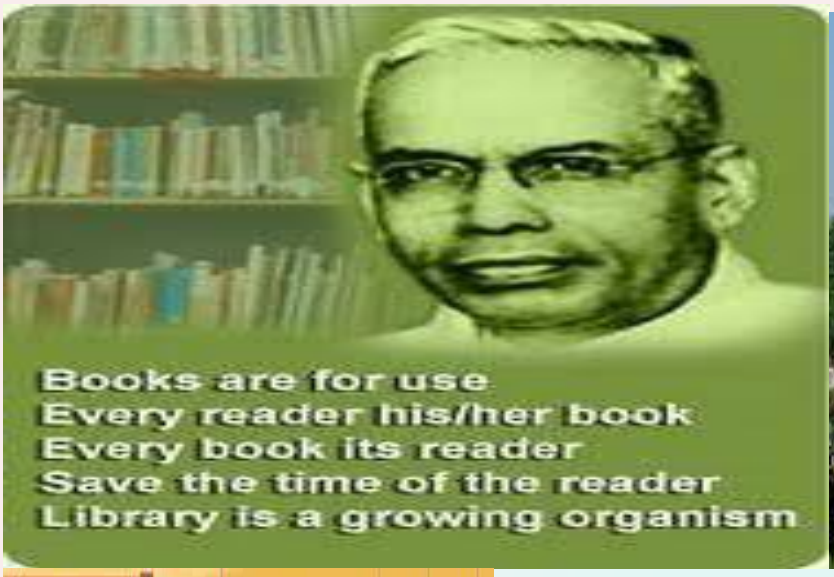
KARNATAKA STATE OPEN UNIVERSITY

Mukthagangothri, Mysuru – 570 006

BACHELOR OF LIBRARY AND INFORMATION SCIENCE

(FIRST SEMESTER)



BLIDSC-1.4: INFORMATION AND COMMUNICATION TECHNOLOGY IN LIBRARIES

BLOCK-3

BLOCK

3

TELECOMMUNICATION TECHNOLOGIES

Programme Name: B.Lib.I.Sc. **Year/Semester: I[st]** Semester **Block No :** 3

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BLIDSC-1.4: Information and communication technology in libraries

Block-3: Telecommunication technologies

Block Introduction

A transmission medium or channel is a path through which data is conveyed from one location to another. In other words, it is a physical path between the transmitter and the receiver. In this unit, you will learn about the different types of data transmission channels and their benefits and drawbacks.

Electronic signals are used in telecommunication for communicating information. For communication enablement, telecommunication makes use of a variety of compatible hardware and software. Telecommunication systems have been made important by digital technology since it is now part of our daily life. Key components of telecommunication systems include signals, communication channels and communication networks. Nowadays, telecommunication systems can transmit graphic images, videos, voice and texts. Components such as computers are required to process information, send, receive, and ensure the safety of transmission of data. In this unit, you will study the basics of telecommunication viz., wave and its properties, modulation, types of modulations, bandwidth and multiplexing.

In this block you will be introduced to-

UNIT -9: Transmission Channels, Mode, and Media, ISDN, PSDN,
UNIT -10: Modulation, Frequency, Bandwidth and Multiplexing,
UNIT -11: Wireless Communication: Media, Wi-fi, Li-fi, Satellite Communication, Mobile Communication
UNIT -12: Computer Networks: Concept, Need, Topologies, Types: LAN, MAN, WAN

Dr.Shilpa Rani N. R.

UNIT -9: Transmission Channels, Mode, and Media, ISDN, PSDN,

Structure

9.0. Objectives

After reading this unit, you will be able to:

- ❖ Understand the basics of transmission channels
- ❖ Different types of media used for data transmission
- ❖ Know the importance of ISDN and PSDN

9.1. Introduction

A transmission medium or channel is a path through which data is conveyed from one location to another. In other words, it is a physical path between the transmitter and the receiver. In this unit, you will learn about the different types of data transmission channels and their benefits and drawbacks.

9.2. Transmission channels

A transmission medium is a physical link between the transmitter and the receiver in the context of data communication. Data is transmitted from one location to another through it. In the context of telecommunications and computer networking, a communication channel can either refer to a physical transmission medium, such as a wire, or to a logical link across a multiplexed medium, such as a radio channel.When sending or receiving information from one or more senders (or transmitters) to one or more receivers, a channel is utilized to transfer the signal. The amount of data that may be transmitted across a channel is typically expressed in terms of its bandwidth (measured in Hz) or data rate (measured in bits per second). This section explains the various kinds of data transmission channels.

9.2.1. Twisted Pair Cable

It comprises two conductor wires that have been twisted around one another. Generally, several such pairs are bundled together in a protective sheath. They are the Transmission Media that are widely used for data transmission. Twisted Pair comes in two varieties and they are as follows:

a) Unshielded Twisted Pair (UTP)

This sort of cable can block interference and does not require a physical shield to do so. These cables are mostly used for telephonic applications. The following are some benefits of unshielded twisted pair:

- Least expensive

- Easy to install
- High-speed capacity
- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short-distance transmission due to attenuation

b) Shielded Twisted Pair (STP)

This kind of cable has a special jacket to prevent outside interference. It is utilized in telephone lines' voice and data channels as well as fast-data-rate Ethernet. The benefits of shielded twisted pair include the following.

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster
- Comparatively difficult to install and manufacture
- More expensive

9.2.2. Coaxial Cable

Coaxial cable is a type of copper cable specially built with a metal shield and other components engineered to block signal interference. It is primarily used by cable TV companies to connect their satellite antenna facilities to customer homes and businesses. It is also sometimes used by telephone companies to connect central offices to telephone poles near customers. Some homes and offices use coaxial cable, too, but its widespread use as an Ethernet connectivity medium in enterprises and data centers has been supplanted by the deployment of twisted pair cabling.

Coaxial cable received its name because it includes one physical channel that carries the signal surrounded by a layer of insulation by another concentric physical channel, both running along the same axis. The outer channel serves as a ground. Many of these cables or pairs of coaxial tubes can be placed in a single outer sheathing and, with repeaters, can carry information for a great distance.

It has an outer plastic covering containing two parallel conductors each having a separate insulated protection cover. The coaxial cable transmits information in two modes: Baseband mode(dedicated cable bandwidth) and Broadband mode(cable bandwidth is split

into separate ranges). Cable TVs and analog television networks widely use Coaxial cables. The coaxial Cables have many advantages, and they are:

- High Bandwidth
- Better noise Immunity
- Easy to install and expand
- Inexpensive

9.2.3. Optical Fabre cables

Fiber or fiber optic technology is an effective cabled-based communication system. It is reliable, versatile, and widely used in many applications and industries.Optical fiber cabling is used to transfer information via pulses of light, which pass along one or more transparent plastic or glass pipes. In some cases, this can be more than several hundred pipes. Each of these strands is a little wider than an average hair and is normally surrounded by a further layer of cladding which is also in plastic or glass but constructed at a different density to the main inner strand. A sheath made up of several layers of the insulated casing is also wrapped around the cladded fibers. This usually comprises a protective wrapper, known as a buffer tube, followed by a final outer jacket designed to protect the entire multi-stranded cable.

Key advantages of optical fibers include:

- **Distance** - because of their low signal power loss rate, fiber optic cables can carry optical signals over far longer distances than older types of cabling. With the ideal combination of network setup, materials, and wavelength, some single fiber optics are effective at carrying signals over hundreds of kilometers.
- **Bandwidth and data transfer** - copper data cables offer quite limited bandwidth as opposed to fiber optics
- **Speed** - fiber optic cables enjoy a significant speed advantage compared to other data transfer modes because they use light pulses as the primary information conveyance source. In this regard, fiber typically outstrips the expected performance of even high-grade copper cables.
- **Interference** - much more protection is provided against interference and cross-talk by fiber optics than metal cables. This is because fiber does not carry a physical electrical signal.

- **Reliability and safety** - although optical fiber cables are usually lighter and thinner, they are also sturdier. This means that they can withstand far greater forces and therefore the chances of incurring breakage or damage across long runs are less likely. Fiber is not influenced by moisture, poor weather, or extreme temperatures nearly as much as copper-based wiring. Additionally, as glass fibers do not carry current, they have not fired hazards even if they are aging or damaged.

