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Introduction to Computer Network

Unit-I

ⓐ Computer Network

A computer network is a system that connects many independent computers to share information, data and resources. The integration of computers and other different devices allows users to communicate more easily. A computer network is a collection of two or more computer systems that are linked together. A network connection can be established using either cable or wireless media. Hardware and software are used to connect computers and tools in any network.

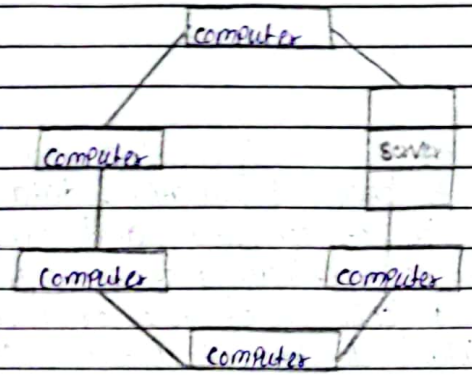
ⓐ Types of computer Networks

1> LAN 2> MAN 3> WAN

1> Local Area Network (LAN)

LAN is the most frequently used network. A LAN is a computer network that connects computer through a common communication path, contained within a limited area, that is locally. A LAN encompasses two or more computers connected over a server. The two important technologies involved in this network are Ethernet and Wi-fi. It ranges upto 2 km & transmission speed is very high.

Examples: Home, School, library, college, office etc.



→ Advantages

- LAN is a private network, thus no outside regulatory body controls it.
- LAN offers a much higher speed (around 100 mbps) and data transfer rate.
- Support different transmission mediums such as Ethernet cable, fibre and wireless transmission
- LAN usually has low cost.

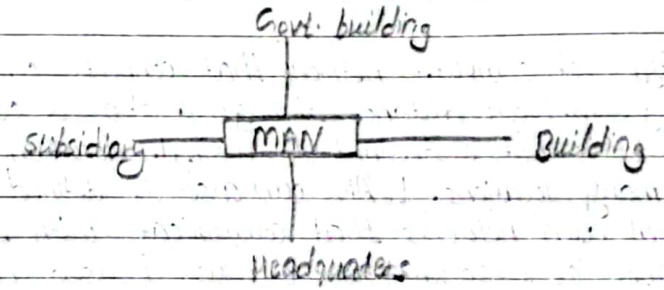
→ Disadvantages

- Communication devices like an ethernet cable, switches, hubs routers are costly.
- LAN are restricted in size and cover only a limited area.

2) Metropolitan Area Network (MAN).

A MAN is larger than a LAN but smaller than a WAN. This is the type of computer network that connects computers over a geographical distance through a shared communication path over a city, town or metropolitan area. This network mainly uses FDDI, CDDI, and ATM. It's range from 5km to 50km. It's transmission speed is average. It is difficult to maintain and comes with a high cost.

Example :- Towns, cities, multiple buildings etc.



→ Advantages

- MAN offers high-speed connectivity in which the speed ranges from 10-100 mbps.
- The security level of MAN is high and strict as compared to WAN

- MAN can serve multiple users at a time with the same high-speed.

