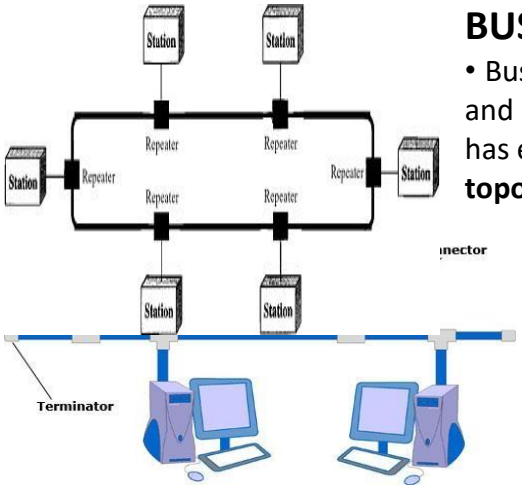
Unit II Network Hardware

Network Topologies

- Types of Network Topology
- Network Topology is the schematic description of a network arrangement, connecting various nodes(sender and receiver) through lines of connection.



BUS Topology

• Bus topology is a network type in which every computer and network device is connected to single cable. When it has exactly two endpoints, then it is called **Linear Bus topology**. It transmits data only in one direction.

Working of Bus topology

- Bus topology is often used when a network installation is small, simple or temporary.
- On a typical bus network the cable is just one or more wires with no active electronics to amplify the signal or pass it along from computer to computer this makes a bus a **passive topology**.
- When one PC sends a signal up and down the wire, all PC's on network receive the information as it is broadcasting.
- But only one (the one with the address that matches the one enclosed in the message) accepts the information the rest will not respond the message.
- Only one PC at a time can send a message therefor number of PC's attached to a bus network can significantly affects the speed of the network.
- A PC must wait until the bus is free before it can transmit. Otherwise the bandwidth will simply get waste.

Advantages and Disadvantage of Bus Topology

Advantage

- simple, reliable in very small network easy to use and easy to understand.
- It is easy for installation
- less expensive
- It is easy to extend-
- A repeater can also be used to extend a bus-
- If one node fails others are not affected.

Disadvantage

- Cables fails then whole network fails.
- If network traffic is heavy the performance of the network decreases.
- Cable has a limited length.
- is difficult to troubleshoot faults as bus cable break or malfunctioning computer.
- A cable break or loose connection also cause reflection and bring down the whole network and causing all the network activity to stop.

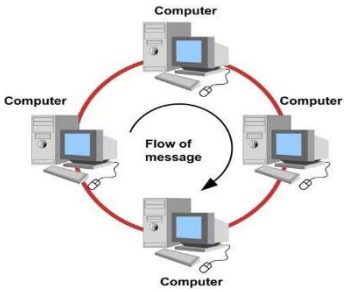
RING Topology

- It is called ring topology because it forms a ring as each computer is connected to another computer, with the last one connected to the first.
- Exactly two neighbors for each device.
- The transmission is unidirectional.

- Data is transferred in a sequential manner that is bit by bit.
- Data transmitted, has to pass through each node of the network, till the destination node.

Working of ring topology

- Every PC is connected to next computer in the ring and each transmits what it receives from the previous PC.
- The message flows around the ring in one direction.
- Since each PC retransmits what it receives a ring is an **active network.**
- There is no termination because there is no end to the ring.



Advantages of Ring Topology

• Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.

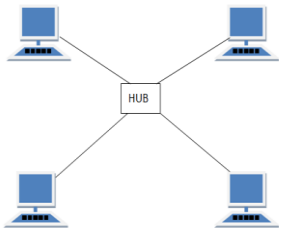
• Cheap to install and expand

Disadvantages of Ring Topology

- **Troubleshooting is difficult in ring topology.**
- **Adding or deleting the computers disturbs the network activity.**
- **Failure of one computer disturbs the whole network.**

STAR Topology

- In this type of topology all the computers are connected to a single hub through a cable.
- This hub is the central node and all others nodes are connected to the central node.
- Every node has its own dedicated connection to the hub.
  - Hub acts as a repeater for data flow.



Working of star topology

• Each PC on star network communicate with central hub that resends the message either to all the PC's (in a broadcast star network) or only to the destination PC (in a switched star network) when the communication between two nodes is to occur a complete circuit is dedicated to the connection for duration of call. The hub in a broadcast star network can be active or passive.

- **An active hub** regenerates the electrical signal and sends it to all the computers connected to it. This type of hub is often called a multipoint repeater. Active hubs and switches require electrical power to run; **a passive hub** such as wiring panel or patch block merely at as a connection point and does not amplify or regenerate the signal. Passive hub doesn't require electrical power to run.
- E.g.: - Ethernet to base t is a popular network based on star topology

Advantages and Disadvantage of Star Topology

Advantage

- Fast performance
- Low network traffic.
- Hub can be upgraded easily.
- Easy to troubleshoot.
- Easy to setup and modify.

- Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantage

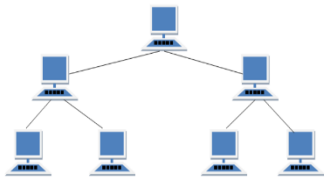
- Cost of installation is high.
- Expensive to use.
- If the hub fails then the whole network is stopped because all the nodes depend on the hub.
- Performance is based on the hub that is it depends on its capacity

Tree Topology

- Tree topology has a group of star networks connected to a linear bus backbone cable.
- It incorporates features of both star and bus topologies.
- Tree topology is also called hierarchical topology.

Advantage

- Ideal if workstations are located in groups.



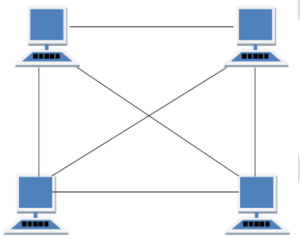
- Used in Wide Area Network.
- Existing network can be easily expanded
- Point-to-point wiring for individual segments means easier installation and maintenance
- Well suited for temporary networks

Disadvantage

- Technical expertise required to configure and wire tree topology
- Failure of backbone cable brings down entire network
- Insecure network
- Maintenance difficult for large networks

MESH TOPOLOGY

- In a mesh topology, every node can be connected to all other nodes in a network and also provide the dedicated links between every nodes with each other.
- In a mesh network topology, each of the network node, computer and other devices, are interconnected with one another. In fact a true mesh topology is the one where every node is connected to every other node in the network.



Advantage

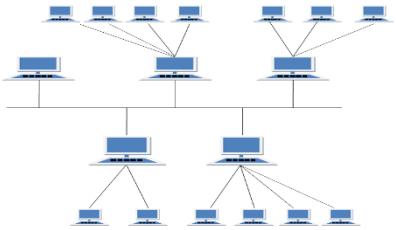
- Each connection can carry its own data load.
- It is robust.
- Fault is diagnosed easily.
- Provides security and privacy.

Disadvantage

- Installation and configuration is difficult.
- Cabling cost is more.
- Bulk wiring is required.

HYBRID Topology

- It is two different types of topologies which is a mixture of two or more topologies. For example if in an office in one department ring topology is used and in another star topology is used, connecting these topologies will result in Hybrid Topology (ring topology and star topology).



Advantage

- Reliable as Error detecting and trouble shooting is easy.
- Effective.
- Scalable as size can be increased easily.
- Flexible.

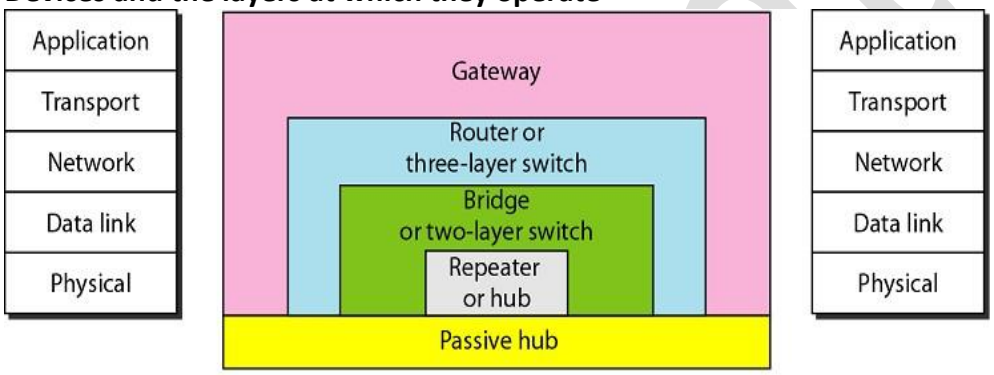
Disadvantage

- Complex in design.
- Costly.

2.2 Network control devices

- To expand a single network without breaking it into new pass or connecting it through another different network. All networks require devices to provide connectivity and functionality.
- **Purpose of Using Network Devices.**
    - Allow a greater number of nodes to be connected to the network.
    - Extend the distance over which a network can extend.
    - Localize traffic on the network.
    - Can merge existing networks.
    - Isolate network problems so that they can be diagnosed more easily.

Devices and the layers at which they operate



Five categories of connecting devices

- You can usually use one of the following devices.
- **NIC**
- **Connectors**
- **Hubs**
- **Repeaters**
- **Bridges**
- **Switches**
- **Routers**
- **Modem**, etc.

Network Interface Card (NIC)

- A network interface card (NIC) is a hardware component without which a computer cannot be connected over a network.
- It is a circuit board installed in a computer that provides a dedicated network connection to the computer.
- It is also called network interface controller, network adapter or LAN adapter.

Purpose

- NIC allows both wired and wireless communications.
- NIC allows communications between computers connected via local area network (LAN) as well as communications over large-scale network through Internet Protocol (IP).

- NIC is both a physical layer and a data link layer device, i.e. it provides the necessary hardware circuitry so that the physical layer processes and some data link layer processes can run on it.

Types of NIC Cards

- Internal NIC
- External NIC

Internal Network Cards

- In internal networks cards, motherboard has a slot for the network card where it can be inserted.
- It requires network cables to provide network access. Internal network cards are of two types.
- The first type uses Peripheral Component Interconnect (PCI) connection, while the second type uses Industry Standard Architecture (ISA).

