

UNIT 4: Data communication

(10 Lectures)

Transmission Media- Coaxial, UTP, Optical-Fiber, Wireless, Components of Computer Networks, Types of wireless communication (mobile, WiFi, WiMAX, Bluetooth, Infrared – concept and definition only)

Computer Networks:

Data communication:

It is the exchange of data between two devices using some form of wired or wireless transmission medium. It includes transfer of data, the method of transfer and preservation of data during transfer process. For any data communication process there must have three fundamental characteristics-

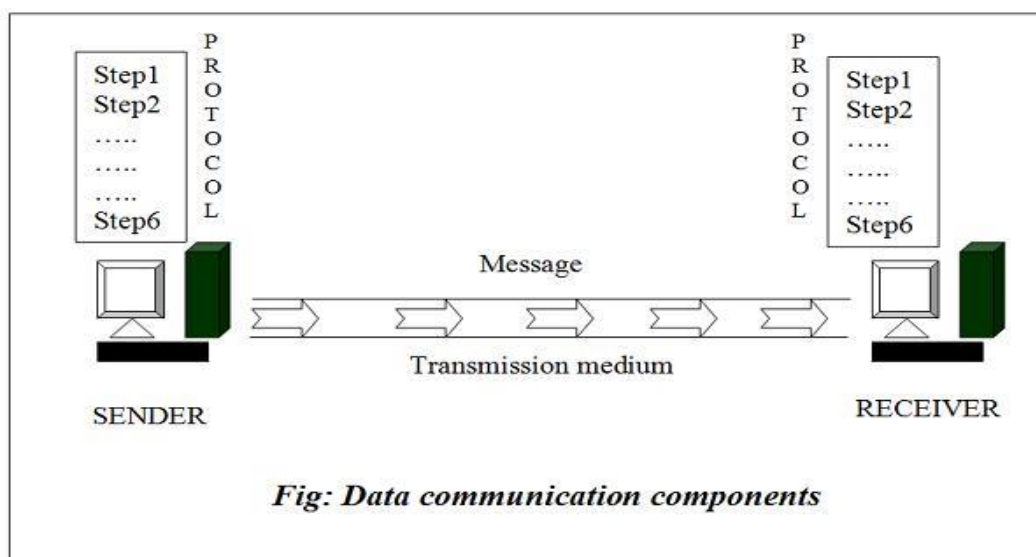
- ✓ Delivery: The system must deliver data to the correct destination
- ✓ Accuracy: The system must deliver data accurately (error free)
- ✓ Time line: The system must deliver data in a timely manner without enough time lags.

A communication system can be defined as the collection of hardware and software that provides intersystem exchange of information between different devices.

Components of data communication:

In general there are five basic components in data communication system-

- ✓ Message: It is the information that is to be communicated.
- ✓ Sender: Sender is the device that sends the message.
- ✓ Receiver: Receiver is the device that receives the message.
- ✓ Medium: The transmission medium is the physical path that communicates the message from the sender to receiver.
- ✓ Protocol: It is the set of rules that coordinate the exchange of information. Both sender and receiver should follow the same protocol to communicate data.



Data Transmission Mode:

Data transmission mode refers to the direction of signal flow between two linked devices. There are three types of transmission modes: Simplex, Half Duplex, Full Duplex.

Simplex: Simplex transmission is the unidirectional. Here the information flow only one direction across the circuit and no capacity to support response in the other direction. Only one communicating devices transmits information and the other can only receive it. For example: Television transmission.

Half Duplex: In this mode, each communicating device can receive and transmit information, but not at the same time. When one device is sending the other can only receive at that point of time. Here the entire capacity of transmission medium is taken over by the device which is transmitting at that moment.

For example: Radio wireless set, where one party speaks and the other party listens.

Full Duplex: This mode is also known as *Duplex mode*. Here both communicating devices are allowed to transmit and receive data simultaneously. It can be considered as a two way road.

