

CS102- Application of Information Communication Technologies

Computer Networking

Communications

**communications
system**



Uses of Computer Communications

Text messaging allows users to send and receive short text messages on a phone or other mobile device or computer

Picture messaging allows users to send pictures and sound files

Video messaging allows users to send short video clips

Wireless instant messaging allows wireless users to exchange real-time messages with one or more other users

Uses of Computer Communications

- A **global positioning system (GPS)** is a navigation system that consists of one or more earth-based receivers that accept and analyze signals sent by satellites in order to determine the GPS receiver's geographic location. GPS receivers are:

Built into
many mobile
devices

Available as
a handheld
device

Available
with new
vehicles

Networks

- A **network** is a collection of computers and devices connected together via communications devices and transmission media
- Advantages of a network include:

Facilitating
communications

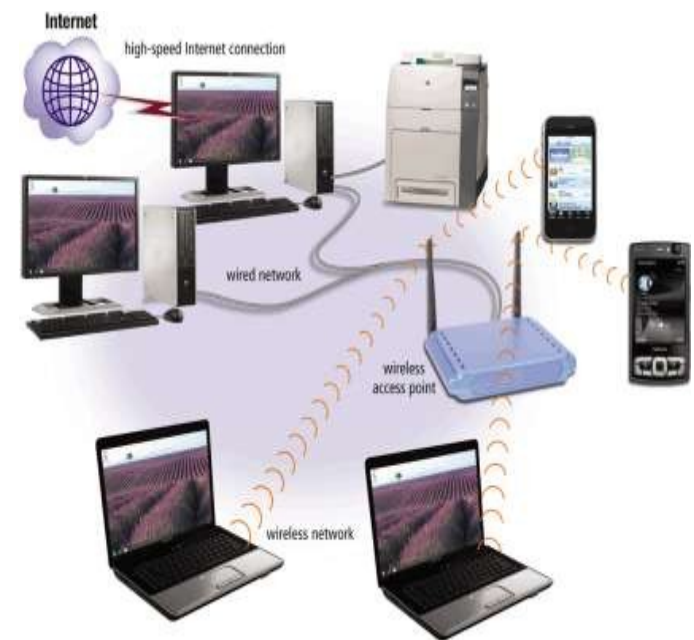
Sharing
hardware

Sharing data
and information

Sharing
software

Network Classifications(size)

- A **Personal area network (PAN)** connects electronic devices within a user's immediate area.
- A **local area network (LAN)** is a network that connects computers and devices in a limited geographical area
- A **wireless LAN (WLAN)** is a LAN that uses no physical wires



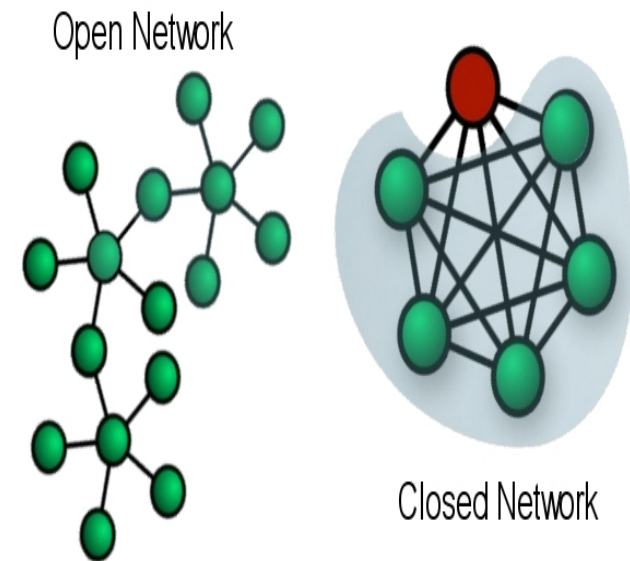
Network Classifications

- A **metropolitan area network (MAN)** connects LANs in a metropolitan area
- A **wide area network (WAN)** is a network that covers a large geographical area



Network Classifications(accessibility)

