



Network Architecture and LAN Topologies

Presented by
Ashutosh Rastogi
Assistant Professor
BBDNITM, Lucknow



Outline

- Computer Network
- LAN architecture
- LAN Topologies
 - Bus Topology
 - Star topology
 - Extended Star topology
 - Ring topology
 - Token Ring
 - FDDI
 - Hybrid topology
 - Mesh Topology



Computer Network

- A network May be represented as a graph with nodes representing computers and network devices like switches, routers etc. and the links representing communication links.
- Modes of communication may be broadcast or point to point.(Both may be shared or dedicated links)



LAN Architecture

- LAN architecture is the overall design of a LAN. It includes:
 - LAN hardware
 - LAN software
 - LAN topology
 - Media access control (MAC) protocol
- The LAN's network operating system is sometimes also considered to be part of LAN architecture.



LAN topologies

- There are two types of LAN topologies: physical and logical
- Physical LAN topology refers to the physical layout of the network
 - The way in which the communication is configured and how nodes attach to the network
 - Because the focus is on physical connections among hardware component, physical topologies correspond to the physical layer of the OSI reference model
- Logical topology is concerned with how messages are passed from node to node within the network.



LAN topologies

- By shape we can classify the network into three most popular LAN topologies. such as:
 - Star
 - Ring
 - Bus
- Although there are other topologies exists such as :
 - Mesh topology
 - Hybrid topology



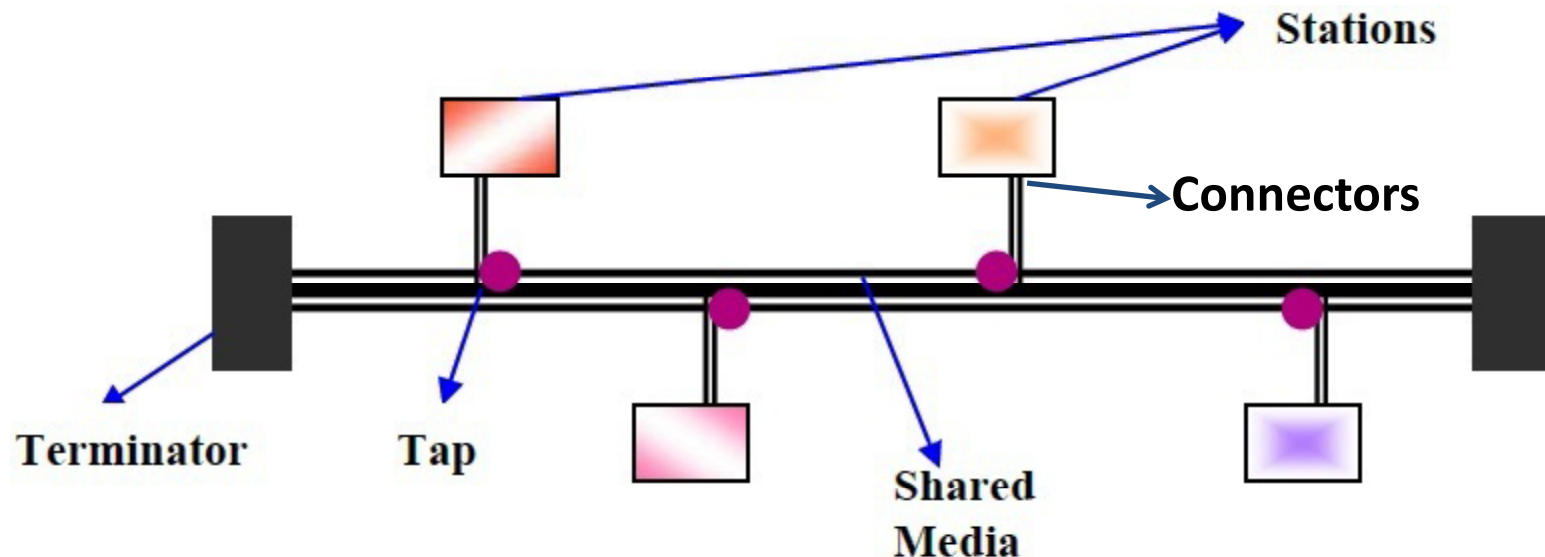
Shared Broadcast Links

- Point to point communication
- Each pair of communicating nodes use the link for a short period of time.
- Other nodes ignore the communication.
- There has to be a distributed protocol to decide who gets the use of link.



Bus Topology

- Single cable connects all the computers.
- Each computer has connector to share cable.
- Computer must synchronize and allow only one computer to transmit at a time.