Some of the other advantages are:

- Increased capacity and bandwidth
- Lightweight
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials

9.3. Integrated Services Digital Network (ISDN)

ISDN is a set of communication standards that uses digital transmission to make phone calls, video calls, transmit data and other network services over the circuits of the traditional PSTN (Public Switched Telephone Network). ISDN was introduced in 1986. It replaced and updated old-fashioned landlines with digital lines and added features that weren't available with a classic telephone system.

These are a set of communication standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network. Before Integrated Services Digital Network (ISDN), the telephone system was seen to transmit voice, with some special services available for data. The main feature of ISDN is that it can integrate speech and data on the same lines, which was not available in the classic telephone system.

ISDN is a circuit-switched telephone network system, but it also provides access to packet-switched networks that allows digital transmission of voice and data. This results in potentially better voice or data quality than an analog phone can provide. It provides a packet-switched connection for data in increments of 64 kilobit/s. It provided a maximum of 128 kbit/s bandwidth in both upstream and downstream directions. A greater data rate was achieved through channel bonding.

9.3.1. ISDN Interfaces

The following are the interfaces of ISDN

a) Basic Rate Interface (BRI)

There are two data-bearing channels (‘B’ channels) and one signaling channel (‘D’ channel) in BRI to initiate connections. The B channels operate at a maximum of 64 Kbps while the D channel operates at a maximum of 16 Kbps. The two channels are independent of each other. For example, one channel is used as a TCP/IP connection to a location while the other channel is used to send a fax to a remote location. In series ISDN supports a basic rate interface (BRl).

The basic rate interface (BRl) specifies a digital pipe consisting of two B channels of 64 Kbps each and one D channel of 16 Kbps. This equals a speed of 144 Kbps. In addition, the BRl service itself requires an operating overhead of 48 Kbps. Therefore, a digital pipe of 192 Kbps is required.

b) Primary Rate Interface (PRI)

Primary Rate Interface service consists of a D channel and either 23 or 30 B channels depending on the country you are in. PRI is not supported on the iSeries. A digital pipe with 23 B channels and one 64 Kbps D channel is present in the usual Primary Rate Interface (PRI). Twenty-three B channels of 64 Kbps each and one D channel of 64 Kbps equals 1.536 Mbps. The PRI service uses 8 Kbps of overhead also. Therefore, PRI requires a digital pipe of 1.544 Mbps.

c) Broadband-ISDN (B-ISDN)

Narrowband ISDN has been designed to operate over the current communications infrastructure, which is heavily dependent on copper cable however B-ISDN relies mainly on the evolution of fiber optics. B-ISDN is best service requiring transmission channels capable of supporting rates greater than the primary rate.

9.3.2. ISDN Services

ISDN provides a fully integrated digital service to users. These services fall into 3 categories- bearer services, teleservices, and supplementary services.

Bearer Services

Transfer of information (voice, data, and video) between users without the network manipulating the content of that information is provided by the bearer network. There is no need for the network to process the information and therefore does not change the content. Bearer services belong to the first three layers of the OSI model. They are well-defined in the

ISDN standard. They can be provided using circuit-switched, packet-switched, frame-switched, or cell-switched networks.

Teleservices –

In this, the network may change or process the contents of the data. These services correspond to layers 4-7 of the OSI model. Teleservices rely on the facilities of the bearer services and are designed to accommodate complex user needs. The user need not be aware of the details of the process. Teleservices include telephony, teletex, telefax, videotex, telex, and teleconferencing. Though the ISDN defines these services by name, they have not yet become standards.

Supplementary Service

Additional functionality to the bearer services and teleservices are provided by supplementary services. Reverse charging, call waiting, and message handling are examples of supplementary services which are all familiar with today's telephone company services.

9. Packet Switched Data Network (PSDN)

A Packet Switched Data Network (PSDN) is generally required for data communication. PSDN is a type of communication network for data transmission operated by a public telephone company and comprises at least one Local Area Network (LAN) interface for connection to an external subscriber terminal having a LAN interface, and the main controller for processing packet data transmitted/received from the external subscriber terminal via the LAN interface and an Internet Control Message Protocol (ICMP) as well.

The PDSN delivers sound information using a Voice over IP (VOIP) as well as data communication between external terminals. VoIP is a term referring to IP telephone technology for a series of equipment for transmitting sound information using an Internet Protocol (IP).In a PSDN, a single main controller controls at least one LAN interface for maintenance and an Internet phone call, and a physical layer and data link layer thereof are realized in a LAN dedicated chip.

Following are the features of PSDN

- It is designed and developed specifically for data transmission rather than voice.
- Communication is shared i.e. many companies share switching networks.
- It uses packet switching.
- It acquires and releases bandwidth as needed.

- No dedicated path exists between the sender and receiver.
- Cost is not based on distance and time. It depends on the usage of the data. The cost of service is normally lower than the leased line

9.5. Summary

Thus, it is concluded that a communication channel is a medium used to transport information from one network device to another. Wired channels transport data through wires and cables. Wireless channels transport data from one device to another without the use of cables or wires. Wired channels include twisted pair wires used for telephone landlines and coaxial cables used for cable television networks.

9.6. Check your progress

1. Co-axial cables are used in
   (a) TV communication
   (b) Satellite communication
   (c) Landline communication
   (d) None of the above

   Answer: A
2. PSDN stands for
   (a) Popular Switched Data Network
   (b) Packet Switched Data Network
   (c) Packets Switching Data Network
   (d) Packet Switched Data Networking

   Answer: B
3. Optical fiber cables use
   (a) Electromagnetic waves
   (b) Eclectic signals
   (c) Microwaves
   (d) Light waves

Answer: D

4. Transmission channels are used to transfer
   (a) Only audio

(b) Only Video

(c) Only graphics

(d) Audio, video, graphics and text

Answer: D

5. Unshielded Twisted Pair (UTP) are commonly used in

(a) Satellite communication

(b) Radio communication

(c) Telephonic applications

(d) Television communication

Answer: C

9.7. Keywords

Transmitter: A transmitter is an electronic device used in telecommunications to produce radio waves to transmit or send data with the aid of an antenna.

TCP/IP: TCP/IP stands for Transmission Control Protocol/Internet Protocol and is a suite of communication protocols used to interconnect network devices on the internet

model: The Open Systems Interconnection (OSI) model describes seven layers that computer systems use to communicate over a network. It was the first standard model for network communications, adopted by all major computer and telecommunication companies in early 1980

Mbps: Megabits per second (Mbps) are units of measurement for network bandwidth and throughput.

LAN: A local area network (LAN) is a collection of devices connected together in one physical location, such as a building, office, or home.

Internet Control Message Protocol (ICMP): The Internet Control Message Protocol is a network layer protocol used by network devices to diagnose network communication issues.

9.8. Questions for self-study

1. Discuss the advantages of Co-axial cables.
2. Explain the ISDN Interfaces
3. Discuss the advantages of twisted pair cables
4. Explain the features fo PSDN

9.9. References

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UNIT -10: Modulation, Frequency, Bandwidth and Multiplexing,

Structure

10.0. Objectives

At end of this unit, you will be able to understand:

- The basic concept of wave and its properties
- The different types of modulations
- Types of bandwidths and multiplexing

10.1. Introduction

Electronic signals are used in telecommunication for communicating information. For communication enablement, telecommunication makes use of a variety of compatible hardware and software. Telecommunication systems have been made important by digital technology since it is now part of our daily life. Key components of telecommunication systems include signals, communication channels and communication networks. Nowadays, telecommunication systems can transmit graphic images, videos, voice and texts. Components such as computers are required to process information, send, receive, and ensure the safety of transmission of data. In this unit, you will study the basics of telecommunication viz., wave and its properties, modulation, types of modulations, bandwidth and multiplexing.

10.2. Wave and its properties

A wave can be described as a disturbance that travels through a medium from one location to another location. A wave is a disturbance in a medium that carries energy without a net movement of particles. It may take the form of elastic deformation, a variation of pressure, electric or magnetic intensity, electric potential, or temperature.

