

Computer Networks



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Computer Networks: - When two or more system are interconnected if they interchange the information.

Components Of Computer Network:-

- Two or more computers
- Cables(coaxial , twisted pair or fiber optic) as links between the computers
- A network interfacing card(NIC) on each computer
- Switches
- A software called network operating system

Benefits of Computer Networks :-

- Increased speed
- Reduce Cost
- Improved Security
- Centralized software managements
- Electronic-mail
- Flexible access

Disadvantage of Networks :-

- High cost of installation
- Requires time for administration
- Failure of server
- Cable faults



Computer Network Criteria:-

- Network is a bond term similar to system. Network is a communication system which supports many user.
- In context with the computers we can say that, a “computer network” is a system which allows communication among the computers connected in the network.
- The most important criteria that network must able to meet are :
 1. Performance
 2. Reliability
 3. Security

Performance:-

- Performance can be measured in many ways .we can measure it in terms of transit time and response time .
- **Transit time** :-It is defined as the amount of time required for a message to travel from one device to the other.
- **Response time**:- It is the time elapsed between enquiry and response
- The other factors deciding the performance are as follows :-
 1. Number of users
 2. Type of transmission medium
 3. Capability of connected hardware
 4. Efficiency of software

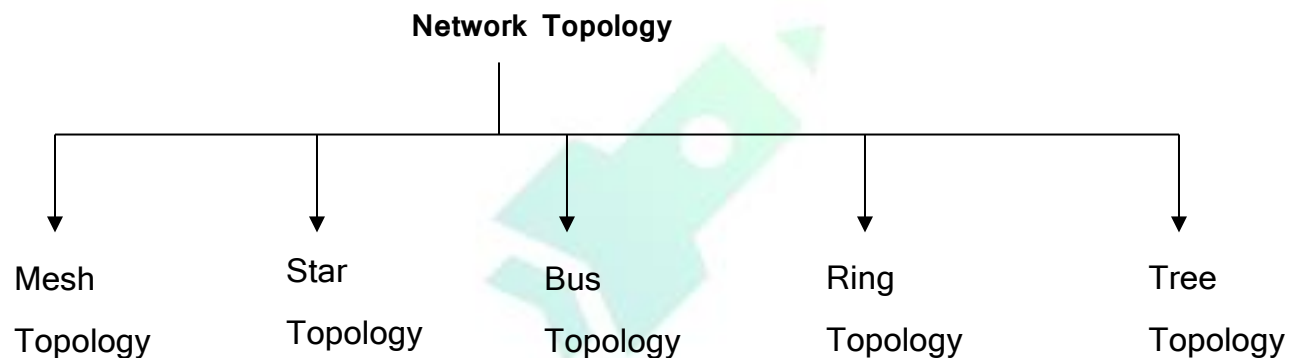
Reliability:-

- The network reliability is important because it decides the frequency at which network failure takes place.
- It also decides the time taken by the network to recover and its robustness in the catastrophe.

Security :- The network security refers to protection of data from the unauthorized users or access.

