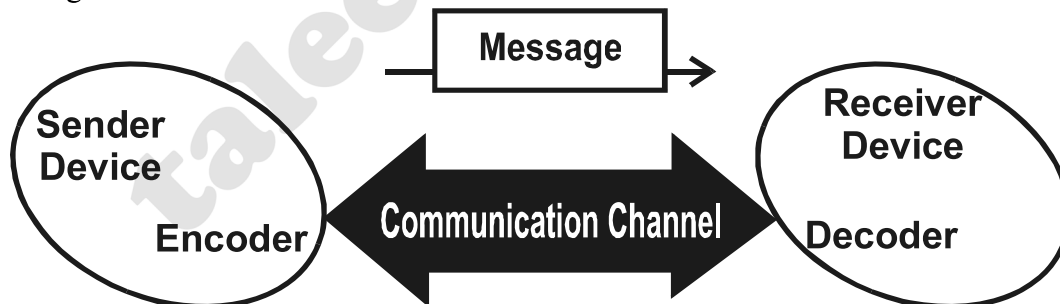


DATA COMMUNICATION

Q1. What is Data Communication? What are the components of Data Communication?

DATA COMMUNICATION:

- Data communication is the exchange of data between two devices via some form of transmission media **or**
- Data communication is the transfer of data or information from one location to another. **or**
- The movement of encoded information by means of electrical transmission system from one computer or device to other computer or device through communication channels.
- In this process data is transmitted electronically from one system to another system using standard methods.



Components of Data Communication:

There are five components of data communication.

Message

Sender

Receiver

Communication channel

Encoder and Decoder

Message:

- The message is the information or data to be communicated.
- Message can be text, numbers, pictures, sound, video or any combination of these.

Sender:

- The sender is the device that sends the data.
- It is also called source or transmitter.
- It can be computer, telephone, camera or so on.

Receiver:

- The receiver is the device that receives the data.
- It is also called destination or sink.
- It can be computer, telephone, TV or so on.

Communication channel:

- It is a path by which data travels from sender to receiver.
- There are two types of communication channels.
- Guided Media (Cables-twisted pair, Coaxial, fiber optic)
- Unguided Media (Microwave, satellite)

Encoder and Decoder:

- **Encoder** converts digital signal to a form which can pass through transmission medium.
- **Decoder** converts signals from encoded form to a digital form understandable for the receiver.
- Sender and receiver cannot communicate without encoder and decoder.

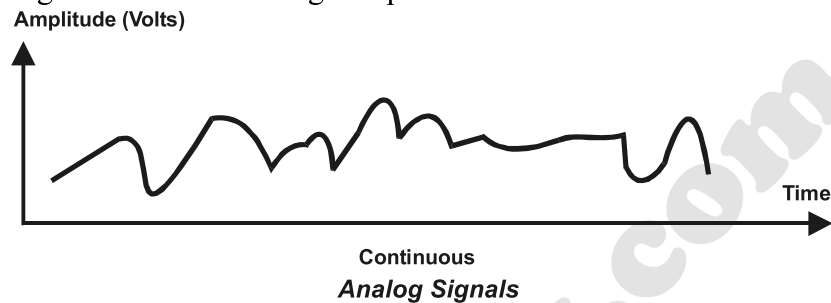
Q2. What are Signals? What are the Types of Signals?**SIGNALS:**

- The electromagnetic or light wave representing data are called signals
- There are two forms of signals.
 - Analog Signals.
 - Digital Signals.

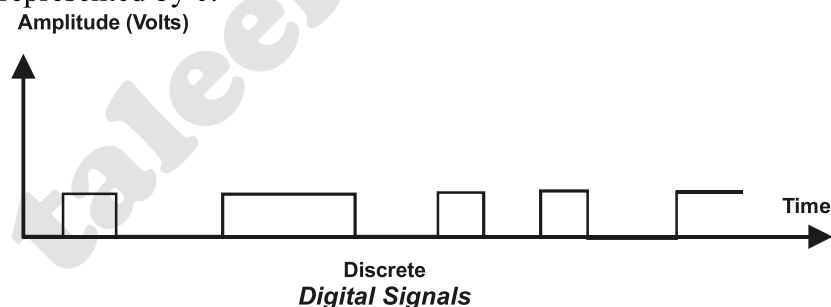
Analog Signals:

- These are continuous electrical signals in the form of wave.
- This wave is called carrier wave.

