

CH 1: INTRODUCTION TO COMPUTER NETWORK

⇒ Data comm/n is always 2 way

Protocol:- A set of rules that govern a comm/n

⇒ Network:- A set of interconnected ^{set of} ~~network~~ comp. which could be distant to the size of a city a building or may be an entire globe. It can be of diff. shapes & sizes. A group of interconnected comp. to share resources, exchange files or allow comm/n.

⇒ Types of Share Resources:- H/W & S/W

⇒ Benefits of CN:-

- File Sharing
- H/W Sharing
- Appl'n
- User Comm/n
- Network Gaming

⇒ Data Comm/n:- Info. can be shared ^(face to face) locally or remotely ^(Takes place over distance)

Telecommunication:- Telephony, telegraphy, & television, means comm/n at a distance

Data Comm/n refers to info. presented in whatever form is ~~agg~~ agreed upon by the parties creating & using the data.

They are the exchange of data b/w devices via some form of transmission medium such as a wired cable

- The communicating devices must be a part of a comm/n system made up of a combination of H/W & S/W

⇒ Effectiveness of a Data Comm/n:-

It depends on 4 fundamental characteristics:-

- Delivery:- The system must deliver data to the correct destination
- Accuracy:- " " " " " accurately.
- Timeliness:- " " " " " in a timely manner.
- Jitters:- Refers to the variation in the packet arrival time due to network congestion.

Delivery:- Data must be received by the intended device or user & only by that device or user.

Accuracy:- Data that have been altered in transmission & left uncorrected are unusable.

Timeliness:- Data delivered late are useless. In case of vdo & audio, timely delivery means delivering data as they are produced, in the same order of delivery is called real-time transmission.

⇒ Components: A data comm/n has 5 components.
Sender →

Sender → Encoder → Message → Decoder → Receiver
↓
Transmission media

- Message should be encoded so that message should not be read by others. And the message should be decoded in front of receiver so that he/she can read the message.

⇒ Data Representation:- Text ; Numbers ; Images ; Audio ; Video.

⇒ Applⁿ of CN :-

- Business App/n
- Home App/n
- Mobile Users
- Social Issues

→ Business Applⁿ :- Resource sharing; Server Client Model; Commⁿ medium;
E-commerce

E-commerce :-

- B2C :- When customer orders shoes online
(Business to ~~customer~~ ^{Consumer})
- B2B :- Truck manufacturer ordering tires from suppliers
(Business to Business)
- C2C :- An online auction site (eBay)
(Consumer to Consumer)
- G2C :- Reduce the avg. time for fulfilling citizen's requests for various Govt. services.
(Govt to Citizen)
- P2P :- Buyer & Seller transact directly.
(Peer to Peer)

→ Home Applⁿ :- Remote info. (GDrive); Interactive Entertainment; Person to Person Commⁿ; Electronic Commerce

→ Mobile Users :- One of the fastest-growing segment of the entire comp. industry.

- ∴ having a wired connection is impossible in cars, boats, airplanes, there is lot of interest in wireless networks.

Wireless hotspots & are another kind of wireless network for mobile comp.

→ Social Issues:- Communal Breakdown; Unauthorized Access; Authentication
Ethical use of N/W; Identity Theft; Cyber Bullying;
Gaming Addiction; Health & fitness.

⇒ Types of N/W:-

i) PAN:- Interconnection of info. tech. devices within the range of an individual person. eg (within 10m)

Types:-

- Wired PAN
- Wireless PAN:- Bluetooth
:- Infrared Data Association

Wired PAN:- e.g:- Data Cable. The connection is for the user's personal use.

Wireless PAN:- WPAN

Bluetooth:- Uses short-range radio waves over dista upto approx. 10 m.

Infrared Data Association:- IrDA uses infrared light, which has a frequency below human eye's sensitivity.
e.g:- TV remote; Gaming remote

ii) LAN:- Usually owned by pvt. Used for single sites where people need to share resources among themselves but not with the outside world

Common transmission tech. in use for LAN are:-

- Ethernet over twisted pair cabling.
- Wifi (Wireless Fidelity)

Historical tech. of LAN include:-

- ARCNET
- Token Ring
- Apple Talk

Two Categories:-

- P2P N/W:- No one is superior or inferior
- Client-Server Model N/W

LAN:- Includes wired as well as wireless connection; Less expensive; More secure than wireless connection

WLAN:- Completely wireless tech. based; More expensive; Less secure than wired connections.

iii) MAN (Metropolitan Area N/W):-

A CN larger than LAN. Also known as Municipal Area N/W because it generally spans the size of a municipal corporation.

iv) WAN:- e.g:- Internet. Any N/W whose comm'n link across metropolitan, regional or national boundaries.
AN/W which is internal to the org. is also termed as intranet

How WAN are established?
 Comp. connected to a WAN are often connected through public networks, such as the telephone system.
 They can also be connected through leased lines or satellites.
 The largest WAN in existence is the Internet.