External Network Cards

- In desktops and laptops that do not have an internal NIC, external NICs are used.
- External network cards are of two types: Wireless and USB based.
- Wireless network card needs to be inserted into the motherboard, however no network cable is required to connect to the network.
- They are useful while traveling or accessing a wireless signal.

Connectors

- To connect **cable between two computers**.
- Connectors are of different type such as –

➢ Twisted Pair cable
➢ Co-axial Cable
➢ Fibre optic cable.

- **Connectors are type such as-**

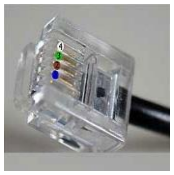
➢ Jacks
➢ Plugs
➢ Sockets and ports

BNC Connector

- (**B**ayonet **N**ut **C**oupling) A commonly used plug and socket for audio, video and networking applications that provides a tight connection.
- This connector has a center pin connected to the center cable conductor and a metal tube connected to the outer cable shield.
- A rotating ring outside the tube locks the cable to any female connector.
- BNCs are used to connect a variety of different coaxial cable types.
- After the plug is inserted, it is turned, causing pins in the socket to be pinched into a locking groove on the plug.

RJ-11 (Registered Jack)

- Standard telephone cable connectors, **RJ-11** has 4 wires (and RJ-12 has 6 wires).
- **RJ-11** is the acronym for Registered Jack-11, a four- or six-wire connector primarily used to connect telephone equipment.



F-Type

- The **F connector** is a type of RF connector commonly used for cable and universally for satellite television.

RJ-45 (Registered Jack)

- The acronym for **Registered Jack-45** is RJ-45.
- The **RJ-45** connector is an eight-wire connector that is commonly used to connect computers to a local area network (LAN), particularly Ethernet LANs.
- Although they are slightly larger than the more commonly used **RJ-11** connectors, RJ-45s can be used to connect some types of telephone equipment.

ST (Straight Tip) and SC (Subscriber Connector or Standard Connector)

- Fibre network segments always require two fibre cables: one for transmitting data, and one for receiving.
- Each end of a fibre cable is fitted with a plug that can be inserted into a network adapter, hub, or switch.
- In the North America, most cables use a square SC connector (Subscriber Connector or Standard Connector) that slides and locks into place when inserted into a node or connected to another fibre cable,
- Europeans use a round ST connector (Straight Tip) instead.

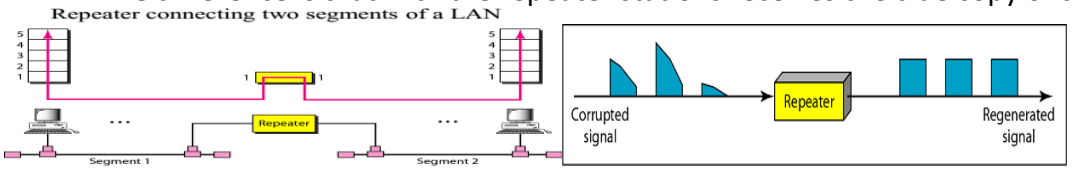
USB (Universal Serial Bus)

- Universal Serial Bus, or USB, is a computer standard designed to eliminate the guesswork in connecting peripherals to a PC.
- It is expected to replace serial and parallel ports.
- A single USB port can be used to connect up to 127 peripheral devices, such as mice, modems, keyboards, digital camera's, printers, scanners, MP3 players and many more.
- USB also supports Plug-and-Play installation and hot plugging.

Repeaters

- A repeater or regenerator is an electronic device that operates on only the physical layer of the OSI MODEL.
- Signal that carry information within a network can travel a fix distance before attenuation(weakning) enlarges the integrity of data.
- It is installed on a link receives the signal before it becomes too weak, and put the refresh copy back on the link.
- It allows us extending only the physical length of a network.

- It does not change the functionality of the network in any way.
- The two sections (segments) connected by the repeater in fig are in reality one network.
- The repeater doesn't have the intelligence to keep the frame from passing to the right side when it is meant for a station on the left.
- The difference is that with the repeater stations receives the true copy of the frame.



- **Repeater as not an amplifier**
- An amplifier can't discriminate between the intended signal and noise. It amplifies equally everything fed into it.
- A repeater doesn't amplify the signal. It regenerates it. When it receives a weak end or corrupted signal it creates a copy bit at the original strength.
- The location of the repeater on a link is vital. A repeater must replace so that a signal reaches it before any noise changes the meaning of any of its bits. A little noise can alert the precision of a bits voltage with losing its identity.

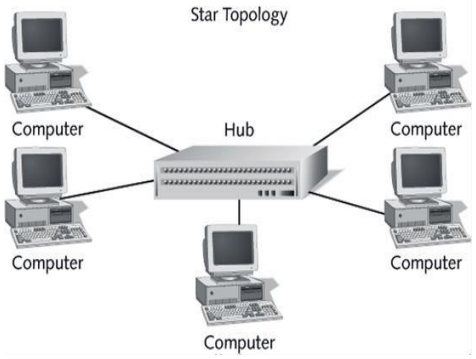
Hub

- Networks using a Star topology require a central point for the devices to connect.
- Originally this device was called a **concentrator** since it consolidated the cable runs from all network devices.