- In analog signals the transmitted power varies over a continuous range e.g. sound, light and radio waves.
- There are two characteristics of analog signals
- **Frequency:**
- Number of times a wave repeats during a specific time. It is measured in hertz (Hz).
- **Amplitude:**
- It is the height of wave within a given period of time.

**Digital Signal:**

- A digital signal uses on-off electrical pulses in discontinuous or discrete form.
- It is a sequence of voltage pulses represented in binary form. Binary means two digits 0 and 1. Each binary digit is called a bit and it is the smallest element of data.
- Computers process the data in the form of digital signals, because it works with binary numbers.
- An electrical pulse inside the computer represented by 1 and the absence of electrical pulse is represented by 0.

**Q3. What is DATA? What are the Types of DATA?****DATA:**

- The collection of raw facts and figures is called data.

Types of data:

- Text
- Numeric

- Image
- Audio
- Video

Text:

- Text consists of words, sentences and paragraphs.
- Text is stored in the form of ASCII codes.
- ASCII stands for American Standard Code for Information Interchange and it is a seven bit coding scheme for computers.
- **Text Processing:** It refers to the ability to manipulate words, lines and pages.

Numeric:

- Numeric data consists of digits from 0 to 9.
- It can be positive or negative number.
- There are two types of numeric data
- Integers (+56, -90 etc.)
- Real (2.34, -8.97 etc.)

Image:

- Image consists of charts, graphs, pictures and free hand drawings.
- The data is transferred in the form of 8 bits pattern.

Audio:

- Sound is a representation of audio.
- Sound is converted into digital code by sampling the sound waves 44056 times per second.
- Each sample is converted into a 16 bit number.

Video:

- It is produced by camera.
- It is a combination of images and it conveys the idea of motion.
- It creates actions and movements.

Q4. What are Encoding Schemes? Discuss different Types of Encoding Schemes.**ENCODING OF DATA:**

- As computer works with binary digits only, therefore, all types of data are converted into binary digits.
- Computers transmit data in the form of binary codes; therefore, both sender and receiver should have the same standard rules to understand it.

Coding Schemes:

- A coding scheme in computers is used to represent data as well as for data communication.

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- Data is represented in the groups of bits.
- The following are some coding schemes.

BCD

EBCDIC

ASCII

Unicode

BCD:

- It stands for Binary Coded Decimal.
- It was a 4 bit encoding scheme.
- 4 bits were insufficient to represent various characters used by the computers.
- 4 bits were insufficient; therefore 6 bits were used to represent characters in BCD code.
- BCD numbers are not used in modern computers.

EBCDIC:

- It stands for Extended Binary Coded Decimal Interchange Code.
- BCD code was extended to 8-bit code
- It was used by IBM (International Business Machines).
- 256 different characters were represented using EBCDIC.
- EBCDIC provides better and faster way to transmit data between two computers.

ASCII:

- ASCII stands for American Standard Code for Information Interchange.
- It was a 7-bit coding scheme.
- 128 different characters were represented using this scheme.
- ASCII codes were developed by ANSI (American National Standard Institute).
- It was extended to 8-bit coding scheme and 256 different characters combination were represented in the form of binary numbers.

Unicode:

- It stands for universal code.
- It is 16-bit code to represent 65536 different characters and symbols in the form of binary numbers.
- It was developed by following the ASCII coding scheme; therefore, Unicode has replaced the ASCII at all levels.
- UTF-8 stands for Universal Transformation Format-8 and with UTF-8 encoding Unicode can be used in backward compatible way because the first 256 codes in Unicode are similar to the 256 codes used by ASCII system.