LAN Vs MAN Vs WAN :-

- LAN :-
- Ownership is pvt.
 - ~~Trans~~ Transmission speed is high
 - Propagation delay is short
- MAN :-
- Ownership can be pvt. or public
 - Transmission speed is avg.
 - There is a moderate propagation delay.
- WAN :-
- Also might not be owned by one org.
 - Transmission speed is low.
 - Long propagation delay.
- LAN :-
- less congestion

LAN	MAN	WAN
Ownership is pvt.	Ownership can be pvt. or public	Ownership Also might not be owned by one org.
Transmission speed is high	Transmission speed is an avg.	Transmission speed is low
Propagation delay is short	Propagation delay is moderate	Propagation delay is long
Less congestion	More congestion	Even more congestion than MAN in WAN
Design & Maintenance is easy	Design & maintenance is difficult	Design & maintenance is more difficult
More fault tolerance	Less fault tolerance	Less Also less fault tolerance

→ Network Topologies :-

An arrangement with which comp. systems or N/w devices are connected to each other.

Topologies may define both physical & logical aspects of N/w.
 Both logical & physical topologies could be same or different in a same n/w.

→ Physical Topology:- The placement of various components of a n/w, including device location & cable installation.

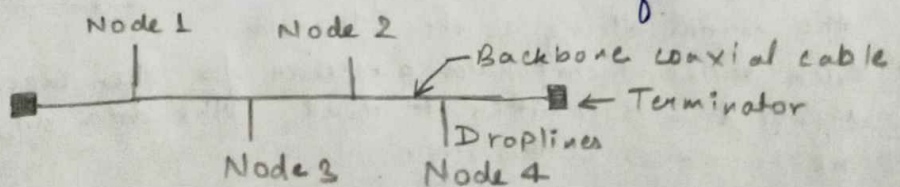
→ Logical Topology:- Illustrates how data flows within a n/w regardless of its physical design.

i) Point to Point Topology:- Simplest topology with a dedicated link b/w 2 endpoints.

ii) Bus Topology:- each node connected to a single cable, by the help of interface connectors.

This central cable is the backbone of the n/w & is known as the bus.

- A signal from the source travels in both directions to all machines connected on the bus cable until it finds the intended recipient.
- If the machine address does not match the intended address for the data, the machine ignores the data.
- Alternatively, if the data matches the machine address, the data is accepted.
- It is a n/w type in which every comp. & n/w device is connected to a single cable.
- It transmits the data from one end to another in single direction. No bi-directional feature is in bus topology.



Terminator:- A terminator is added at ends of the central cable to prevent bouncing of signals.

Working:-

- A signal from the source is broadcasted & it travels to all workstations connected to bus cable.
- Although the message is broadcasted but only the intended recipient, whose MAC address or IP address matches, accept it.
- If the MAC/IP address of machine does n't match with intended address, machine discards the signal.

Advantages:-

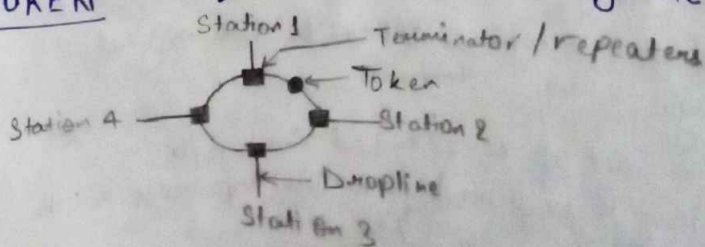
- Easy to set up & extended bus n/w.
- Cable length required for this topology is the least compared to other n/w.
- ~~Cost~~ + Costs very less.
- Mostly used in small n/w. Good for LAN.

Disadvantages:-

- There is a limit on central cable length & no. of nodes that can be connected.
- Dependency on central cable. If the main cable encounters some problems, whole n/w breaks down.
- Proper termination is required to dump signals. Use of terminators is must.
- It is difficult to detect & troubleshoot fault at individual station.
- Maintenance costs can get higher with time.
- Efficiency reduces, as the no. of devices connected to it increases.
- It is not suitable for n/w with heavy traffic.
- Security is very low because all the comp. receive the sent signal from the source.

iii) Ring Topology:-

- A n/w topology is set up in a circular fashion in such a way that they make a closed loop.
- This way data travels around the ring in one direction & each device on the ring acts as a repeater to keep the signal strong as it travels.
- Each device incorporates a receiver for the incoming signal & a transmitter to send the data on to the next device in the ring.
- The n/w is dependent on the ability of the signal to travel around the ring.
- When a device sends data, it must travel through each device on the ring until it reaches its destination.
- Every node is a critical link.
- There is no server comp. present; all nodes work as a server & repeat the signal.
- Sending & receiving of data takes place by the help of a TOKEN.



Token passing:- Token contains a piece of info. which along with data is sent by the source comp.

This token then passes to next node, which checks if the signal is intended to it. If yes, it receives it & passes the empty token into the n/w, otherwise passes token along with the data to next node.

This process continues until the signal reaches its intended destination.

The nodes with token are the ones only allowed to send data.

Other nodes must wait for an empty token to reach them.

This network is usually found in offices, schools & small buildings.