Bus Topology

- Network maintained by a single cable.
- Cable segment must end with a terminator.
- Uses thin co-axial cable for general purpose whereas backbone network would have been thick Co-axial cable.
- Extra stations can be added in daisy chain manner.
- Becomes obsolete these days because of loose connector problems.



Bus Topology

- Standard is IEEE 802.3
- Thin Ethernet(10base2) has a maximum segment length of 200 meters.
- Maximum number of connections is 30 devices.
- Four repeaters may be used to a total cable length of 1000 meters.
- Maximum numbers of nodes is 150.



Bus Topology

- Thick Ethernet (10base5) is used for backbone.
- Limited to 500 meters.
- Maximum of 100 nodes per segments.
- Total of four repeaters, 2500 meters, with a total of 488 nodes.



Bus Topology

- Advantages of Bus topology:
 - Inexpensive to install.
 - Easy to add stations.
 - Use less cable than other topologies.
 - Works well for small networks.



Bus Topology

- Disadvantages of Bus topology:
 - No longer recommended.
 - If backbone breaks whole network down.
 - Limited number of devices can be attached.
 - Sharing same cables slows response rate.



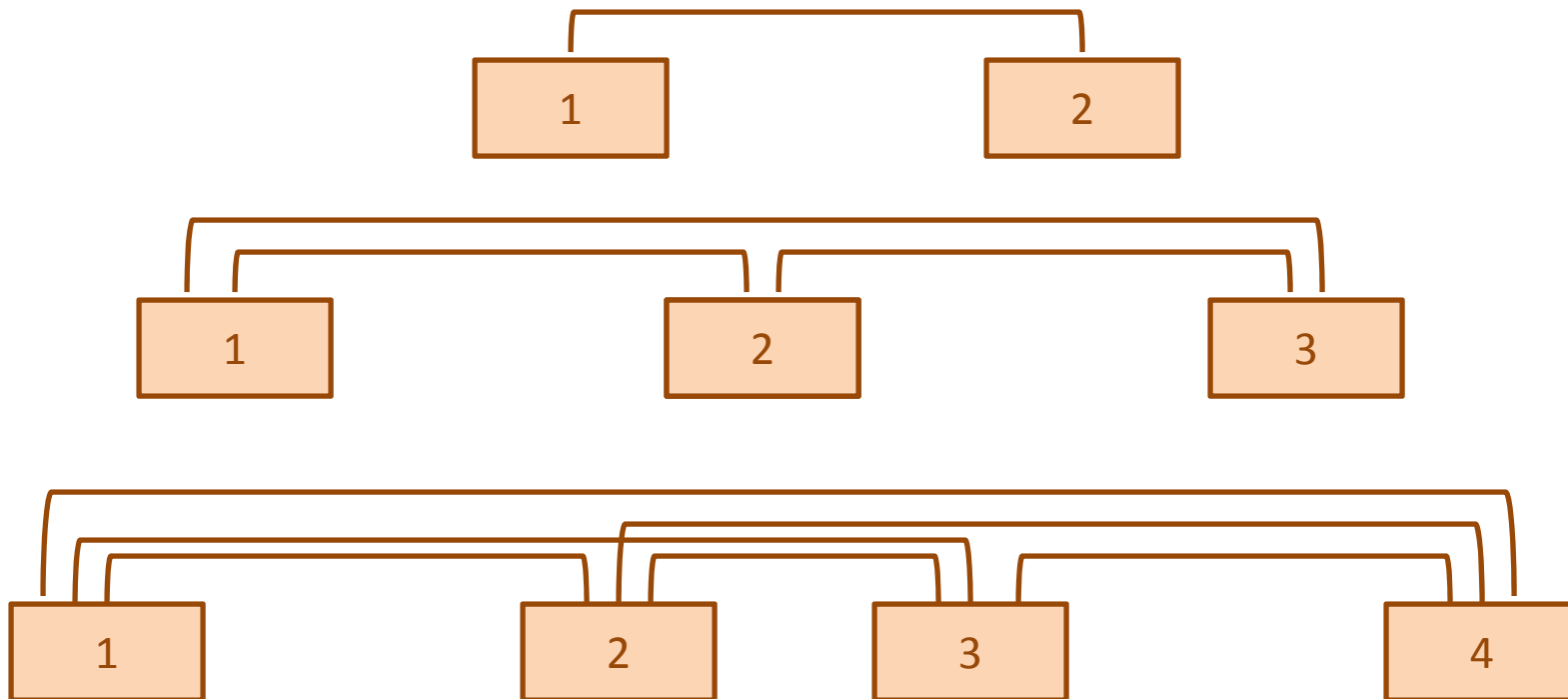
Direct Point to point communication

- Computers connected by communication channels or links such that each connects exactly two computers.
- Forms mesh or point to point network.
- Allows flexibility in communication hardware, packet formats etc.
- Provides security and privacy because communication channel is not shared.



