networks of networks are internets
- Use a variety of communication methods and conventions
 - Seamless flow of data provided by layered protocol
 - set of rules that communicating devices follow

What are the components of a LAN?

■ Local Area Network

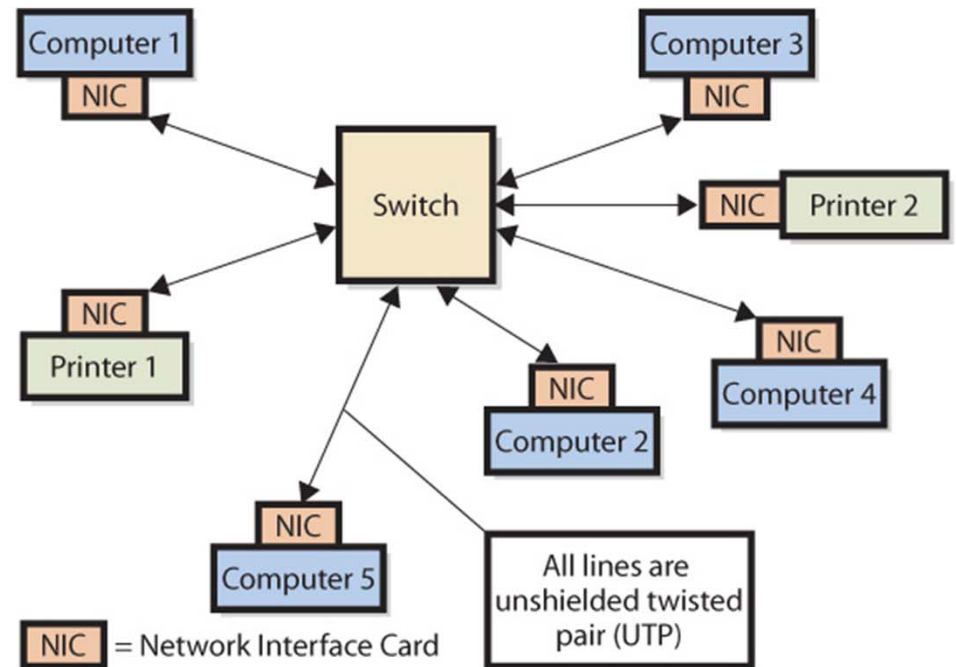
- Computers connected on a single company site
- Usually located within half mile area
- Property controlled by company operating network
 - company can run cabling as necessary

■ Components

- Switch
 - special purpose computer that receives and transmits messages on the LAN
- Network Interface Card (NIC)
 - hardware that connects each device's circuitry to the cable
 - onboard NIC or card that fits into an expansion slot

Local Area Network (LAN)

Figure 6-3
Local Area Network (LAN)



Network Interface Card (NIC)

- Each device on a LAN has a hardware component called ***network interface card***
- ***NIC*** connects the device's circuitry to network cable
- MAC address - Unique identifier
- Media connections
 - Unshielded twisted pair (UTP) cable
 - RJ-45 connector
 - Optical fibre cables
 - light rays reflected inside glass core surrounded by cladding
 - uses ST and SC connectors

Network Interface Card, continued



Figure 6-4

Network Interface Card (NIC)

Source: Courtesy of Linksys.

IEEE 802.3 (Ethernet) Protocol

- Ethernet protocol standard
 - Specifies hardware characteristics
 - Describes how messages are packaged
 - Determines how messages are processed
 - Operates at Layers 1 and 2 of TCP/IP-OSI architecture
- Personal computers usually support **10/100/1000 Ethernet**
 - transmission rate of 10, 100, or 1000 Mbps (megabits per second)

