

KCA 101: FUNDAMENTAL OF COMPUTERS & EMERGING TECHNOLOGIES

for Master of Computer Application (MCA)

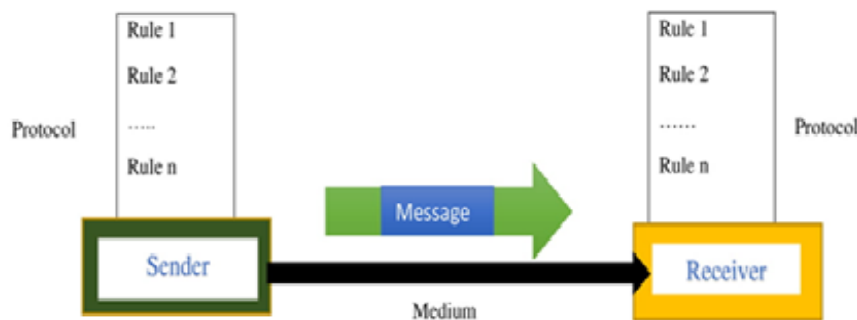
Data Communication

Data exchange between a source and a receiver across a transmission medium, like a wire connection, is referred to as data communication. When communicating devices are located in the same building or another similarly constrained geographic area, data communication is referred to as local. Source and receiver have extremely straightforward definitions. Source and receiver are terms used to describe the devices that transmit and receive data respectively.

Components of Communication System

1. **Message:** It is the data or information that needs to be shared. Text, numbers, images, sound, video, or any mix of these can all be included.
2. **Sender:** The sender of a communication is the machine or computer that creates and sends it.
3. **Receiver:** The message is received by a computer or other device.
4. **Medium:** The physical road or channel used to transmit a message from one party to another. The medium can be wireless like a laser, radio waves, or microwaves or wired like twisted pair wire, coaxial cable, or fiber-optic cable.
5. **Protocol:** is a collection of rules guidelines that controls how devices communicate with one another. The same protocols are used for communication between the sender and the recipient.

Data Communication System



A protocol carries out the following tasks:

1. **Sequencing of data:** It means dividing a lengthy communication into discrete packets of a set size.
2. **Data movement:** The most effective route between the source and the destination is defined by data routing.
3. **Formatting data:** The bits or characters that make up a packet of data, control, addressing, or other information are determined by data formatting standards.
4. **Flow management:** Additionally, a protocol for communication keeps a quick transmitter from overwhelming a sluggish receiver. It controls the data flow on communication connections to ensure resource sharing and protection against traffic congestion.

5. **Control of Error:** These guidelines are intended to identify message mistakes and guarantee that the right messages are transmitted. Retransmitting erroneous message blocks is the most used technique. A block with an error in this scenario is disregarded by the receiver and sent again by the sender.
6. **Transmission sequence and precedence:** These regulations make sure that every node has the opportunity to utilize the network's communication channels and other resources in accordance with the priority allocated to them.
7. **Establishing and ending a connection:** When two nodes in a network desire to communicate with one another, these rules specify how connections are created, kept up, and ended.
8. **Data protection:** In most communication systems, providing data security and privacy is also standard.