Connections in a point to point Network

- Number of wires grows as a square of numbers of computers.





Bus Topology

- $${}^n C_2 = \frac{n(n-1)}{2}$$
$$= n^2$$
- Not recommended for LAN.(not because of extra wires they demand but the number of ports are limited)
- Connections between the buildings can be prohibited.



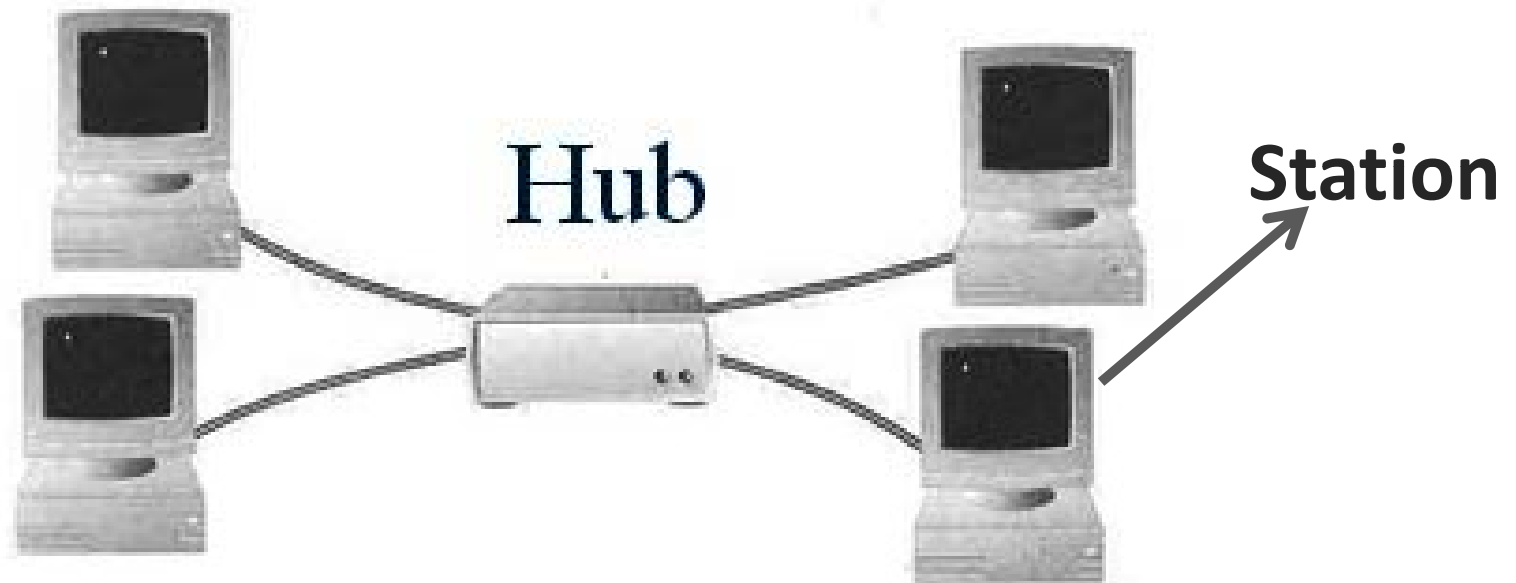
Remedy for multiple connections

- LAN developed in late 1960s and early 1970s.
- Reduce number of connections by sharing connections among many computers.
- Computer take turns time division multiplexing.
- Must include techniques for synchronizing use.



Star Topology

- All computers attached to a central point.



- Centre of star is called hub.



