Computer Network

Unit – I

Computer Networking :

What is computer networking?

Computer networking refers to interconnected computing devices that can exchange data and share resources with each other.

Advantages of computer networks: -

File Sharing: - The major advantage of computer network is that it allows file sharing and remote file access. A person sitting at one computer of a network can easily access the file which is stored on another computer.

Resource sharing: - Resource sharing is also an important benefit of a computer network. Multiple computers can be connected with each other and share the resources like printer, modem, folders etc…

Increased storage capacity: - A single computer might fall of storage memory, but when many computers are on network, storage memory of different computers can be used in such case. One can also design a storage server on the network in order to have a huge storage capacity.

Increase cost efficiency: - There are many type of software available in the market which are costly and take time for installation. Computer network resolve this problem as the software can be stored or installed on a system.

Disadvantages of computer network: -

Security issue: - One of the major drawbacks of computer network is the security. If a computer is on network, a computer hacker can get access by using different tools. In the case of big organization, various network security software are used to stop network attack for confidential data.

Computer viruses: - Any computer system is on network get affected by viruses. It is possible that virus of other system getting affected too. Viruses are spread on a networkeasily because each computer is connected with each other. Data are corrupted by the virus.

Expensive set up: - The set up cost of computer network can be high depending on the number of computers to be connected. Network devices are costly like router, hubs, switch, fibrotic cable, NIC cards, etc…

Server failure: - In the case of main server of computer network break down, the system become useless.

Uses of Computer Network :- Business Application, Home Application, Mobile Users

Computer Networks: Business Applications

Resource Sharing, Server-Client model, Communication Medium, eCommerce:

Computer Networks: Home Applications

Some of the most important uses of the Internet for home users are as follows:

- Access to remote information
- Person-to-person communication
- Interactive entertainment
- Electronic commerce

Computer Networks: Mobile Users

Mobile computers, such as notebook computers and Mobile phones, is one of the fastest-growing segment of the entire computer industry.

Types of networks (Categories of networks)

Local area network (LAN): -

A LAN is usually private network.
This is created in single office, building, or campus.
Depending on the needs of organization LAN is created.LAN size is limited up to a few kilometers.
LAN is designed to allow resources to be shared between computers. The resources to be shared can be includes hardware, software, ordata.
One of the computers may be given a large capacity disk drive and become a server to theother client.
Software can be stored on central server and used by all clients.The data rate of LAN is up to 100 Mbps with gigabit.

Metropolitan area network (MAN): -

A MAN is designed for an entire city.
It may be a single network or connecting a multiple LAN in large network.
By using MAN we can share the resources of LAN-to-LAN as well as device-to-device.
A MAN may be operated by private company or any service provider.
Consider the following figure.

Wide area network (WAN): -

A WAN provides communication for long distance.
WAN provides long distance transmission of data, voice, image, and video information over world wide.
A WAN that is handled and used by a single company is often referred to as an enterprise network.
WANs may used public line, leased line, or private communication devices and therefore they are covers the large geographical areas.

Types of Network Topologies

Star topology: -

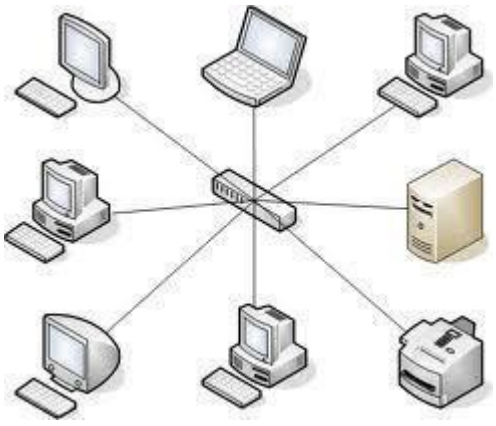
Each computer on star network communicates with each other with a central hub. It resends the message either to all computers or only to the destination computer.The hub in a star network can be either active or passive.
An active hub regenerates the electrical signal and sends it to all computers.A passive hub does not regenerate the electrical signals.

Advantages of star topology: -

1. It is easy to modify and add new computers to a star network.
2. It is easy to identify the network error.
3. If the single computer is fails that is not effect to entire star network.
4. We can use several cable types in same network.