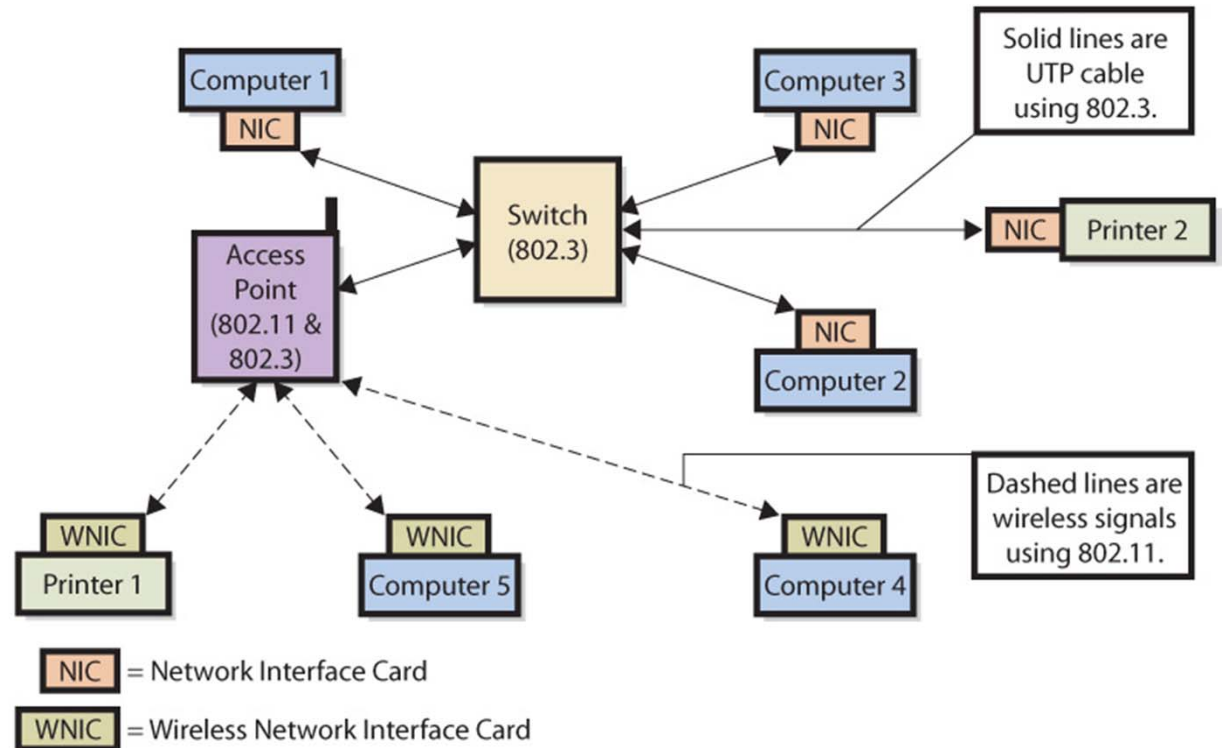
Wireless LANs

- A computer network that allows users to connect without using a network cable
- Wireless NIC (WNIC)
- LAN operation
 - NICs operate on 802.3 protocol
 - WNICs operate on 802.11 protocol (Wi-Fi)
 - WNICS connect to Access Point (AP)
 - AP processes both standards

Local Area Network with Wireless

Figure 6-7

Wireless Local Area Network



Why is Mobile Computing Important?

- Two trends for accessing the Internet:
 - Your computer is likely to be a portable laptop than desktop
 - Your new smartphone or other highly portable device such as a tablet
- Cellular phones are no longer just phones
- Mobile devices provide a wide variety of services
- Mobile devices are built for communication and collaboration

Examples of Mobile Devices

- Apple's iPhone or latest Samsung Galaxy series
- Combines a powerful processor with sophisticated operating systems and cellular network technology
- Provide a host of applications such as voice, text, email, web browsing, etc
- User of mobile devices can access email, instant message, respond via voice or text messaging, browse the Internet anywhere
- These devices change the way that people work, and more changes are still being expected

