

Computer Networks

SECTION – A

Network Topologies

Outline of the talk

- Modes of communication
- Classification of Network
- Network Topologies

Modes of Communications

- **Point to point**
 - Dedicated (simplex, half duplex, full duplex)
 - Shared (multiplexing)
- **Broadcasting**
 - Dedicated (Channel level – one way)
 - Shared (Multiple access)
- **Multicasting (communicating to a specified group like sms to group of friends)**

Classification

■ Local Area Network

- Privately Owned
- Restricted in Size

■ Metropolitan Area Network

- Bigger Size
- Access Issues (because of cost)

■ Wide Area Network

- **Cost** (means more & more users are using it, volume went up, cost went down. But cost is still an issue)
- **Internetwork** (may connect various LANs / or it is a n/w of n/ws)

Network Topologies

Outline

- A Computer Networks would be number of nodes connected by communication links, so there is a some kind of graph, this graph has a structure, structure has an implication about how we will go about communication,
- Generally its not feasible to have one to one communication b/t each pair of nodes.
- Nodes connected in which manner is the subject matter of discussion today.

Quick Recap

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

LAN Topologies

- Networks may be classified by shape

Three most popular :

- Star
- Ring
- Bus

BUS Topology based on : Shared Broadcast links

- **Point to point communication.** (Eg. A communicates with B and C, D, E are in the n/w, but A specifically communicates with B)
- **Each pair of communicating nodes use the link for a short time.**
- **Other nodes ignore the communication.**
- **There has to be a distributed protocol to decide who gets to use the link.**

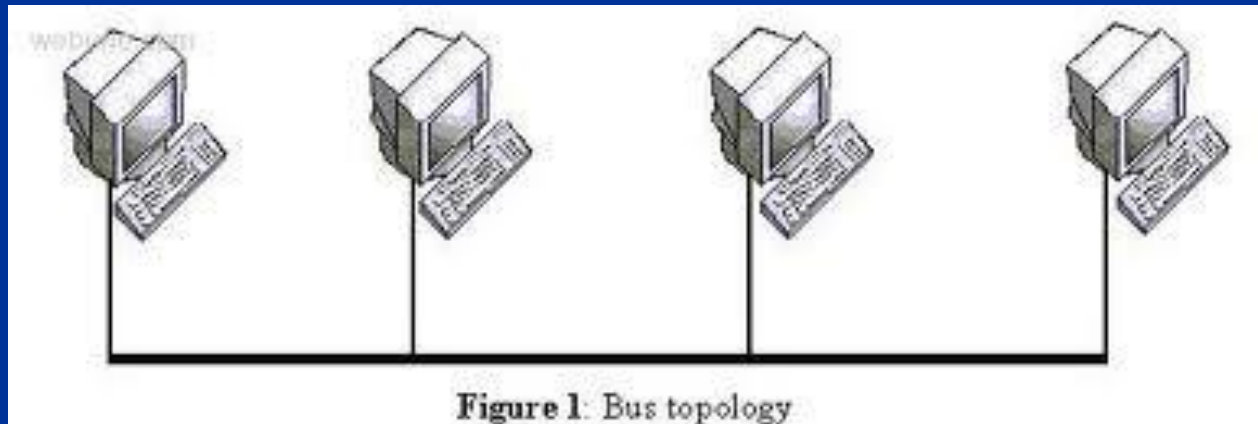
(if A wants to communicate B and C wants to communicate with D, there communications will go and collide with each other in shared broadcast medium. Communication with both the pair of nodes, they will get garbled.)

Bus topology

- Single cable connects all computers.
- Each computer has connector to shared cable.
- Computers must synchronize and allow only one computer to transmit at a time.
(N/w is simple , it's a simple copper cable.)

Bus topology

Bus: shared cable



Bus Topology (2)

- Network maintained by single cable.
- Cable segment must end with a terminator.
- Uses thin coaxial cable (backbones will be thick coaxial cable)
- Extra stations can be added in a daisy chain manner.

Bus topology (3)

- **Standard IEEE 802.3**
- **Thin Ethernet (10Base2, which means 10 stands for 10 Mbps speed 2 means it has a maximum segment length of 200m) has a maximum segment length 200m.**
- **Max. no. of connections is 30 devices.**
- **Four repeaters maybe used to a total cable length 1000m.** (although its not recommended practice, in case of long cable, signal gets week , down the line so we've re-generate the signal by using repeater – take weak signal amplify it and send stronger signal down the line.)
- **Max no. of nodes is 150.**

Bus Topology (4)

- Thick Ethernet (10Base5) used for backbones.
- Limited to 500m
- Max of 100 nodes per segment.
- Total of four repeaters, 2500m with a total of 488 nodes.