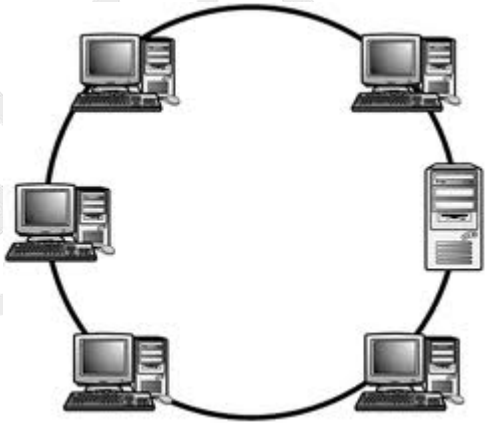
Disadvantages of star topology: -

1. If the central hub fails, the whole star network become fail.
2. Many star networks require a device at the central point for rebroadcast network traffic.
3. More cables are required because all computers are connected with central hub.



Ring topology: -

- In ring topology all nodes are connected with each other in circle using cables. In this layout, each node is physically connected to only two other computers. Each computer passes information to the next, until it arrives at its destination.
- Performance of ring topology is faster.
- This type of topology can be used in peer-to-peer networks.
- **Advantages of ring topology: -**
  1. Ring topology provides faster performance.
  2. The sharing of files and data are become easy.
  3. Each node can perform on same speed.
  4. Each portion of the cabling system is handling only the data flow between machines.
- **Disadvantages of ring topology: -**
  1. Failure of one computer on the ring topology can affect the entire network.
  2. It is difficult to solve the problems.
  3. Adding or removing computers disturbs the network.

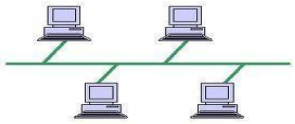


Bus topology: -

- In bus topology a single main cable connects each node.Each node is connected to two other nodes.
- The node at either start or end of cable connected with only one machine.A single cable is dedicated to all the information traffic.
- In bus topology the performance can be slow at a time.
  This topology is often found in client/server systems.

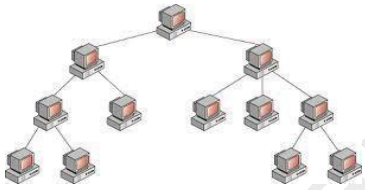
- **Advantages of bus topology: -**
  1. The bus is simple, reliable in very small network.
  2. It is easy to use, and easy to understand.
  3. The bus topology is the simplest and most widely used for network design.
  4. This topology is less expensive then other topology.
  5. It is easy to extend.

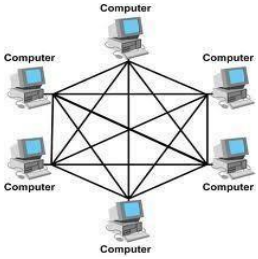
- **Disadvantages of bus topology: -**
  1. The topology can not handle heavy network traffic.
  2. It is difficult to troubleshoot a bus.
  3. Only one computer can send a message at a time.
  4. A computer must wait until the bus is free.
  5. The number of computers can affect the speed of network.



Tree topology: -

- Tree is network topology containing two or more nodes are connected with each other.They are
- connected with each other in hierarchical fashion.
- The topmost node is called root.
- The root node may have zero or more child nodes.
- The root is parent node for its child node.
- Every node in tree topology has one parent node.
- These relationships ensure that there is always one and only one path from one node to any othernode in the tree.





Mesh topology: -

In a mesh topology, every device is directly connected to every other device.A fully connected mesh network has n(n-1)/2 physical links for devices.
In a mesh topology, every device has dedicated point-to-point link.
The dedicated means that the link carries traffic only between the two devices it connect.

Advantages of mesh topology: -

1. In mesh topology each connection can carry its own data.
2. If one link becomes fail, it does not affect to entire network.
3. It provides privacy or security.
4. It easy to find out any fault in network.

Disadvantages of mesh topology: -

1. The main disadvantages of mesh topology are related to the amount of cabling.
2. The hardware which is used in this topology is very costly.
3. Every device is must be connected to every other device.

Reference Models:-

The OSI reference model: -

- The OSI reference model is known as "**O**pen **S**ystem **I**nterconnection".

□ Consider the following figure:

□ The OSI reference model is consist of seven layers.

□ **Physical layer: -**

1. The physical layer defines the characteristics of the interface.
2. The data of physical layer is consisting of stream of bit.
3. The physical layer defines the duration of bits.
4. The physical layer also defines the direction of transmission between two devices: simplex, half-duplex, or full-duplex.