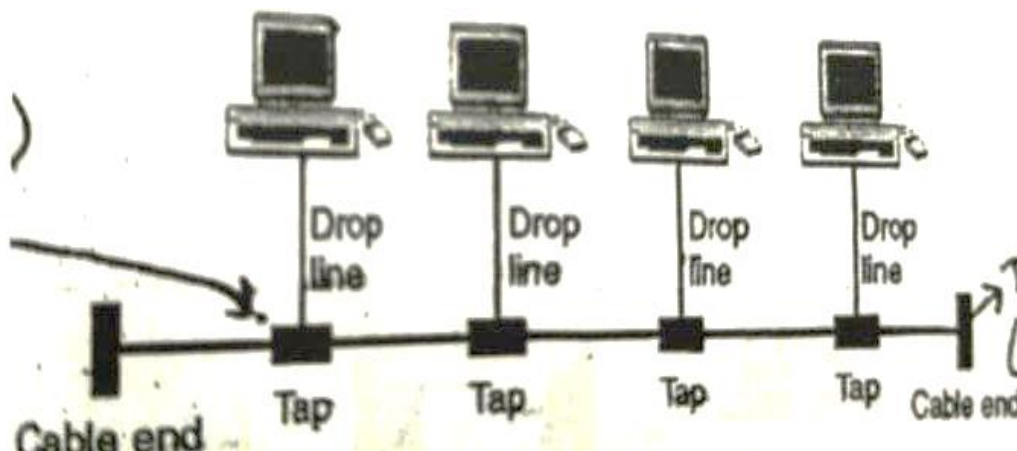
Network topology types :-

- The meaning of physical topology indicates the way in which a network is physically laid out.
- Two or more devices connect to a link , two or more links form a topology
- The topology of a network is the geometric representation of the relationship of all the links connecting the device (or nodes).
- There are basically five topology.



Bus Topology:-

- The bus topology is usually used when the network installation is small , simple or temporary
- On a typical bus network cable is just one or more wires, with no active electronics to amplify the signal or pass it along from computer to computer. This make bus topology a passive topology.



- When one computer sends a signal up the cable ; all the computers on the network receive the information, but the one with the address that matches the one encoded in the message accepts the information while all the other rejects the message.
- The speed of the bus topology is slow because only one computer can send a message at a time. A computer must wait until bus is free before it can transmit.
- The bus topology requires a proper termination at both the ends of the cable.
- Since the bus is a passive topology, the electrical signal from a transmitting computer is free to travel the entire length of cable.
- The transmitted waves and reflected waves, if they are in phase add and if they are out of phase cancel.
- Thus adding and cancellation of the wave leads to what is called a standing wave.
- The standing waves can distort the normal signals which travelling along the cable.
- This standing waves are overcome by attaching terminators (load impedance equal to the characteristics impedance of the cable e.g. a 50Ω cable is terminated by a 50Ω load impedance) at both the ends of the cable.
- The terminators absorb the electrical energy and stop reflections.

Characteristics of the bus topology:-

- This is a multipoint configuration. There are more than two devices connected to the medium and they are capable of transmitting on the medium. Hence, the medium access control is essential for the bus topology.
- The signal strength of the transmitted signal should be adequately high so as to meet the minimum signal strength requirements of the receiver.
- Adequate signal to noise ratio should be maintained
- The signal should not be too strong. This is necessary to avoid the overloading of transmitted and hence the possibility of signal distortion.
- This is called signal balancing which is not an easy task at all. Specially the signal balancing become increasingly difficult with increase in number of station

- The solution to this problem is to device the transmission medium into small segments and within each such segment a pair wise balancing is done using amplifiers or repeaters between the segments.

Transmission Media For BUS LANs:-

We can use the following transmission media for the bus LAN's:

1. Twisted pair
2. Basebond co-axis cable
3. Broadband co-axial cable
4. Optical fiber

Advantages of Bus Topology:

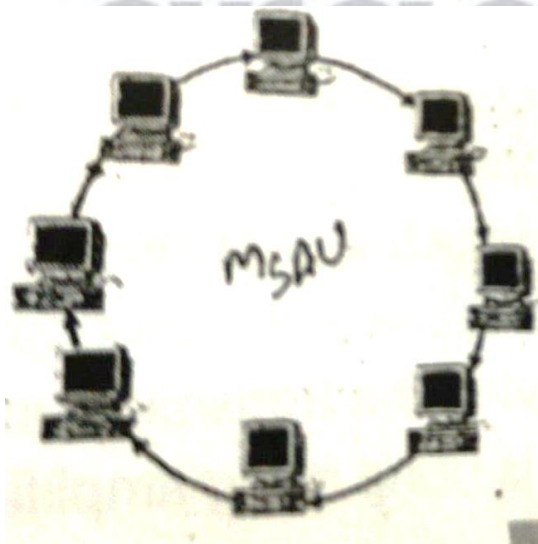
- The bus topology is easy to understand , install and use for small network
- The cabling cost is less as the bus topology requires the least amount of cable connect the computer .
- The bus topology is easy to expand by joining two cables with BNC barrel connector
- In the expansion of a bus topology repeaters cab be used boost the signal and increase the distance .