Bus Topology (5)

■ Advantages

- Inexpensive to install
- Easy to add stations.
- Use less cable than other topologies.
- Work well for small networks.

■ Disadvantage

- No longer recommended. (not reliable)
- Backbone breaks, whole network down.
- Limited no. of devices can be attached.
- Difficult to isolate problems. (if there's a problem, whole n/w is down.)
- Sharing same cable slows response rates.

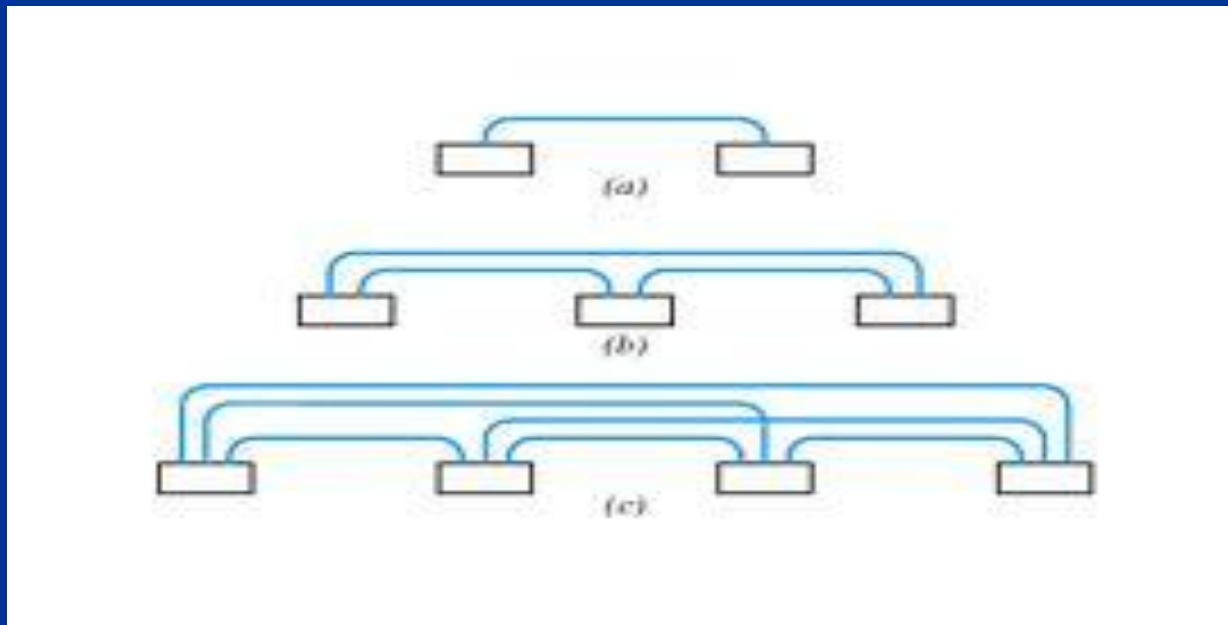
Direct point-to-point communication

(communication channel not shared/dedicated)

- Computers connected by some communication channels that each connect 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.

