Telecommunications and Networks

ICT II

2022

Makerere University Business School

Telecommunication

Telecommunication is the transmission of data (voice, audio, facsimile, image, video etc.) over signif cant distances by use of electronic technologies like telephones (wired and wireless), microwave communications, f ber optics, satellites, radio and television broadcasting, and the internet. Electronic communications including but not limited to emails, instant messages and phone calls are examples of data communications.

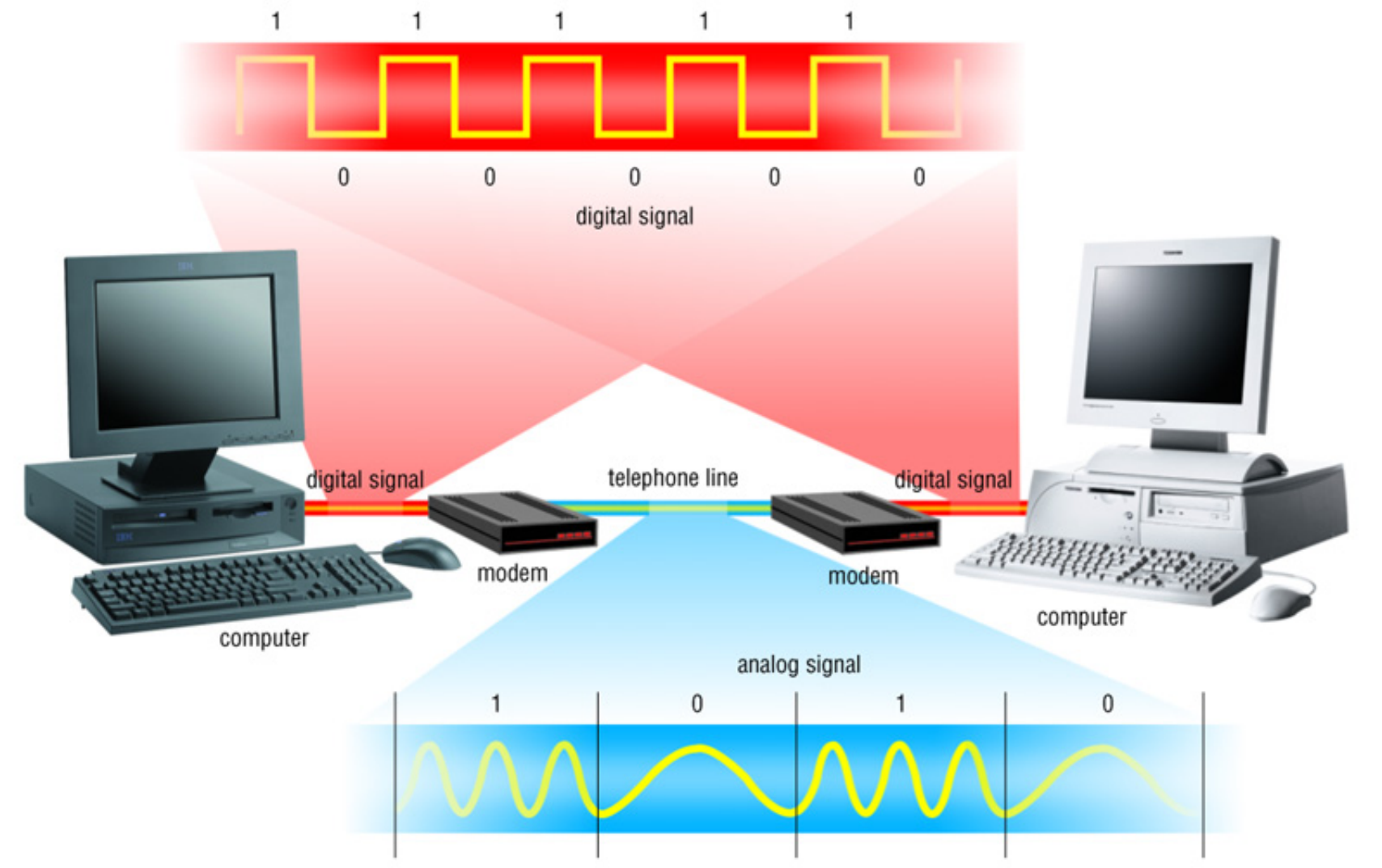
TELECOMMUNICATION

- Is defined as long distance communication using electromagnetic methods. It encompasses other words that use the “tele” prefix such as
  - telephone (speaking at a distance)
  - television (seeing at a distance)
  - telegraph (writing at a distance) and teleconference (conferencing at a distance)..
- Telecommunications can also be defined as the transfer of information by electronic means usually over long distances

Data Communications

- The term telecommunication means communication at a distance. The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.
- **Data communications** are the exchange of data between two devices via some form of transmission medium such as a wire cable.

Communication Systems



Computer Communication

- Two computers can communicate in two ways

1. Through telecommunications - two computers establish a link through the telephone system
2. Networks - computers are linked directly by high speed cables or wireless connections

The information superhighway

The fusion of computer and communication has made it possible for the telephone companies to expand from traditional voice communication into new information services such as providing transmission of news reports, TV programs, software programs and movies.(Voice, data and video)

- *Example of known information superhighway is **Internet.***

Telecommunication systems