Disadvantages of Bus topology :-

- Heavy network traffic slow down the bus speed. In bus topology only one computer can transmit and other have to wait till it turn comes and there is no co-ordination between computers for reservation of transmitting time slot.
- The BNC connectors used for expansion of the bus attenuates the signal considerably .
- A cable break or loose BNC connector will cause reflections and bring down the whole network causing all network activity to stop.

Ring Topology :-

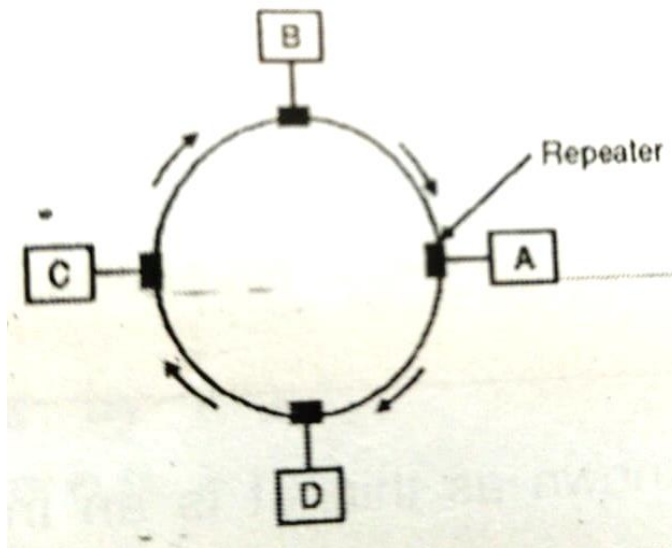
- In a ring topology , each computer has is connected to the next computer with the least one connected to the first as shown below .
- Rings are used in high-performance networks where large bandwidth is necessary e.g. time sensitive feature such as audio and video.
- Every computer is connected to the next computer in the ring and each retransmits what it receives from the previous computer hence the ring is an active network.
- The message flow around the ring in single direction. There is no termination because there is not end to the ring.
- Some ring networks do token passing. A short message called token is around the ring until a computer wishes to send information to another computer.
- That computer modifies the token, add an electronic address and data and sends it around the ring.



- Each and every computer in sequence receives the token and the information and passes them to the next computer until either the electronic address matches the address and a computer or token return to the origin
- The receiving computer returns a message to originator indicating that the message has been received.
- The sending computer then creates another token and places it on the network, allowing another station to capture the token and being transmitting.
- The token circulates until a station is ready to send and capture the token. Faster networks circulate several tokens at once
- Some ring networks have two counter-rotating rings that help them to recover from the network faults.

Characteristics of Ring :

- The basic ring topology shown below , which shows that a number of repeaters are used and that the transmission is unidirectional.



- The data is transferred in sequential manner bit by bit around the ring . Note that the each repeater will generate and retransmit each bit.

Advantages of Ring:

- No one computer can monopolies the network because every computer is given equal access to the token
- The fair sharing of the network allows the network to continue function in a useful , if slower, manner rather than fail once capacity is exceeded as more user are added .

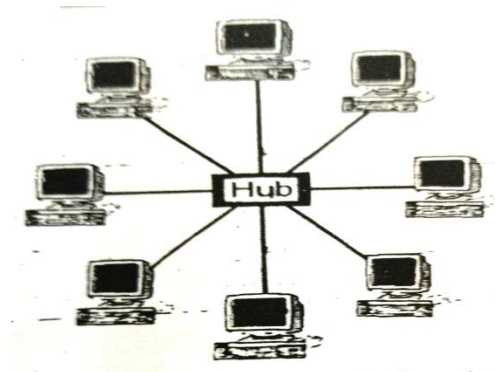
Disadvantage of Ring :

- Failure of one computer on the ring can affect whole network.
- It is difficult to trouble shout the ring
- Adding or removing the computers disturb the network activity

Star Topology:-

In a star topology all the cables run from the computers to a central location where they are all connected by a device called a hub as shown in the figure .