For example: Standard telephone call or mobile telephone communication is of *full duplex* type because both parties can talk and hear at the same time.

Transmission Media:

Transmission medium is the physical media through which data can be transmitted from one point to another. This transmission is done with the help of electromagnetic signals. An Electromagnetic signal is the combination of electric and magnetic fields. It includes radio waves, infrared light, ultraviolet rays, X-rays etc. these signals can travel through vacuum, air or any other transmission medium.

Transmission media can be divided into two categories: Guided/wired and Unguided/wireless.

Guided/wired media: This media use cabling system that guide the data signals along a specific path. It consists of cable composed of metals like copper, tin or silver. There are 3 basic guided media- *Twisted pair*, *Coaxial cable* and *Optical fibre*.

Twisted pair:

It is the one of the most commonly used cabling system in networking in this world. Each twisted pair consists of a wire used for receiving data signals and another wire used to transmitting data signals. Twisted pairs are used for short distance communication (less than 100 meters).

Twisted pair comes with 2 forms, commonly known as *Unshielded Twisted Pair (UTP)* and *Shielded Twisted Pair (STP)*.

UTP cable: It mainly used as telecommunication media suited for both data and voice transmission, hence most commonly used in telephone system. The cable has four pairs of twisted wires. Here each pair consists of two metal conductors (usually copper) that are insulated separately with their own coloured plastic insulations. Also each pair is twisted with different number of twist per inch.

STP cable: This cable has a metal foil covering each pair of insulated twisted pairs. This metal foil is used to prevent infiltration of electromagnetic noise. It also helps to eliminate crosstalk. Shielded twisted pair is suitable for environments with electrical interference.

Coaxial cable:

It is another common type of cable used as transmission media. It has better shielding than twisted pairs, so it can span longer distances at higher speed. Coaxial cable has two varieties. One kind is of 50 ohm cable, used for digital transmission from the start, another kind is of 75 ohm cable, commonly used for analog transmission and cable TV transmission.

Coaxial cable has a central conductor which is made up of solid wire (copper). This conductor surrounded by an insulator over which a sleeve of metal mesh is covered to block any outside interference. This metal mesh is again shielded by an outer covering of a thick PVC material, known as jacket. The following figure shows the inner and outer layers of a coaxial cable.

Advantages of coaxial cables:

- It has high resistant to signal interference.
- It can support greater cable lengths between network devices.
- It has higher bandwidth than twisted pair cable.
- It can transmit data at rate of 10 Mbps.
- Coaxial cable is more robust and is most commonly used in cable TV network

Optical Fibre:

Twisted pair and Coaxial cable transmit data in the form of current, however optical fibre consists of thin glass which carries information in the form of visible light. A typical optical fibre consists of a very thin fibre of glass as core. Optical transmission system has three key components: light source, transmitting media and the detector. Here a pulse of light indicates 1 bit and absence of light indicates 0 bit. **The detector generates an electrical pulse when light falls on it. By attaching a light source to one end of an optical fibre and a detector at the other end we can have a unidirectional data transmission system.**

The core of an optical fibre is of different sizes. For a multimode fibre the core is about 50 microns in diameter which is about thickness of a human hair. Again in single mode fibres the core is about 8 to 10 microns. The core is surrounded by a glass *cladding* with a lower index of refraction, to keep all the light in the core. Again the *cladding* is covered by a protective layer of plastic, known as *jacket*. Generally fibres are grouped in bundles and are protected by an outer sheath.

Advantages of optical fibres:

- It has the ability to transmit signals over much longer distances than coaxial and twisted pair.
- Light signals do not heat up the wire so efficiency of optical fibre is more.
- It does not leak light and is extremely hard to tap.
- Fibres are much lighter than other cables (100 kg vs. 8000 kg in 1km long)
- It has higher bandwidth than copper wires.