- It can represent the characters of all languages in the world.

Q5. What are Modes of Data Communication? Discuss different Types of Modes.

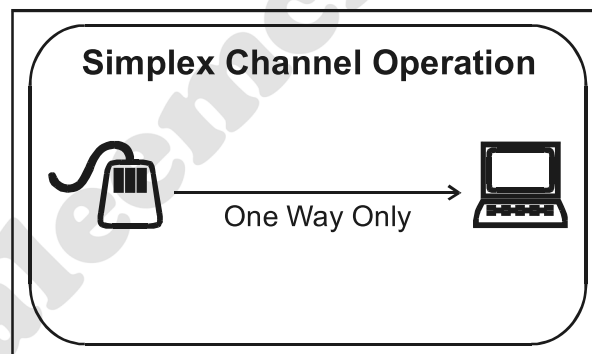
MODES OF DATA COMMUNICATION:

- The way in which data is transmitted from one place to another is called data communication mode.
- There are three types of data transmission mode.

Simplex, Half-duplex, Full-duplex

Simplex:

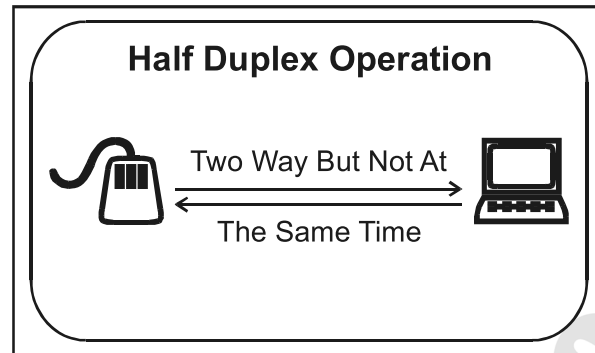
- It is a mode of transmission in which data flows in one direction only.
- Sender only sends data and can not receive and receiver only receives the data and can not transmit.
- It is not a popular transmission mode because most modern computers use two-way transmission of data.
- Examples: TV Transmission, Point of sale terminal in which sale data is entered without any reply.



Half-Duplex:

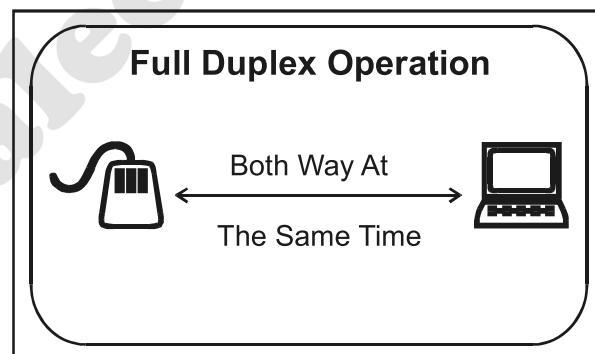
- In half-duplex transmission, data can be sent and received in both directions but not at the same time.
- Only one end transmits at a time and the other end receives i.e. Data is sent and received alternatively.
- It is possible to perform error detection and requests the sender to retransmits information.

- The data transmission rate of this mode is very slow.
- Example: Internet surfing: user issues a request of web page then that document is downloaded and displayed.



Full-Duplex:

- In full-duplex transmission, data can be sent and received in both directions at the same time.
- The data transmission rate of this mode is very fast.
- Full-duplex transmission can be made possible by special devices called **Multiplexers**.
- Full-duplex transmission is limited to mainframe computers because expensive hardware is required for bidirectional mode.
- Example: Conversation on Telephone