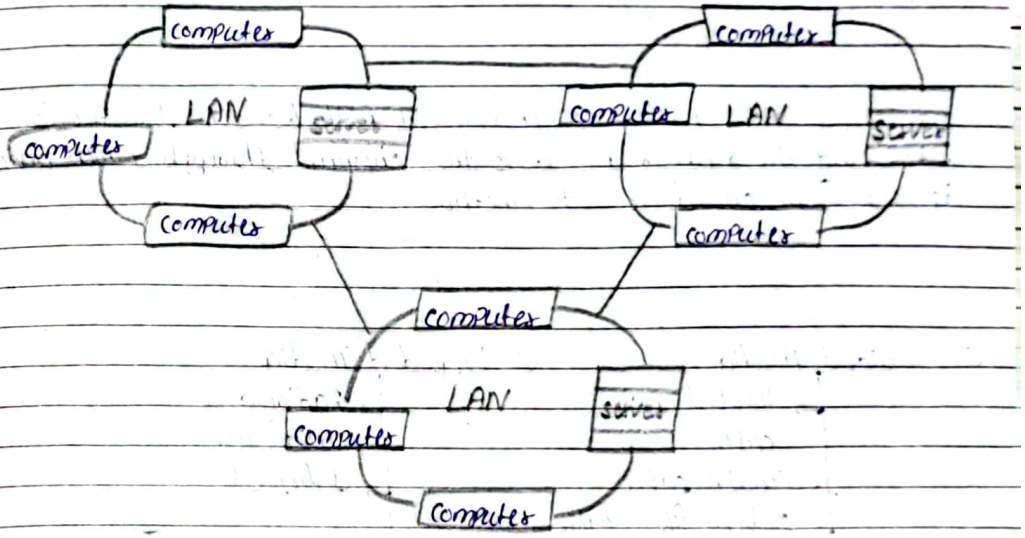
→ Disadvantages

- The architecture of MAN is quite complicated hence, it is hard to design and maintain.
- It provides less fault tolerance.
- The data transfer rate in MAN is low when

3) Wide Area Network (WAN)

WAN is a type of computer network that connects computers over a large geographical distance through a shared communi-cation path. It is not restrained to a single location but extends over many locations. WAN can also be defined as a group of local area networks that communicate with each other with a range over 50 km. Here we use Leased-Line & Dial-up technology. Its transmission speed is very low and it comes with very high maintenance and very high cost.

Example:- Internet



→ Advantages

- It covers large geographical area which enhances so buisness can connect on the network.
- The data can be stored in centralized manner.

→ Disadvantages

- Traffic congestion in Wide Area Network is very high.
- The fault tolerance ability of WAN is very less.

⊕ Transmission Media

A transmission medium is a physical path between the transmitter and the recievers ie. it is the channel through which data is sent from one device to another.

→ Types of Transmission Media

① Guided Media
- Twisted pair cable
- Coaxial cable
- Optical fibre cable
- Stripline
- Microstripline

② Unguided Media
- Radiowaves
- Microwaves
- Infrared

1) Guided Media

Guided Media is also refered to as wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

→ Features:
- High speed
- Secure
- Used for comparitively shorter distances

→ Advantages
- Data security is high as data signals are passed through definite path.
- Data transmission is faster.
- There is no effect in data transmission due to weather.

→ Disadvantages
- Expensive because many wires are required.
- Not suitable for portable devices.

2) Unguided Media

It is also refered to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

→ Features:-
- Less secure
- Used for longer distance
- The signal is broadcasted through air.

→ Advantages
- Easy setup as no wiring is required for individual nodes.
- New nodes can be easily connected as just sharing password.

→ Disadvantages

- Data security is in risk as signals can be hacked.
- Transmission of data may affected by weather condition.

④ Difference b/w Guided and Unguided Media

Guided Media		Unguided Media
(i) The guided media is also also called wired communication	i)	Also called wireless communication
(ii) The signal energy propagates through wires.	ii)	The signal energy propagates through the air.
(iii) Used to perform point-to-point communication.	iii)	Generally suited for radio broadcasting in all directions.
(iv) It is affordable.	iv)	It is costly.
(v) Unable to pass through walls	v)	It can pass through walls.

⑤ Transmission Modes

Transmission mode means transferring data between two devices. It is also known as communication mode. Buses and networks are designed to allow communication to occur b/w individual devices that are interconnected.

→ Types of Transmission Modes

1) Simplex Mode

In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit, the other can only receive. The simplex mode can use the entire capacity of the channel to send data in one direction.

Exa:- keyboard and traditional monitors

→ Advantages

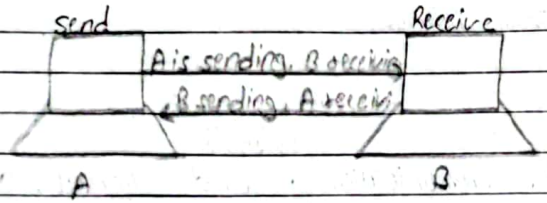
- Simplex mode is the easiest and most reliable mode of communication.
- It is the most cost-effective mode, as it only requires only one communication channel.

→ Disadvantages

- Only one-way communication is possible.
- It is not suitable for applications that require bidirectional communication.

2) Half - Duplex Mode

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive and vice-versa. This mode is used in cases where there is no need for communication in both directions at the same time.