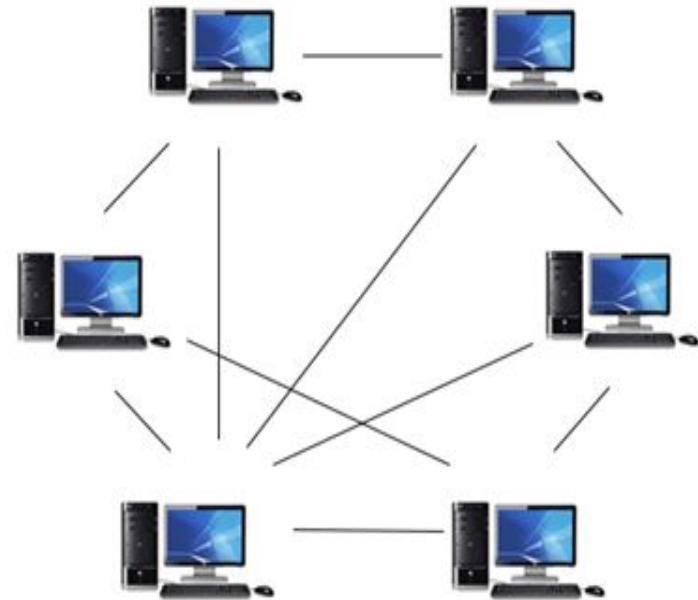
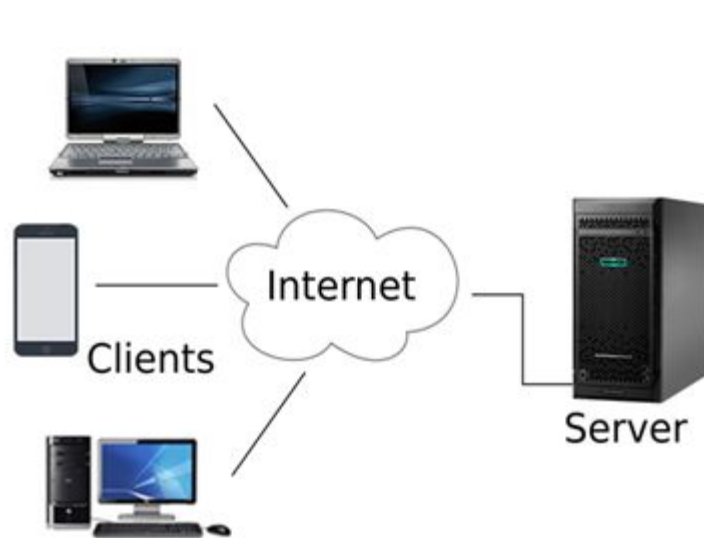
- **Open Network** internal operation is based on designs that are in the public domain. communication. i.e., Internet
- **Close Network** innovations owned and controlled by a particular entity such as an individual or a corporation. i.e., Microsoft Corporation



Network Architecture

- The design of computers, devices, and media on a network is sometimes called the network architecture.

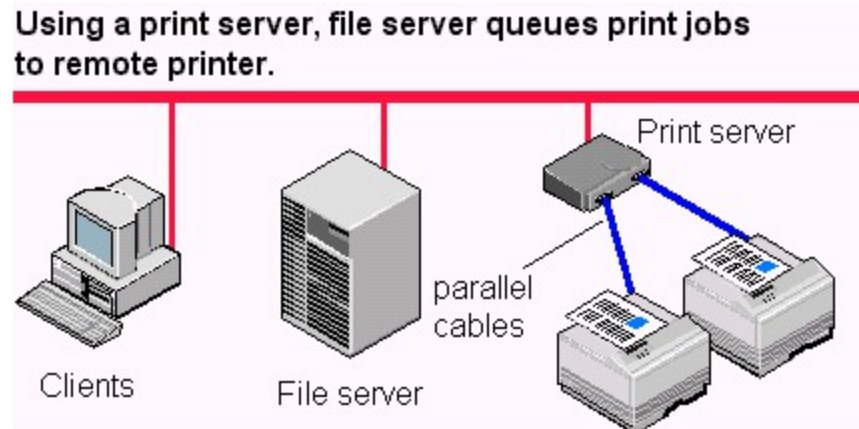
Client/server network Peer-to-peer network



Print Server Network

- A print server is a dedicated appliance or central point of software. They help clients/users/devices connect to shared printers and they process or pass through spool files from a client to the printer.
- When you hit print, the print server accepts the job and pushes it to the appropriate printer. Essentially, print servers are the intermediary between the computer and the printer. They help minimize chaos from breaking loose.

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Client/Server Network

- The Client/Server network is designed for the end users called clients, to access the resources such as songs, video, etc. from a central computer known as Server.
- Clients communicate with each other through a server. For example, if client1 wants to send some data to client 2, then it first sends the request to the server for the permission. The server sends the response to the client 1 to initiate its communication with the client 2.

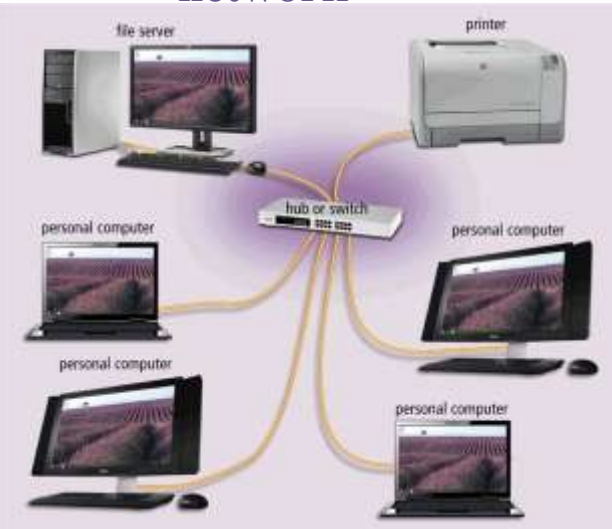
Peer-To-Peer Network

- Peer-To-Peer network is a network in which all the computers are linked together with equal privilege and responsibilities for processing the data.
- P2P describes an Internet network on which users access each other's hard disks and exchange files directly over the Internet.
- Peer-To-Peer network has no dedicated server.
- Special permissions are assigned to each computer for sharing the resources, but this can lead to a problem if the computer with the resource is down.