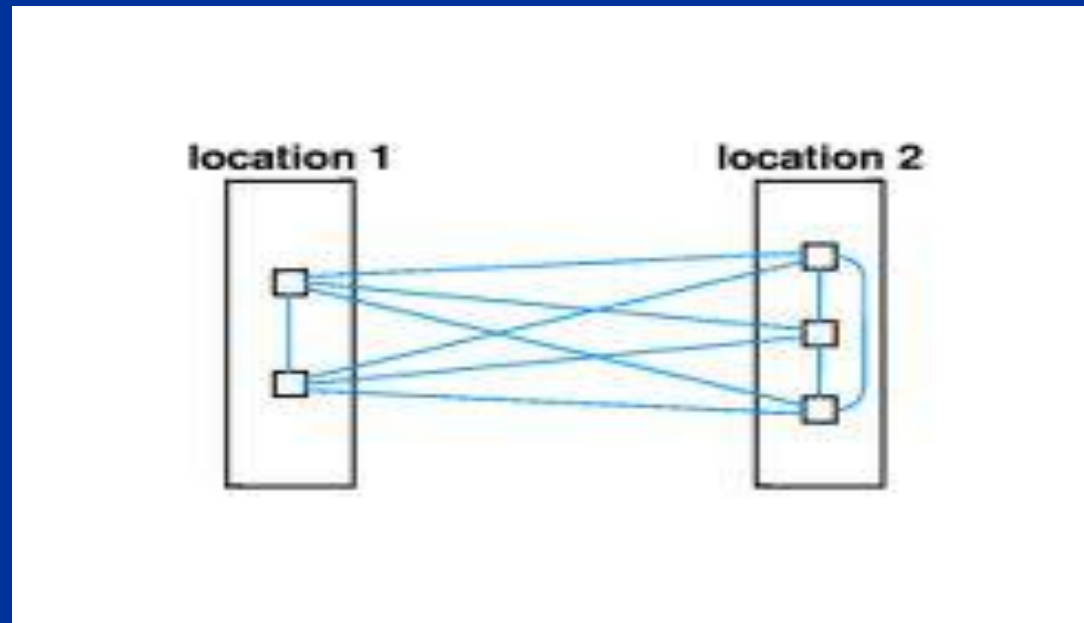
Connections in a point-to-point network

- Number of wires grows as square of number of computers



Connections in a point-to-point network

- Connections between buildings can be prohibitive.

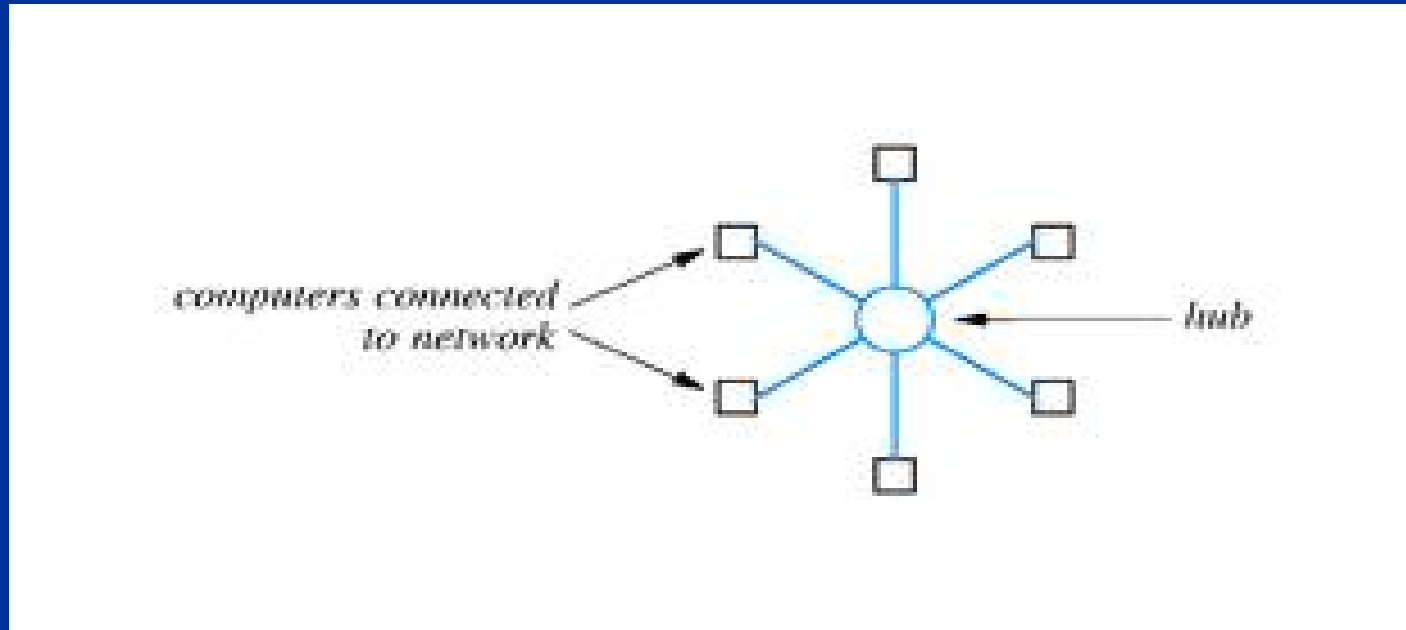


Reducing the number of communication channels

- LAN developed in late 1960s and early 1970s.
- Reduce number of connections by sharing connections among many computers.
- Computers take turns(in orderly fashion) – Time Division Multiplexing (TDM)
- Must includes techniques for synchronizing use.