Disadvantages of optical fibres:

- Fibre is less familiar technology which requires good skills by the engineers that very less people have.
- Fibres can be damaged easily by being bent too much.
- Optical fibres are very costly than coaxial and twisted pairs.

WIRELESS COMMUNICATION:

Wireless communication is among technology's biggest contributions to mankind. Wireless communication involves the transmission of information over a distance without help of wires, cables or any other forms of electrical conductors. The transmitted distance can be anywhere between a few meters (for example, a television's remote control) and thousands of kilometres (for example, radio communication).

ADVANTAGES:

Wireless communication has the following advantages:

- i. Communication has enhanced to convey the information quickly to the consumers.
- ii. Working professionals can work and access Internet anywhere and anytime without carrying cables or wires wherever they go.
- iii. Doctors, workers and other professionals working in remote areas can be in touch with medical centres through wireless communication.
- iv. Urgent situation can be alerted through wireless communication.
- v. Wireless networks are cheaper to install and maintain.

DISADVANTAGES:

Wireless network has led to many security threats to mankind. It is very easy for the hackers to grab the wireless signals that are spread in the air. It is very important to secure the wireless network so that the information cannot be exploited by the unauthorized users. This also increases the risk to lose information. Strong security protocols must be created to secure the wireless signals like WPA and WPA2. Another way to secure the wireless network is to have wireless intrusion prevention system.

Mobile communication system:

There are a variety of wireless communication systems for transmitting voice, video, and data in local or wide areas. There are point-to-point wireless bridges, wireless local area networks, multidirectional wireless cellular systems, and satellite communication systems.

A cell in a cellular system is a roughly circular area with a central transmitter/receiver base station. The station is raised up on a tower or placed on top of a building. Some are located on church steeples. The station has a 360-degree omnidirectional antenna (except when directional transmissions are required) that is tuned to create a cellular area of a specific size. Cells are usually pictured as hexagonal in shape and arranged in a honeycomb pattern. Cell size varies depending on the area. In a city, there are many small cells, while rural area may have very large cells.

When a user turns a phone on, its phone number and serial number are broadcast within the local cell. The base station picks up these signals and informs the switching office that the particular device is located within its area. This information is recorded by the switching office for future reference. An actual call takes place when the user enters a phone number and hits the Send button. The cellular system selects a channel for the user to use during the duration of the call.

Wi-Fi: (Wi-Fi is short for "wireless fidelity,")

It is a popular technology that allows an electronic device to exchange data wirelessly (using radio waves) over a computer network, including high-speed Internet connections. The Wi-Fi Alliance defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards".

A device that can use Wi-Fi (such as a personal computer, video-game console, smartphone, tablet, or digital audio player) can connect to a network resource such as the Internet via a wireless network access point. Such an access point (or hotspot) has a range of about 20 meters (65 feet) indoors and a greater range outdoors.

How Wi-Fi Works:

Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. When an RF current is supplied to an antenna, an electromagnetic field is created that then is able to propagate through space. In order to connect to an access point and join a wireless network, computers and devices must be equipped with wireless network adapters

WiMAX:

WiMAX can be abbreviated as , Worldwide Interoperability for Microwave Access, a technology standard that enables high speed wireless internet.

It is an IP based, wireless broadband access technology that provides performance similar to 802.11/Wi-Fi networks. WiMAX is a wireless digital communications system, also known as IEEE 802.16, which is intended for wireless "metropolitan area networks. WiMAX provides wireless broadband access up to a radius of 50 kilometres (30 miles) for fixed receivers and 5-15 kilometres (3-10 miles) for mobile receivers.

WiMAX operates on both licensed and non-licensed frequencies.

As it is possible to use WiMAX over longer distances, this technology may come in handy in creating city wide networks. It is also better suited than WiFi for large area public places like airports, college and university campuses and large office set ups. It also provides for greater mobility to users. This way WiMAX may be the best option for people on the move who uses laptops, iPods and PDAs.