A medium is a substance or material that carries the wave. The wave medium is not the wave and it doesn't make the wave; it merely carries or transports the wave from its source to other locations.

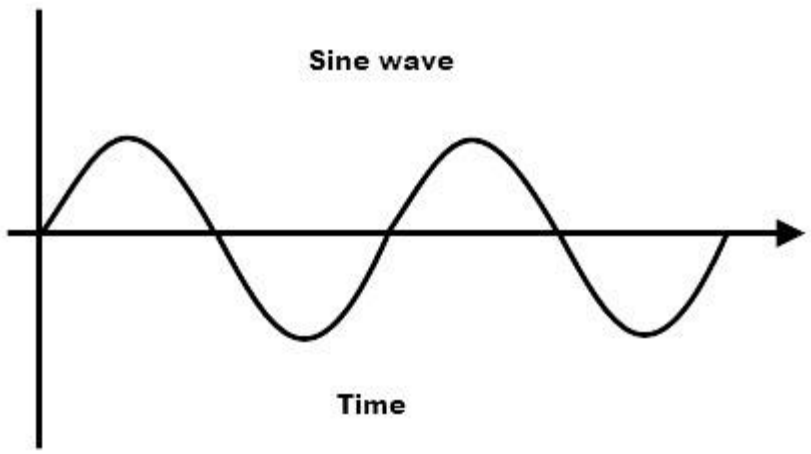


Figure.1: Waveform

Properties of a wave

a) Wave amplitude (a): It is the maximum displacement from the neutral position. This represents the energy of the wave. Greater amplitude carries greater energy. Displacement is the position of a particular point in the medium as it moves as the wave passes. In other words, the maximum displacement of a wave is the amplitude of the wave.

b) Frequency – The frequency of a wave is the number of waves passing a point in a certain time. The unit of frequency is hertz (Hz) which is equal to one wave per second.

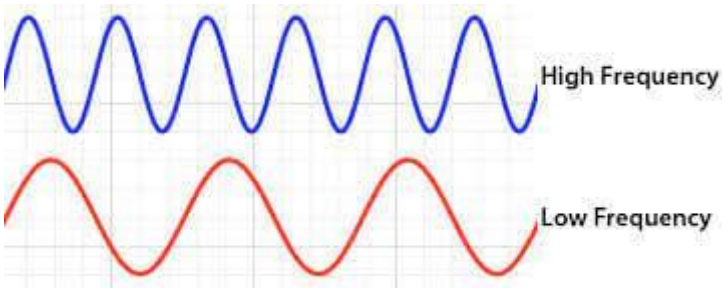
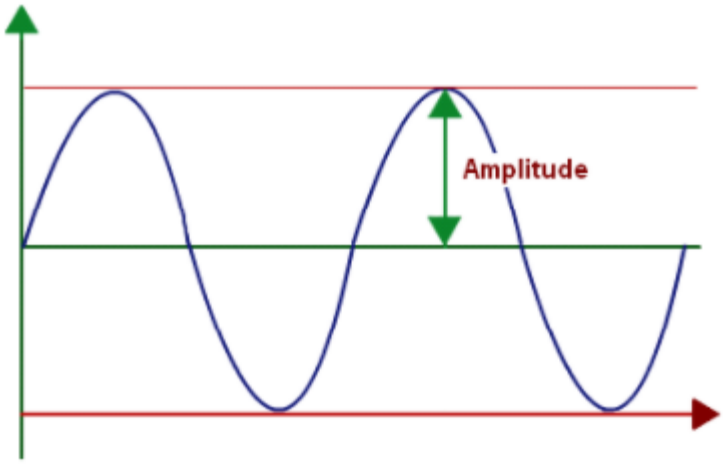


Figure.2: Wave frequency

c) Wave amplitude: Amplitude is the maximum displacement or distance moved by a point on a vibrating body or wave measured from its equilibrium position.



d) Wave velocity: Wave velocity is the distance traveled by a wave per unit time. It is the speed with which a disturbance of the particle-like a crest/ trough, compression/rarefaction propagates through a medium.

10.3. Modulation

Modulation is the process of encoding information from a message source in a way that is suitable for transmission. This is achieved by altering the characteristics of a wave. By superimposing a message onto a high-frequency signal known as a carrier wave (or sinusoidal signal), video, voice and other data can be transmitted. In the modulation process, a parameter of the carrier wave is varied in accordance with the modulating signal. This variation acts as a code for data transmission. This modulated signal is then transmitted by the transmitter. he receiver demodulates the received modulated signal and gets the original information signal back.

10.4. Types of modulations

The different types of wave modulations are:

a) Amplitude modulation

Amplitude modulation or AM is the method of varying the instantaneous amplitude of the carrier signal accordingly to the instantaneous amplitude of the message signal.

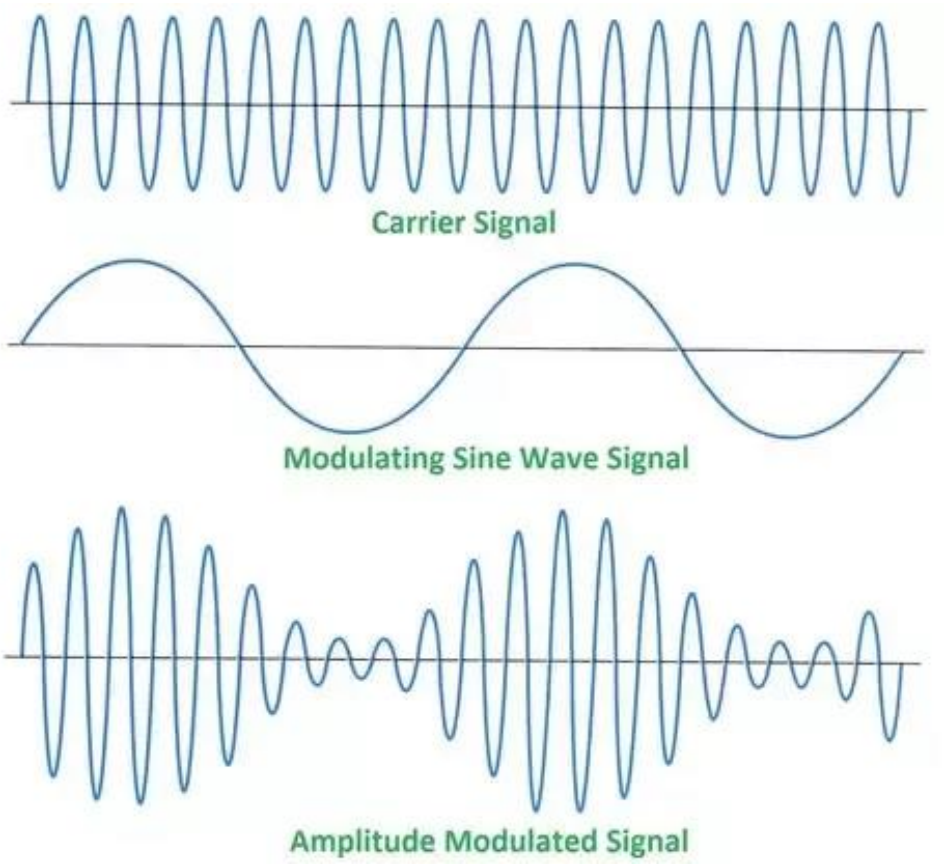


Figure.4: Amplitude modulation

b) Frequency modulation

Frequency modulation is the process of varying the instantaneous frequency of the Carrier signal accordingly with the instantaneous amplitude of the message signal.