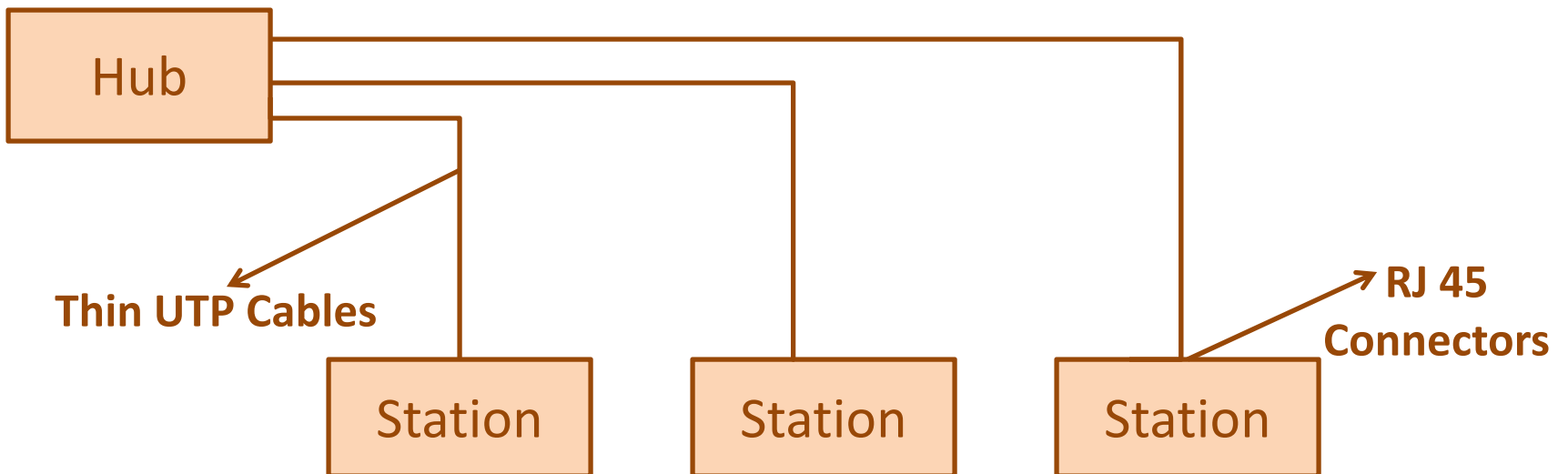
Star Topology

- Physical topology(like star)
- Logical topology(like point to point)
- Better of (shared bus)others likewise the cable used is of different quality and connections does not loosen up.
- Can handle the connections at a central point.



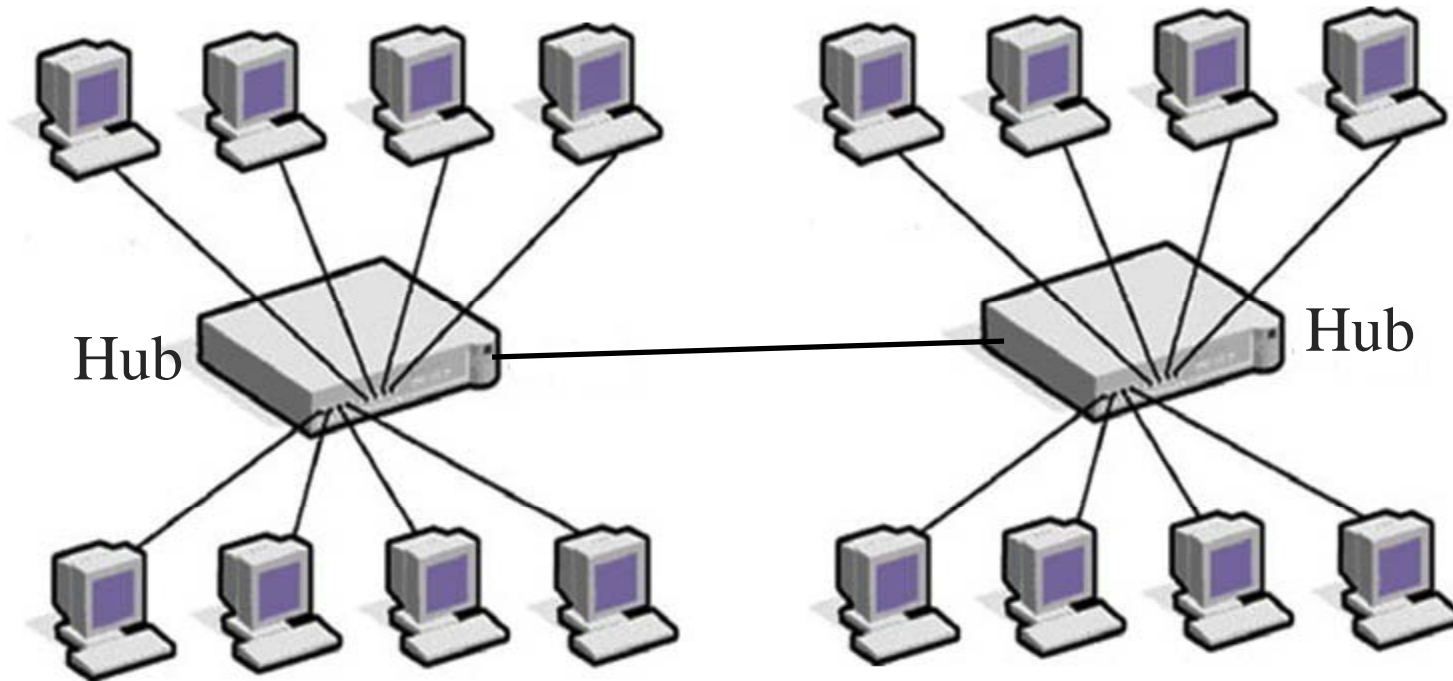
Star Topology

- Star topology in practice:
 - Previous diagram was idealized usually connecting cables run in parallel to computers.