□ **Data link layer: -**

1. The data link layer divides the stream of bits into manageable data unit known asframes.
2. Data link layer is responsible for physical addressing.
3. The data link layer provides source address and destination address to the frame.
4. The data link layer provides the flow control for transmission.
5. Data link layer handle the error control like lost of frame, duplication of frame etc…

□ **Network layer: -**

1. The network layer is responsible for the source-to-destination delivery.
2. The network layer provides the logical addressing.
3. When independent networks are connected together to create internetwork, the connecting devices route the packets to their final destination.
4. If two systems are connected to the different network, there is often need to the network layer.

□ **Transport layer: -**

1. The transport layer is responsible for source-to-destination delivery of the entire message.
2. The transport layer provides the service-point addressing.
3. The transport layer is responsible for segmentation and reassembly.
4. The transport layer can be either connectionless or connection oriented.
5. Transport layer is also responsible for flow control.

□ **Session layer: -**

1. The session layer is the network dialog controller.
2. It establishes the communication between systems.
3. This layer also maintains the communication.
4. It allows the communication between two processes to take place either in half-duplex or full-duplex.

□ **Presentation layer: -**

1. The presentation layer is concern with the syntax of information.
2. Presentation layer is provides the facility for data translation.
3. The presentation layers at the sender side change the information from its sender-dependentformat into common format.
4. The presentation layers at the receiving side change the common format into its receiver-dependent format.
5. The presentation layer also provide encryption and description facility.

□ **Application layer: -**

1. The application layer allows the user to access the network.
2. It provides user interface.
3. The application layer allows a user to log on to a remote host.
4. It also provides the mail services.
5. The application layer provides the facility like file transfer, remote access of data etc…

The TCP/IP reference model: -

- The TCP/IP reference model is known as "**T**ransmission **C**ontrol **P**rotocol".
  Consider the following figure.

Application Layer: -

1. In TCP/IP model, session or presentation layers are not present.
2. Application layer is present on the top of the transport layer.
3. It includes all the higher level protocols like TELNET, FTP, SMTP etc…
4. It defines TCP/IP application protocols and how host programs interface with transport layer.

Transport layer: -

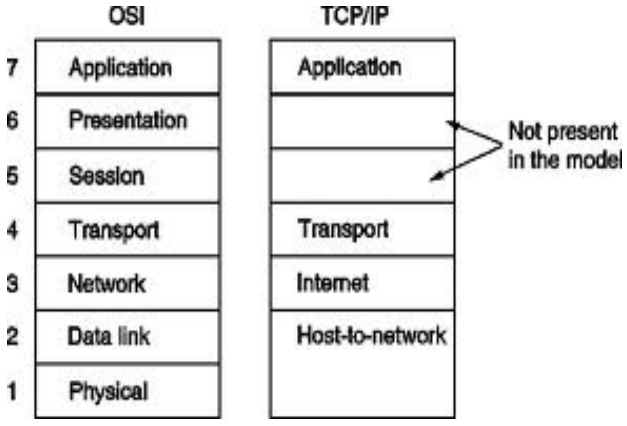
1. In TCP/IP model, the layer above the internet layer is known as transport layer.
2. It is developed to permit entities on the source and destination hosts to carry on conversation.
3. It provides two protocols. TCP and UDP.
4. The transport layer is the interface between the application layer and hardware.

Network layer: -

1. The responsibility of network layer is to insert the data packet into any network.
2. The data packet can travel independently on network.
3. The layer defines IP for its official packet.
4. Packet routing is a major responsibility of this protocol.
5. Another job of this layer is packet switching.

Host to network layer: -

1. In this layer the host has connect to the network using some protocols.
2. It can transmit IP packet over network.
3. It is responsible for host-to-network layer interface.
4. It is also specifies detail of how data is physically sent through network.



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The politics of telephone: -

Before 1984, AT&T owned all of the regional telephone companies as well as the long distancelines.
In 1984, AT&T was forced to split up into smaller subgroups of the regional BOCs and the long distance company it is today.
But most of the telecommunications infrastructure we have today is due to AT&T.

Structure of the telephone system: -

The telephone was patented by Graham Bell in 1876.
The telephones were sold in pairs and it was up to customer to string a single wire between them.Bell formed also the Bell Telephone Company which opened its first switching office in New Haven, Connecticut, in 1878.
To make a call, the customer would crank the phone to ring in the telephone company office wherethe operator manually connected the caller to the callee using a jumper cable.
The switching offices had to be connected to make long-distance calls possible.Therefore second-level switching offices became necessary.