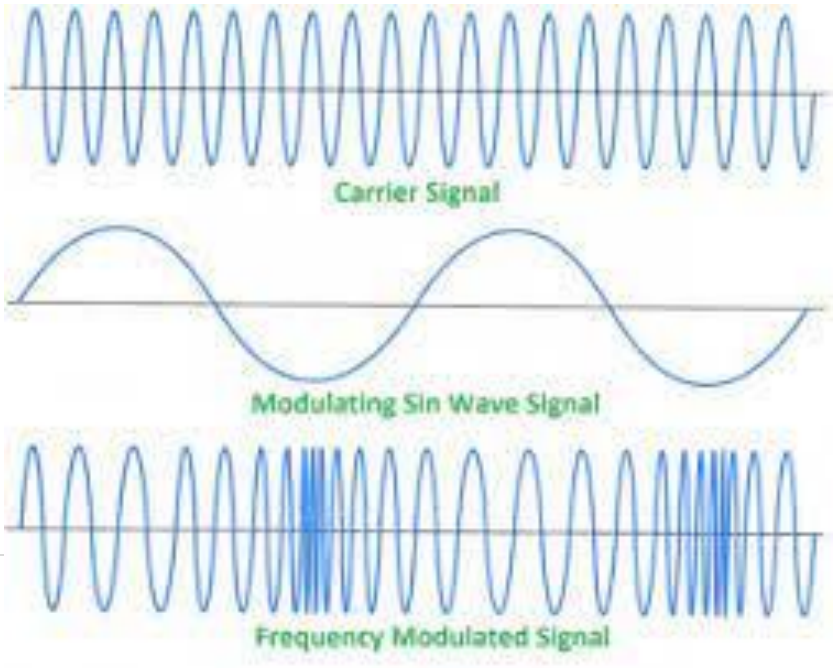


Figure.5: Frequency modulation

10.5. Bandwidth

The bandwidth of a signal is defined as the difference between the upper and lower frequencies of a signal generated. As seen from the above representation, the Bandwidth (B) of the signal is equal to the difference between the higher or upperfrequency (fH) and the lower frequency (fL). It is measured in terms of Hertz(Hz) i.e. the unit of frequency.

10.5.1. Radio Frequency bands

To prevent interference between different users, the generation and transmission of radio frequency bands are strictly regulated by national laws and coordinated by an international body, the International Telecommunication Union (ITU). Different parts of the radio spectrum (RF bands) are allocated by the ITU for different radio transmission technologies and applications.

Table-1: Wavebands

Band name	Abbreviation	Frequency	Wavelength	Example Uses
Extremely low frequency	ELF	3–30 Hz	100,000–10,000 km	Communication with submarines
Super low frequency	SLF	30–300 Hz	10,000–1,000 km	Communication with submarines
Ultra-low frequency	ULF	300–3,000 Hz	1,000–100 km	Submarine communication, communication within mines
Very low frequency	VLF	3–30 kHz	100–10 km	Navigation, submarine communication, geophysics
Low frequency	LF	30–300 kHz	10–1 km	Navigation, AM longwave broadcasting, RFID
Medium frequency	MF	300–3,000 kHz	1,000–100 m	AM (medium-wave) broadcasts

High frequency	HF	3–30 MHz	100–10 m	Shortwave broadcasts, RFID, mobile
Very high frequency	VHF	30–300 MHz	10–1 m	FM, television broadcasts, mobile communications
Ultra high frequency	UHF	300–3,000 MHz	1–0.1 m	Television broadcasts, microwave oven, microwave devices/communications, radio astronomy, mobile phones, wireless LAN, Bluetooth
Extremely high frequency	EHF	30–300 GHz	10–1 mm	Radio astronomy, high-frequency microwave radio relay, microwave remote sensing

10.6. Multiplexing

Multiplexing is a technique used to combine and send multiple data streams over a single medium. The process of combining the data streams is known as multiplexing and the hardware used for multiplexing is known as a multiplexer. Multiplexing is achieved by using a device called Multiplexer (**MUX**) that combines n input lines to generate a single output line. Multiplexing follows many-to-one, i.e., n input lines and one output line. Demultiplexing is achieved by using a device called Demultiplexer (**DEMUX**) available at the receiving end. DEMUX separates a signal into its component signals (one input and n outputs).

10.6.1. Need for Multiplexing

The need for the multiplexing is as follows:

- The transmission medium is used to send the signal from the sender to the receiver. The medium can only have one signal at a time.
- If there are multiple signals to share one medium, then the medium must be divided in such a way that each signal is given some portion of the available bandwidth. For example: If there are 10 signals and the bandwidth of the medium is100 units, then the 10 unit is shared by each signal.

- When multiple signals share a common medium, there is a possibility of collision. The multiplexing concept is used to avoid such collision.
- Transmission services are very expensive.

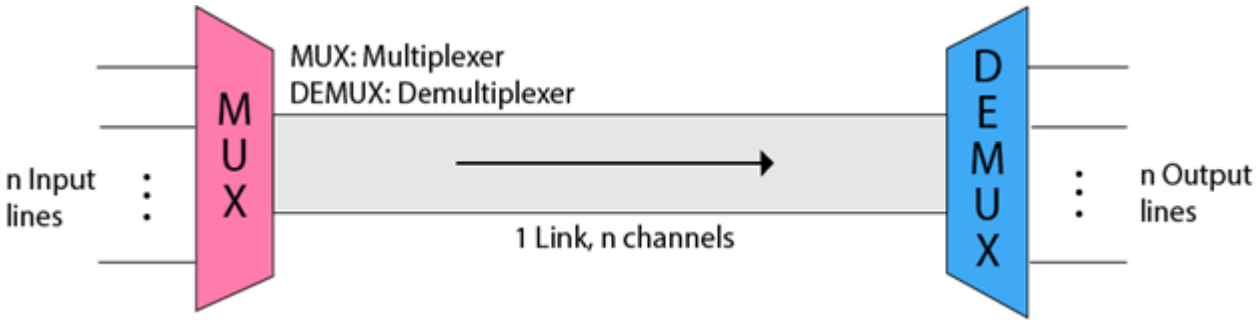


Figure.6: Multiplexing

- The 'n' input lines are transmitted through a multiplexer and the multiplexer combines the signals to form a composite signal.
- The composite signal is passed through a Demultiplexer and the demultiplexer separates a signal into component signals and transfers them to their respective destinations.

10.6.2. Types of Multiplexing Techniques

These techniques are mainly used in communication, and these are classified into three types. The 3 types of multiplexing techniques include the following.

a) Frequency Division Multiplexing (FDM)
b) Wavelength Division Multiplexing (WDM)
c) Time Division Multiplexing (TDM)

a) Frequency Division Multiplexing (FDM)

The FDM is used in telephone companies in the 20th century in long-distance connections for multiplexing many voice signals using a system like a coaxial cable. For small distances, low-cost cables were utilized for different systems such as bell systems, K- and N-carrier, however, they don't let huge bandwidths. This is analog multiplexing used to unite analog signals. This type of technique is useful when the link's bandwidth is better than the United bandwidth of the transmitted signals.

In FDM, signals are produced by transmitting various device-modulated carrier frequencies, and then these are united into a solo signal which can be moved by the connection. To hold the adapted signal, the carrier frequencies are divided by sufficient bandwidth, & these ranges of bandwidths are the channels through the different traveling

signals. These can be divided by bandwidth which is not used. The best examples of the FDM comprise signal transmission in TV and radio.

b) Wavelength Division Multiplexing (WDM)

In fiber communications, the WDM is one type of technology. This is the most useful concept in high-capacity communication systems. At the end of the transmitter section, the multiplexer is used to combine the signals as well as at the end of the receiver section, the de-multiplexer for dividing the signals separately. The main function of WDM at the multiplexer is for uniting various light sources into only light sources, and this light can be changed into numerous light sources at the de-multiplexer.

The main intention of WDM is to utilize the high data rate capacity of the FOC (fiber optic cable). The high data rate of this FOC cable is superior to the data rate of the metallic transmission cable. Theoretically, the WDM is similar to the FDM, apart from the data transmission through the FOC in which the multiplexing & de-multiplexing occupies optical signals.

c) Time Division Multiplexing (TDM)

The TDM is one kind of method for transmitting a signal over a channel of communication by separating the time edge into slots. Like single slot is used for each message signal.TDM is mainly useful for analog and digital signals, in which several channels with low speed are multiplexed into high-speed channels used for transmission. Depending on the time, every low-speed channel will be assigned to an exact position, wherever it works in the mode of synchronization. Both the ends of MUX and DEMUX are synchronized in a timely & at the same time switch toward the next channel.