Advantages:-

- Very organized.
- Each node gets to send the data when it receives an empty token.
- This reduces chances of collision.
- All the traffic flows in only one direction at very high speed.
- Even when the load on the n/w increases, its performance is better than that of Bus Topology.
- There is no need for network servers to control the connectivity b/w workstations.
- Additional components don't affect the performance of n/w.
- Each comp has equal access to resources.
- If one node stops working, the entire n/w is affected or stops working.
- Each packet of data must pass through all the comp. b/w source & dest. This makes it slower than Star.
- If one workstation or port goes down, the entire n/w gets affected.
- N/w is highly dependent on the wire which connects diff. components.

iv) Star Topology:-

- Each n/w host is connected to a central hub with a P2P.
- So, it can be said that every comp. is indirectly connected to every other node with the help of the hub.
- Every node is connected to a central node called hub, router or switch.
- The switch is the server, & the peripherals are the clients.
- All the nodes on the n/w must be connected to one central device.
- All traffic that traverse the n/w passes through the central hub.

- The hub acts as a signal repeater.
- ~~The star~~ It is considered the easiest topology to design & implement.
- Devices typically connect to the hub with Unshielded Twisted Pair (UTP) Ethernet.

Advantages:-

- It gives much better performance than bus.
- A sent signal reaches the intended dest. after passing through no more than 3-4 devices & 2-3 links.
- Performance of the n/w is dependent on the capacity of central hub.
- Easy to connect new nodes or devices without affecting rest of the n/w. Removal is also easy.
- Failure of one nodes or devices without affecting rest of n/w. It is also easy to detect the failure & troubleshoot it.
- Centralized management. It helps in monitoring the n/w.

Disadvantages:-

- The ~~pr~~ disadvantage is that the hub represents a single point of failure.
- Compared to bus, a star generally requires more cable.
- The use of hub, a router or a switch as central device increases the overall cost of the n/w.
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v) Mesh Topology:-

- Each of the n/w node, comp. & other devices are interconnected with one another.
- Every node not only sends its own signals but also relays data from nodes.
- In fact, a true mesh topology is the one where every node is connected to every other node in the n/w.
- It is very expensive as there are many redundant connections, thus it is not mostly used in comp. n/w.
- It is commonly used in wireless n/w.
- Flooding or routing technique is used in mesh topology.

Types:-

- Full Mesh :- Each component is connected to every other component.
- The n/w traffic can't be redirected to other nodes if one of the nodes goes down.
 - It is used only for backbone n/w.

Partial Mesh:- Some systems are connected in mesh while rest are only connected to 1 or 2 devices.

- The workstations are 'indirectly' connected to other devices.
- It is less costly & reduces redundancy.

Advantages:-

- Data can be transmitted from diff. devices simultaneously.
- It can withstand high traffic.
- If one of the components fails, there is always an alternative.
- Expansion & modification can be done without disrupting other nodes.

Disadvantages:-

- High chances of redundancy in many of the n/w connections.
- Overall cost of the n/w is high.
- Set-up, maintenance & administration of the n/w is difficult.

vi) Tree Topology:- (Expanded Star)

- It integrates the characteristics of Star & Bus.
- The no. of Star are connected using Bus.
- This main cable seems like a main stem of a tree, & other star n/w as the branches.
- At. Ethernet protocol is commonly used.

Advantages:-

- An extension of Star & Bus.
- Expansion of n/w is possible & easy.
- Here, we divide the whole n/w into segments (Star), which can be easily managed & maintained.
- Error detection & correction is easy.
- Each segment is provided with dedicated P2P wiring to central hub.
- If one segment is damaged, other segments are not affected.

Disadvantages:-

- Bcoz of its basic str., tree relies heavily on the main bus cable, if it breaks whole n/w is crippled.
- As more & more nodes & segments are added, the maintenance becomes difficult.
- Scalability of the n/w depends on the type of cable used.

Vii) Hybrid Topology:-

- It is mix. of 2 things.
- Integrate 2 or more top. diff. topologies to form a resultant topology which has good points (as well as weaknesses)
- This combination is done acc. to the requirements of the org.

Advantages:-

- Reliability:- Fault detection & troubleshooting is easy. The detected fault can be isolated from the rest of the n/w. Required corrective measures can be taken, without affecting the functioning of rest of the n/w.
- Effectiveness:- It is the combination of 2 or more topologies
- Scalability:- It's easy to increase the size of the n/w by adding new components, without disturbing existing architecture.
- Flexibility:- It can be designed acc. to the requirements of the org. & by optimizing the available resources. Special care can be given to nodes where traffic is high as well as where chances of fault are high.
- Synergizes the Strength of Constituent Topologies:- Strength of constituent topologies are maintained, maximized while their weaknesses are neutralized.

Disadvantages:-

- Complexity of Design:- It's not easy to design this type of architecture & it's a tough job for designers. Config. & installation process needs to be very efficient.
- Costly hub:- These hubs are diff. from usual hubs as they need to be intelligent enough to work with diff. architectures & should be functional even if a part of n/w is down.
- Costly infrastructure:- As hybrid architectures are usually larger in scale, they require a lot of cables, cooling systems, sophisticated n/w devices, etc.