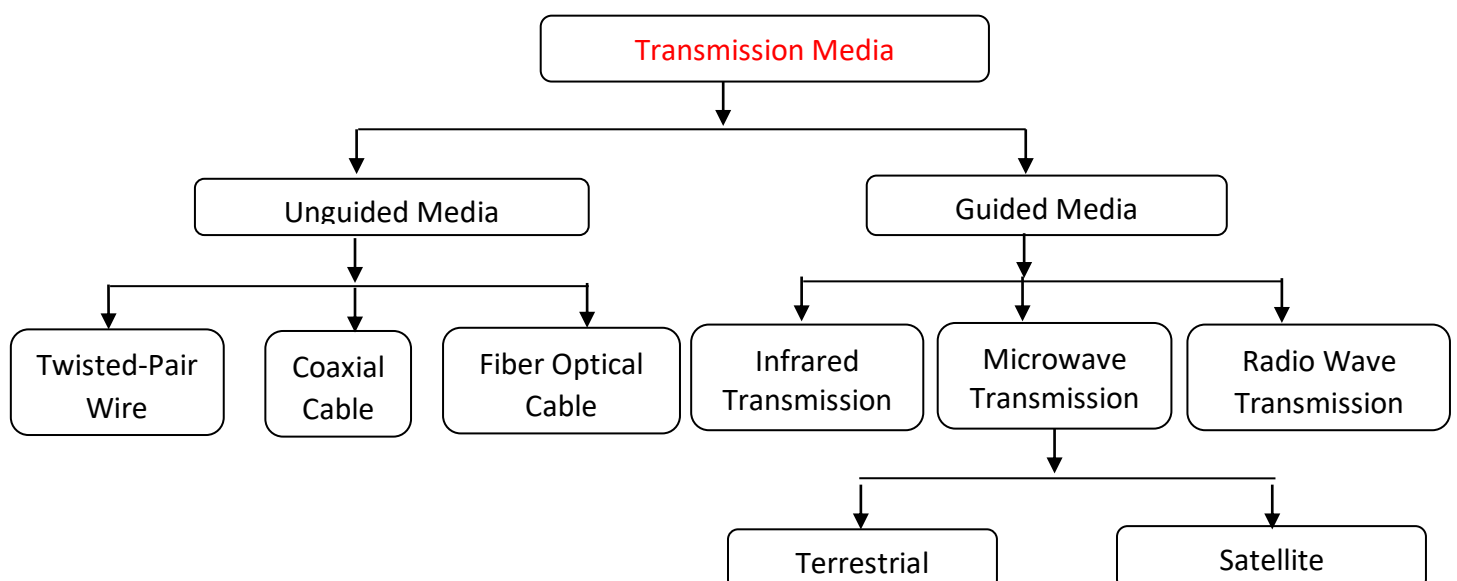
Data Transmission Modes

The phrase "transmission mode" describes the process of transmitting data between two communication devices using an interaction channel that specifies the direction of data flow. Based on the direction of the information exchange, there are three main types of transmission modes. Simplex comes first, then half-duplex, and lastly full-duplex.

1. **Simplex Mode:** When there is only a single or one-way information flow from sender to receiver, the Simplex transmission method is employed in computing networks. Communication only takes place in one way in this manner of transmission; hence, the circuit is set up to either transmit or receive data. Example:-Keyboard-to-computer communication, TV broadcasting, etc.
2. **Half-Duplex:** This mode of transmission, the linked devices can send or receive data, but not concurrently. As radio stations can both receive and send data in half-duplex mode, the communication's direction can be switched. When simultaneous communication in both directions is not necessary, the half-duplex mode is utilized. Example: Walkie-talkie.
3. **Full duplex:** This mode of transmission is used in computing networks when there is simultaneous information flow in both directions, from sender to receiver. In this mode of transmission, the channel capacity is shared between the two devices, and communication occurs in both directions across a communication link that requires two wires. Example:-telephone network etc.

Data Transmission Media

Data is transmitted from one computer to another over network with help of transmission media. Transmission median can be categorized as guided media and unguided media.



Guided Media

Data are sent along specific path through wires or cables. Fiber Optical and copper wire are most commonly used guided media.

Guided media are categorized as

1. Twisted pair Cables
2. Coaxial cables
3. Optical fiber cables.

Twisted pair Cables

Twisted pair cable consists of four pair of copper wires insulated with material like plastic or Teflon, twisted together. It reduces interference from external sources. It is used in network of short and medium distance communication.

Types of twisted pair cable: There are two types of twisted pair cables:

1. Unshielded Twisted-Pair Cable
2. Shielded Twisted-Pair Cable

Unshielded Twisted-pair cable: unshielded twisted pair cable is widely used in telecommunications. Unshielded Twisted pair (UTP) cable is categorized as follows:

Category 1 UTP: Mostly used in telephone lines as it supports only low-speed data.