Star topology

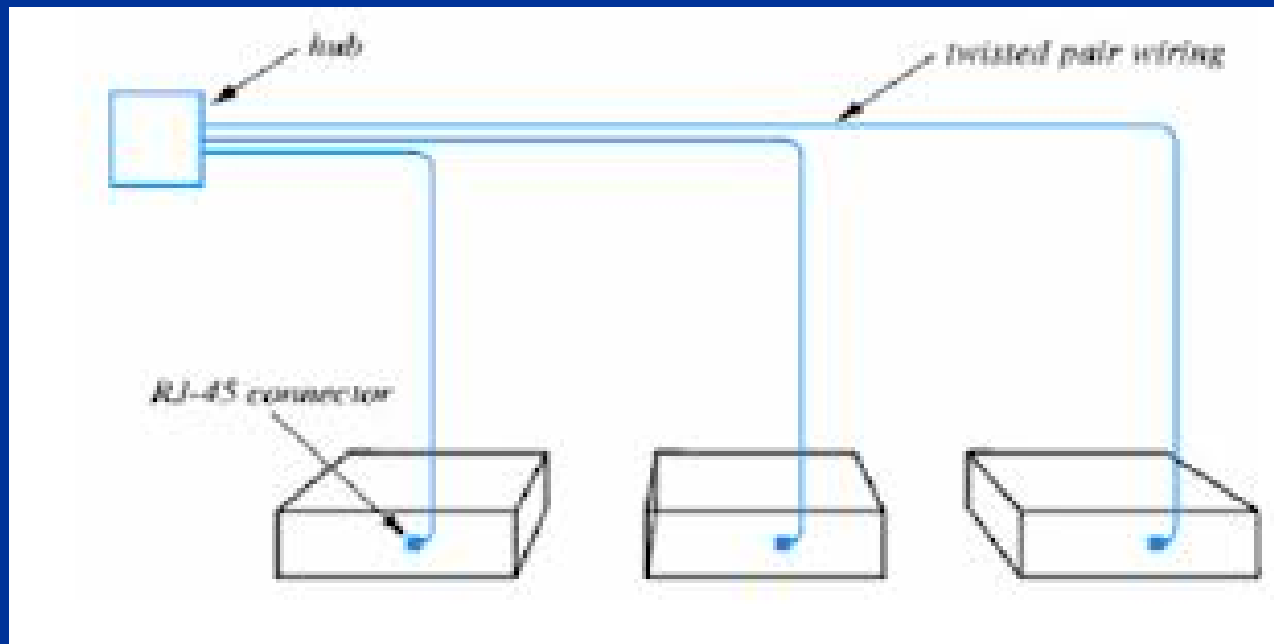
- All computers attach to a central point :



Center of star is sometimes called a hub.