Extended Star Topology



Extended Star Topology

- A star network which has been expanded to include an additional hub or hubs.

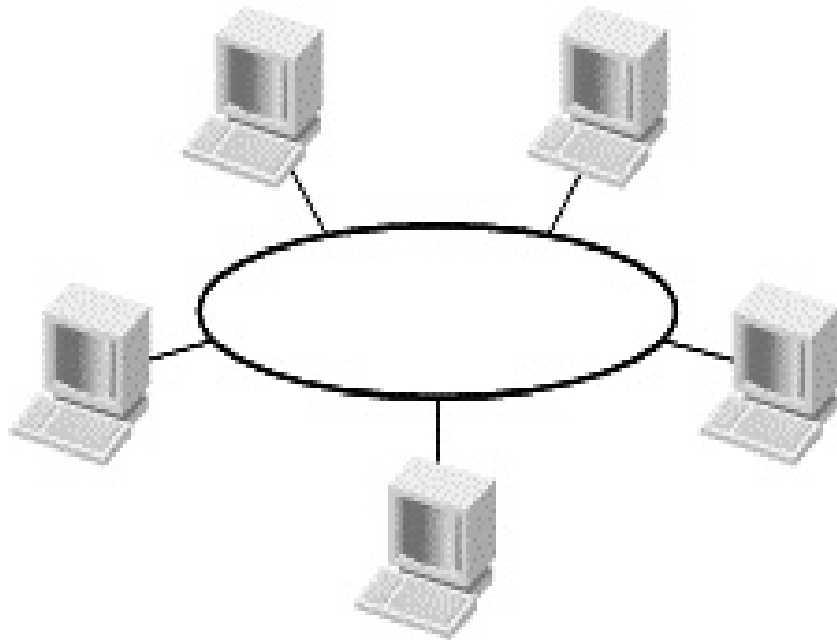


Ring Topology

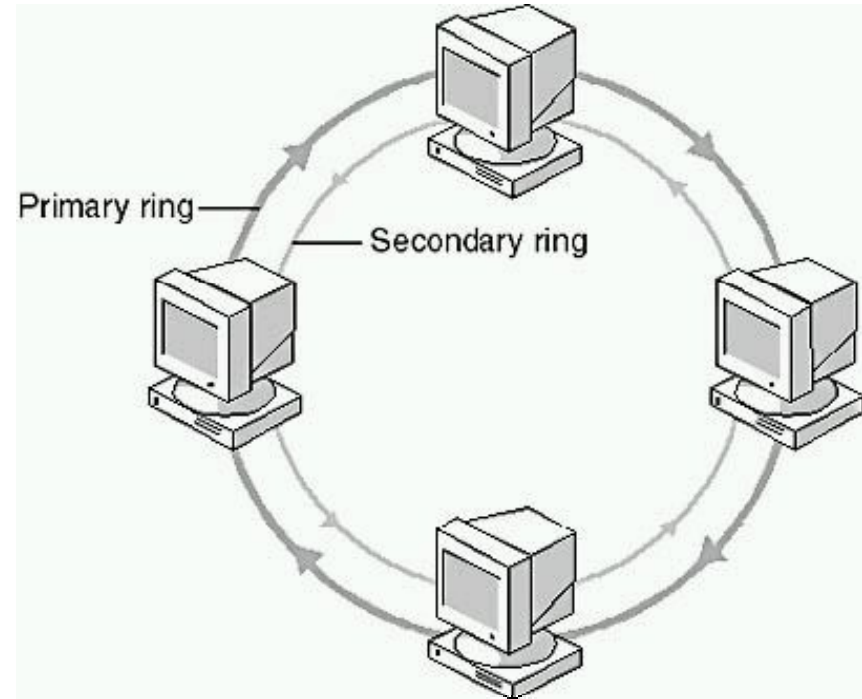
- Computers connected in a closed loop.
- First passes data to second, second passes data to third and so on.
- In practice, there is a short connector cable from the computer to the ring.
- Ring connections may run past the offices with connector cable to socket in the office.