Category 2 UTP: It supports upto 4Mbps.

Category 3 UTP: It supports upto 16Mbps.

Category 4 UTP:It supports upto 20Mbps. It can also be used for long-distance communications.

Shielded Twisted-pair cable: Shielded twisted pair cable contains the metal foil surrounding the twisted copper wires to avoid external interference.

Advantages of Twisted pair cable:

1. Lightweight cable
2. Installation is easy
3. Can carry both analog and digital data.
4. Cheaper than other transmission media.

Disadvantages of Twisted pair cable:

1. Not durable, easy to break.
2. Attenuation is high
3. Poor security.
4. Support only lower bandwidth.

Coaxial Cable

It contains a central conductor enclosed in insulating cover, which is in turn enclosed in metal foil shield. The whole cable is covered in plastic cover. The metal foil shield protects against noise. The inner conductor is used for data transfer and upper copper mesh is used to protect against noise.

Coaxial cables are categorized as

1. **Baseband Coaxial cable:** Used to transmit signal at high speed. It is used for digital transmission.
2. **Broadband Coaxial Cable:** Used to transmit multiple signals simultaneously. It is used for analog transmission.

Advantages of Coaxial cable:

1. High speed of data transmission.
2. High bandwidth
3. Long distance communication.
4. Better noise reduction.

Disadvantages of Coaxial cable:

1. More expensive than twisted-pair cable.
2. Whole network consists of single cable; any fault in cable can cause failure of entire network.

Optical Fiber Cable

It is also known as fiber-optic cable. It is made up of glass and data transmission is based on the concept of reflection of light through glass. In fibre optic cable, the optical fibres are coated in plastic. These optical fibres send the data by pulses of light. The plastic coating protects the cable from temperature, electromagnetic inference and other types of wiring issue.

Components of a fibre optic cable:

Core: The core of the fibre optic cable contains optical fibres and is responsible for data transmission in form of light pulses.

Cladding: The core is enclosed in a layer of glass and this layer is called cladding. The main use of cladding is to reflect the light so that the light can be transmitted from source to the destination through reflection.

Jacket: The jacket is the outer layer of fibre optic cable which is made up of plastic and the whole purpose of jacket is to protect the cable.

Advantages of Fibre Optics:

1. High speed of data transmission.
2. High bandwidth supported.
3. Longer distance communication.
4. More secure as light signals are difficult to tap.

Disadvantages of Fibre Optics:

1. Installation is difficult.
2. More cost is associated.
3. They are more fragile because they can break on bending.
4. Need electric-light signal converter at sender and light-electric signal converter at receiver.

Unguided Media They are also called wireless media because they use air as transmission medium. **Types of unguided media**

1. Radio Wave Transmission
2. Infrared Transmission
3. Terrestrial Microwave Communication
4. Satellite Microwave Communication

Radio Wave Transmission

Radio waves are very low frequency electromagnetic waves that are transmitted in all directions. In radio transmissions, the antennas need not be aligned nor required to be set in a particular manner to send and receive signals. Since radio waves are omnidirectional (all

directions), it is not possible to isolate communication inside the building. Radio transmission frequency ranges from 3KHz to 1GHz.

Advantages of Radio Transmission:

Radio waves are mainly used for Wide Area Networks (WAN) for example: Mobile networks.

1. Suitable for longer distance communications.
2. Signals can penetrate walls.
3. Higher data transmission rate compared to other transmission mediums.

Disadvantages of Radio Transmission:

1. Waves are omnidirectional so faces interference from other signals of same frequency so disturbance can be there.
2. Not possible to isolate the communication inside the building.

Infrared Transmission

Infrared waves are highest frequency waves; frequency ranges from 300GHz to 400 THz. Suitable for short distance communication. Bandwidth is high so data transmit rate is high compared to other mediums. These waves cannot penetrate walls, thus they are ideal for isolated communications.