- The basic form of concentrator is the hub.
- As shown in Figure; the hub is a hardware device that contains multiple, independent ports that match the cable type of the network.
- Most common hubs interconnect Category 3 or 5 twisted-pair cable with RJ-45 ends,
- The hub is considered the least common denominator in device concentrators.
- Hubs offer an inexpensive option for transporting data between devices, but hubs don't offer any form of intelligence. Hubs can be active or passive.

Important Points

- A hub is used as a **central device**.
- Connects the computers in **star topology**.



- **Hubs** are simple devices that **direct data packets to all devices connected to the hub**.
- Hubs regenerate and retime network signals
- **hubs work at the OSI physical layer**
- They **cannot filter** network traffic.
- They cannot determine best path
- They are really **multi-port repeaters**
- There are three main types of HUB
- Passive HUB
- Active HUB
- Intelligent HUB

Passive HUB

- A passive hub simply combines the signal of n/w segment.
- There is no signal processing or regeneration because it does not boost the signal and in fact absorbs some of the signal.
- A passive hub reduces by half the maximum, cabling distance permitted.
- *E.g. If a segment normally allows a reliable transmission distance of 100 meters, the distance between a passive hub and a device can be only 50m also with a passive HUB each pc can receive the signal send from all the other pc's connected to the* ***hub.***

Active HUB

- These are like passive hub except that they have electronic component that regenerate or amplify signal.
- Because of this the distance between devices can be increased.
- The main drawback to some active hub, i.e. they amplify noise as well as signal depending on whether they function as simple amplifies or an as signal regenerator.
- They are also much more expensive than passive hubs function as repeaters (Create a duplicate copy of signal).
- They are sometimes called multi- port repeaters.

Intelligent HUB

- In addition to signal regenerations these hubs perform some n/w management and intelligent path selection.
- A switching HUB chooses only the port of the device where the signal leads to go rather than sending the signal along all paths.
- Many switching hubs can choose which alternative path with be weakest and send the signal that way.
- One disadvantage to this is that you can permanently connect all transmission media segments because each segment will be used only when a signal is send to device using that segment.
-

Bridges

- A **bridge** is used to join two network segments together, it allows computers on either segment to access resources on the other.
- They can also be used to divide large networks into smaller segments.

- Bridges have all the features of repeaters, but can have more nodes, and since the network is divided, there is fewer computers competing for resources on each segment thus improving network performance.

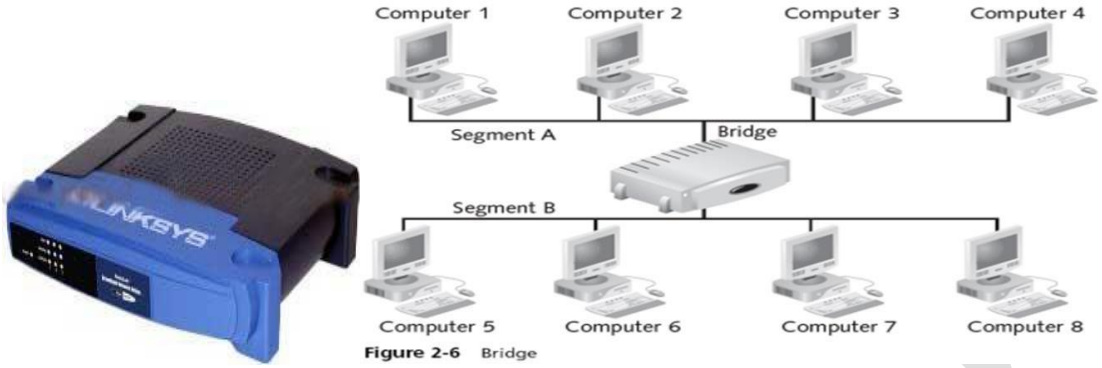
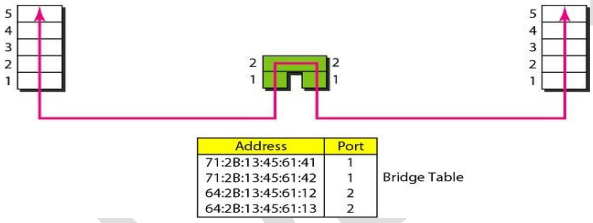


Figure 2-6 Bridge

- Bridges can also connect networks that run at different speeds, different topologies, or different protocols.
- But they cannot, join an Ethernet segment with a Token Ring segment, because these use different networking standards.
- Bridges operate at both the **Physical Layer** and the MAC sub layer of the **Data Link layer**.
- Bridges read the MAC header of each frame to determine on which side of the bridge the destination device is located, the bridge then repeats the transmission to the segment where the device is located.

- Unlike the repeaters which simply passes on all the signals it receives a bridges selectively determines the appropriate segment to which it should pass a signal.
- It does this by reading the address of the entire signal it receives.
- The bridges read the physical location of the source and destination computers from the addresses and store it to a table.