Smartphones

- Smartphones are also enabling new applications - **m-commerce**, mobile commerce
- M-commerce allows users to conduct new kinds of transactions
- Examples: Mobile banking, mobile ticket purchases
- Mobile coupons are replacing paper coupons with electronic versions
- Students interact among themselves and professors to vote on choices and ask questions

Smart Phone Basics

- Design to be easy to use and most smart phones operate on a 3G (3rd Generation) network
- 3G is a group of standards for wireless communications
- The difference between 2G and 3G is that 3G provides higher data transfer rates and allows for simultaneous use of voice and data transfer
- Before buying a cell phone you need to understand the operating system at the foundation of each phone

Smartphone Basics

- Users do not need to know intricacies of mobile device networks
- Before purchasing a smartphone, you need to think about how and where you will use it
- Telecommunication companies may not have the same types of technology outside Canada
- Systems compatibility is a factor that must be considered
- Understanding operation system (OS) is a factor that a user must also consider
- Examples of OS: Blackberry OS, iPhone OS, Windows Mobile, Android and Linux

Tablets and eReaders

- Thought as hybrid-type devices that fill a gap between small handheld smartphones and notebook computers
- eReaders, such as the Amazon Kindle or Barnes and Noble Nook, were originally designed mainly for reading books and magazines
- Tablets, such as the Apple iPad, were designed for more general use, for example, email and Internet browsing
- Issues in these devices include support, security, synchronization complexity and ownership

What do I need to know about connecting to the Internet?

- The Internet is a Wide Area Network (WAN)
- WANs connect computers at separate sites
 - No cabling between sites
 - Cable connections made through licensed communications companies
 - Routers implement the protocol for WANs
- Internet Service Provider (ISP)
 - Provides legitimate Internet address
 - Serves as gateway to the Internet
 - Pay for the Internet

Names and Addresses

- Rules for naming sites on the Internet
- Top-Level Domain (TLD)
 - .ca, .com, .org, .biz
- Uniform Resource Locator (URL)
 - easy to remember address on the Internet
- IP address is a numbered address for each machine connected to the network
 - Public IP addresses are used on the Internet
 - Private IP addresses are used within private networks and internets

Obtaining an IP Address

■ Two kinds of IP addresses

- Public IP addresses are used on the Internet
- Private IP addresses are used within private networks and internet – they are controlled only by the private company that operates them

■ DHCP Server

- Dynamic Host Configuration Protocol server is a computer or router that host a program called DHCP
- DHCP assigns a temporary IP address to your computer
- Whey you disconnect, the IP address is available again
- The DHCP server re-assigns it when it is needed

Domain Names

- **Domain Name System (DNS)** converts human-friendly URLs into computer-friendly IP addresses
- Domain name resolution
 - Conversion of domain name into a public IP address
 - Done by domain name resolvers
- Three ways of connecting Home and small-business computers to an ISP:
 - through a regular telephone line
 - through a special telephone line called a *DSL line*
 - through a cable TV line

Analog versus Digital Signals

- Those three connections require that the digital data in the computer be converted to an **analog**, or wavy, signal before being sent
- When receiving data, the analog signal must be converted to a digital signal before the computer can read it
- A device called a modulator/demodulator, or **modem**, performs these conversions
- Different modems use different protocols and speeds