10.6.3. Advantages of Multiplexing

The process which is used to transmit multiple signals over a single physical medium is known as multiplexing. The main advantages of multiplexing include the following.

- The utilization of a medium bandwidth can be done very effectively.
- Multiplexing enhances the network's economic stability because it reduces both the time as well as cost required for the operation of the physical medium when a single medium serves many signals or subscribers or applications.

- In telecommunications, multiplexing plays a key role to reduce the cost of networks by reducing the number of communications links required between two points.
- More than one signal can be sent over a single medium.
- The bandwidth of a medium can be utilized effectively.

10.7. Summary

In this unit, the basic concept of a wave, the different properties of a wave are discuses. Further, the concept of modulation and different types of modulation are also briefly explained. In the next unit, you will learn in detail about the standards and protocols.

10.8. Check your progress

1. The maximum displacement of a wave from the neutral position is

(a) Wave frequency

(b) Wave amplitude

(c) Wavelength

(d) Wave velocity

Answer: B

2. The unit of frequency is

(a) Hertz

(b) Meters

(c) Ohm

(d) (Meter/Sec

Answer: A

3. In case of Amplitude modulation

(a) Both amplitude and frequency vary

(b) Both amplitude and frequency are constant

(c) The frequency varies and the amplitude remains constant

(d) The amplitude varies and frequency remains constant

Answer: D

4. Extremely low-frequency waves are mainly used in

(a) Communication with submarines

(b) Radio broadcasting

(c) RADAR

(d) Television broadcasts

Answer: A

5. The technique used to combine and send multiple data streams over a single medium is called

(a) Amplitude modulation

(b) Frequency modulation

(c) Multiplexing

(d) Demultiplexing

Answer: C

10.9. Keywords

Hertz: It is a unit of frequency. The number of hertz (abbreviated Hz) equals the number of cycles per second.

Carrier wave: In telecommunications, a carrier wave is a waveform that is modulated with an information-bearing signal to convey information.

Modulated signal: In telecommunications, modulation is the process of varying one or more properties of a periodic waveform, called the carrier signal, with a separate signal called the modulation signal that typically contains information to be transmitted.

Waveband: a range of wavelengths falling between two given limits, used in radio transmission.

Submarine: A submarine is a watercraft capable of independent operation underwater.

RFID: RFID tagging involves small devices that use radio frequencies to transfer data, mainly to track and identify objects, animals and people

Bluetooth: It is a short-range wireless technology standard that is used for exchanging data between mobile devices over short distances

10.10. Questions for self-study

1. Explain the features of a wave.
2. State and explain the different types of modulations.
3. Discuss the need for multiplexing.

4. What is bandwidth? Explain the different radio frequency bands and their applications.

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UNIT -11: Wireless Communication: Media, Wi-fi, Li-fi, Satellite Communication Mobile Communication

Structure

11.0. Objectives

At end of this unit, you will be able to understand:

- The basic concept of wireless communication
- The different wireless communications
- The advantages of Wi-Fi and Li-Fi
- Importance of Satellite communication and mobile communication

11.1. Introduction

Communication systems can be wired or wireless and the medium used for communication can be guided or unguided. In wired communication, the medium is a physical path like co-axial cables, twisted pair cables and optical fiber links, etc. which guides the signal to propagate from one point to other. Such a type of medium is called a guided medium. On the other hand, wireless communication doesn't require any physical medium but propagates the signal through space.

Since space only allows for signal transmission without any guidance, the medium used in Wireless communication is called an unguided medium. Even though there are no cables used in wireless communication, the transmission and reception of signals are accomplished with Antennas. Antennas are electrical devices that transform electrical signals into radio signals in the form of Electromagnetic (EM) Waves and vice versa. These Electromagnetic Waves propagate through space. Hence, both the transmitter and receiver consist of an antenna.

Another scenario where wireless communication got replaced by wired communication is Television broadcasting. In the early days, television signals were broadcasted using wireless radio transmitters. But this setup got replaced by cable television.

11.2. Wireless Communication

A typical wireless communication system can be divided into three elements: the Transmitter, the Channel and the Receiver. The following image shows the block diagram of a wireless communication system.

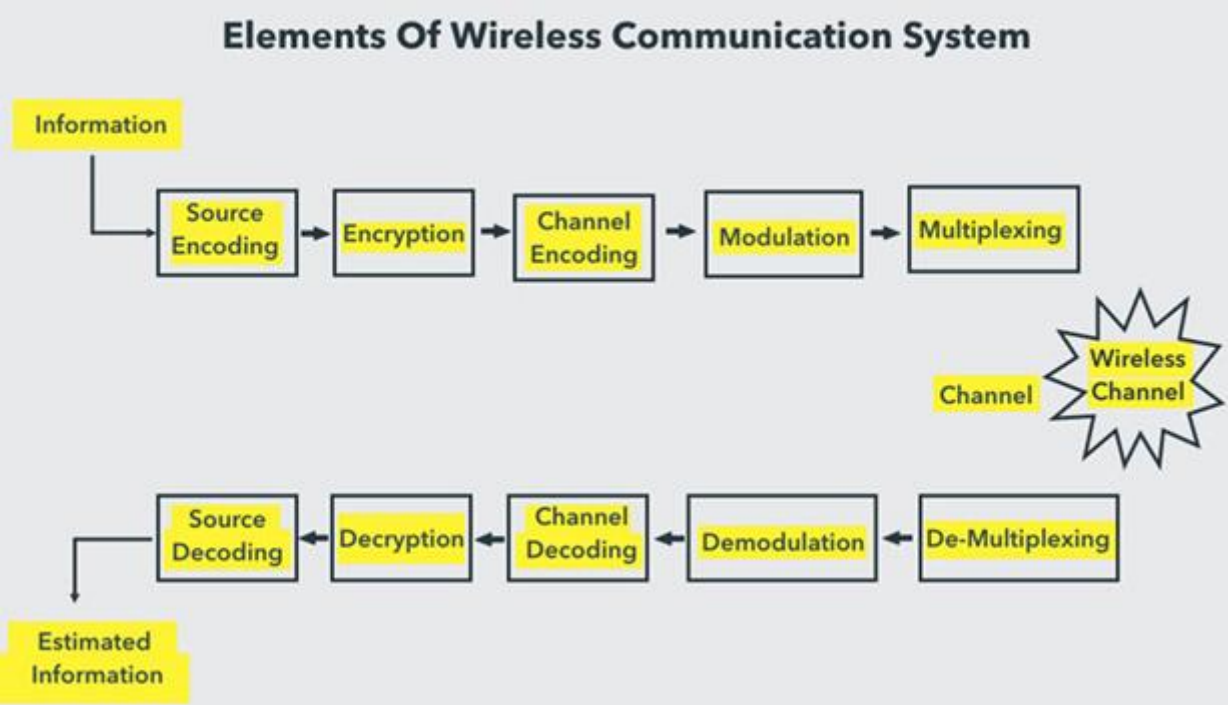

Figure-1: Basic elements of wireless communication

a) The Transmission Path

A typical transmission path of a Wireless Communication System consists of Encoder, Encryption, Modulation and Multiplexing. The signal from the source is passed through a Source Encoder, which converts the signal into a suitable form for applying signal processing techniques. The redundant information from the signal is removed in this process to maximize the utilization of resources. This signal is then encrypted using an Encryption Standard so that the signal and the information are secured and don't allow any unauthorized access.