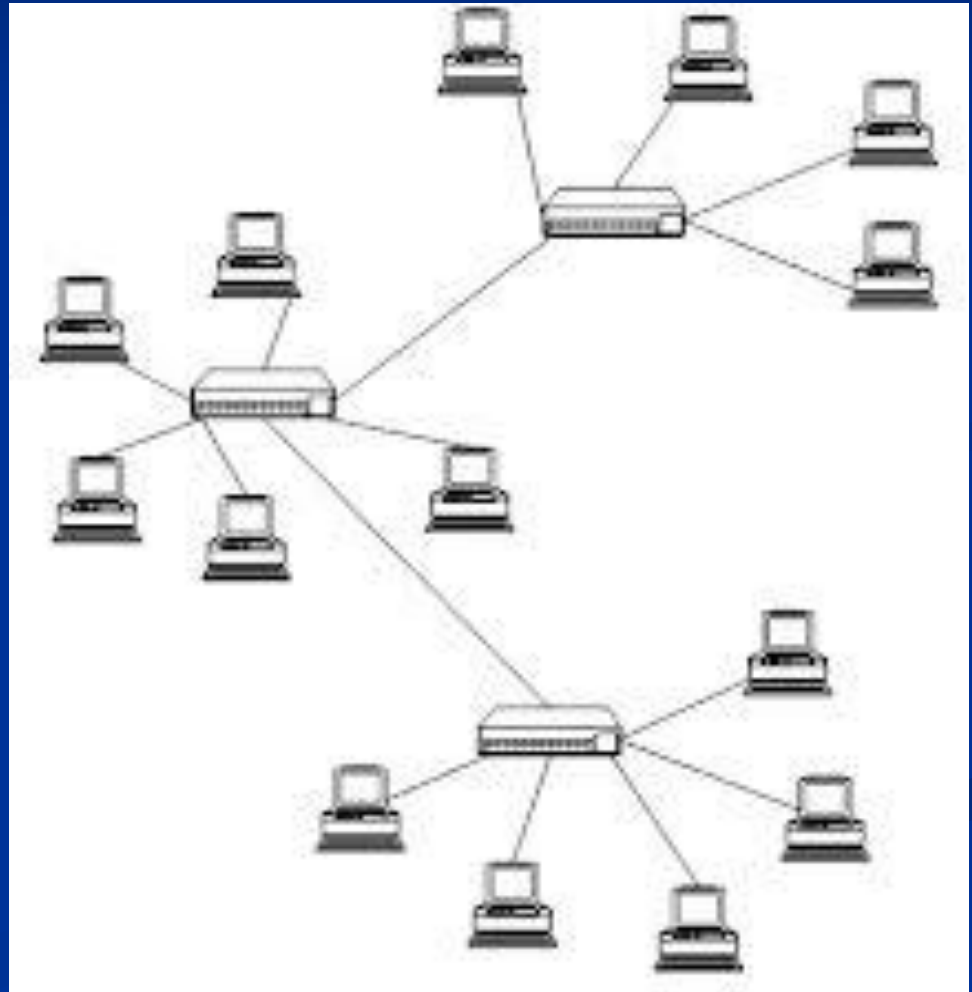
Star topology in practice

- Previous diagram is idealized: usually, connecting cables run in parallel computers.