Analog versus Digital Signals, continued



Figure 6-9

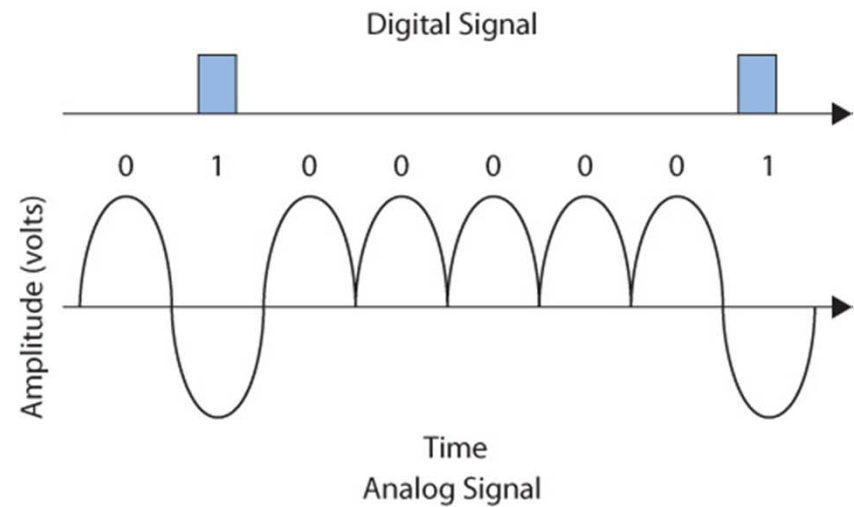
Touch Screen Smartphone

Source: istock.

Internet Access

Figure 6-10

Analog versus Digital Signals



Types of Modems

- Dial-up modems
- Digital Subscriber lines (DSLs)
- Cable modems
- All require digital data in the computer to be converted to analog
 - Modem (modulator/demodulator) device performs conversion

Dial-Up Modems

- Operate over regular telephone lines
- Interfere with voice telephone service
- Perform conversion between analog and digital
- Connection made by dialing ISP's phone number
- Maximum transmission speed of 56 kbps

DSL Modems

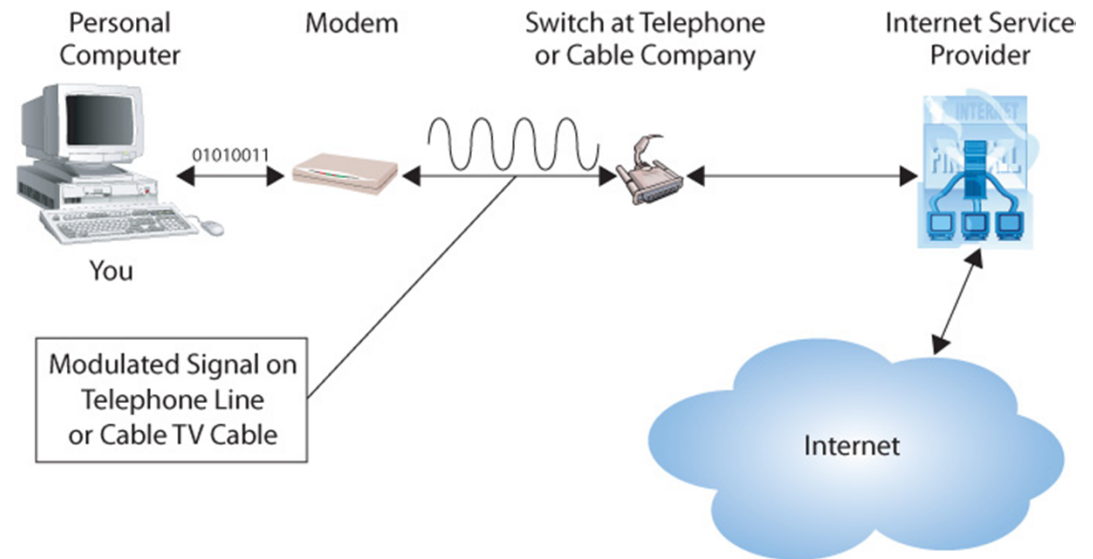
- DSL (Digital Subscriber Line) modems operate on the same lines as voice telephones and dial-up modems
- Do not interfere with voice telephone service
- Faster data transmission than dial-up
- Connection always maintained
- Download and upload speeds vary
 - Asymmetric Digital Subscriber Lines (ADSL)
 - Symmetrical Digital Subscriber Lines (SDSL)