- The telecommunication system is a collection of compatible hardware and software arranged to communicate information from one location to another. Telecommunication systems can transmit text, graphic images, voice or video information

Telecommunication system components

- **Computers**: which process data into information
- **Terminals:** these support input and output, are devices that send and receive data.
- **Communication channels:** these are the links by which data or voice is transmitted between sending and receiving devices in a network. Communication channels use various communication media such as telephone lines, f bre optic cables as well as wireless transmissions
- **Processors:** these are devices which support functions for data transmission and reception. These may include Multiplexers, controllers, front end processors, modems etc.
- **Communication software:** this manages the various activities of a communication network providing the intelligence that controls input and output

Functions of a telecommunication system

- Transmission: Medium used to transmit data and voice signals.
- Interface: Acts as a link between the sender and the receiver
- Routing: Chooses the most efficient path to deliver your message.
- Processing: Processes messages so that it can get to the right target! direction
- Editorial: Checks for transmission errors and puts the message right (edits it)
- Conversion: Used to Change the transmission speed or codes from one device to another.
- Control: Controls how messages are transported i.e. by routing which receiver to receive the message and also network maintenance.

Properties of Transmission

Five basic properties of both the physical and wireless links:

1. Type of signal communicated (analog or digital).
2. The speed at which the signal is transmitted (how fast the data travels).
3. The type of data movement allowed on the channel (one-way, two-way taking turns, two-way simultaneously).
4. The method used to transport the data (asynchronous or synchronous transmission).
5. Single channel (baseband) and multichannel (broadband) transmission.