Ring Topology



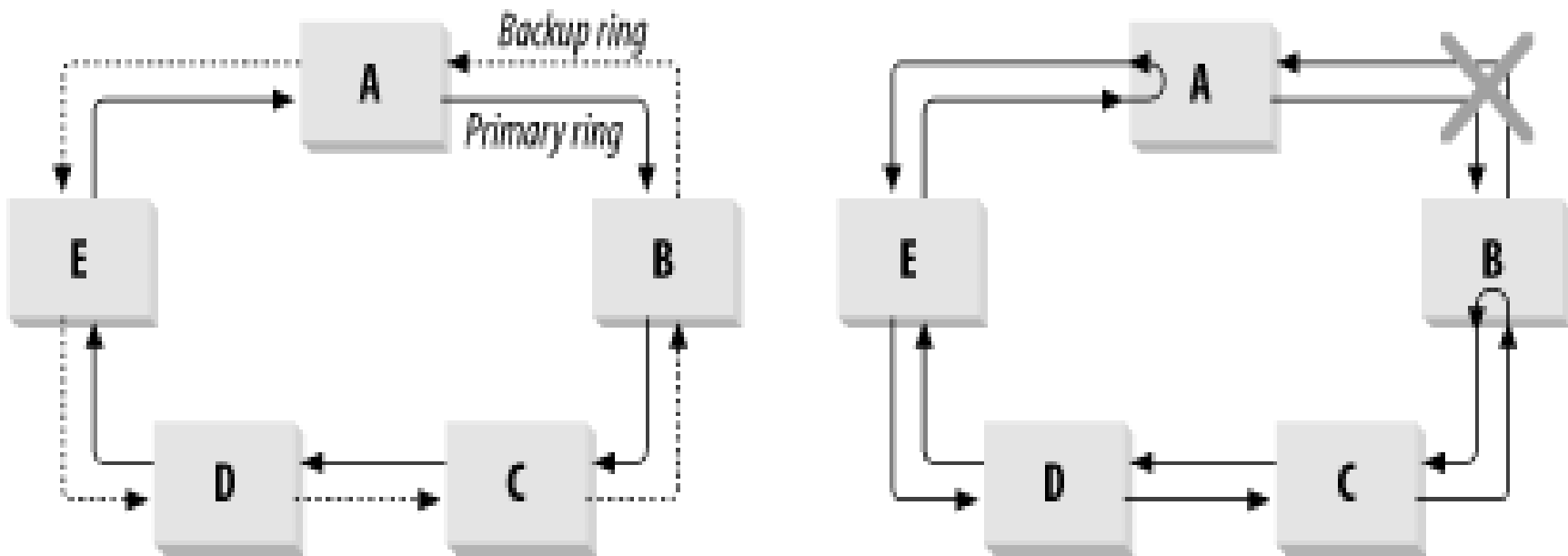
Single ring architecture



Double ring architecture



Ring Topology



fault tolerance in a dual ring architecture



Ring Topology

- There is no starting or ending point.(a ring)
- All the nodes have equal access to the media.
- Single ring data can travels in one direction only whereas in double it can travel in both directions and it also provide fault tolerance and reliability.
- Each device has to waits for its turn to transmit the data.
- Most common type of ring topology is **token ring** (IEEE802.5).



Ring Topology

- A token contains the information, reaches to the destination, data is extracted and acknowledgement is sent to the transmitting device.
- Transmitting device removes the acknowledgement and release the empty token if it does not have anything to send, for the other users to use the networking media.



Ring Topology

- Advantages of Ring Topology
 - Data packets travels at great speed.
 - No collisions
 - Easier to find the fault
 - No terminators are required.



Ring Topology

- Disadvantages of Ring Topology
 - Requires more cable than a bus.
 - A break in the ring will break the network.
 - Not as common as the bus—less devices are available(Actually they are popular in WAN).