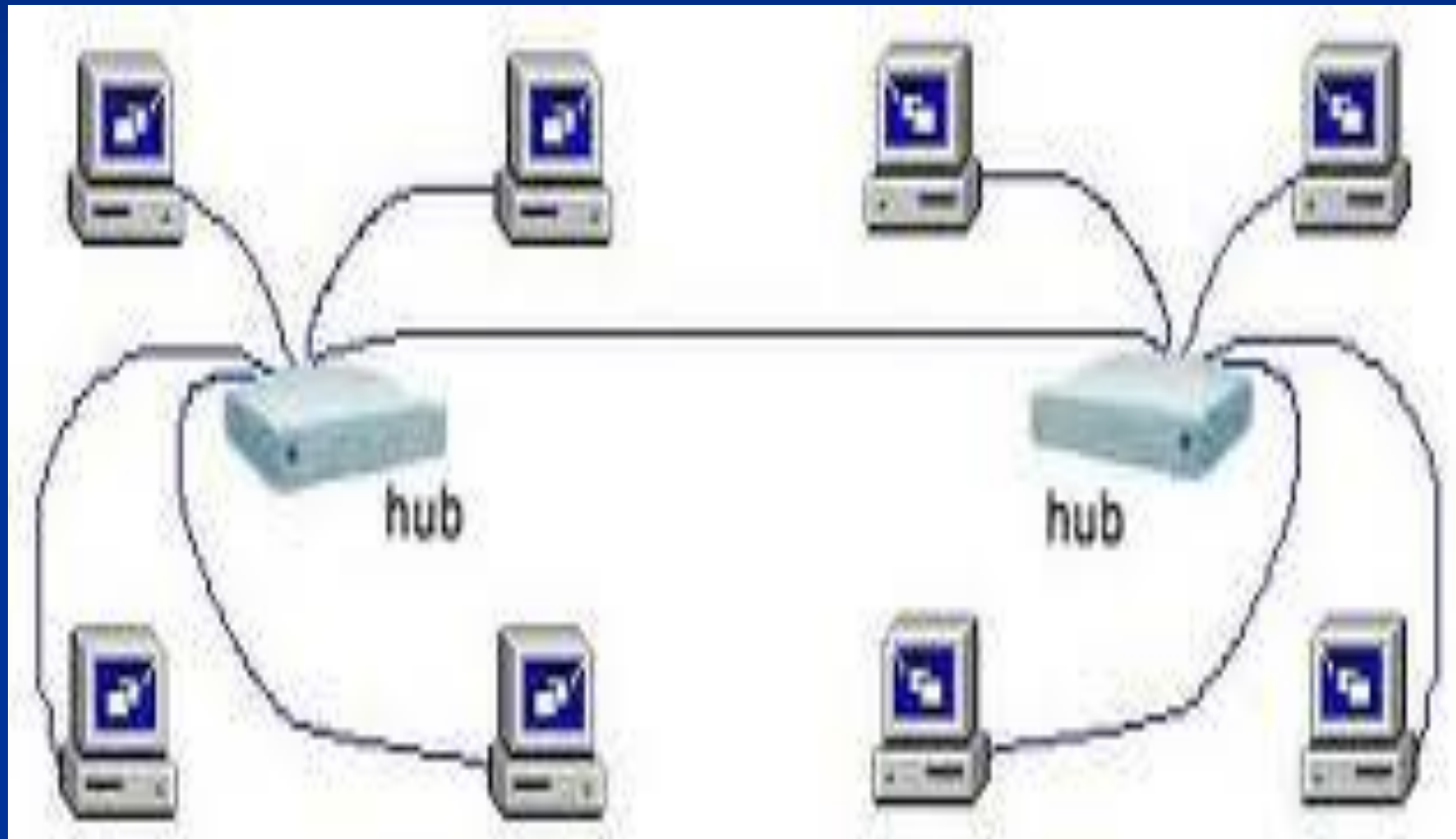


Extended Star Topology

A Star Network which has been expanded to include an additional hub or hubs



Hybrid Topology

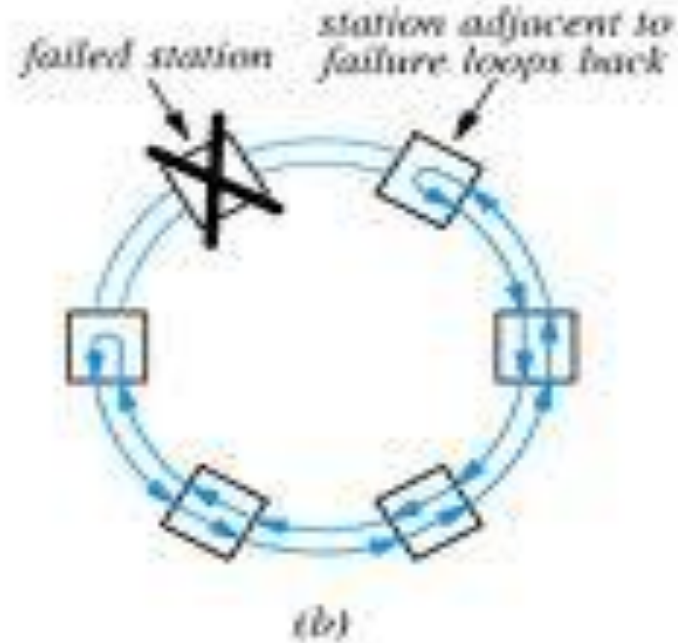
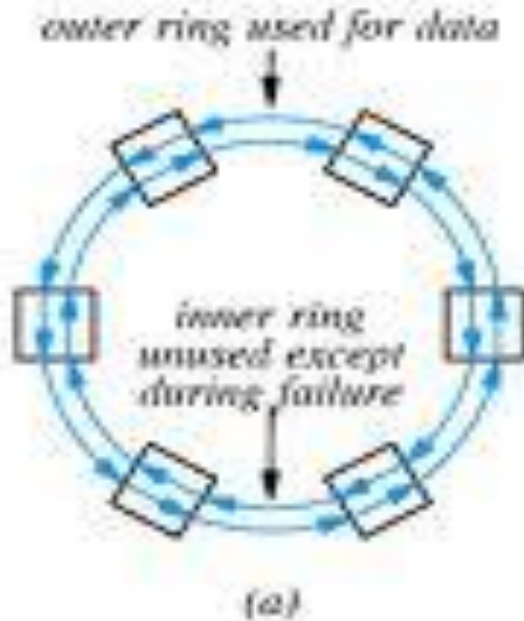


Ring Topology

- 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 offices with connector cable to socket in the office.