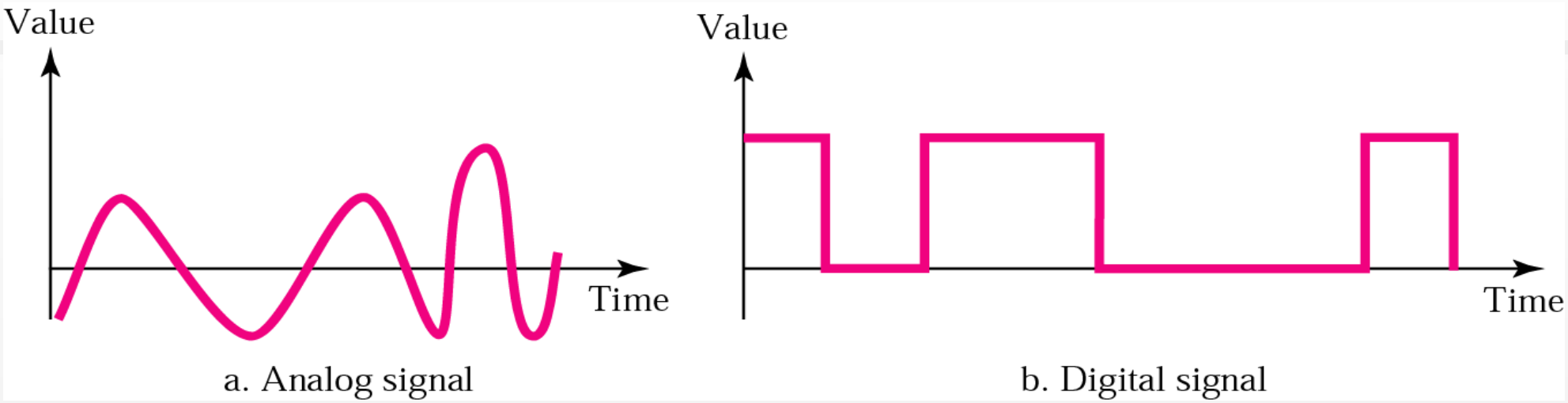
Types of Signals

- **Analog signals**: These are continuous time-varying signals in form of waves. Temperature sensors, FM radio signals, photocells, light sensor, resistive touch screen are examples of analog signals.
- **A digital signal:** is a signal that is used to represent data as a sequence of separate values at any point in time. It can only take on one of a fixed number of values. For example, HDTV uses digital signals to broadcast high quality video signals.

Digital and analog

Analog and **digital** signals are used to transmit information, usually through electric signals. In both these technologies, the information, such as any audio or video, is transformed into electric signals. The **difference between analog and digital** technologies is that in analog technology, information is translated into electric pulses of varying amplitude. In digital technology, translation of information is into binary format (zero or one) where each bit is representative of two distinct amplitudes.

Comparison of analog and digital signals



Signals can be analog or digital. Analog signals can have an infinite number of values in a range; digital signals can have only a limited number of values.

DATA TRANSMISSION

- Serial and parallel transmission. The most effective type of transmission used in general for computer communications is the serial transmission.

- Parallel transmission: This is where data is transferred using several transmission paths.

- It can be used when a large amount of data is being sent, data being sent is time sensitive or when the data needs to be sent quickly. An example of parallel mode transmission is a connection established between a computer and a printer.

- Serial transmission is where data is transmitted over a single communication path. data is sent down the line one at a time.

Asynchronous and Synchronous transmission

- Asynchronous transmission is where data is transmitted one character at a time, where each character is five to eight bits in length. The most common transfer rates in these are btn 1200 & 19200 bits per second.
  - This is used mainly to transfer medium quantities of data over long distances.
- Synchronous transmission is a mode of transmission where data is transferred in a block of bits at ago without a start and stop.
  - It is amore efficient mode of transfer used mainly to transfer large quantities of data e.g. contents in disk already assembled

Transmission direction

- *Simplex transmission*: Where by data can travel in only one direction at all times. These systems are often employed in broadcast networks, where the receivers do not need to send any data back to the transmitter/broadcaster. eg radio stations and TV
- *A half-duplex system* allows communication in both directions, but only one direction at a time (not simultaneously). E.g Any radio system where you must use "Over" to indicate the end of transmission.

Transmission direction cont;

- A *full-duplex system* allows communication in both directions, and unlike half-duplex allows this to happen simultaneously.
- Most telephone networks are full duplex as they allow both callers to speak at the same time.
- A good analogy for a full-duplex system would be a two lane road with one lane for each direction.
  Example: Telephone, Mobile Phone, etc.

Communication channel,

- Refers to the medium used to convey information from a sender (or transmitter) to a receiver (sink).
- A communication channel is the communication link between two or more nodes, it is an interface by which data or voice is transmitted between sending and receiving devices in a network.
- There are two types of communication Channels that is guided (wire) and unguided (wireless)

Characteristics of communication channels

- *Transmission speed*: Measured in bits per second also called baud rate
- *Bandwidth*: This refers to the capacity of a communication channel, measured by the difference between the highest and lowest frequencies that can be transmitted by the channel. The bigger the bandwidth the better the transmission, measure for band-width is called Hertz.