Channel encoding is a technique that is applied to the signal to reduce the impairments like noise, interference, etc. During this process, a small amount of redundancy is introduced to the signal so that it becomes robust against noise. Then the signal is modulated using a suitable Modulation Technique so that the signal can be easily transmitted using an antenna. The modulated signal is then multiplexed with other signals using different Multiplexing Techniques like Time Division Multiplexing (TDM) or Frequency Division Multiplexing (FDM) to share the valuable bandwidth.

b) The Channel

The channel in Wireless Communication indicates the medium of transmission of the signal i.e. open space. A wireless channel is unpredictable and also highly variable and random in nature. A channel maybe subject to interference, distortion, noise, scattering, etc. and the result is that the received signal may be filled with errors.

c) The Reception Path

The job of the Receiver is to collect the signal from the channel and reproduce it as the source signal. The reception path of a Wireless Communication System comprises Demultiplexing, Demodulation, Channel Decoding, Decryption and Source Decoding. From the components of the reception path, it is clear that the task of the receiver is just the inverse to that of the transmitter. The signal from the channel is received by the Demultiplexer and is separated from other signals. The individual signals are demodulated using appropriate Demodulation Techniques and the original message signal is recovered. The redundant bits from the message are removed using the Channel Decoder. Since the message is encrypted, the Decryption of the signal removes the security and turns it into a simple sequence of bits. Finally, this signal is given to the Source Decoder to get back the original transmitted message or signal.

11.3. Types of Wireless Communication Systems

Today, people need Mobile Phones for many things like talking, internet, multimedia, etc. All these services must be made available to the user on the go i.e. while the user is mobile. With the help of these wireless communication services, we can transfer voice, data, videos, images, etc. Wireless Communication Systems also provide different services like video conferencing, cellular telephone, paging, TV, Radio, etc. Due to the need for a variety of communication services, different types of Wireless Communication Systems are developed. Some of the important Wireless Communication Systems available today are:

- Television and Radio Broadcasting
- Satellite Communication
- Radar
- Mobile Telephone System (Cellular Communication)
- Global Positioning System (GPS)

- Infrared Communication
- WLAN (Wi-Fi)
- Bluetooth
- Radio Frequency Identification (RFID)

There are many other systems with each being useful for different applications.

The devices used for Wireless Communication may vary from one service to another and they may have different sizes, shapes, data throughput and costs. The area covered by a Wireless Communication system is also an important factor. The wireless networks may be limited to a building, an office campus, a city, a small regional area (greater than a city) or might have global coverage. In this section, let us discuss some of the wireless communication systems.

11.4.Wi-Fi

A Wireless Local Area Network or WLAN (Wi-Fi) is an Internet-related wireless service. Using WLAN, different devices like laptops and mobile phones can connect to an access point (like a Wi-Fi Router) and access the Internet. Wi-Fi is one of the widely used wireless networks, usually for internet access (but sometimes for data transfer within the Local Area Network). It is very difficult to imagine the modern world without Wi-Fi.

Wi-Fi is a wireless networking technology that allows devices such as computers (laptops and desktops), mobile devices (smart phones and wearable's), and other equipment (printers and video cameras) to interface with the Internet. It allows these devices--and many more--to exchange information with one another, creating a network. Internet connectivity occurs through a wireless router. When you access Wi-Fi, you are connecting to a wireless router that allows your Wi-Fi-compatible devices to interface with the Internet.

Advantages of Wi-Fi

Some of the advantages of Wi-Fi are:

a) Convenience: The wireless nature of such networks allows users to access network resources from nearly any convenient location within their primary networking environment (home or office). With the increasing saturation of laptop-style computers, this is particularly relevant.

b) Mobility: With the emergence of public wireless networks, users can access the Internet even outside their normal work environment.

c)Expandability: Wireless networks can serve a suddenly increased number of clients with the existing equipment. In a wired network, additional clients would require additional wiring.

Disadvantages of Wi-Fi

The following are the disadvantages of Wi-Fi

a) Security: To combat this consideration, wireless networks may choose to utilize some of the various encryption technologies available. Some of the more commonly utilized encryption methods, however, are known to have weaknesses that a dedicated adversary can compromise.

b) Speed: The speed on most wireless networks is far slower than even the slowest common wired networks. However, in specialized environments, the throughput of a wired network might be necessary.

11.5. Li-Fi

LiFi or "Light Fidelity" is a communication technology using light. LiFi is based on LEDs turning on & off several million times per second. By using the invisible spectrum of light, the infrared, Oledcomm converts this information into binary data, such as optical Morse code.

This modulation occurs so quickly, more than 10 million times per second, that the eye cannot perceive it. With a transmitter from one side and a receiver from another, LiFi exchanges data at a very high speed. This new communication network is radio wave free, fast, robust and ultra-secure.

Advantages of Li-Fi

a) Quicker Data Transmission than Wi-Fi: An essential selling purpose of Li-Fi innovation is that it has a quicker information transmission rate than Wi-Fi. The noticeable light range has a transmission capacity that is multiple times bigger than the whole radio recurrence and microwave range.

b) Simple and Inexpensive to Deploy: Recall that the current operational ideas and trial utilization of Li-Fi innovation focus on the utilization of LED lights. This implies that a Li-Fi organization can be incorporated effectively with existing LED lighting frameworks. Any place there is a light source, there can be admittance to the Internet. It is additionally worth referencing that LED lights are reasonable to deliver and their market cost is moderately moderate.

c) Security due to the limitations of Light: Another remarkable advantage or preferred position of Li-Fi is that it is safer than Wi-Fi. Remote correspondence innovations dependent on radio recurrence and microwaves are more helpless against snooping, signal capturing or unapproved interference.

d) Safe from electromagnetic interferences: Moreover, Li-Fi additionally has a bit of leeway of being insusceptible from electromagnetic impedances that influence radio-based remote correspondence advancements. The innovation is likewise helpful in territories that are electromagnetic delicate, for example, airplane lodges, clinics, and atomic force plants, among others since it doesn't cause electromagnetic obstructions.

11.6. Satellite Communication

Satellite communication is the method of transporting information from one place to another using a communication satellite in orbit around the Earth. A communication satellite is an artificial satellite that transmits a signal via a transponder by creating a channel between the transmitter and the receiver located at different locations on the Earth.Telephone, radio, television, internet, and military applications use satellite communications.

How do satellite communication works?

The communication satellites are similar to the space mirrors that help us in bouncing the signals such as radio, internet data, and television from one side of the earth to another. Three stages are involved which explain the working of satellite communications. These are:

- Uplink
- Transponders
- Downlink

Let's consider an example of signals from a television. In the first stage, the signal from the television broadcast on the other side of the earth is first beamed up to the satellite from the ground station on the earth. This process is known as uplink.

The second stage involves transponders such as radio receivers, amplifiers, and transmitters. These transponders are used for boosting the incoming signal and to change their frequency so that the outgoing signals are not altered. Depending on the incoming signal sources, the transponders vary.

The final stage involves a downlink in which the data is sent to the other end of the receiver on the earth. It is important to understand that usually there is one uplink and multiple downlinks.

Advantages of Satellite Communication

There are numerous advantages of wireless communication technology, wireless networking and wireless systems over wired communication including cost, mobility, ease of installation, and reliability, etc.

Cost: The cost of installing wires, cables and other infrastructure is eliminated in wireless communication and hence lowering the overall cost of the system compared to wired communication systems. Installing a wired network in the building, digging up the Earth to lay the cables and running those wires across the streets is an extremely difficult, costly and time-consuming job.

Mobility: As mentioned earlier, mobility is the main advantage of the wireless communication system. It offers the freedom to move around while still connected to the network.

Ease of Installation: The setup and installation of the wireless communication network's equipment and infrastructure are very easy as we need not worry about the hassle of cables. Also, the time required to setup a wireless system like a Wi-Fi network, for example, is very less when compared to setting up a full-cabled network.

Reliability: Since there are no cables and wires involved in wireless communication, there is no chance of communication failure due to damage to these cables, which may be caused by environmental conditions, cable splice and natural diminution of metallic conductors.

Disaster Recovery: In case of accidents due to fire, floods or other disasters, the loss of communication infrastructure in a wireless communication system can be minimal.

Disadvantages of Satellite Communication

Even though wireless communication has many advantages over wired communication, there are a few disadvantages as well. The most concerning disadvantages are Interference, Security and Health.

a) Interference: Wireless Communication systems use open space as the medium for transmitting signals. As a result, there is a huge chance that radio signals from one wireless communication system or network might interfere with other signals.