→ Advantages

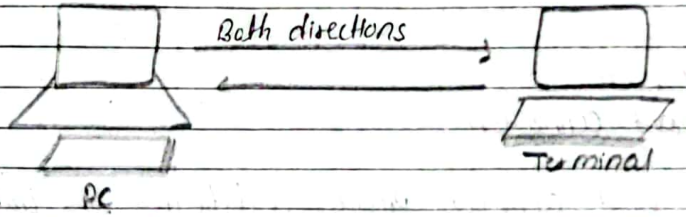
- Half-duplex mode allows for bidirectional communication.
- It is less expensive.

→ Disadvantages

- Half-duplex mode is less reliable.
- There is a delay b/w transmission and reception.

3) Full-Duplex Mode

In full-duplex mode, both stations can transmit and receive simultaneously. It is used when communication in both directions is required all the time. The capacity of the channel must be divided into two directions.



→ Advantages

- It allows for simultaneous bidirectional communication.
- It provides a high level of reliability and accuracy.

→ Disadvantages

- It is the most expensive mode.
- It is more complex.

④ Line configuration

A network is two or more devices connected through a link. A link is a communication pathway that transfers data from one device to another. Devices can be a computer, printer, or any other device that is capable to send or recive data.

Types :-

1) Point - to - Point connection

- A point - to - point connection provides a dedicated link btw two devices.
- The entire capacity of the link is reserved for transmission btw those two devices.
- Point to point network topology is considered to be one of the easiest and most conventional networks topologies.
- It is also the simplest to establish and understand.

→ Advantages

- Simple and easy to set up.
- It is more secure than multipoint connection

→ Disadvantages

- It can be more expensive.
- It offers limited flexibility.

2) Multipoint connection

- It is also called Multidrop configuration. In this connection two or more devices share a ~~signal~~ single link.
- If more than two devices share the link then the channel is considered a 'shared channel'. With shared capacity. there can be two possibilities in a multipoint line configuration

(i) Spatial shaing :- If several devices can share the link simultaneously, it's called spatially share line configuration.

(ii) Temporal (Time) ~~Sharing~~ sharing :- If users must take turns using the link, then it's called Temporally shared line configuration.

→ Advantages :-

- Less expensive
- It can improve network efficiency by allowing multiple device.
- More flexible.

→ Disadvantages

- Less secure than point - to - point connection
- Less reliable

④ Network Topologies

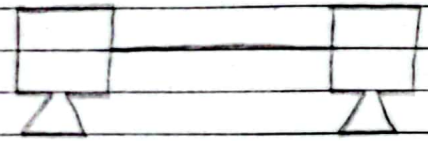
Network topology is the way devices are connected in a network. It defines how these components are connected and how data transfer b/w the network.

Two categories :- Physical and Network Topology

→ Types of Network Topology :-

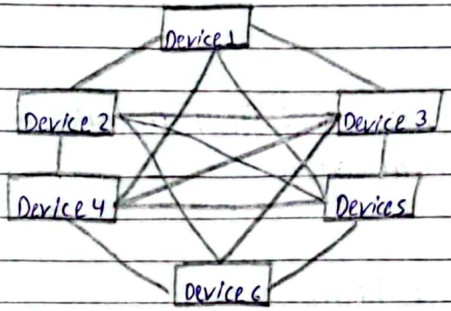
(i) Point to Point Topology

Point to Point topology is a type of topology that works on the functionality of the sender and receiver. It is the simplest communication b/w two nodes, in which one is the sender and other is receiver.



(ii) Mesh Topology

In a mesh topology, every device is connected to another device via a particular channel. Every device is connected to another via dedicated channels. These channels are known as links.

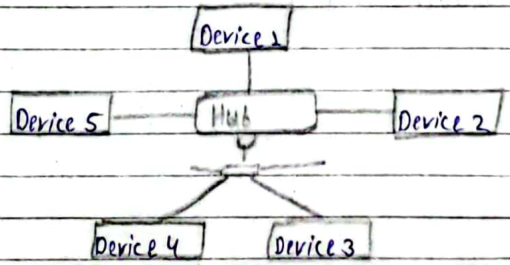


→ Advantages
- Communication is very fast b/w the nodes.
- Provides security and privacy.

→ Disadvantages
- Installation and configuration are difficult.
- The cost of maintanence is high.

(iii) Star topology

In star Topology, all the devices are connected to a single hub through a cable. This hub is the central node and all other nodes are connected to central node.