Ring topology

(useful in WAN , Eg. Telephone exchange)



Ring Topology (2)

- No beginning or end (a ring in fact !!)
- All devices have equal access to media
- Single ring – data travels in one direction only.
- Double ring a double ring allows fault tolerance
- Each device has to wait its turn to transmit
- Most common type is Token Ring (IEEE 802.5)
- A token contains the data, reaches the destination, data extracted, acknowledgement of receipt sent back to transmitting device, removed, empty token passed on for another device to use.

Ring Topology (3)

Advantages

- Data packets travel at great speed (synchronous operation)
- No collisions
- Easier to fault find
- No terminators required

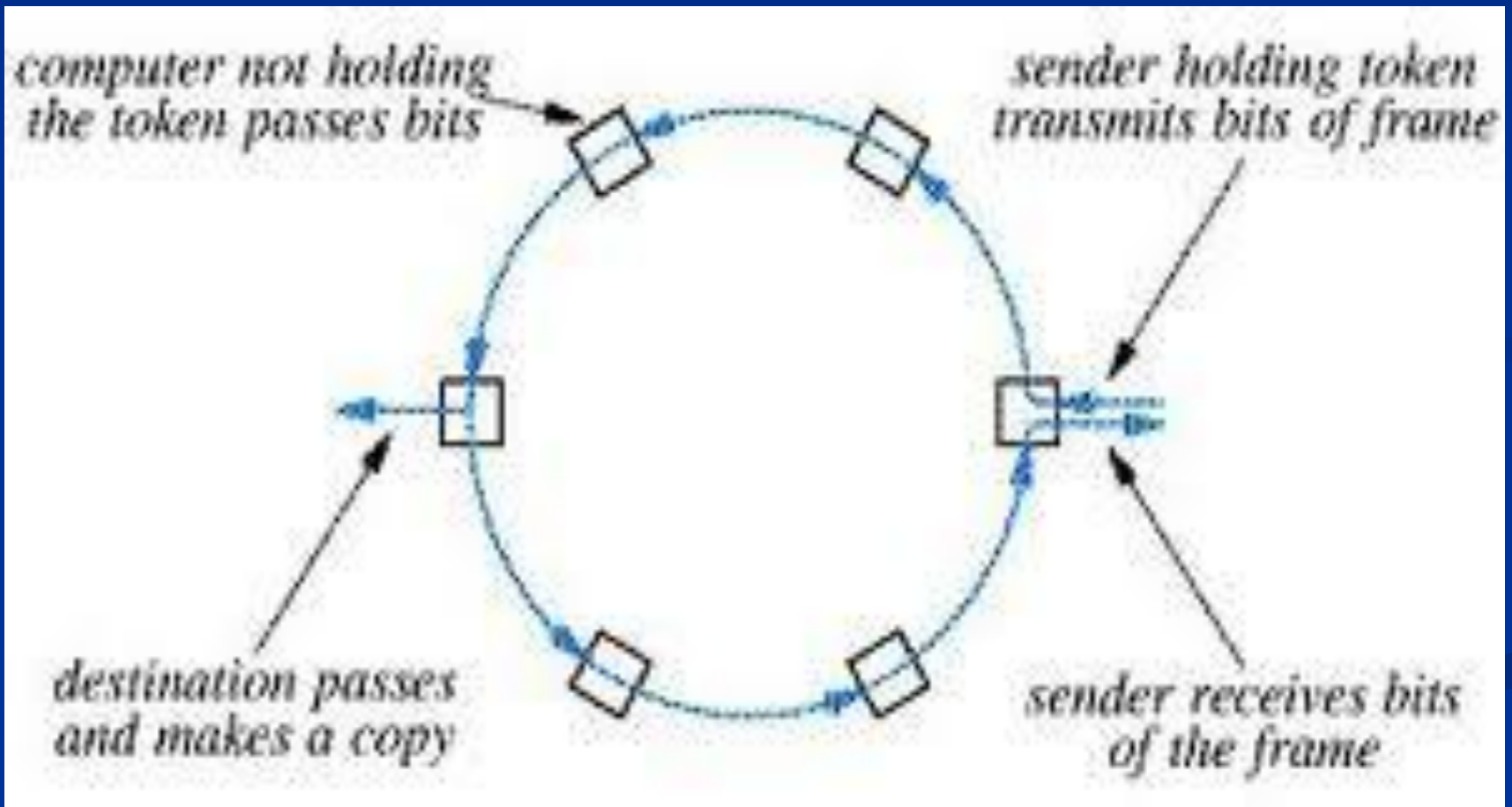
Disadvantages

- Requires more cable than a bus
- A break in the ring will bring it down.(if there are couple of breakdown)
- Not as common as the bus – less devices available

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 transmitter, past other computers and are copied by destination.
- Hardware must be designed to pass token even if attached computer is powered down.