The best example is Bluetooth and Wi-Fi (WLAN). Both these technologies use very high-frequency waves for communication and when both of these devices are active at the same time, there is a chance of interference.

b) Security : One of the main concerns of wireless communication is the Security of the data. Since the signals are transmitted in open space, it is possible that an intruder can intercept the signals and copy sensitive information.

c) Health Concerns: Continuous exposure to any type of radiation can be hazardous. Even though the levels of radio frequency energy that can cause the damage are not accurately established, it is advised to avoid radio frequency radiation to the maximum.

11.7. Mobile Communication

Mobile Communication is the use of technology that allows us to communicate with others in different locations without the use of any physical connection (wires or cables). Mobile communication makes our life easier, and it saves time and effort.A mobile phone is an example of mobile communication. It is an electric device used for full duplex two-way radio telecommunication over a cellular network of base stations known as a cell site.

Need and importance of mobile communication

Communication: The primary function of mobile phones is to enable and facilitate communication among individuals.

Storage: Cellular phones allow their users to store data. Be it photos, audio files, or text messages, everything can be stored on this single device. This feature allows mobile phone users to carry these files anywhere and everywhere.

Applications: The various applications available in mobile phones further enhance their functions. Many mobile applications can also be downloaded from Google Playstore.

Advantages of Mobile Communication

Flexibility: Wireless communication enables people to communicate with each other regardless of location. There is no need to be in an office or some telephone booth to pass and receive messages.

Cost-effectiveness: In wireless communication, there is no need for any physical infrastructure (Wires or cables) or maintenance practice. Hence, the cost is reduced.

Speed: Improvements can also be seen in speed. The network connectivity or accessibility was much improved in accuracy and speed.

Accessibility: With the help of wireless technology easy accessibility to remote areas is possible. For example, in rural areas, online education is now possible. Educators or students no longer need to travel to far-flung areas to teach their lessons.

Constant connectivity: Constant connectivity ensures that people can respond to emergencies relatively quickly. For example, a wireless device like a mobile can ensure you constant connectivity though you move from place to place or while you travel, whereas a wired landline can't.

11.8. Summary

A brief overview of wireless communication, its advantages and disadvantages, different types of wireless communication and also some important applications are discussed.

11.9. Check your progress

1. Li-Fi stands for
   (a) Light Fidelity
   (b) Life fidelity
   (c) Light Field
   (d) Lighter fidelity

Answer: A

2. Which one of the following is not a Indain Satellite?
   (a) Aryabhata
   (b) Bhaskara-I
   (c) KalamSAT-V2
   (d) Chanukya

Answer: D

3. RADAR is not used in
   (a) Military
   (b) Space exploration
   (c) Air traffic controller
   (d) Amplitude modulation

Answer: D

4. GPS stands for

(a) Globe Positioning System

(b) Global Position System

(c) Global Positioning System

(d) Globalization Positioning System

Answer: C

5. Bluetooth is used for

(a) Long-range communications between devices

(b) Short-range communications between devices

(c) Both (a) and (b)

(d) None of the above

Answer: B

11.10. Keywords

Electromagnetic (EM) Waves: Electromagnetic waves are created as a result of vibrations between an electric and a magnetic field.

Global Positioning System (GPS): It is a radio navigation system used on land, sea, and air to determine the exact location, time and velocity irrespective of weather conditions.

Radio Frequency Identification (RFID): It is a method that is used to track or identify an object by radio transmission uses over the web.

Wi-Fi Router: It connects local networks to other local networks or to the Internet. A wireless access point connects devices to the network wirelessly, using radio frequencies

Light-emitting diode (LED): It is a semiconductor device that emits light when current flows through it

11.11. Questions for self-study

1. Discuss the components of wireless communication.
2. Explain the advantages of Wi-Fi.

3. State and explain the need and importance of mobile communication.
4. Write a brief note on Li-Fi.

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UNIT -12: Computer Networks: Concept, Need, Topologies, Types: LAN, MAN, WAN

Structure

12.0. Objectives

In this unit you will understand

- The basic concept of computer network
- The different types of computers
- The various topologies

12.1. Introduction

Computer networking refers to interconnected computing devices that can exchange data and share resources. These networked devices use a system of rules, called communications protocols, to transmit information over physical or wireless technologies. Nodes and links are the basic building blocks in computer networking. A network node may be data communication equipment such as a modem, hub or, switch, or data terminal equipment such as two or more computers and printers. A link refers to the transmission media connecting two nodes. Links may be physical, like cable wires or optical fibers, or free space used by wireless networks. In this unit, you learn about the basic concept of computer networks, their need and importance, types of networks and topologies.

12.2. Computer network

Information is the building block for effective communication. Communication is the universal currency that knits us together and drives our day-to-day operations. Computer networking is a favorite among many businesses. A computer network is a group of computers linked to each other that enables the computer to communicate with another computer and share its resources, data, and applications. In other words, Computer networking is a pool of integrated computers configured to one another. Computer networks or data networks are chains of nodes linked by communication channels. The nodes receive, transmit and exchange data between endpoints.

12.3. Need and Importance of networks

Computer Network is an interconnection of numerous computers to share an operating system, hardware, and information through a transmission mode among them. The followings are the need and importance of computer networking.

a) Data Sharing

With the help of Computer networking, every user can access all data from the network. For example – if you are doing any office work at your home such as filling out tax files, and at the same time your friend/colleague can receive your file at the destination place without going physically to your home.

b) Hardware device sharing

Computer network provides great flexibility such as multiple computers can share the same hardware devices (printer, plotter, Fax machine, and more). No need, to add a separate printer/plotter with every computer system.

c) Program Sharing

Multiple programs can be shared on the network, and it allows using client/server applications.

d) User Interaction

Networks permit all users to make communication with the help of different modes such as chat platforms, e-mail, newsgroups as well as video conferencing, etc.

e) Data security

On the network, all users can access all your data from an offsite and online server, so it can be more harmful. To protect all data from intruders, all companies use a firewall.

12.4. Components of a network

Here are essential computer network components:

Switches*:* Switches work as a controller which connects computers, printers, and other hardware devices to a network on campus or a building. It allows devices on the network to communicate with each other, as well as with other networks. It helps to share resources and reduce the cost of any organization.

Routers**:** Routers help to connect with multiple networks. It enables to share single Internet connection with multiple devices and saves money. This networking component acts as a dispatcher, which allows to analyze data sent across a network. It automatically selects the best route for data to travel and send it on its way.

***Servers*:** Servers are computers that hold shared programs, files, and the network operating system. Servers allow access to network resources to all the users of the network.

Clients: Clients are computer devices that access and use the network as well as share network resources. They are also users of the network, as they can send and receive requests from the server.

Transmission media: Transmission media is a carrier used to interconnect computers in a network, such as coaxial cable, twisted-pair wire, and optical fiber cable. It is also known as links, channels, or lines.

Access points: Access points allow devices to connect to the wireless network without cables. A wireless network allows one to bring new devices and provides flexible support to mobile users.

Shared data: Shared data are data that is shared between the clients such as data files, printer access programs, and email.

Network interface card: Network Interface card sends, receives data, and controls data flow between the computer and the network.

Local Operating System: A local operating system that helps personal computers to access files, print to a local printer and use one or more disk and CD drives that are located on the computer.

Network operating system: The network operating system is a program that runs on computers and servers. It allows computers to communicate via the network.

***Protocol*:** A protocol is a set of defined rules that allows two entities to communicate across the network.

Hub: Hub is a device that splits network connections into multiple computers. It acts as a distribution center so whenever a computer requests any information from a computer or from the network it sends the request to the hub through a cable. The hub will receive the request and transmit it to the entire network.

LAN cable: Local Area Network (LAN) cable is also called Ethernet or data cable. It is used for connecting a device to the internet.

Port: Port is a logical channel that allows network users to send or receive data to an application. Every host can have multiple applications running. Each of these applications is identified using the port number on which they are running.

12.5. Types of networks

A computer network can be categorized as follows:

- Local Area Network (LAN)
- Wide Area Network (WAN)
- Metropolitan Area Network (MAN)

12.5.1. Local Area Network (LAN)

A LAN is generally confined to a specific location, such as a floor, building or some other small area. The technology is less expensive to implement than WAN. LANs are widely used to connect personal computers and workstations in libraries and offices to share recourses.