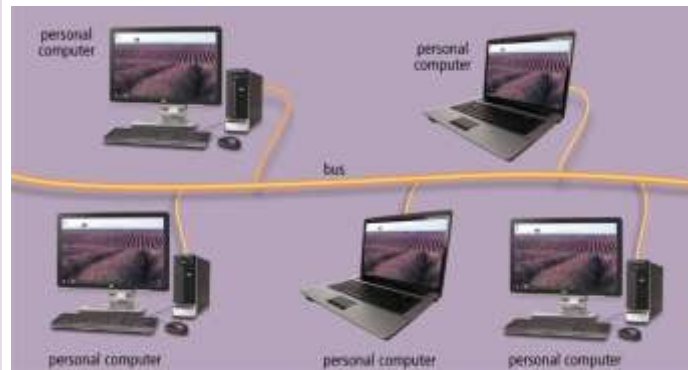
Network Topologies

- A **network topology** refers to the layout of the computers and devices in a communications network

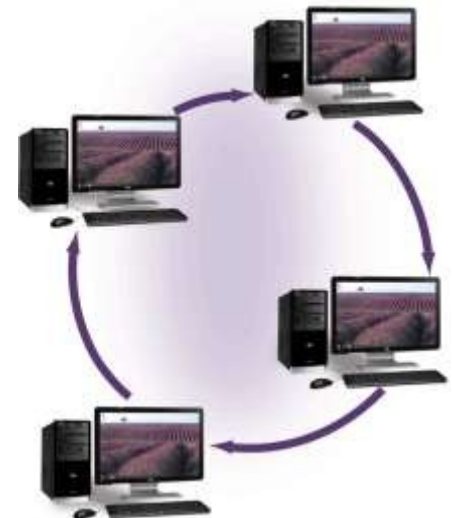
Star network



Bus network



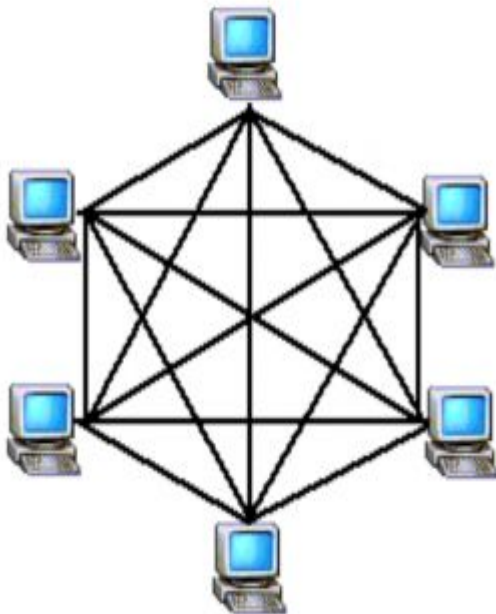
Ring network



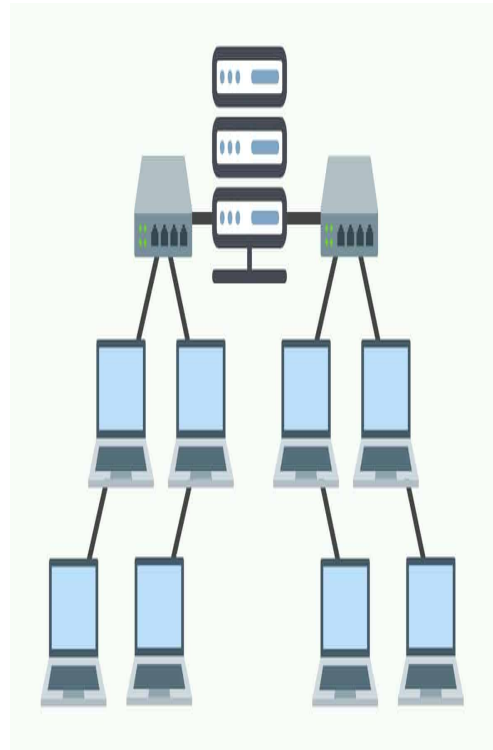
Networks Topology

Mesh Topology

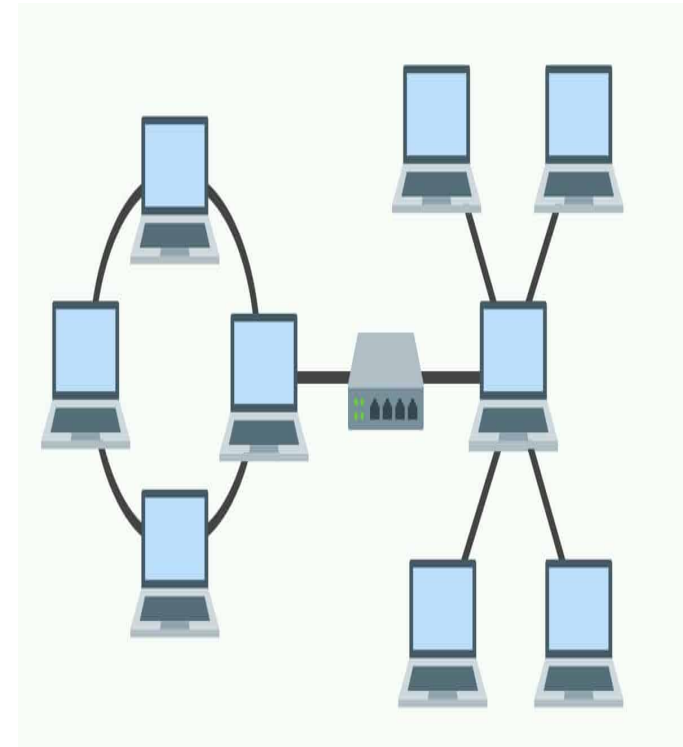
Mesh Topology



Tree Topology