- Stars are used in the concentrated networks, where the endpoints are directly reachable from a central location; when network expansion is expected and when the greater reliability of a star topology is needed.
- Each computer on a star network communicates with the central hub that resends the message either to all the computers in broadcast star network or only to the destination computer is a switched star network.



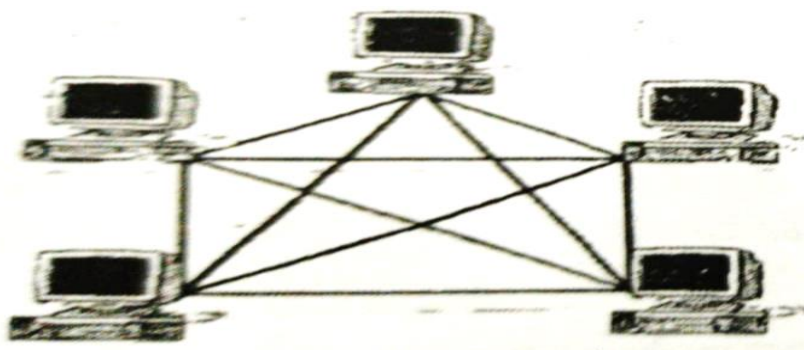
- The hub in a broadcast star network can be passive or active . An active hub generates the electrical signal and sends it to all the computer connected to it.
- This type of hub is usually called multiport repeater . Active hubs requires external power supply.
- A passive hub is wiring panel down block which acts a connection point. It does not amplify or regenerates the signal. Passive hub do not require electrical power supply .
- Several types of cables can be used to implement a start network. A hybrid hub can use different types of cable in the same star network.
- A star network can be expanded by placing another star hub .
- This arrangement allows several more computers or hub to be connected to that hub. This creates a hybrid star network.

Disadvantage of star topology:-

- The whole network fails to operate., if there is failure in central hub.
- Many star networks require a device at the central point to switch the network traffic or to rebroadcast.
- The cabling cost is more since cable must be pulled from all computers to the central hub.

Mesh Topology :-

In mesh topology every device has a dedicated point-to-point link to every other device as shown in figure :-



- The term dedicated means that the link carries traffic only between two devices which it connects.
- A full connected mesh network therefore has $n(n-1)/2$ physical channels to link n devices .