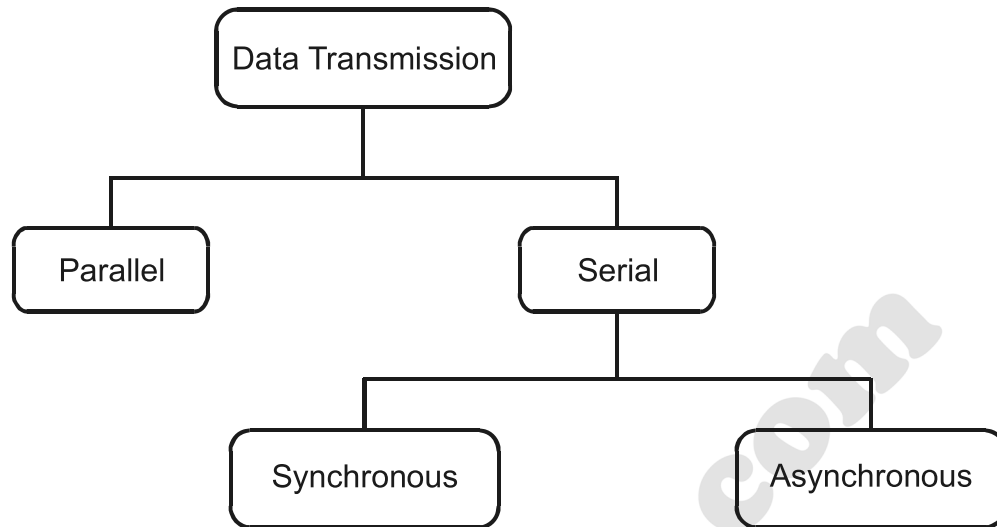


Q6. What are different Types of Data Transmission?

TYPES OF DATA TRANSMISSION:

- There are two types of data transmission.
 1. Parallel Transmission

2. Serial Transmission



Parallel Transmission:

- Methods in which groups of bits are sent at the same time using multiple wires.
- Parallel data transmission uses multiple communication lines. Multi-line highway is an example of parallel transmission.
- Parallel data transmission mode is very fast.
- Within computer data is transmitted using parallel mode. If the computer uses 32 bit internal structure, then all the 32 bits of data are transferred simultaneously on 32 lane connections.
- Parallel data transmission is not suitable for long distance.
- It is expensive than serial transmission.
- As printers are connected to the parallel port of computer; therefore, computers transfer data to printers using parallel transmission mode.

Serial Transmission:

- Serial transmission uses single communication line. Serial data transmission mode is very slow because data is sent sequentially in bit-by-bit pattern.
- Serial mouse and telephone lines use serial transmission mode in computer.
- There are two classifications of serial transmission.
- Asynchronous Transmission

- Synchronous Transmission

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Asynchronous Transmission:

- A type of communication that sends data using flow control rather than a clock to synchronize data between the source and destination.
- It is also called **start/stop transmission**.
- In asynchronous transmission each character is surrounded by start and stop signals.
- A start bit is sent before sending the data. The start bit has a value **zero** and is called **space state**.
- When a line switches from 1 to 0, the receiver is alerted that a character or data is coming.
- In asynchronous transmission an **idle line** is identified with a value **1** also called **mark state** i.e. one (1) indicates that no data is being sent.
- A stop bit i.e. 1 is sent after sending the data.
- In asynchronous transmission, data is transmitted character by character at irregular intervals.
- Keyboard is an example of asynchronous transmission.
- Its advantage is that it does not require any local storage at the terminal or computer.
- The disadvantage of asynchronous transmission is that the transmission line is idle during the time intervals between transmitting characters.
- It is less efficient than synchronous transmission.
- Its cost of transmission is low.

Start	Character	Stop	Start	Character	Stop	Start	Character	Stop
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Synchronous Transmission:

- A type of transmission that uses a clock to control the timings of bits.
- In synchronous transmission large volumes of information can be transmitted at a single time.
- Data is transmitted block by block i.e. each block may contain many bytes of data.
- A synchronized clock is necessary for synchronous transmission.
- Printer is an example of synchronous transmission.
- It is very efficient way of transmitting data.
- The disadvantage is that it requires storage at both ends to assemble blocks of data.

- Its equipment is very expensive.

Start	Message	Error Check bit	Stop	Start	Message	Error Check bit	Stop	Start	Message	Error Check bit	Stop
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Q7. What are Bandwidth? Explain Baseband and Broadband Techniques.