Advantages of Infrared Transmission:

1. Secure
2. High speed
3. High frequency signals
4. High data transfer rate
5. low interference

Disadvantages of Infrared Transmission:

1. Sun rays interfere with the infrared rays so not ideal for outdoor communication.
2. Suitable for short distance communication only.
3. Cannot penetrate walls so difficult to establish a communication between two different rooms

Terrestrial Microwave Transmission

In this type of microwave transmission, both the sender and receiver antennas are in direct sight with each other. The frequency range of terrestrial microwave ranges from 4 to 6GHz. It supports the bandwidth from 1 to 10 Mbps. If used in short distance communication, the implementation cost is cheap as we do not need relay towers. However when terrestrial type microwave transmission is used for long distances, the implementation cost goes high as we need relay towers to extend the signals. Attenuation means loss of signal. In terrestrial type microwave transmission, attenuation mainly depends on frequency and signal strength. Implementation is difficult as the tower needs to be line of sight and the signal requirement makes it even more difficult to implement.

Advantages of Terrestrial type microwave transmission:

1. It is cheaper than cable transmission
2. Possible to implement in areas where cable transmission is difficult to implement such as hill areas.

Disadvantages of Terrestrial type microwave transmission:

1. Not secure, susceptible to eavesdropping.
2. Weather condition can affect the transmission.
3. Limited bandwidth.

Satellite type microwave transmission

This type of communication uses the satellite antenna for communication. The sender antenna sends the signal to the satellite antenna which is revolving around the earth at a known height. The satellite antenna then amplifies the received signal and sends it to the receiver antenna.

Advantages of Satellite type transmission:

1. The transmission can be done to the longer distances.
2. Satellite communication is unaffected by the distance of the data transmission.
3. Easy to install compared to terrestrial type.

Disadvantages of Satellite type transmission:

1. Installation of satellite is extremely tough.
2. Installation cost is high and development requires more time.

Computer Network

It is defined as a system that connects two or more computing devices for transmitting and sharing information. Computing device may be anything from mobile phone, printer, desktop or a server. These devices may connect using physical wires or wireless.

The first working network was ARPANET.