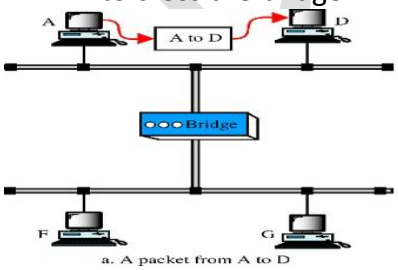
A bridge connecting two LANs



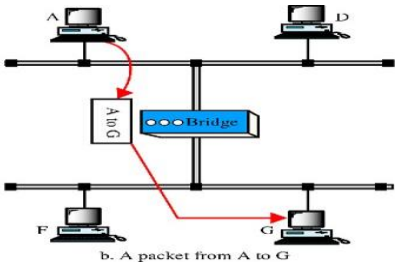
Address	Port
71:2B:13:45:61:41	1
71:2B:13:45:61:42	1
64:2B:13:45:61:12	2
64:2B:13:45:61:13	2

Bridge Table

- The process works like this
- For learning bridges receives all signals from both the segments.
- The bridge reads the address and discards (filters) all signals from segment1 that are address to segment1 because they don't need to cross the bridge.



a. A packet from A to D



b. A packet from A to G

- The figure shows the messages or signals which do not need to cross the bridge (Message from computer-A to Computer- D) and other half part shows the messages that needs to pass through the bridge (Message from computer-A to Computer-G).
- Bridges also provide security through this portioning of traffic.
-

Basic types of bridges.

Transparent bridges

- Keeps a table of addresses in memory to determination where to send the data.
    - Also called **learning bridges**
    - Build a table of MAC addresses as frames arrive.
    - **Ethernet networks use transparent bridge**
    - Duties are : **Filtering frames**, **forwarding and blocking**

Source routing bridge

- Requires the entire rule to be included in the transmission and don't rout packets intelligently.
- IBM token ring n/w uses this type of bridges.
- If a segment on n/w is been used only 60% then consider, using bridges will improve performance.
    - Used in **Token Ring networks**
    - Frame contains not only the **source and destination address** but also the
- **bridge addresses**.

Reasons to go for bridges

- To divide the big n/w like university.
- Organization may geographically spread over multiple buildings.
- To split an n/w logical.
- Single LAN is adequate (sufficient but physical distance is too great).
- For reliability bridges can be placed at critical nodes. To prevent a single node go out of order from bringing down the entire system. (E.g. bus topology)
- For security insert bridges at various places and being careful not to forward sensitive traffic.

Advantages of using a bridge

- Extend physical network
- Reduce network traffic with minor segmentation
- Reduce collisions
- Connect different architecture

Disadvantages of using bridges

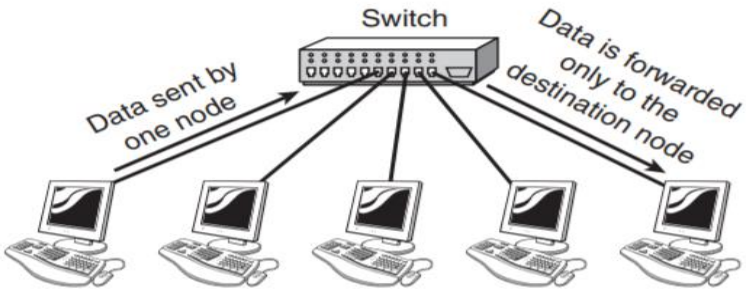
- **Slower** than repeaters due to filtering
- **Do not filter broadcasts**
- **More expensive** than repeaters

Switch

- On the surface, a switch looks much like a hub.
- Despite their similar appearance, switches are far more efficient than hubs and are far more desirable for today's network environments.
- Following Figure shows an example of a 32-port Ethernet switch.
- If you refer to it you'll notice few differences in the appearance of the high-density hub and this switch.

- a hub forwards data to all ports, regardless of whether the data is planned for the system connected to the port.

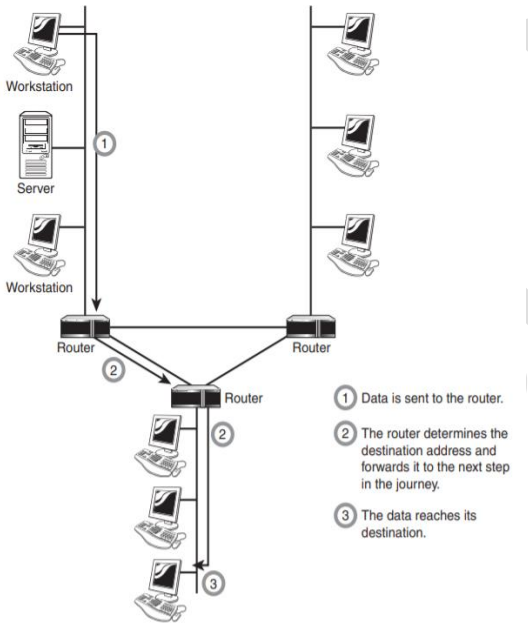
- This arrangement is inefficient; however, it requires little intelligence on the part of the hub, which is why hubs are inexpensive.
- Rather than forwarding data to all the connected ports, a switch forwards data only to the port on which the destination system is connected.
- It looks at the Media Access Control (MAC) addresses of the devices connected to it to determine the correct port.