BANDWIDTH:

- The amount of data can be transferred through a communication medium at unit time is called bandwidth.
- It is the measure of transmission rate of communication channel.
- Different communication media has different transmission speed depending on bandwidth i.e. if bandwidth is higher then the transmission speed of communication channel is faster.
- For analog signals bandwidth is measured in hertz (Hz).
- For digital signals bandwidth is represented in bits per second (bps).

BASEBAND:

- It is a communication technique in which digital signals are transmitted over a transmission medium without change in modulation.
- Digital signals are called baseband signals. Token ring and Ethernet uses baseband signals.

BROADBAND:

- It is a technique of transmitting a large amount of data, voice, and videos over long distances simultaneously by modulating each signal on to a different frequency.
- **Modulation** is a process in which modem converts digital signals into analog signals.
- FDM (frequency division multiplexing) technique is used in broadband transmission.
- Broadband is the bandwidth and it is used by very high speed computers e.g. mainframe.
- It includes microwave, satellite, coaxial and fiber optic media.

Q8. What is Communication Channel or Media? Discuss Different Types of Communication Media.

COMMUNICATION MEDIA:

- It is a pathway that is used for transmitting data from sender to receiver.

- These pathways are called communication channels.
- There are two kinds of transmission media.

Guided media and unguided media

GUIDED MEDIA:

- It refers to those channels that allow the transmission of data through a physical media.
- These are also called bounded media.
- Examples are Twisted pair, Coaxial and Fiber optic

Twisted pair/ wire pairs:

- These are used in local telephone communication and short distance digital transmission.
- It is made of copper. The pair of wires are twisted together to reduce the interference by adjacent wires.
- It consists of four pair of wires (8-wires).
- These are used to connect terminals to the main computer placed at a very short distance.
- Data transmission speed is up to 9600 bps if the distance is not more than 100 meters.
- It is an inexpensive medium of data transmission.
- It is easy to install.
- Its bandwidth is less than coaxial and fiber optic cable.

Coaxial:

Structure:

- It consists of single copper wire surrounded by insulating material.
- It contains 4 to 22 coaxial units called tubes.
- Each co-axial unit consists of 0.1 inch copper inner conductor kept centered within 0.375 inch cylindrical copper outer conductor by polythene insulating disks spaced about 1 inch apart (**It consists of central copper wire surrounded by a PVC insulation material over which a sleeve of copper mesh is placed. The metal sleeve is again shielded by an outer shield of thick PVC material**).
- The outer conductor is formed into a cylinder around the disk.

Advantages:

- It can be used for long distance telephone lines for data and voice transmission at a very high frequency.

- The bandwidth of coaxial cable is 80 times greater than twisted pair media.
- It is also used in LAN
- It has low transmission error rate i.e. it creates less distortion or less interference of electromagnetic waves.

Fiber optic:

- It is a cost effective alternative to satellite communication.

Structure:

- Fiber optic cable consists of tubes of glass through which data is transmitted as pulse of light.
- A normal fiber optic cable is a fiber of glass called the CORE (about the size of human hair). The diameter of core is 62.5 micron (1 micron = 10^{-6} meters).
- The core is surrounded by concentric layers of glass called CLADDING. The diameter of cladding is 125 micron.
- The cladding is surrounded by a plastic material called Jacket. Its source side is a converter that it converts electrical signals into light waves. These light waves are transmitted over the fiber. Another converter (photoelectric diodes) is placed at the receiving end which converts the light waves into electrical signals.

Characteristic of fiber optic:

- Refraction is the characteristic of fiber optic i.e. either pass or reflect the light.
- When light passes through a medium, it bends as it passes from one medium to another.
- Its transmission capacity is 26000 times faster than twisted pair cable.

Advantages:

- Its transmission speed is very fast.
- It is not affected by electromagnetic interference; therefore noise and distortion are also reduced with fiber optics.
- It is more reliable than the other transmission medium i.e. it has high level of data security.
- Its error rate is very low i.e. it is high quality transmission.