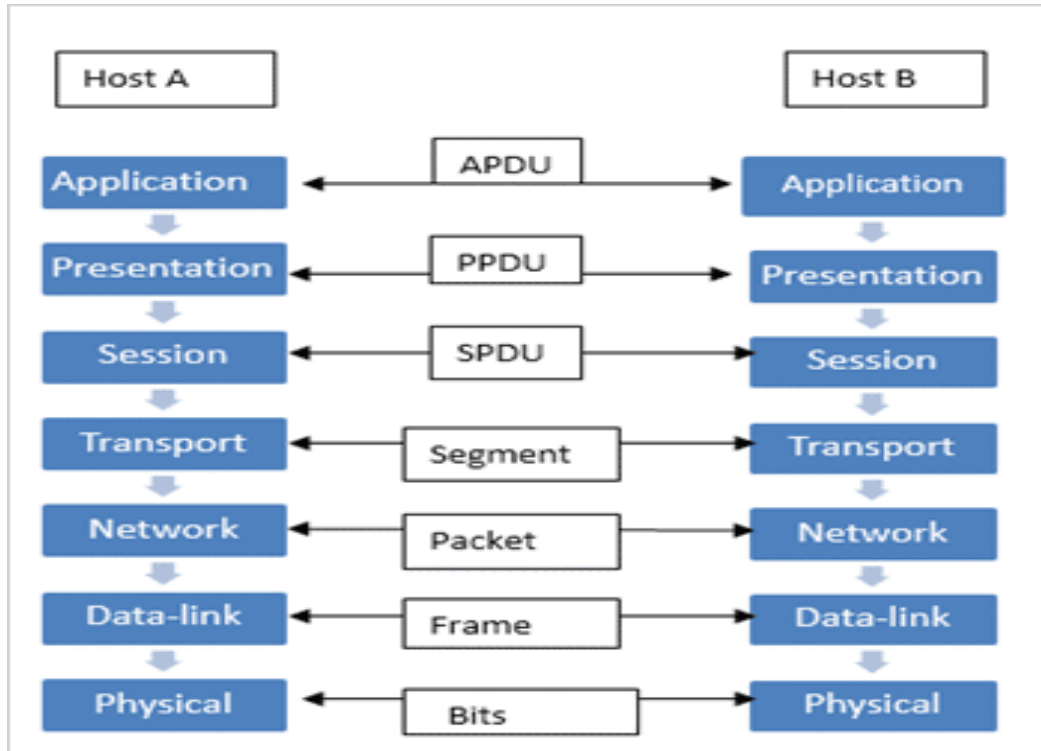
Goals of Network

- It provides sharing of resources such as information, devices or printers.
- Network users have maximum performance with minimum cost.
- Manage geographically distributed computers.
- It provides compatibility with dissimilar equipments and software.
- It supports distributed Processing.

OSI Model

- ✓ OSI stands for Open System Interconnection is a reference model that describes how information from a software application in one computer moves through a physical medium to the software application in another computer.
- ✓ OSI consists of seven layers, and each layer performs a particular network function. OSI model was developed by the International Organization for Standardization (ISO) in 1984, and it is now considered as an architectural model for the inter-computer communications.

- ✓ OSI model divides the whole task into seven smaller and manageable tasks. Each layer is assigned a particular task.
- ✓ Each layer is self-contained, so that task assigned to each layer can be performed independently.
- ✓



Functions of the OSI Layers

There are the seven OSI layers. Each layer has different functions.

A list of seven layers is given below:

1. Physical Layer

- a. The main functionality of the physical layer is to transmit the individual bits from one node to another node.
- b. It is the lowest layer of the OSI model.
- c. It establishes, maintains and deactivates the physical connection.
- d. It specifies the mechanical, electrical and procedural network interface

2. Data-Link Layer

Data –Link layer is divided into two parts

- (a) Logical Link Control Layer
- (b) Media-Access Control Sublayer

The function of data link layer is

- (a) Physical (Mac) Addressing to transfer data.
- (b) Node-to-Node delivery of data.
- (c) **Framing** of data and special bit to indicate starting and ending of frame.

- (d) **Flow control:** There must synchronization between sending and receiving devices for smooth transfer of data.
- (e) **Error Control:** A mechanism in which DLL detects and retransmits the damaged frame.
- (f) **Access Control:** It is required when multiple devices share a communication channel.

3. Network Layer

- (a) **Routing:** Selects suitable route from source to destination for data transfer.
- (b) **Logical Addressing:** This layer uses IP address to identify source and destination in the network.
- (c) **Packets:** It creates packets by appending header at the beginning of segment.
- (d) **Subnetting:** Process of logical partitioning of big network in subnetworks.
- (e) Responsible for end-to-end delivery of packets.

4. Transport Layer

- (a) It provides service to the application and takes service from network layer.
- (b) This layer is responsible for process-to-process delivery of data.
- (c) **Segmentation and Reassembly:** After receiving message from session layer it fragments the message into smaller units. Segment is created by appending header to the message. The destination reassembles it.
- (d) Port addressing for correct delivery of message.
- (e) Congestion Control

Two services are provided by transport layer

- i. Connectionless
- ii. Connection-Oriented.

5. Session Layer

- Session Management
- Dialog Management
- Token Management
- Synchronization
- Authentication and Authorization.