Cable Modems

- Provide high-speed data transmission
- Connection always maintained
- Use cable television lines
 - High-capacity optical fibre cable run to neighborhood distribution centre
 - Television cables connect at distribution centre and run to subscribers (up to 500 per one centre)
 - Do not interfere with television transmission
- Transmission speeds
 - Narrowband – less than 56 kbps
 - Broadband – in excess of 256 kbps

Transmission Line Types, Uses, and Speeds

Figure 6-11
Personal Computer (PC)
Internet Access



Wireless WAN

- **Wireless WAN (WWAN)** differs from a wireless LAN
 - Covers a larger area
 - Use cellular networks to transfer data
- Portable computer with a wireless WAN modem connects to a base station on the wireless networks via radio waves
- Radio tower carries the signal to a mobile switching centre, where the data are passed on to the appropriate network
- Wireless service provider then provides the connection to the Internet

How Does Email Actually Work?

■ Network Layers

- Transmission Control Program/Internet Protocol (TCP/IP) four-layer scheme
 - Layer 1 is used to transmit data within a single network
 - Layers 2 & 3 are used for data transmission across an internet
 - Layer 4 provides protocols that help different applications interact with each other and the person using the computer

IETF Network Levels

Line Type	Use	Maximum Speed
Telephone line (twisted pair copper lines)	Dial-up modem	56 kbps
	DSL modem	3 Mbps
	WAN—T1—using a pair of telephone lines	1.544 Mbps
Coaxial cable	Cable modem	Upstream to 768 kbps Downstream 1–6 Mbps (usually much less, however)
Unshielded twisted pair (UTP)	LAN	10 Gbps
Optical fibre cable	LAN and WAN—T3, OC-768, etc.	40 Gbps or more
Satellite	WAN—OC-768, etc.	40 Gbps or more

Figure 6-12

Transmission Line Types, Uses, and Speeds

Emailing Steps

1. Getting Internet Access and Pressing “Send/Receive”
 - Layer 4, Simple Mail Transfer Protocol (SMTP)
2. Break Apart Message and Get Ready for Transport
 - Layer 3, Transmission Control Program (TCP)
3. Send and Receive Packets
 - Layer 2, Internet Protocol (IP)
4. Reassemble Packets and Display Message

A LAN operated in a Niagara fall hotel

Layer	Name	Specific Function	Broad Function
4	Application Layer	Data are passed between programs (such as email application, web browser, and file transfer programs) and the transport layer.	Programs for mail, web browsing, file transfer
3	Transport Layer	This layer deals with opening connections and maintaining them. It uses the Transmission Control Program (TCP). TCP works to ensure packets are received with correct content.	Transmission across an internet (TCP/IP)
2	Internet Layer	This layer works with IP addresses. There are many ways to navigate packets from one IP address to another. The Internet layer standards also control packet organization and timing constraints.	
1	Network Access Layer	This layer describes the equipment that is used for communications (UTP, fibre-optic) the signalling used (analog, digital), and the protocols that will be used to communicate between machines.	Transmission within a single network (local area network)

Figure 6-13

IETF Network Levels

What are Firewalls, Encryption and VPNs?

- **Firewall:** Computing device that prevents unauthorized network access
- May be special-purpose computer or program
- Access Control List (ACL) encodes rules stating what packets are allowed or prohibited
- Organizations may have multiple firewalls
 - Perimeter firewalls sit outside organizational network
 - Internal firewalls are inside network
 - Packet-filtering firewalls examine source address, destination address, and other data before allowing message to pass
 - May filter both incoming and outgoing messages

Encryption

- Process of transforming clear text into coded, unintelligible text for secure storage or communication
- A key is a number used to encrypt data
- Coding and decoding messages are done using encryption algorithm
- Types of Encryption
 - Symmetric: the same key is used to encode and to decode
 - Asymmetric: different keys are used; one encodes the message, and the other decodes the message
- Symmetric encryption is simpler and much faster than asymmetric encryption