Token ring



Using the token

- When a computer wants to transmit, it waits for the token
- After transmission, computer transmits token on ring
- Next computer ready to transmit receives token and then transmits.

FDDI

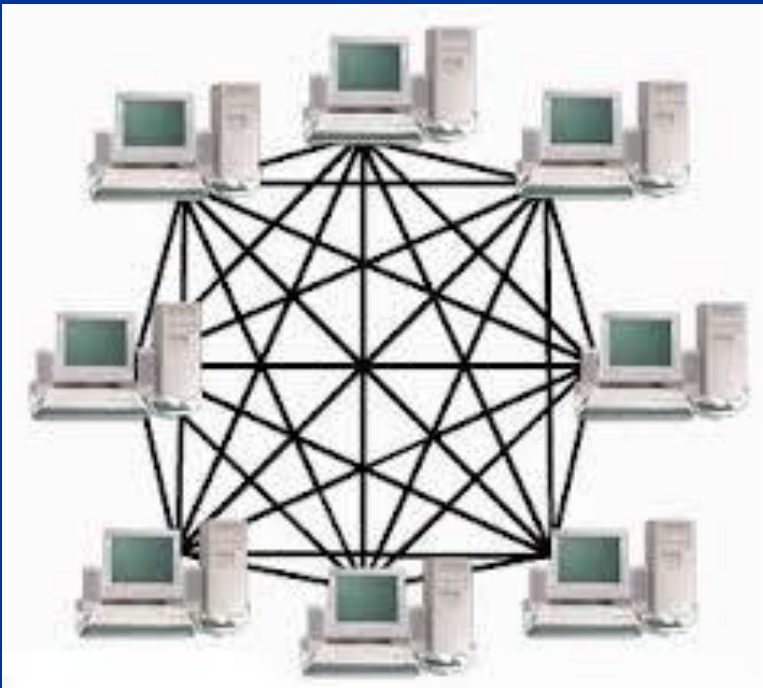
- **Fiber Distributed Data Interconnect (FDDI)** is another ring technology. (esp. used in LAN)
- Uses fiber optics between stations.
- Transmits data at 100 Mbps
- Uses pairs of fibers to form two concentric rings.

Hybrid Topology (2)

- Old networks are updated and replaced, leaving older segments (legacy)
- Hybrid Topology – combines two or more different physical topologies.
- Commonly Star-Bus or Star-Ring
- Star-Ring uses MAU (Multistation Access Unit (see later slide)

Mesh Topology

- Complete mesh will take lot of cable. 8 nodes. Direct & in-direct many paths.



Mesh Topology (2)

- Not common on LANs.
- Most often used in WANs to interconnect LANS.
- Each node is connected to every other node.
- Allows communication to continue in the event of a break in any one connection.
“It is “Fault – Tolerant”

Mesh Topology

Advantages

- Improves Fault Tolerance
- Can carry more data.

Disadvantages

- Expensive.
- Difficult in to install
- Difficult to manage
- Difficult to trouble-shoot.

Why multiple topologies

- Each has advantage and disadvantages:
 - Ring ease synchronization: may be disabled if any cable is cut.
 - Star easier to manage and more robust; requires more cables.
 - Bus requires fewer cables; may be disabled if cable is cut. (it wouldn't have a fault tolerance)
- Industry is setting (extended) star topology as most widely used.

Physical vs. Logical Topology

- The actual layout of a network and its media is its Physical Topology.
- The way in which the data access the medium and transmits packets is the Logical Topology.
- A glance at a network is not always revealing. Cables emerging from a Hub does not make it necessarily a Star Topology – it may actually be a bus or a ring.

Physical vs. Logical Topology (2)

- Your choice of Logical Topology will affect the Physical Topology – and vice versa.
- Design carefully – it may be difficult to change part way through the installation.
- Your choice will determine cable installation, network devices, network connections, protocols (and where you will drill holes in the building !)

Factors

- Cost.
- Scalability
- Bandwidth Capacity
- Ease of Installation
- Ease of fault finding and maintenance