- A MAC address is a unique number that is stamped into every NIC.
- By forwarding data only to the system to which the data is addressed, the switch decreases the amount of traffic on each network link dramatically.

- In effect, the switch literally channels (or switches, if you prefer) data between the ports.

Router



- Routers are an increasingly common sight in any network environment, from a small home office that uses one to connect to an Internet service provider (ISP) to a corporate IT environment where racks of routers manage data communication with disparate remote sites.
- Routers are network devices that literally route data around the network. By examining data as it arrives, the router can determine the destination address for the data; then, by using tables of defined routes, the router determines the best way for the data to continue its journey.
- Unlike bridges and switches, which use the hardware-configured MAC address to determine the destination of the data, routers use the software-configured network address to make decisions.

- This approach makes routers more functional than bridges or switches, and it also makes them more complex because they have to work harder to determine the information.

Working of Router

- The basic requirement for a router is that it must have at least two network interfaces.
- If they are LAN interfaces, the router can manage and route the information between two LAN segments.
- More commonly, a router is used to provide connectivity across wide area network (WAN) links.

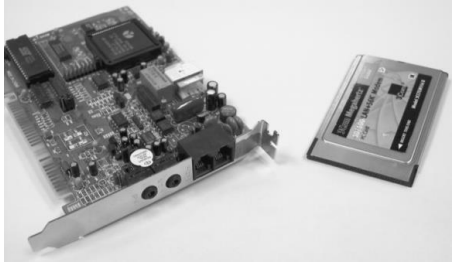
- Figure shows a router with two LAN ports (marked AUI 0 and AUI 1) and two WAN ports (marked Serial 0 and Serial 1).
- This router is capable of routing data between two LAN segments and two WAN segments.

Gateway

- The term gateway is applied to any device, system, or software application that can perform the function of translating data from one format to another.
- The key feature of a gateway is that it converts the format of the data, not the data itself.
- Software gateways can be found everywhere.
- Many companies use an email system such as Microsoft Exchange or Novell GroupWise.
- These systems transmit mail internally in a certain format. When email needs to be sent across the Internet to users using a different email system, the email must be converted to another format, usually to Simple Mail Transfer Protocol (SMTP).
- This conversion process is performed by a software gateway.

Modem

- Modem is a contraction of the terms modulator and demodulator.
- Modems perform a simple function: They translate digital signals from a computer into analog signals that can travel across conventional phone lines.
- The modem modulates the signal at the sending end and demodulates at the receiving end.
- Modems are available as internal devices that plug into expansion slots in a system; external devices that plug into serial or USB ports; PCMCIA cards designed for use in laptops; and specialized devices designed for use in systems such as handheld computers.
- In addition, many laptops now come with integrated modems. For large-scale modem implementations, such as at an ISP, rack-mounted modems are also available



ISDN Terminal Adaptor

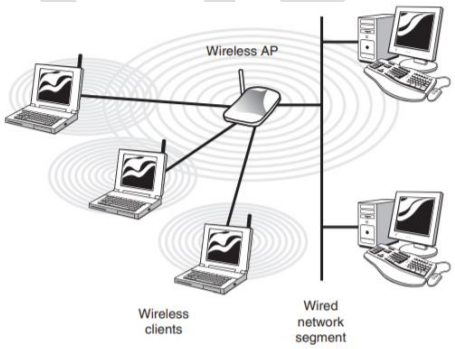
- When the speed provided by a modem just isn't enough, you must seek alternatives.
- One of the speedier options available is an ISDN link.
- ISDN is a digital communication method that can be used over a conventional phone line, although certain criteria must be met for an ISDN line to be available (such as the availability of the service and the proximity of your location to the telco's site).

- To use ISDN, you need a device called an ISDN terminal adapter.
- ISDN terminal adapters are available as add-in expansion cards installed into computers, external devices that connect to the serial interfaces of PC systems, or modules in a router.
- An ISDN terminal adapter as a kind of digital modem. Remember that a modem converts a signal from digital to analog and vice versa. An ISDN terminal adapter translates the signal between two digital formats

Wireless Access Points

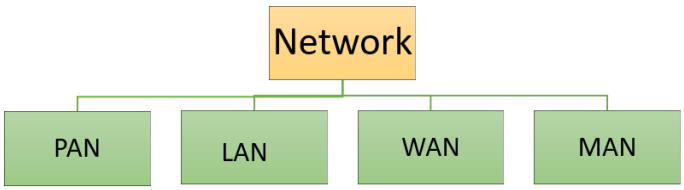
- Wireless access points, referred to as either WAPs or wireless APs, are a transmitter and receiver (transceiver) device used for wireless LAN (WLAN) radio signals.
- A WAP is typically a separate network device with a built-in antenna, transmitter, and adapter.
- WAPs use the wireless infrastructure network mode to provide a connection point between WLANs and a wired Ethernet LAN.
- WAPs also typically have several ports allowing a way to expand the network to support additional clients
- Depending on the size of the network, one or more WAPs may be required.
- Additional WAPs are used to allow access to more wireless clients and to expand the range of the wireless network.
- Each WAP is limited by a transmissions range, the distance a client can be from a WAP and still get a useable signal.