Advantages of LAN

- A local Area Network is a group of computers connected in a small area such as a library, building, or office.
- LAN is used for connecting two or more personal computers through a communication medium such as a twisted pair, coaxial cable, etc.
- It is less costly as it is built with inexpensive hardware such as hubs, network adapters, and ethernet cables.
- The data is transferred at an extremely faster rate in the Local Area Network.
- Local Area Network provides higher security.

Disadvantages of LAN

- It covers a small geographical area.
- A virus can be spread more easily.
- A high degree of maintenance.
- Printing can be too much slow, long print queues may develop.
- Data is shared requires a greater security system.
- The level of maintenance continues to grow.

12.5.2. Wide Area Network (WAN)

A wide area network spans a large geographical area, often a country or continent. It multiplies multiple connected LANs; that can be separated by any geographical distance. In most WANs, the network contains numerous cables or telephone lines, each one connecting a pair of routers.

Advantages of Wide Area Network

- A Wide Area Network provides a large geographical area.
- In a WAN network, messages are transmitted fast.
- In WAN network, we can share the software and other resources.
- If the leased lines are used, then WAN gives a high bandwidth. The high bandwidth increases the data transfer rate which in turn increases the productivity of our company.

Disadvantages of Wide Area Network:

- A WAN network has more security issues than LAN.
- The data is transferred on the internet which can be changed or hacked by hackers, so a firewall needs to be used. Some people can inject the virus into the system so antivirus is needed to protect from such a virus.
- The installation cost of the WAN network is high as it involves the purchasing of routers and switches.
- It covers a large area so fixing the problem is difficult.

12.5.3. Metropolitan Area Network (MAN)

Metropolitan Area Network is a bigger version of LAN and normally uses the same technology. It might cover a group of nearby corporate offices or a city and might be either private or public. On another hand, MAN is a network running throughout a metropolitan area such as a backbone for a phone service carrier. A MAN just has one or two cables and does not contain switching elements.

Advantages of MAN

- MAN is a network that covers a larger geographic area by interconnecting a different LAN to form a larger network.
- Government agencies use MAN to connect to the citizens and private industries.
- In MAN, various LANs are connected through a telephone exchange line.
- It has a higher range than a Local Area Network (LAN).

Disadvantages of MAN

- More cable is required for a MAN connection from one place to another
- The data rate is slow compared to LAN
- It is difficult to make a system secure from hackers
- The large network difficult to manage
- It is difficult to secure the network once it becomes large
- Network installation requires skilled technicians and network administrators. This increases overall installation and management costs
- Cost is higher than LAN

12.6. Network topology

The geometric representation of how the computers are connected to each other is known as topology. There are five types of topology – Mesh, Star, Bus, Ring and Hybrid.

12.6.1. Star topology

Each machine is connected to a central hub or switch. It allows each machine on the network to have a point-to-point connection to the central hub. All of the traffic which transverses the network passes through the central hub. The hub acts as a signal booster or repeater which in turn allows the signal to travel greater distances. In star topology, each device in the network is connected to a central device called a hub. Unlike Mesh topology,

star topology doesn't allow direct communication between devices, a device must have to communicate through a hub. If one device wants to send data to another device, it has to first send the data to a hub and then the hub transmits that data to the designated device.

Advantages of Star topology

- Less expensive because each device only needs one I/O port and needs to be connected to a hub with one link.
- Easier to install
- Less number of cables are required because each device needs to be connected to the hub only.
- Robust, if one link fails, other links will work.
- Easy fault detection because the link can be easily identified.

Disadvantages of Star topology

- If the hub goes down everything goes down, and none of the devices can work without the hub.
- Hub requires more resources and regular maintenance because it is the central system of star topology.

12.6.2. Bus topology

In case of bus topology, each machine is connected to a single cable. Each computer or server is connected to a single bus cable through some kind of connector. A signal from the source travels in both directions to all computers connected on the bus cable until it finds the address on the network that is the intended recipient. If the computer address does not match the intended address for the data, the computer ignores the data. Alternatively, if the data does match the computer address, the data is accepted.

Advantages of bus topology

- Easy to install. Each cable needs to be connected to the backbone cable.
- Less cables are required than mesh and star topology

Disadvantages of bus topology

- Difficult in fault detection.
- Not scalable as there is a limit to how many nodes you can connect with the backbone cable.

12.6.3. Ring topology

Each computer is connected to the network in a closed loop or ring. Each machine or computer has a unique address that is used for identification purposes. The signal passes through each machine or computer connected to the ring in one direction. Ring topologies typically utilize a token-passing scheme, used to control access to the network. By utilizing this scheme, only one machine can transmit on the network at a time. In a ring topology, each device is connected to the two devices on either side of it. This structure forms a ring thus it is known as a ring topology. If a device wants to send data to another device, then it sends the data in one direction, each device in the ring topology has a repeater, if the received data is intended for another device then the repeater forwards this data until the intended device receives it.

Advantages of Ring Topology

- Easy to install.
- Managing is easier as to add or remove a device from the topology only two links are required to be changed.

Disadvantages of Ring Topology

- A link failure can fail the entire network as the signal will not travel forward due to failure.
- Data traffic issues, since all the data is circulating in a ring.

12.6.4. Mesh topology

In mesh topology, each device is connected to every other device on the network through a dedicated point-to-point link.

Advantages of Mesh topology

- No data traffic issues as there is a dedicated link between the two devices which means the link is only available for those two devices.
- Mesh topology is reliable and robust as a failure of one link doesn't affect other links and the communication between other devices on the network.
- This topology is secure because there is a point-to-point link thus unauthorized access is not possible.
- Fault detection is easy.

Disadvantages of Mesh topology

- The number of wires required to connect each system is tedious and a headache.
- Since each device needs to be connected to other devices, more I/O ports required must be huge.
- Scalability issues because a device cannot be connected with a large number of devices with a dedicated point-to-point link.

12.7. Summary

An interconnected collection of computers is called a computer network. Two computers are said to be interconnected if they can exchange information. Nodes and links are the basic building blocks in computer networking. A network node may be data communication equipment such as a modem, hub or, switch, or data terminal equipment such as two or more computers and printers. A link refers to the transmission media connecting two nodes. Links may be physical, like cable wires or optical fibers, or free space used by wireless networks.
In a working computer network, nodes follow a set of rules or protocols that define how to send and receive electronic data via the links.

12.8. Check your progress

1. Computer networking is mainly used for
   (a) Only data sharing
   (b) Only hardware device sharing
   (c) Only program sharing
   (d) All the above

2. _____ connects computers, printers, and other hardware devices to a network.
   (a) Switch
   (b) Router
   (c) Server
   (d) Client

3. Which one of the devices split network connections into multiple computers?

(a) Switch

(b) Router

(c) Hub

(d) Client

4. The Topology in which all the devices are connected to a single hub is called_____

a) Bus

b) Mesh

c) Ring

d) Star

5. In which topology each device is connected to every other device on the network?

a) Srat

b) Bus

c) Mesh

d) Tree

12.9. Keywords

Fax machine: Fax machines are designed to scan printed textual and graphic material and then transmit the information through the telephone network to similar machines.

Plotter: It is a computer hardware device used for printing vector graphics. Instead of toner, plotters use a pen, pencil, marker, or another writing tool to draw multiple, continuous lines on paper rather than multiple dots, like a traditional printer.

Video conferencing: Video conferencing is an online technology that allows users in different locations to hold face-to-face meetings without having to move to a single location together.

Server: A server is a computer program or device that provides a service to another computer program and its user, also known as the client.

TCP/IP: TCP/IP stands for Transmission Control Protocol/Internet Protocol. It is a set of protocols or rules and procedures that governs communications among computers on the internet.

UDP: It is a message-oriented communication protocol, used for communication channels and data paths

FTP: The term File Transfer Protocol (FTP) refers to a process that involves the transfer of files between devices over a network.

12.10. Questions for self-study

1. What is a computer network? Discuss its need and importance.
2. State and explain various components used in computer networking.
3. What is LAN? Explain its advantages and disadvantages.
4. Discuss the different types of network topologies.

12.11. References

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