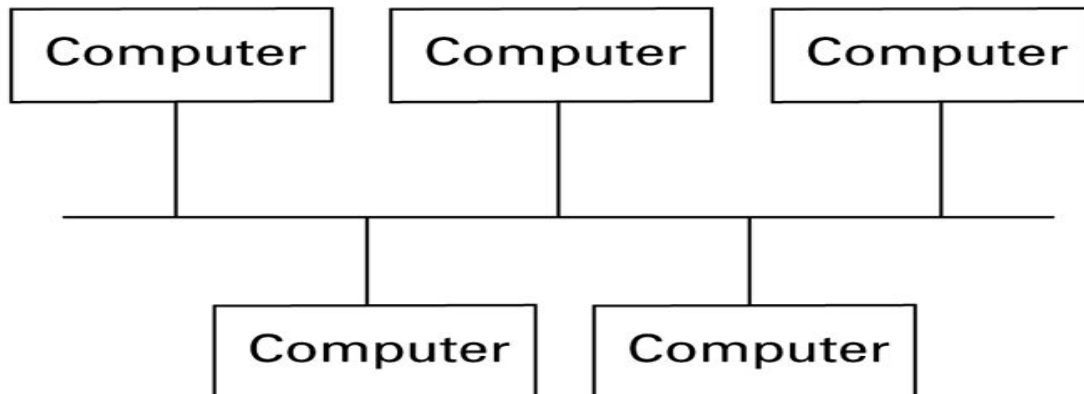
Hybrid Topology



Bus topology

- In Bus topology, the machines are all connected to a common communication line called a bus.
- The bus cable is considered as a "single lane" through which the message is broadcast to all the stations.

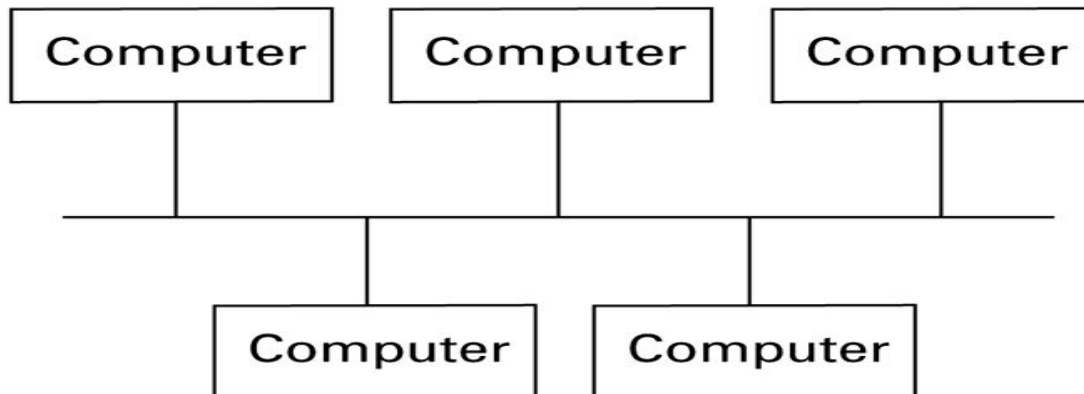
a. Bus



Bus topology

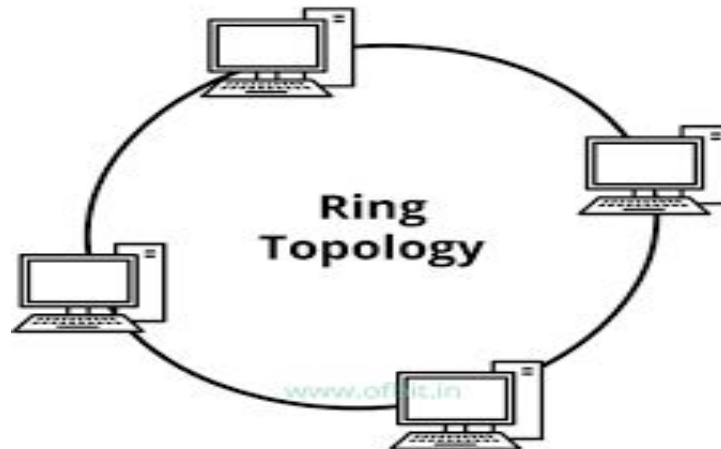
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a. Bus