The actual distance depends on the wireless standard being used and the obstructions and environmental conditions between the client and the WAP
An infrastructure wireless network uses a WAP.



- WAP receives transmissions from wireless devices within a specific range and transmits those signals to the network beyond.
- This network may be a private Ethernet network or the Internet.
- The transmission range a WAP can support and number of wireless devices that can connect to it depends on the wireless standard being used and the signal interference between the two devices.
- In infrastructure wireless networking, there may be multiple access points to cover a large area or only a single access point for a small area such as a single home or small building.

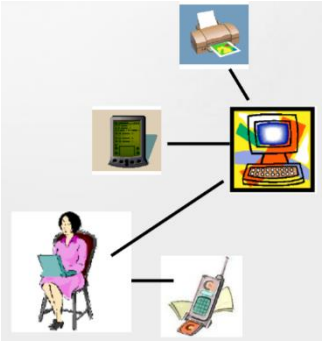
2.3 Types of Computer Networks



- There are various types of computer networks available. We can categorize them according to their size as well as their purpose.
- The size of a network should be expressed by the geographic area and number of computers, which are a part of their networks.
- It includes devices housed in a single room to millions of devices spread across the world.

PAN (Personal Area Network)

- PAN is a computer network formed around a person.
- It generally consists of a computer, mobile, or personal digital assistant.
- PAN can be used for establishing communication among these personal devices for connecting to a digital network and the internet.



Characteristics of PAN

- It is mostly personal devices network equipped within a limited area.
- Allows you to handle the interconnection of IT devices at the surrounding of a single user.
- PAN includes mobile devices, tablet, and laptop.
- It can be wirelessly connected to the internet called WPAN.
- Appliances use for PAN: cordless mice, keyboards, and Bluetooth systems.

Advantages

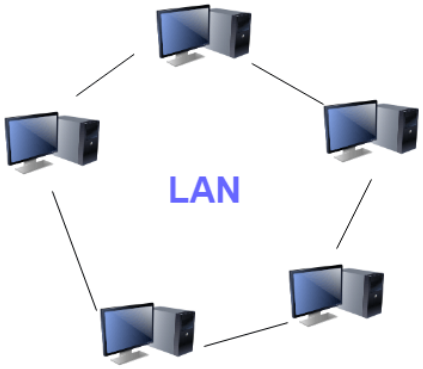
- PAN networks are relatively secure and safe
- It offers only short-range solution up to ten meters
- Strictly restricted to a small area

Disadvantages

- It may establish a bad connection to other networks at the same radio bands.
- Distance limits.

LAN(Local Area Network)

- A **L**ocal **A**rea **N**etwork (LAN) is a group of computer and peripheral devices which are connected in a limited area such as school, laboratory, home, and office building.
- It is a widely useful network for sharing resources like files, printers, games, and other application.
- The simplest type of LAN network is to connect computers and a printer in someone's home or office.
- In general, LAN will be used as one type of transmission medium.
- It is a network which consists of less than 5000 interconnected devices across several buildings.



Characteristics of LAN

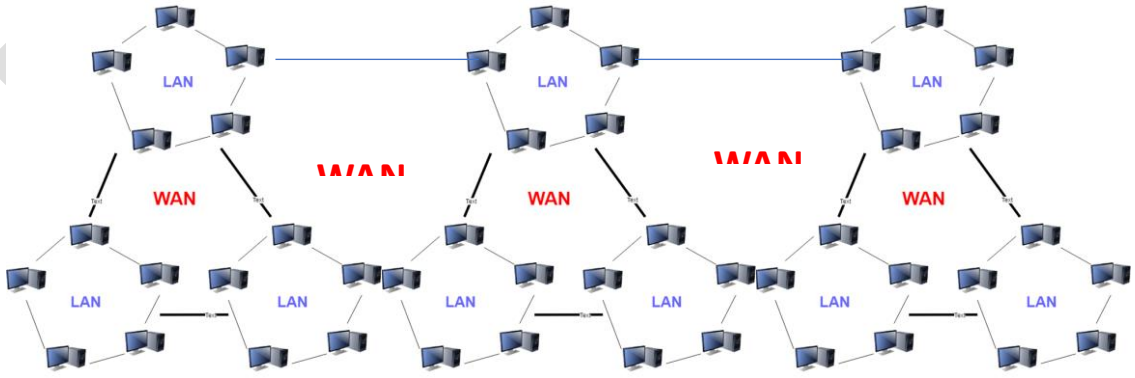
- It is a private network, so an outside regulatory body never controls it.
- LAN operates at a relatively higher speed compared to other WAN systems.
- There are various kinds of media access control methods like token ring and ethernet.

Advantages of LAN

- Computer resources like hard-disks, DVD-ROM, and printers can share local area networks. This significantly reduces the cost of hardware purchases.
- You can use the same software over the network instead of purchasing the licensed software for each client in the network.
- Data of all network users can be stored on a single hard disk of the server computer.
- You can easily transfer data and messages over networked computers.
- It will be easy to manage data at only one place, which makes data more secure.
- Local Area Network offers the facility to share a single internet connection among all the LAN users.