Types of Guided (wire)

- **Twisted pair of copper wires:** Mainly used for simple communication that does not require a lot of transmission speed.
- The types of Twisted Pairs are Shielded Twisted Pair (STP); the two conductors are coated with a plastic sheath and Unshielded Twisted Pair (UTP); has no ground shield or sheath

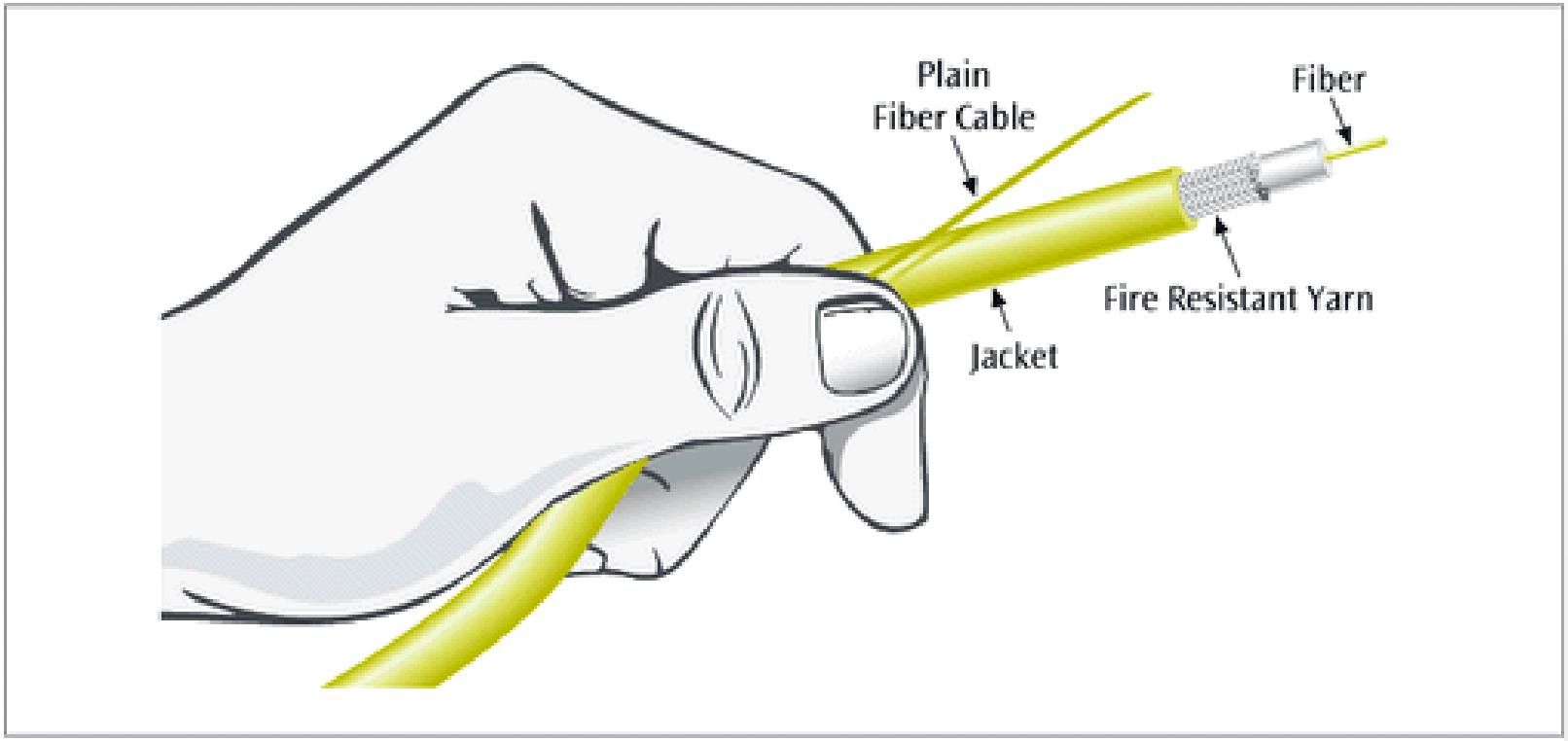
Types of Guided (wire)