Eg:- LAN

→ Advantages

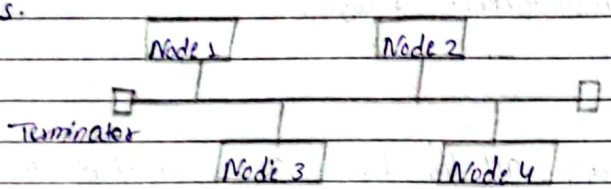
- Easy to fault identification and fault isolation.
- It uses inexpensive coaxial cable.

→ Disadvantages

- The cost of installation is high.
- Performance is based on the single hub.

(iv) Bus Topology

Bus topology is a network type in which every computer and network device is connected to a single cable. It is a multipoint connection because if the backbone fails the topology crashes.



→ Advantages

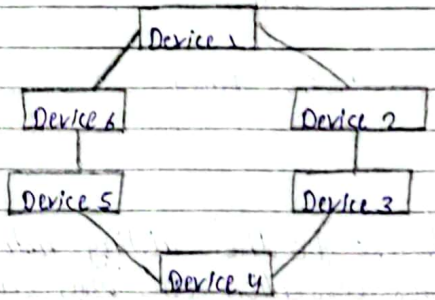
- The cost of the cable is less.
- Easy to install.

→ Disadvantages

- Limited Performace.
- Security Problems.

(v) Ring Topology

In a ring topology, it forms a ring connecting devices with exactly two neighboring devices. A no. of repeaters are used for Ring topology with a large no. of nodes, because if someone wants to send data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.



→ Advantages

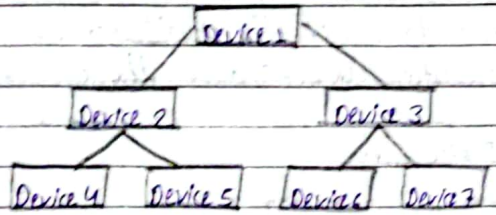
- Data transmission is high speed.
- Cheap to install and expand

→ Disadvantages

- Less secure
- Troubleshooting is difficult in this topology.

(vi) Tree Topology

Tree topology is the variation of the star topology. This topology has a hierarchical flow of data. In tree topology the various secondary hubs are connected to the central hub which contains the repeater.



Advantages

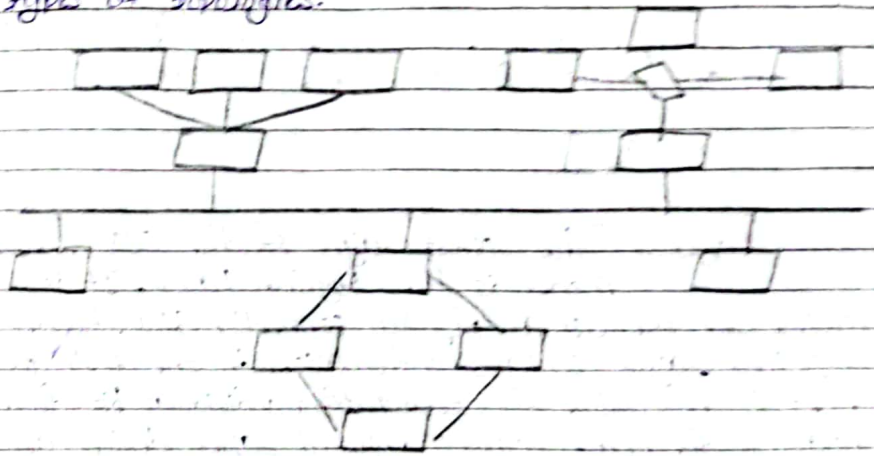
- We can add new devices to the existing network.
- Error detection & Error correction are very easy.

→ Disadvantages

- If the central hub fails the entire system fails.
- Cost is high.

(vii) Hybrid Topology

Hybrid topology is the combination of all the various types of topologies.



→ Advantages

- This topology is very flexible.
- Size of the network can be easily expanded.

→ Disadvantages

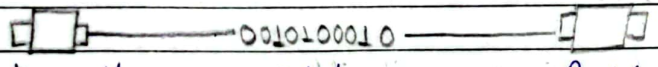
- Hubs used in this topology are very expensive.

ISO - OSI Reference Model

The OSI (Open System Interconnection) model is a set of rules that explains how different computer systems communicate over a network. OSI model was developed by International Organization for standardization (ISO).