Ring Topology

- Ring topology is like a bus topology, but with connected ends.
- The node that receives the message from the previous computer will retransmit to the next node.
 - **Token passing:** It is a network access method in which token is passed from one node to another node.
 - **Token:** It is a frame that circulates around the network.



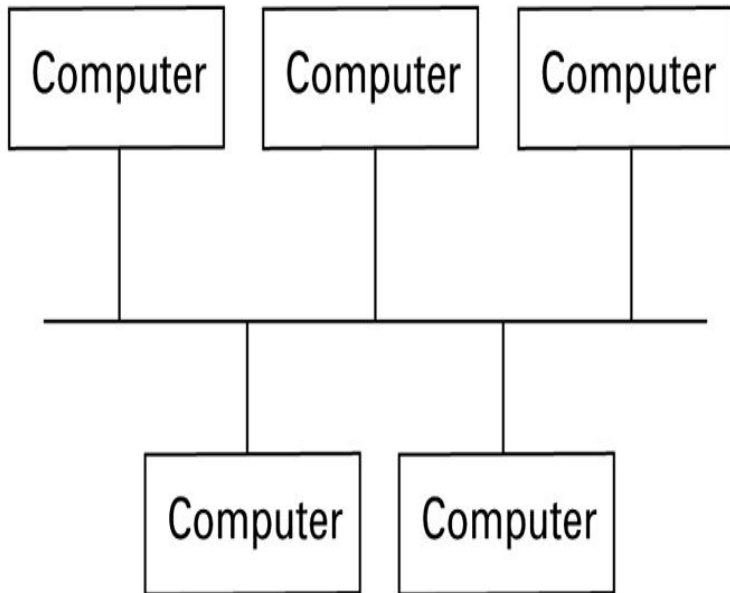
Protocols

For a network to function reliably, it is important to establish rules by which activities are conducted. Such rules are called **protocols**.

Benefit: vendors are able to build products for network applications that are compatible with products from other vendors

Example: Communication between Friends

CSMA/CD



- **Wait until the bus is silent**
- **Messages are broadcast, Everyone keeps what ever it needs**
- **If another machine also transmit collision is detected, then wait before transmitting next packet**
- **Humans Say sorry, you start please but machine start after some wait**

CSMA/CD

Not suitable for wireless star networks.

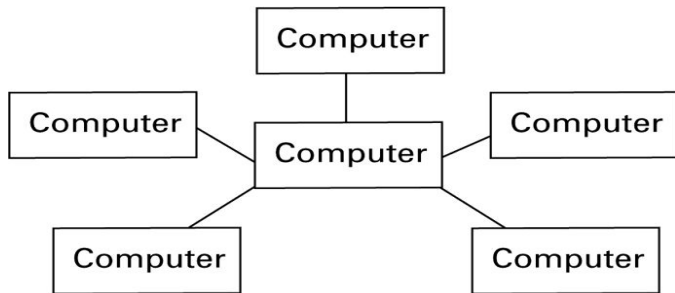
It would not be possible to detect whether transmission is colliding:

Due to signal drowns

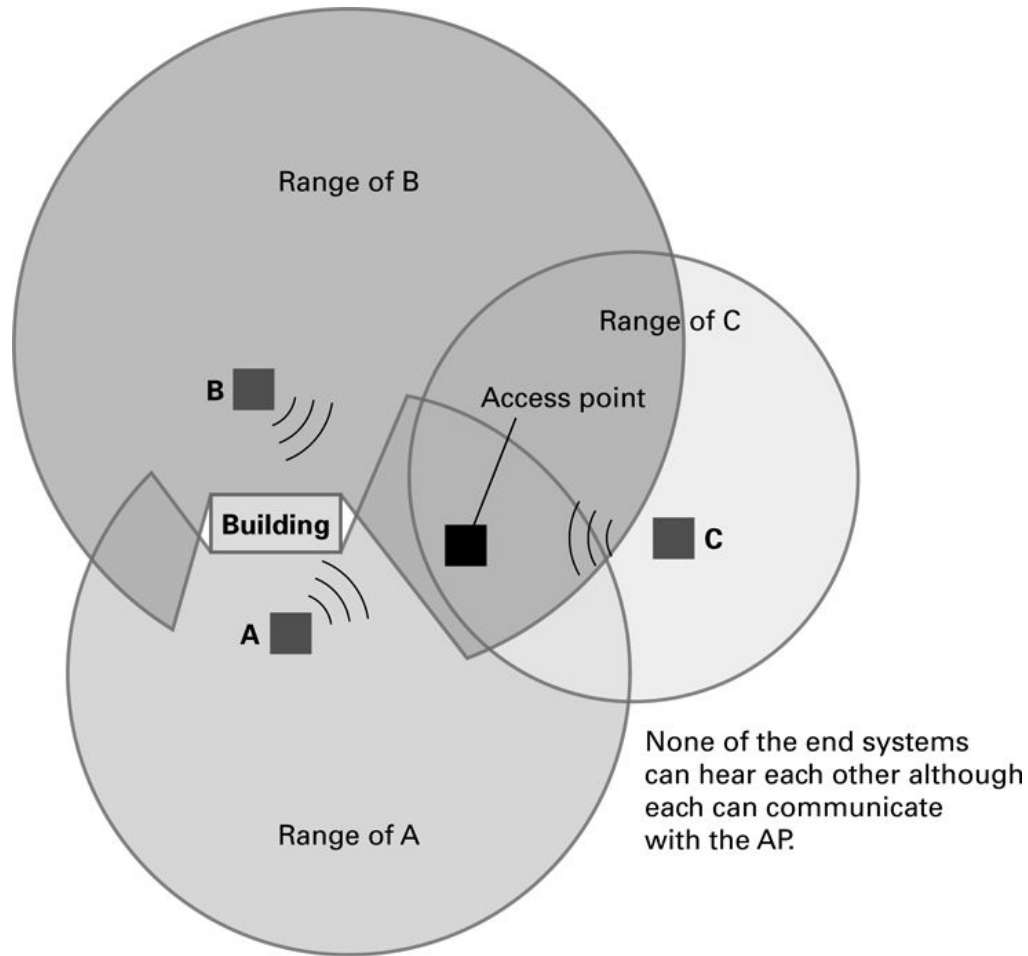
Or signals from different machines are blocked by objects or distance.

Although they can communicate with the Central node. This is known as hidden terminal problem

b. Star



The hidden terminal problem



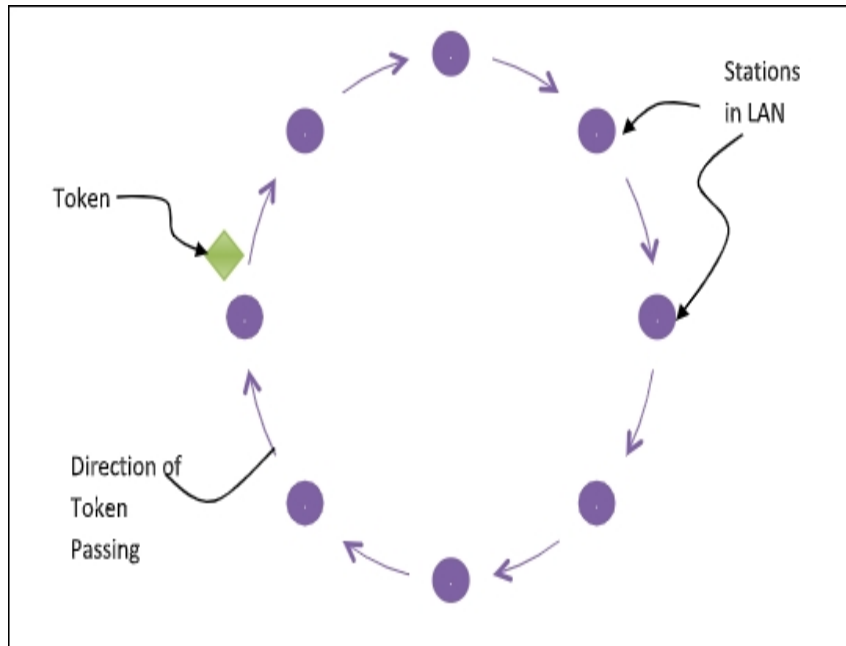
CSMA/CA

- As soon as a node receives a packet that is to be sent, it checks to be sure the channel is clear (no other node is transmitting at the time).
- If the channel is clear, then the packet is sent.
- If the channel is not clear, the node waits for a randomly chosen period of time, and then checks again to see if the channel is clear. This period of time is called the backoff factor
- If the channel is clear when the backoff counter reaches zero, the node transmits the packet.
- If the channel is not clear when the backoff counter reaches zero, the backoff factor is set again, and the process is repeated

Token Ring

- Token ring is a communication protocol in a local area network (LAN) where all stations are connected in a ring topology.
- A token is a special frame of 3 bytes that circulates along the ring of stations.
- A station can send data frames only if it holds a token.
- The tokens are released on successful receipt of the data frame

Token Ring Continue..