Disadvantages of LAN

- LAN will indeed save cost because of shared computer resources, but the initial cost of installing Local Area Networks is quite high.
- The LAN admin can check personal data files of every LAN user, so it does not offer good privacy.
- Unauthorized users can access critical data of an organization in case LAN admin is not able to secure centralized data repository.
- Local Area Network requires a constant LAN administration as there are issues related to software setup and hardware failures



WAN (Wide Area Network)

- WAN (Wide Area Network) is another important computer network that which is spread across a large geographical area.

- WAN network system could be a connection of a LAN which connects with other LAN's using telephone lines and radio waves.
- It is mostly limited to an enterprise or an organization.

Characteristics of WAN:

- The software files will be shared among all the users; therefore, all can access to the latest files.
- Any organization can form its global integrated network using WAN.

Advantages of WAN

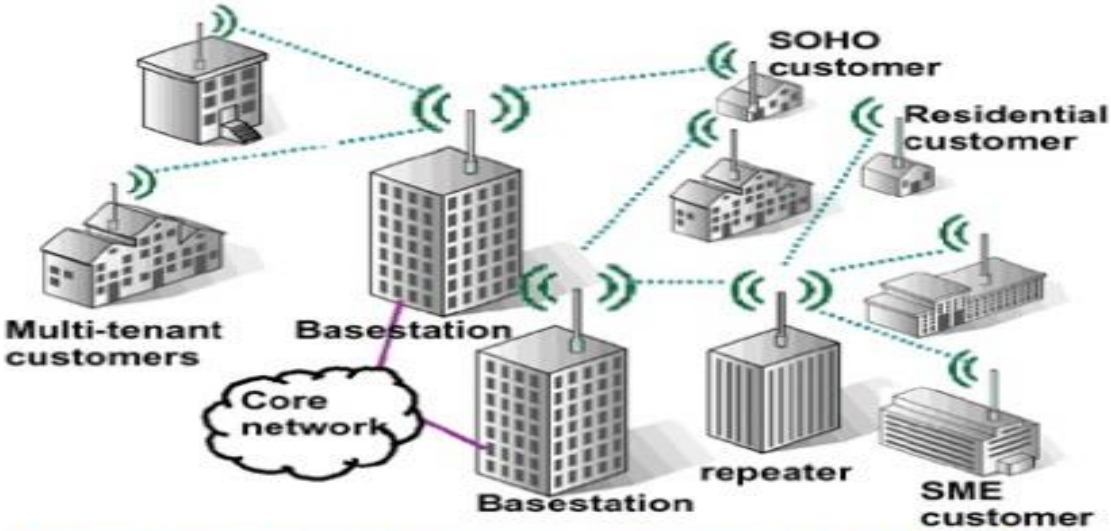
- WAN helps you to cover a larger geographical area. Therefore business offices situated at longer distances can easily communicate.
- Contains devices like mobile phones, laptop, tablet, computers, gaming consoles, etc.
- WLAN connections work using radio transmitters and receivers built into client devices.

Disadvantage of WAN

- The initial setup cost of investment is very high.
- It is difficult to maintain the WAN network. You need skilled technicians and network administrators.
- There are more errors and issues because of the wide coverage and the use of different technologies.
- It requires more time to resolve issues because of the involvement of multiple wired and wireless technologies.
- Offers lower security compared to other types of networks.

MAN(Metropolitan Area Network)

- This is a network which is larger than a LAN but smaller than a WAN, and incorporates elements of both. It typically spans a town or city and is owned by a single person or company, such as a local council or a large company.



Characteristics of MAN

- It mostly covers towns and cities in a maximum 50 km range
- Mostly used medium is optical fibers, cables
- Data rates adequate for distributed computing applications.

Advantages of MAN

- It offers fast communication using high-speed carriers, like fiber optic cables.

- It provides excellent support for an extensive size network and greater access to WANs.
- The dual bus in MAN network provides support to transmit data in both directions concurrently.
- A MAN network mostly includes some areas of a city or an entire city.

Disadvantages of MAN

- You need more cable to establish MAN connection from one place to another.
- In MAN network it is tough to make the system secure from hackers

Other Types of Networks

- Apart from above mentioned here, are some other important types of networks:
    - WLAN (Wireless Local Area Network)
    - Storage Area Network
    - System Area Network
    - Home Area Network
    - POLAN- Passive Optical LAN
    - Enterprise private network
    - Campus Area Network
    - Virtual Area Network

Question Bank

- What is topology?
- Describe
    - Bus topology with diagram and state it's merits and demerits.
    - Star topology with diagram and state it's merits and demerits.
    - Ring topology with diagram and state it's merits and demerits.
    - Mesh topology with diagram and state it's merits and demerits.
- Describe Types of Networks (**LAN / WAN/ MAN/ PAN**)
- What is (NIC Card/HUB / Switch/ Bridge/ WAP/ Router/ Gateway/ Modem/ ISDN Terminal Adaptor/ Repeaters) Explain it in brief