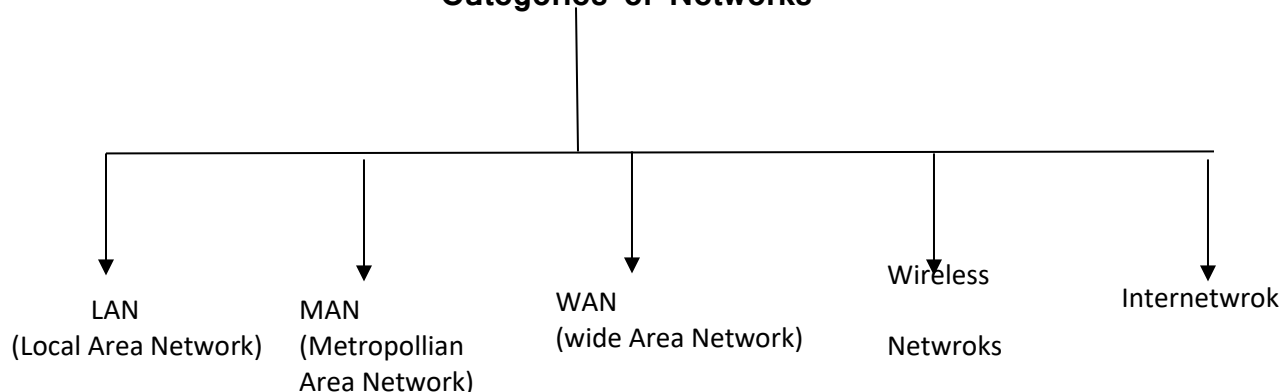
Advantages:-

- The use of dedicated links guarantees that each connection can carry its own data load , thus eliminating traffic problem .
- A mesh topology is robust because the failure of any one computer does not bring down the entire network.
- It provides privacy and security because every message sent travels along a dedicated line.
- Point to point links makes fault diagnose easy.

Disadvantages:

- Since every computer must be connected to every other computer reconfiguration and installation is difficult .
- Cabling cost is more.
- The hardware required to connect each link input/output and cables are expensive.

Categories of Networks



LAN:-

- The local area network(LAN) is a network which is designed to operate over a small physical area such as office, factory or a group of building. LANs are very widely used in variety of applications.
- LANs are easy to troubleshoot and design . The personal computer and workstations in the offices are interconnected via LAN.
- The exchange of information and sharing of resources become easy because of LAN.
- In LAN all the machines are connected to the single cable. Different types of topologies such as Bus, Ring ,Star ,tree etc are used for LANs.
- A LAN is usually privately owned and linked the devices in a single office , building or campus of upto a few kilometre in size.
- LANs are widely used to allow resources to be shared between personal computers and workstations. The resources to be shared can be hardware like printer or software or data.
- A common example of LAN found in many business organizations links a work group of a task related computers e.g. accounting and finance PCs , administrative PCs or engineering workstation.

Application of LAN:-

1. File transfer and file access
2. Personal computing
3. Office automation
4. Distributed computing
5. Work and text processing
6. Document distribution
7. Remote access to database
8. Electronic message handling



Metropolitan Area Network (MAN)

- A MAN is basically version of a LAN and normally uses similar technology . It is designed to extend over the entire city.
- It can be single network such as a cable TV network , or it be a means of connecting a number of LANs into a large network so that resources can be shared device to device as well as LAN to LAN.
- A MAN may be wholly operated and owned by a private company or it may be a service provided by a public company , such as a local telephone company.
- A MAN is distinguished by IEEE 802.6 standard or it is also known as Distributed Queue Dual Bus(DQDB)
- He DQDB consists of two unidirectional cables(buses) to which all the computers are connected.
- Each bus has a device which initiates the transmission activity called as the head-end.
- Traffic that is destined for a computer to the right of the sender uses the upper bus and to left uses the lower bus.

WIDE AREA NETWORK (WAN):-

- When a network spans over a large distance or when the computers to be connected to each other are at widely separated locations a local area network cannot be used .
- A WAN must be installed. The communication between different used of “WAN” is established using leased telephone lines or satellite link and similar channels.
- It is cheaper and efficient to use the phone network for the links.
- Most WAN are used for transferring large blocks of data between its users. As the data is from the existing records or files, the exact time taken for this data transfer is not a critical parameter.



- Because of the large distances involved in the wide area network the propagation delays and variable signal travel times are major problem.
- Therefore most WAN are not used for time critical applications.
- A WAN provides long distance transmission of the data, voice image and video information over large geographical areas that may be comprise a country, a continent or even the whole world.

S.No.	Parameter	LAN	WAN	MAN
1	Ownership of network	Private	Public or Private	Private or public
2	Area covered	Small	Very large (states or country)	Moderate (city)
3	Design and Maintenance	Easy	Not easy	Not easy
4	Communication media	Coaxial cable	PSTN or satellite	Coaxial cable, PSTN, optical fiber cables, wireless
5	Data rates	High	Low	Moderate
6	Mode of communication	Each station can transmit and receive	Each station cannot transmit	Each station can transmit or receive
7	Principal	Operates on the principle of broadcasting	Switching	Both
8	Propagation delay	Short	Long	Moderate





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