Flow of Symmetric Encryption

1. Your computer obtains the public key of the website to which it will connect
2. Your computer generates a key for symmetric encryption
3. Your computer encodes that key using the website's public key. It sends the encrypted symmetric key to the website
4. The website then decodes the symmetric key using its private key
5. From that point forward, your computer and the website communicate using symmetric encryption

The Virtual Private Network (VPN)

- Virtual Private Network (VPN)
 - Uses the Internet or private internet to create appearance of private point-to-point connections
 - Uses public Internet to create appearance of private connection
 - Client and server have point-to-point connection called a **tunnel**
 - private pathway over shared network
 - Secure, encrypted communications

WAN Using VPN

Figure 6-18

Types of Access to a WiMax Network

Source: Table 1, "Types of Access to a WiMax Network," from Fixed, Nomadic, Portable, and Mobile Applications for 802.16–2004 and 802.16e WiMax Networks, prepared by Senza Fili Consulting on behalf of the WiMax Forum. © 2005 WiMax Forum, www.wimaxforum.org/technology/downloads (accessed June 2008).

Definition	Devices	Locations/ Speed	Handoffs	802.16–2004	802.16e
Fixed access	Outdoor and indoor CPEs	Single/stationary	No	Yes	Yes
Nomadic access	Indoor CPEs, PCMCIA cards	Multiple/ stationary	No	Yes	Yes
Portability	Laptop PCMCIA or mini cards	Multiple/ walking speed	Hard handoffs	No	Yes
Simple mobility	Laptop PCMCIA or mini cards, PDAs or smartphones	Multiple/low vehicular speed	Hard handoffs	No	Yes
Full mobility	Laptop PCMCIA or mini cards, PDAs or smartphones	Multiple/high vehicular speed	Soft handoffs	No	Yes

How Does A Search Engine Work?

- Search engines are a tool used to search for information on the Internet
- Web search engines require two things:
 - a way to collect URLs
 - a method for storing/accessing the URLs so that they can be searched
- Web crawlers browse the web to find URLs
- Search engine indexing
 - creates indexes for the results from the web crawling
- Search engine needs understanding of breadth of coverage and the ordering of the results from a search

MIS in Use

■ Never Miss Your Bus

- MyBus is a text messaging application
- Sends a text message to a student's cell phone with information about when the bus was next scheduled to arrive at a stop near them
- Connecting with Translink and using the university's existing access to a text messaging application programming interface (API), MyBus parses text messages, retrieves bus information, and sends the results back in a text message
- Facebook version of the application

MIS in Use Questions

1. What problem does MyBus solve?
2. How important was access to the Translink website and the text messaging API?
3. Does this system cooperate or compete with Translink?
4. What technological changes could affect John and Igor's efforts to commercialize MyBus?
5. What advice would you give John and Igor?

What do YOU think?

Human Networks Matter More

- Six Degrees of Separation theory points out the importance of human networks
- Most successful professionals consistently build personal human networks
- *Weak tie* links are crucial in connecting you to everyone in six degrees
- In general, the people you know the least contribute the most to your network

What do YOU think?

1. Determine the shortest path from you to your university's president. How many links does it have?
2. Give an example of a network to which you belong and sketch a diagram of who knows whom for six or so members of that group.
3. Recall a recent social situation and identify two people, one of whom could have played the role of Linda (someone in your group whom you do not know) and one of whom could have played the role of Eileen (someone in a different group whom you do not know). How could you have introduced yourself to either person?

What do YOU think?, continued

4. Does it seem too contrived and calculating to think about your social relationships in this way? Even if you don't approach relationships like this, are you surprised to think that others do? Under what circumstances does this kind of analysis seem appropriate, and when does it seem inappropriate? Are you using people?
5. Consider the phrase "It's not what you know, it's whom you know that matters." Relate this phrase to a network diagram. Under what circumstances is this likely to be true? When is it false? When is it ethical?
6. Describe how you can apply the principle "The people you know the least contribute the most to your network" to the process of a job search. Are you abusing your relationships for personal advancement?