- If a station has a frame to transmit when it receives a token, it sends the frame and then passes the token to the next station; otherwise, it simply passes the token to the next station.
- Passing the token means receiving the token from the preceding station and transmitting to the successor station

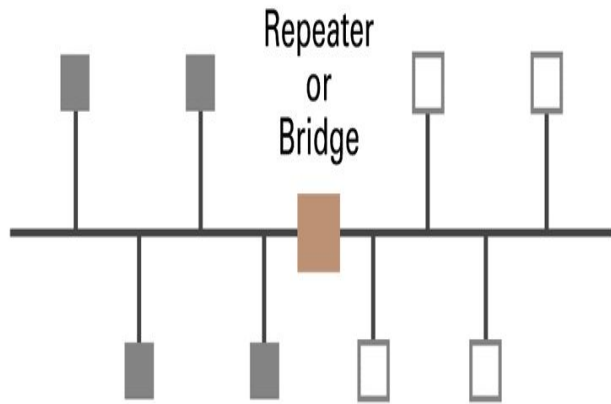
Connecting Networks

Why to combine?

Sometimes it is necessary to connect existing networks to form an extended communication system. This can be done by connecting the networks to form a larger version of the same “type” of network

- **Example:** it is often possible to connect the buses to form a single long bus. done by means of different devices known as repeaters, bridges, and switches

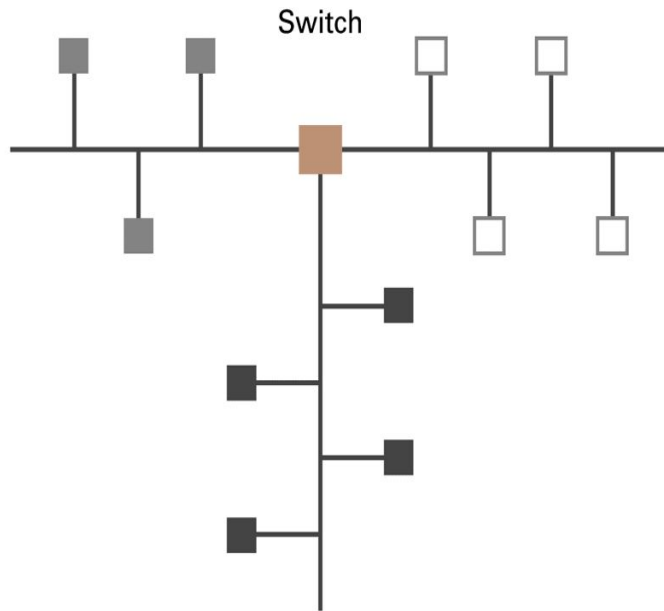
Building a large bus network from smaller ones



Repeater: Extends a network; a device that passes signals back and forth between the two original buses (usually with some form of amplification) without considering the meaning of the signals

Bridge: More complex than, a repeater. It connects two buses, but it does not necessarily pass all messages across the connection. Instead, it looks at the destination address that accompanies each message and forwards a message across the connection only when that message is destined for a computer on the other side

Building a large bus network from smaller ones



Switch: essentially a bridge with multiple connections, allowing it to connect several buses rather than just two.

Produces a network consisting of several buses., a switch considers the destination addresses of all messages and forwards only those messages destined for other spokes.