→ Layers of OSI model

1) Physical Layer :- The lowest layer of the OSI reference model is the Physical Layer. It is responsible for the actual physical connection b/w the devices. The physical layer contains information in the form of bits. It is responsible for transmitting individual bits from one node to the next. Common physical layer devices are Hub, Repeater, Modem and cables.



→ Functions

- Bit Synchronization:
  - Physical layer provides the synchronization of the bits by providing a clock.
  - The clock contain both sender and receiver.
- Bit Rate control :- The Physical layer also defines the transmission rate i.e. the no. of bits sent per second.
- Physical Topologies:- Physical layer specifies how the different devices/nodes are arranged in a network i.e. bus topology, star topology or mesh topology

2) Data Link Layer (DLL) :- The data link layer is responsible for the node-to-node delivery of the message. The main function of this layer is to make sure data transfer is error-free from one node to another.

→ Functions

- Framing :- Framing is a function of the DLL. It provides a way for a sender to transmit a set of bits that are meaningful to the receiver.
- Physical address :- After creating frames, DLL add physical address of the sender or receiver in the header of each frame.
- Error control :- The data link layer provides the mechanism of error control in which it detects and retransmits damaged or lost frames.

3) Network Layer :- The network layer works for the transmission of data from one host to the other located in different networks. The sender and receiver's IP address are placed in the header by the network layer.

→ Functions

- Routing :- The network layer protocols determine which route is suitable from source to destination. This function is known as routing.
- Logical Addressing :- The sender & receiver's IP address are placed in header by network layer. Segment in network layer is referred as packet.

4) Transport Layer :- The transport layer provides services to the application layer and takes services from the network layer. The data in the transport layer is reffered to as segments. It is responsible for end-to-end delivery of the message.

→ Functions

- Segmentation & Reassembly :- This layer accepts the message from the session layer and breaks the message into smaller units. Each of the segments produced has a header associated with it.
- Service Point Addressing :- To deliever the message to the correct process, the transport layer header includes a type of address called service point address.

5) Session Layer :- Session layer is responsible for the establishment of connections, management of connections, terminations of sessions b/w two devices. It also provides authentication & security.

→ Functions

- Synchronization :- This layer allows a process to add checkpoints that are considered synchronization points in the data.
- Dialoge controller :- The session layer allows two systems to start communication with each other in half-duplex or full-duplex.

6) Presentation Layer :- This layer is also called Translation layer. The data from application layer is extracted here and manipulated as per requirement over the network.

→ Functions

- Translations :- ASCII to EBCDIC
- Encryption / Decryption :- Encryption translates data into another form or code. The encrypted data is known as ciphertext and the decrypted data called plain text.

7) Application Layer :- At the very top of the OSI Reference Model, we find the application layer which is implemented by the network applications. These applications produce the data to be transferred over the network.

→ Functions

- Network Virtual Terminal (NVT) :- It allows a user to log on to a remote host.
- Mail services :- Provide email service.

④ TCP/IP Model

The TCP/IP model is a fundamental framework for computer networking. It stands for Transmission Control Protocol (TCP) / Internet Protocol (IP), which are the core protocols of the Internet. This model defines how data is transmitted over networks, ensuring reliable communication b/w devices. It consists of four layers : the Link Layer, the Internet Layer, the Transport layer and the Application Layer.

TCP/IP was designed and developed by the Department of Defence (DoD) in the 1960. The TCP/IP model is a concise version of the OSI model.

⑤ Difference b/w TCP and IP

	TCP		IP
(i)	Connection-oriented	(i)	Connectionless
(ii)	Yes, includes flow control mechanisms	(ii)	No
(iii)	Yes, manages network congestion	(iii)	No
(iv)	Larger, 20-60 bytes	(iv)	Smaller, typically 20 bytes

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Difference b/w OSI Model and TCP/IP Model

OSI Model	TCP/IP Model
(i) OSI stands for open system Interconnection	(i) TCP/IP stands for Transmission Control Protocol / Internet Protocol
(ii) It has 7 layers	(ii) It has 4 layers
(iii) It is low in usage	(iii) It is mostly used
(iv) It is vertically approached	(iv) It is horizontally approached
(v) It is less reliable	(v) It is more reliable
(vi) Delivery of the package is guaranted in OSI model	(vi) Delivery of the package is not guaranted in TCP/IP model