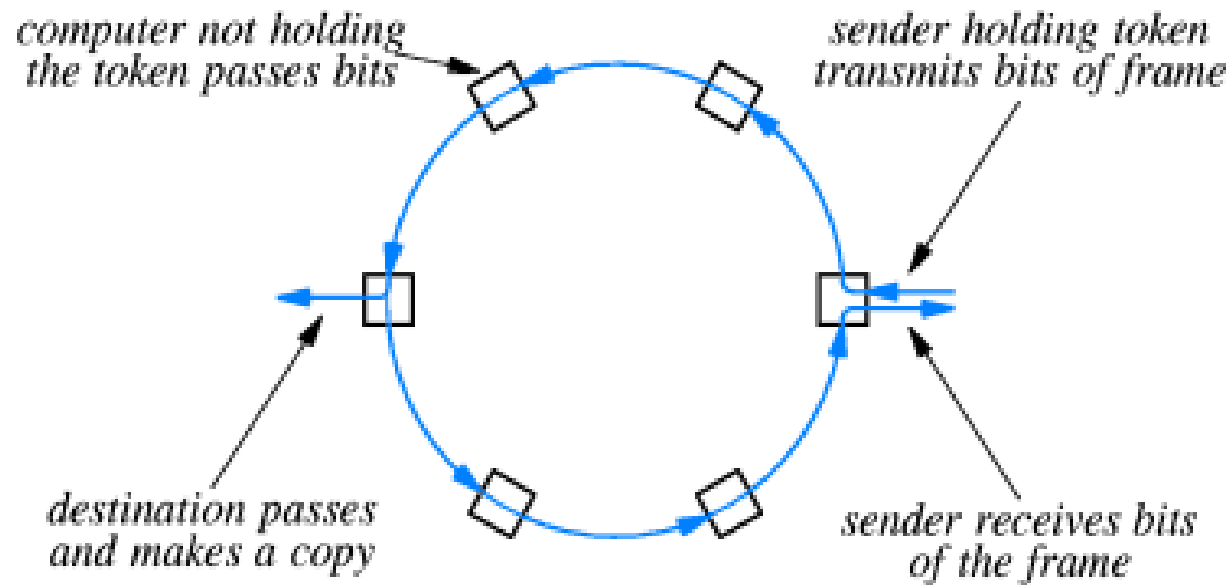


Token Ring

- Many LAN Technologies that use ring topology use token passing for synchronized access to the ring.
- Ring itself is treated as a single, shared communication medium.
- Bits pass from the transmitter , past other computers and are copied by destination.
- Hardware must be designed to pass token even if the attached computer is powered down.



Token Ring



Operation of token ring



Token Ring

- Working of Token Ring:
 - When computer wants to transmit, it waits for the token.
 - After Transmission, computer transmit token on the ring.
 - Next computer ready to transmit when receives the token then it starts transmission.