6. Presentation Layer

It is also called translation layer. Main task of presentation layer are

- Encoding and decoding
- Encryption and decryption
- Compression and decompression

7. Application Layer

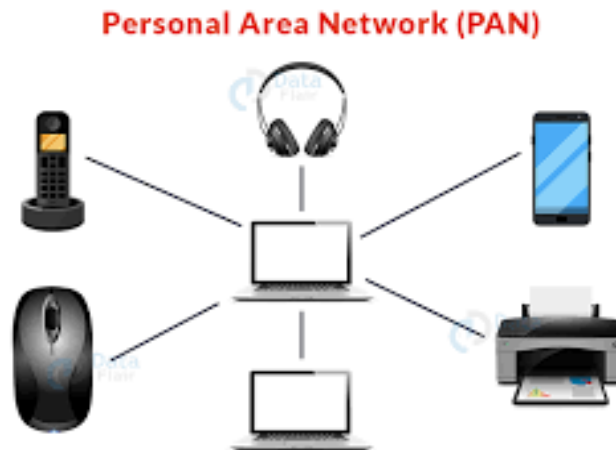
- 8. It is the top layer of OSI model. It is implemented by network applications. The applications provide data that has to be transferred over network. Main function of application layer are
 - Network virtual Terminal
 - File Transfer Access and management.
 - Mail Services
 - Directory Services.

Types of Computer Network

- (a) Personal Area Network
- (b) Local Area Network
- (c) Metropolitan Area Network
- (d) Wide Area Network

Personal Area Network (PAN)

This network is formed by connecting few personal devices like computer, laptop, mobile phones, smart phones, printer etc. It works in the range of 10 m. It can be wired or wireless.



Advantages of PAN

- 1) It is secure and reliable.
- 2) It is portable.
- 3) It is affordable
- 4) You can connect at any time.

Disadvantages of PAN

- 1) Operated in limited range
- 2) Slow data transfer speed.
- 3) Infrared signal travel in line-of-sight.

Local Area Network (LAN)

It is connection of two or more computers. LAN is contained in smaller geographic area usually within same building. They are privately owned network. They operate in the range of 1 km to 10km.



Advantages of LAN

- 1) Simple and inexpensive.
- 2) Software can be shared on LAN.
- 3) Fast communication
- 4) Resource sharing

Disadvantages of LAN

- 1) Weak data protection.
- 2) Maximum data loss on crashes.
- 3) Security issue as threats propagate in LAN rapidly.
- 4) Memory requirement.
- 5) Frequent maintenance is required.

Metropolitan Area Network

It is a network spread over city. The computers in man connected coaxial cable and fibre optics. It also connects several LANs spread over city.

Ex. New York City provides to all residents free wi-Fi to form MAN.

Advantages of MAN

- 1) It provides higher security than WAN.
- 2) It is wider than LAN.
- 3) Provides interface among LANs.
- 4) Need fewer resources than WAN.
- 5) It provides backbone for Larger networks such as WAN.
- 6) Higher speed than WAN.

Disadvantages of MAN

- 1) More cables are required.
- 2) Data transmission speed is slow.
- 3) Security Issue.
- 4) Large networks are difficult to manage.
- 5) Higher maintenance cost is associated with MAN over LAN.

Wide Area Network

WAN is a form of telecommunication network that connects devices from multiple locations across the globe. They are most expensive form of networks. They connect multiple LANs and MANs.

Advantages of WAN

- 1) Large area coverage is possible using WAN.
- 2) Share information over globe.
- 3) It supports global market and business.
- 4) Instant transfer of information at anywhere.

Disadvantages of WAN

- 1) It is slow in speed.

- 2) It is complicated and complex.
- 3) Data transmission speed is slow.
- 4) It is difficult to maintain.
- 5) Security and reliability issues.

Comparison LAN, MAN and WAN

So. No.	Properties	LAN	MAN	WAN
1	Speed	High	Low	Moderate
2	Bandwidth	low	moderate	high
3	Area Coverage	Building	City	Country or continent
4	Data Rate	High	Moderate	Low
5	Error Rate	Less	Moderate	High
7	Set-up Cost	Less	More than LAN	Highest
8	Maintenance Cost	Less	More than LAN	More costly
10	Security	More secure	Less secure than LAN	Less secure
12	Signal Deterioration	No	Moderate	Yes
15	Range	10 Km	100KM	Beyond 100Km
16	Ownership	Private	Private or Public	Public