- **Coaxial cables:**
  Consists of thick insulated copper wire and can transmit data faster than a twisted pair of copper wire, that is to say between 56kps-200mbps also used in

Types of Guided (wire)

- **Fibre optic cables:**
  They are fast, light and durable transmission mediums consisting of thin strands or pieces of clear glass fibre bound into cables. They transmit at a speed of 500kbps to 10 gbs, they have the highest transmission speed in all communication channels

Figure 3-6
A person holding plain fiber optic cable and fiber optic cable in an insulated jacket



Wireless Connections

- The link is made using electromagnetic energy that goes through space instead of along wires or cables.
- Three types of wireless communications commonly used in networking:
  - Infrared
  - Radio frequency
  - Microwave

Wireless Connections- **Infrared**

- Commonly used in TV and VCR remote controls.
- Use infrared frequencies of electromagnetic radiation that behave much like visible light.
- Must be in the line of sight.
- Often used to connect keyboards, mice, and printers.

Wireless Connections- Bluetooth

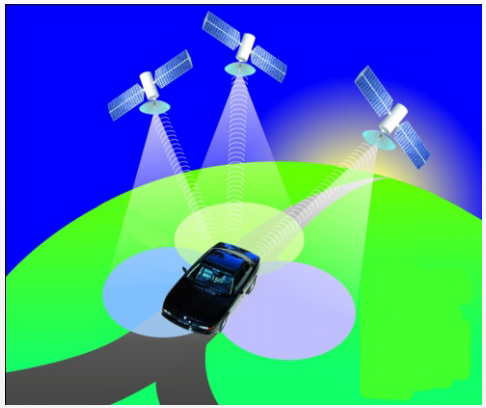
- Bluetooth is a Radio Frequency specification for short-range, point-to-multipoint voice and data transfer.
  - Bluetooth can transmit through solid, non-metal objects.
  - Bluetooth will enable users to connect to a wide range of computing and telecommunication devices without the need of connecting cables.
  - Typical uses include phones and pagers, modems, LAN access devices, headsets, notebooks, desktop computers, and PDAs.

Wireless Connections- **Radio frequency**

- Uses radio frequencies.
  - Function even though line of sight is interrupted.
- Not commonly used because of the possible interference from other sources of electromagnetic radiation such as old electric drills and furnace motors.