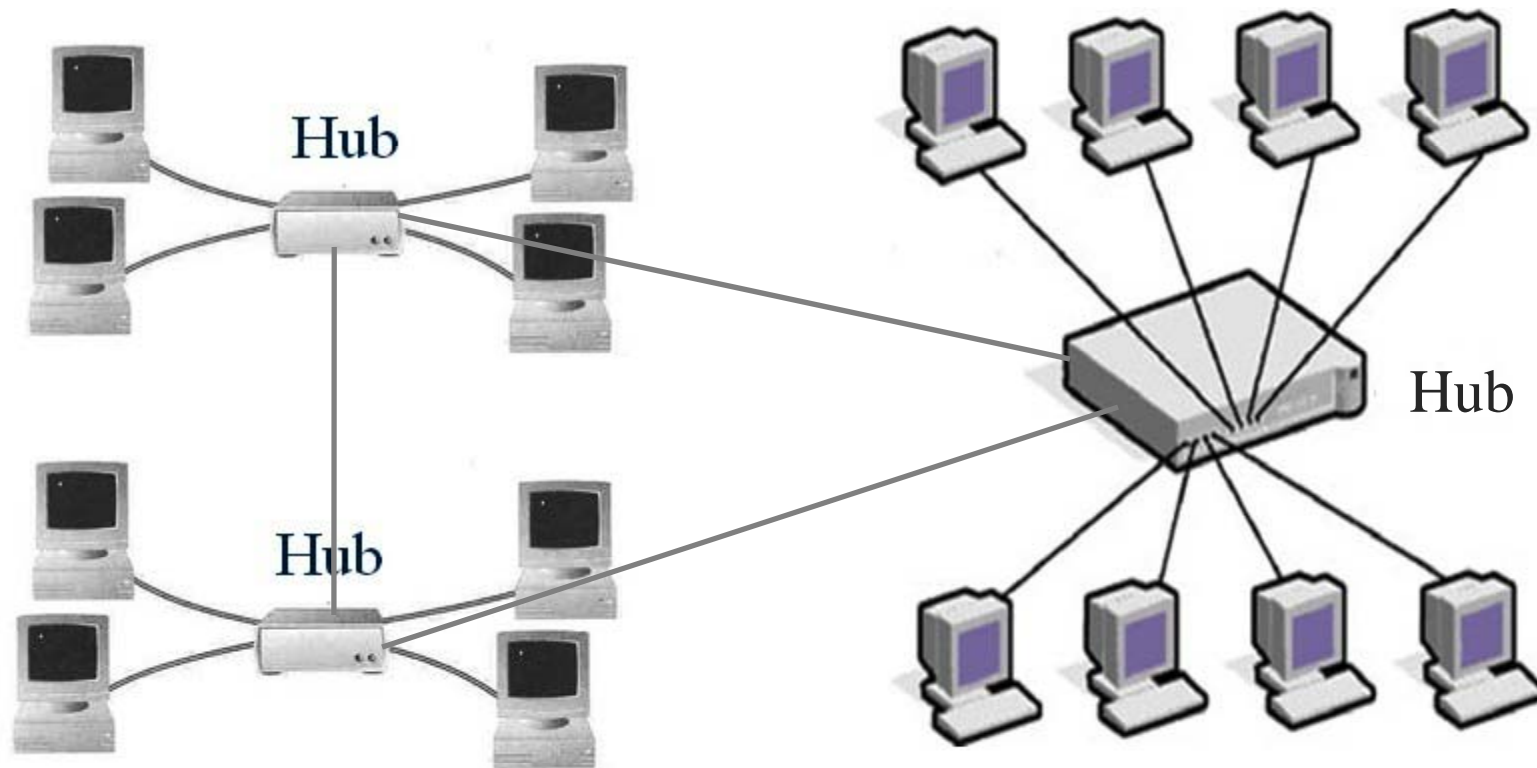


FDDI

- Fiber Distributed Data Interconnect(FDDI) is another ring topology.
- Uses Fiber Optics between Stations.
- Transmits Data at higher speeds at 100 Mbps.
- In case of node failure of if one node becomes down FDDI automatically switches.



Hybrid Topology



Hybrid Topology

- Some portion point to point and some portion broadcast.



Hybrid Topology

- Hybrid topology combines two or more different physical topologies.
- Commonly Star-Bus or Star-Ring.
- Star-ring uses MAU.(Multi-station Access Unit)

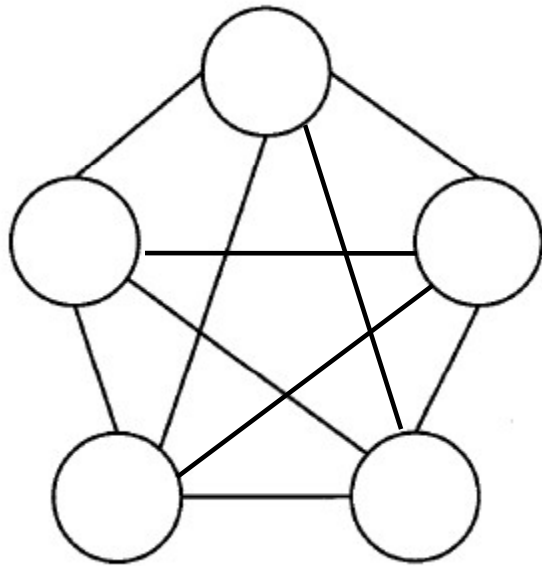


Mesh Topology

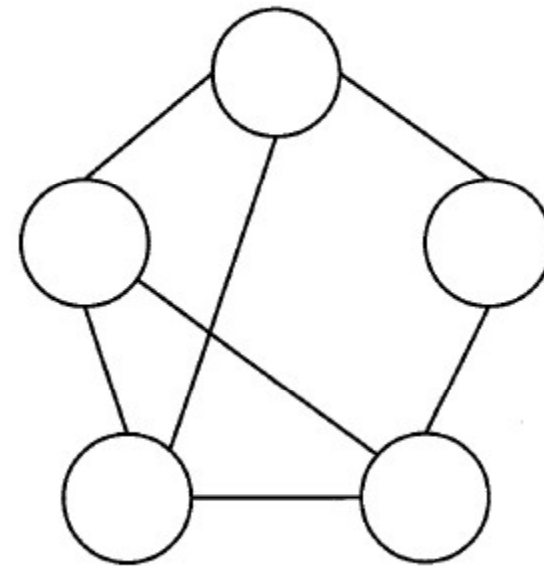
- In a fully connected mesh network every computer is directly connected to all the other computers in the network.
- Complete mesh could have been considered as full graph.
- Not used in LAN because of excessive cable length.
- Now a days partially connected mesh topology is used.



Mesh Topology



Fully Connected Mesh



Partially Connected Mesh



Mesh Topology

- In a partially connected mesh network, every computer is connected (either directly or via a relay computer) to at least two other computers in the network by more than one path.
- Most often used in WAN to interconnect various LAN's.
- Allows communication to continue in the event of a break in any connections.



Mesh Topology

- Advantages of Mesh Topology:
 - Improves Fault Tolerance.
 - Can carry more data.
- Disadvantages of Mesh Topology:
 - Expensive
 - Difficult to install
 - Difficult to manage
 - Difficult to troubleshoot



Important factors about Topology

- How you will going to choose which type of topology you prefer?
 - Cost
 - Scalability
 - Bandwidth Capacity
 - Ease of installation
 - Ease of fault finding and maintenance



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Thanks