UNGUIDED MEDIA:

- It refers to those channels that transmit data and information in the form of wave.
- These are the communication channels in which data is transmitted through the air instead of cables i.e. there is no physical path between two devices for the transmission of data.
- Data signals are not bounded to cabling media therefore it is also known as unbounded media.

- The space and atmosphere are the examples of unguided media through which microwave and satellites are used for data communication.
- Examples are: Microwave Transmission, Satellites and Mobile communication

Microwave Transmission:

- These are the communication channels in which data is transmitted through the air instead of cables.
- Microwave is the high frequency waves that can only be traveled in straight lines.
- These waves cannot bend or pass through obstacles.
- It is limited to a particular city or a community.
- The transmitter or receiver are mounted on a very high towers should be in a line of sight.
- This may not be possible for long distance transmission because signals become weaker and require power amplification.
- Repeaters on antennas are mounted at very high towers usually 20 to 30 miles apart to overcome the problem of weakening signals and line of sight.

Satellites:

- The main problem with microwave communication is that the curvature of earth, mountains and other structures often blocks the line of sight.
- Instead of antenna, Satellite can also be used to transmit microwave messages from one location to another.
- Satellite rotates approximately 23300 miles above the earth in precise location.
- Satellite transmission stations that can both send and receive messages are known as earth stations.
- The transmission from earth station to satellite is called uplink and transmission from satellite to earth station.
- Moon was used in the early years of satellite transmission.
- The time taken by a signal to reach to the moon and back was about 2 seconds. This time is called **Satellite delay** and it is still present in all our satellite communication.

Advantages:

- A large volume of data can be transmitted at a very high speed.
- Transmission and reception costs are independent of the distance between two points.
- Different communication satellites are used to carry different kinds of information.

- Telephone calls, TV Channels, Internet, military communication, weather and radio stations use these satellites for broadcasting.

Disadvantages:

- The bad weather can severely affect the quality of transmission.
- Satellite transmission causes security problems because it is easy to intercept the transmission travels through the air.
- Its cost of transmission is very high.
- **Satellite delay** is still present in all our satellite communication.

Mobile communication:

- It is radio based network that transmits data to and from the mobile computers.
- Computer can be connected to the network through wired ports or through wireless connections.

Q9. What is a Modem? Discuss Different Types of Modem.**MODEM:**

- Modem stands for modulator and demodulator.
- Modulator means that it converts digital signals into analog signals and sends it over telephone lines. This process is known as **modulation**.
- Demodulator means that receiving modem converts analog signals into digital signals and this process is known as **demodulation**.
- It helps us to transmit data from one computer to another computer using standard telephone lines.

Transmission Rate:

- It indicates how many bits per second a modem can transmit or receive.

Speed:

- The speed of modem is determined by the modulation and demodulation standard.
- The rate at which a modem converts digital signals into analog signals and sends them over transmission media and modem converts analog signals into digital signals is called modem speed.
- It is measured in bits per second (bps).
- Different modems have different speeds

2400 bps, 9600 bps, 56.6 kbps

Self Testing:

- Modem can test the digital connection with computer and analog connection with remote modem.

Voice over data:

- It has the facility of voice conversation while data being is transmitted.

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Error Control:

- It uses different methods to control errors for transmitting data.

Types of Modem:

- Modem can be divided in to three categories in terms of size and shape.

External Modem

Internal Modem

Wireless Modem

External Modem:

- External modem is attached to the computer system with the help of Com 1 or Com 2 port.
- It is connected to the telephone wall jack by another cable.
- An external power is supplied to it.
- It is very easy to setup.

Internal Modem:

- An internal modem is a circuit board that can be attached inside the system through expansion slots.
- It cannot be moved easily from one PC to another.
- Its setup is difficult.

Wireless Modem:

- Wireless modems transmit data through air (using unguided media) instead of cable (guided media).
- It is also called radio frequency modem.
- These are designed to work with cellular technology and wireless local area network.
- These are not yet perfected but the technology is rapidly improving.