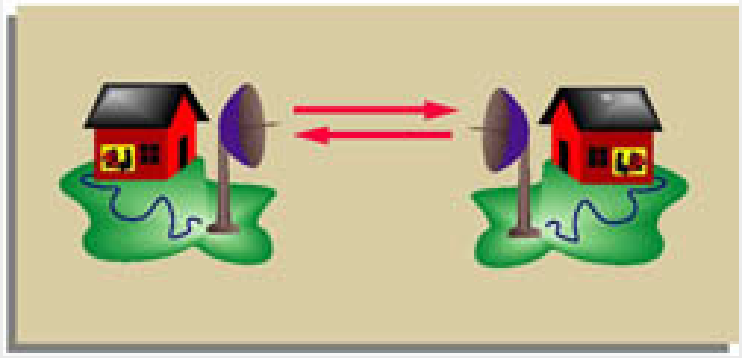
Wireless Transmission Media

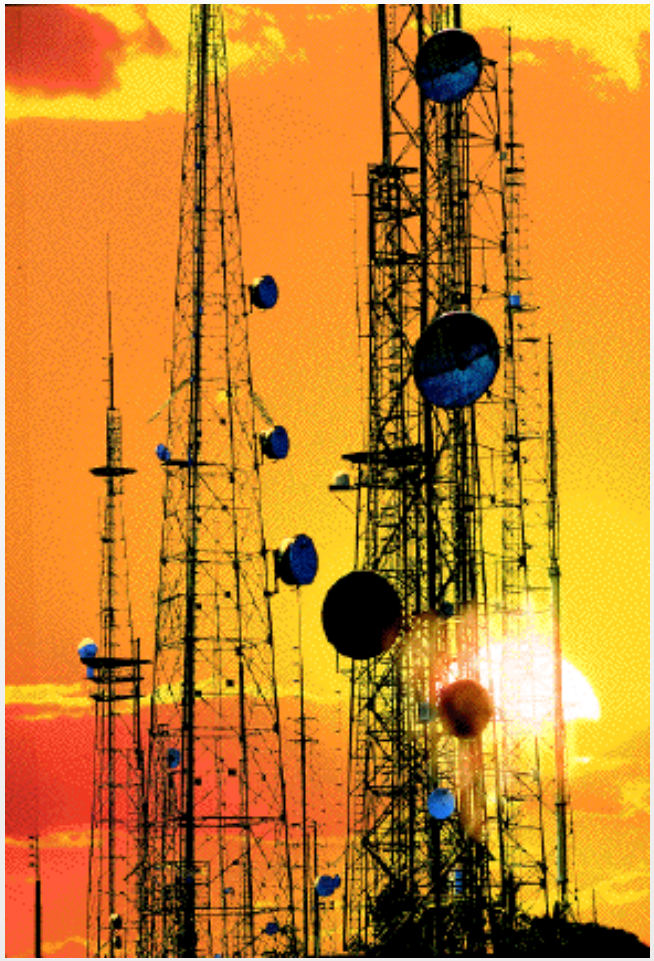
- Broadcast Radio
  - Distribute signals through the air over long distance
  - Uses an antenna
  - Typically for stationary locations
  - Can be short range
- Cellular Radio
  - A form of broadcast radio used for mobile communication
  - High frequency radio waves to transmit voice or data
  - Utilizes frequency-reuse



Wireless Connections- Microwave

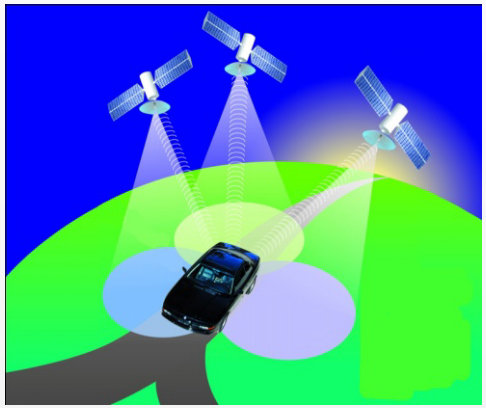
- **Microwave**
  - Often used to communicate with distant locations.
  - Must be line of sight.
  - Satellite





Wireless Connections- **Microwave cont;**

- Microwaves
  - Radio waves providing high speed transmission
  - They are point-to-point (can't be obstructed)
  - Used for satellite communication
  - These are high volume long distance point to point transmission where high frequency radio signals are transmitted through the atmosphere from one transmission station to another, their speed is 256kbps- 100mbps. See illustration diagram



Wireless Technologies -Wimax

- Is a wireless metropolitan area network (MAN) technology that provides broadband wireless connectivity to Fixed, Portable and Nomadic users. This powerful technology can be used to backhaul LANs to the Internet, provide inter-campus connectivity, and enable a wireless alternative to cables.

- It provides up to 50-kilometers of service area range, allows users to get broadband connectivity without needing direct line of sight with the base station, and provides total data rates of hundreds of Mbps per base station.