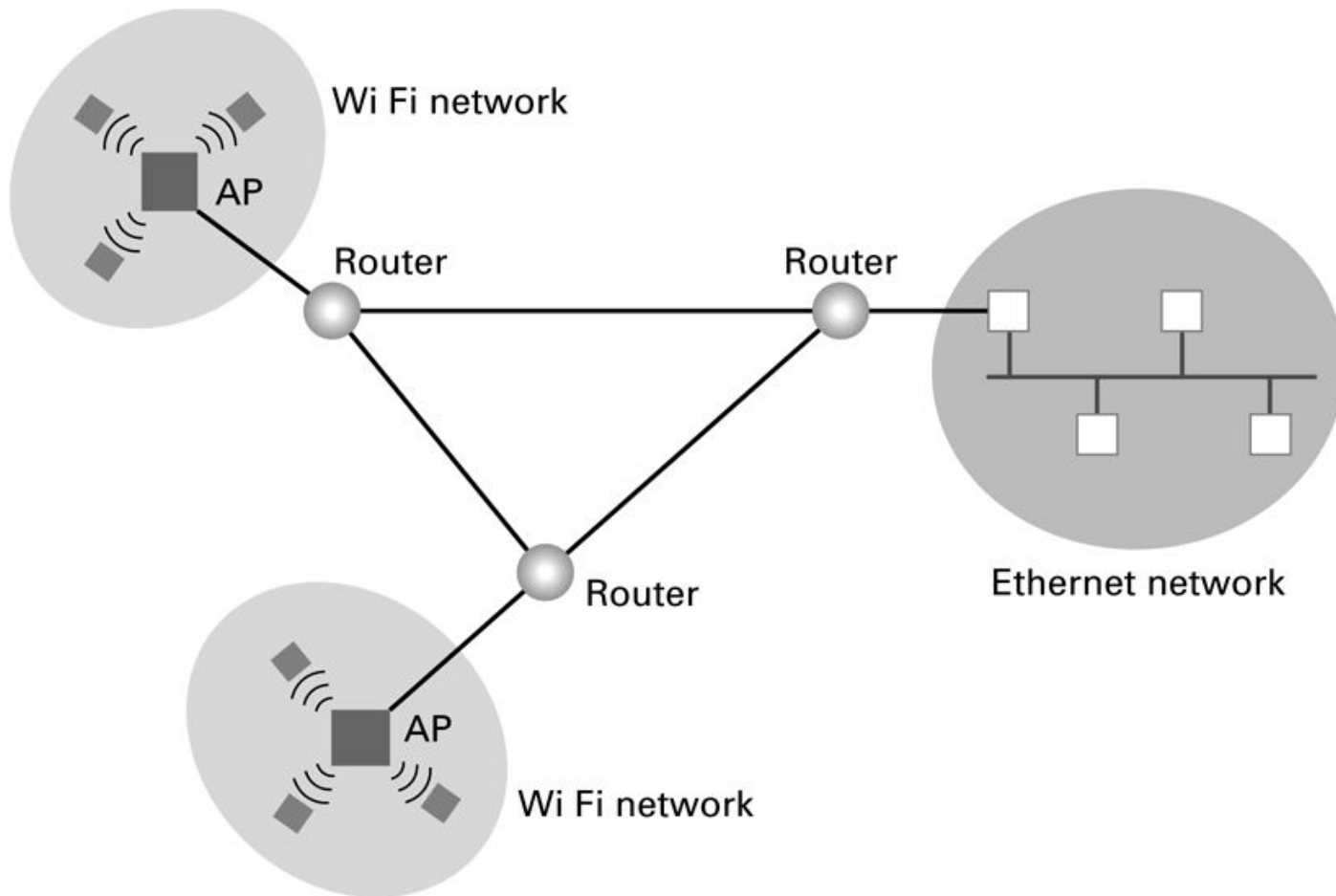
Limitation of Repeater, bridges and Switches,

- Can not be used with different types of networks
- If we have to combine and bus network with a star network...
- Routers does this

Routers

- Handel connection between networks to form an internet
- Special purpose computers used for forwarding messages.
- Different from that of repeaters, bridges, and switches
- Provide links between networks while allowing each network to maintain its unique internal characteristics.
- Decides routes
- Forwarding table
- Example shown on next slide depicts two WiFi star networks and an Ethernet bus network connected by routers.

Routers connecting two WiFi networks and an Ethernet network to form an internet



Distributed Systems

- Software units that are executed as processes on different computers
- Problem to be solved in 100 hrs on one computer can be solved by using 100 computers
- Distribute the load of 1 computer to 100 computers even located on different geographical area

Distributed System continued...

Which softwares are distributed?

By using the advanced network technologies:

- Global information retrieval systems
- Company wide accounting and inventory
- Computer Games
- Software controlling the network infrastructure

Distributed system continued..

- **Evolution**

- Early Distributed system were to develop from the scratch
- Now a days some basic infrastructures are available, different vendors can use these infrastructures to develop a DS.
- Communication and security systems are available, you need to only develop a unique part of the application

Available infrastructures

- Cluster Computing
- Grid Computing
- Cloud Computing

Cluster Computing

- Many independent computers work closely together to provide computation and services
- Cost of all machines + cost of high speed network remains less than the cost of the higher speed super computes
- Advantages
 - Low Maintenance cost
 - High availability
 - Load Balancing

Grid Computing

- Loosely coupled than clusters but that still work together to accomplish large tasks.
- Involve specialized software's to make it easy to distribute data and algorithms over the different machines
- Examples: Condor System, Berkeley's Open Infrastructure for Network Computing (BOINC)
- Softwares are installed for volunteer computers
- Services of these computers can be used when they are free
- Power of millions of computers available in a grid

Cloud Computing

- Huge pools of shared computers on the network can be allocated for use by clients as needed.
- As the spread of metropolitan electrical grids in the early twentieth century eliminated the need for individual factories and businesses to maintain their own generators, the Internet is making it possible for entities to entrust their data and computations to “the Cloud,” which in this case refers to the enormous computing resources already available on the network.
- Amazon’s Elastic Compute Cloud allows clients to rent virtual computers by the hour, without concern for where the computer hardware is actually located.

Cloud Computing

- Google Drive and Google Apps allow users to collaborate on information or build Web services without needing to know how many computers are working on the problem or where the relevant data are stored.
- Cloud computing services provide reasonable guarantees of reliability and scalability, but also raise concerns about privacy and security in a world where we may no longer know who owns and operates the computers that we use.

Summary

- Cluster computing focuses on high-performance computing and tightly coupled nodes in a single location.
- Grid computing connects geographically dispersed and often heterogeneous resources to create a distributed computing network.
- Cloud computing provides on-demand access to a variety of computing resources and services over the internet, offering scalability and flexibility.