Wireless Technologies- Wifi

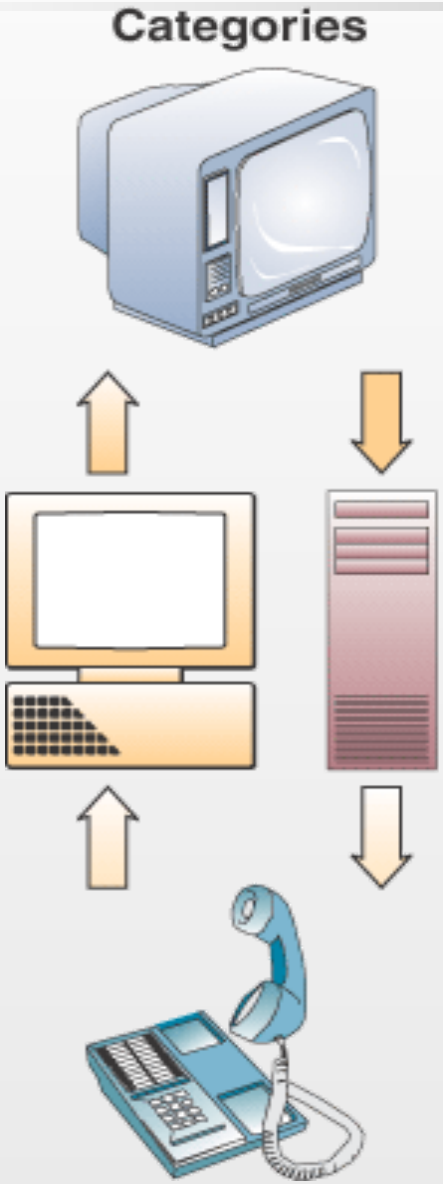
- Short for **wi**reless **fi**delity. Wi-Fi is a wireless technology that uses radio frequency to transmit data through the air. Wi-Fi can be used for
  - Quick/easy network access
  - Staff access to Corporate networks
  - Patron internet access (hotspot)
  - Interconnecting two networks

Wireless Technologies -Broadband

- Broadband Transmits voice, data and video over high frequency radio signals.
- Public institutions and private users regard it as an enabling technology and it has become a given requirement for delivering communications services in the Information Age.
- In today's markets where traditional cable or copper infrastructures are either outdated or simply out of reach, Broadband Wireless Access (BWA) technology fills the void admirably, providing highly efficient and cost effective access services.

Telecommunication Trends

Telecommunications-Based Services



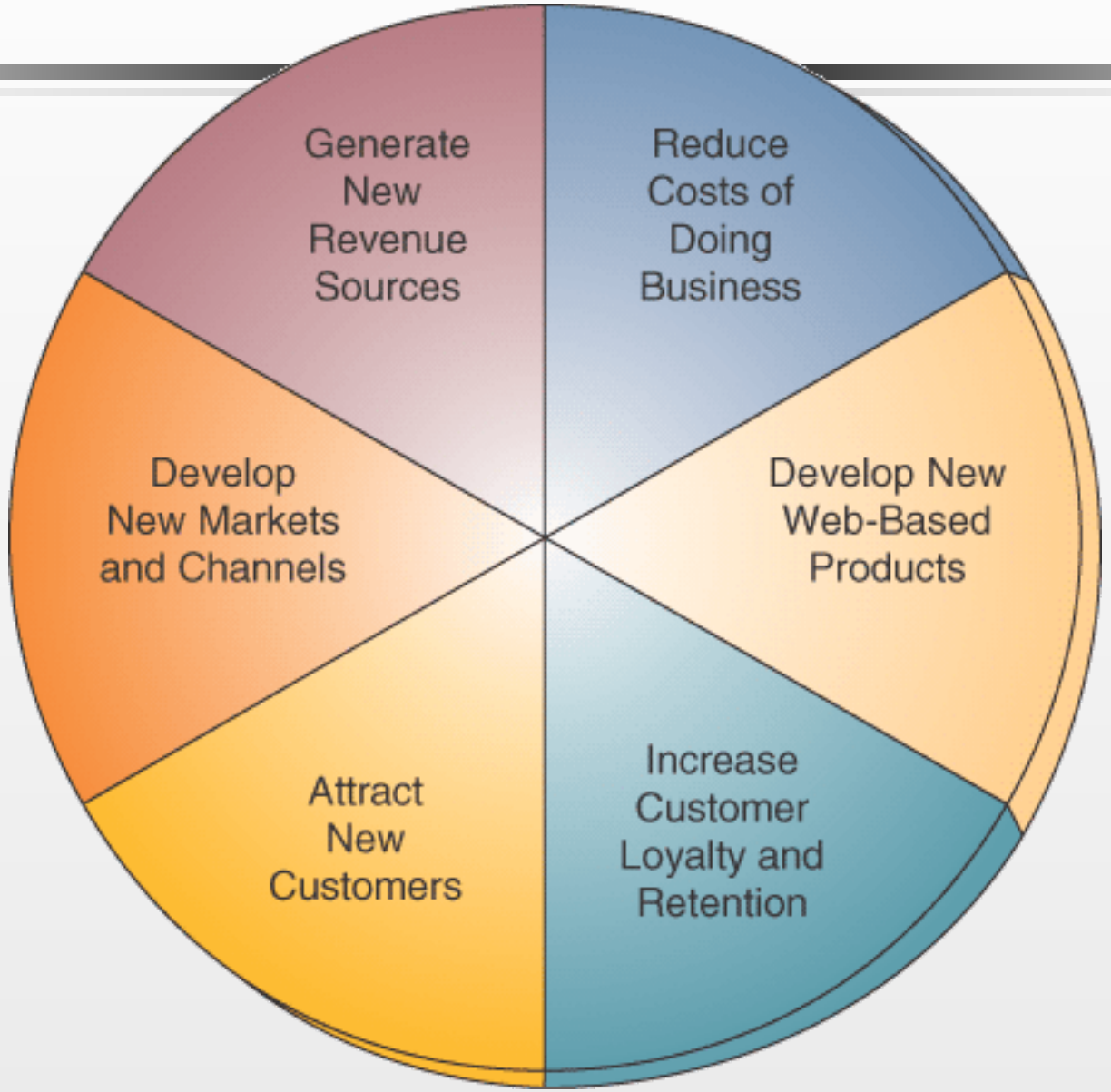
Full Service Spectrum

Categories	
Entertainment	■ Broadcast TV ■ High-definition TV ■ Enhanced pay-per-view ■ Video-on-demand ■ Interactive TV ■ Interactive video games ■ Video catalog shopping
Information Transactions	■ Distance learning ■ Multimedia services ■ Image networking ■ Transaction services ■ Internet access ■ Telecommuting ■ Videoconferencing
Communications	■ Video telephony ■ Wireless access ■ Cellular/PCS systems ■ POTS—Plain old telephone service

Value of Telecommunications Networks

Strategic Capabilities	e-Business Examples	Business Value
Overcome geographic barriers: Capture information about business transactions from remote locations.	Use the Internet and extranets to transmit customer orders from traveling salespeople to a corporate data center for order processing and inventory control.	Provides better customer service by reducing delay in filling orders and improves cash flow by speeding up the billing of customers.
Overcome time barriers: Provide information to remote locations immediately after it is requested.	Credit authorization at the point of sale using online POS networks.	Credit inquiries can be made and answered in seconds.
Overcome cost barriers: Reduce the cost of more traditional means of communication.	Desktop videoconferencing between a company and its business partners using the Internet, intranets, and extranets.	Reduces expensive business trips; allows customers, suppliers, and employees to collaborate, thus improving the quality of decisions reached.
Overcome structural barriers: Support linkages for competitive advantage.	Business-to-business electronic commerce Web sites for transactions with suppliers and customers using the Internet and extranets.	Fast, convenient services lock in customers and suppliers.

Business Value of the Internet



Summary of bulleted list

Internet Applications

- E-mail- this is the sending & receiving of electronic messages over the internet
- E-commerce – this is the buying & selling of goods and services electronically
- E-conferencing & video conferencing. Holding long distance conferences electronically
- E- entertainment eg video games
- E- education
- E- marketing
- Online social networks
- Students contribute more……

Internet Applications-online social networks

- Soon coming……
- Examples of online social networks
- Business value of online social networks
- Shortcomings of online social networks