(a) Fully interconnected network. *(b) Centralized network.* *(c) Two level hierarchy.*

At present, the telephone system can be, with some simplifications, described as follows:
Each telephone has two copper wires coming out of it that go directly to the telephone company'snearest end office.
The two wire connection of the telephone and end office is called local loop.

Local loop: -

- The local loop is the pair of wire that goes from telephone office to each users home.The
- figure shows how these wires go from telephone office to users home.
- A cable from a telephone instrument can be plugged into the socket on the box for connection tothe telephone system.
- With the help of the local loops, telephones are connected to the nearest local central office.The
- system was designed for voice transmission.
- This connection is usually on a pair of copper wires known as twisted pair.
-

Trunks: -

- They communicate with each other via high bandwidth interoffice trunks formed today by coaxialcables, microwaves and especially fiber optics.
- The number of different kinds of switching centres and their topology varies from country to country depending on its telephone density.
- Digital signal can pass through arbitrary number of regenerators with no information loss. In contrast, analog signals always suffer some information loss when amplified, and this loss is cumulative.
- Voice, data, music, and images can be interspersed to make more efficient use of the circuits and equipment.
- Much higher data rates are possible.
- Maintenance of digital system is easier.
- A transmitted bit is either received correctly or not.

Multiplexing: -

In a multiplexed system devices share the capacity of one link.The devices are transmits data stream to a multiplexer (MUX).

On the receiving side data are collected from de-multiplexer (DEMUX).

Signals are multiplexed using two basic methods.

[1] Frequency division multiplexing (FDM)

[2] Time division multiplexing (TDM).

[3] Wavelength division multiplexing (WDM)

Frequency division multiplexing (FDM): -

FDM is an analog technique that can be applied when bandwidth of a link is higher than the combined bandwidth of the signal to be transmitted.

In FDM, signals generated by each sending device on different carrier frequency.

These modulated signals are combined into single composite signals and transmitted on the link.

The link must be separated by strips of unused bandwidth for overlapping.

Inside the multiplexer these signals are modulated onto different carrier frequency.

The de-multiplexer uses a series of filter to decompose the multiplexed signal into its original signals.

The individual signals are passed to the receiving devices.

Time division multiplexing (TDM): -

TDM is a digital process.

That can be applied when the data rate capacity of the transmission medium is greater than the data rate required by the sending and receiving device.

In such a case multiple, transmission can occupy a single link dividing into a portion.

Here link is provided by time.

The TDM is implemented in two ways: [1] Synchronous TDM [2] Asynchronous TDM.

In synchronous TDM the multiplexer allocates exactly time slot to each device at all time.

If device is unable to transmit or does not have data to send, its time slot remains empty.

Synchronous TDM does not guarantee that the full capacity of a link is used.

An asynchronous TDM is design to avoid this type of waste. In asynchronous TDM each slot is available to any of the attached input lines that have to datasent.

The multiplexer scans the input lines, accepts portions of data until a frame is filled.

In asynchronous TDM has ability to allocate time slot dynamically.

Wavelength division multiplexing (WDM) is a technique of multiplexing multiple optical carrier signals through a single optical fiber channel by varying the wavelengths of laser lights. WDM allows communication in both the directions in the fiber cable.

Let's see that the difference between TDM and FDM:

S.NO	TDM	FDM
1.	TDM stands for Time division multiplexing.	FDM stands for Frequency division multiplexing.
2.	TDM works with digital signals as well as analog signals.	While FDM works with only analog signals.
3.	TDM has low conflict.	While it has high conflict.
4.	Wiring or chip of TDM is simple.	While it's wiring or chip is complex rather than simple.
5.	TDM is efficient.	While it is inefficient.
6.	In TDM, time sharing takes place.	While in this, frequency sharing takes place.
7.	In TDM, synchronization pulse is necessary.	While in it Guard band is necessary.

Switching: -

A switched network consists of a series of interconnected nodes, known as switch.
Switches are hardware or software device which is capable of creating temporary connection between two or more device.
There are three methods of switching. (1) Circuit Switching (2) Packet Switching (3) Message Switching.

Circuit switching: -

Circuit switching creates a direct physical connection between two devices.A circuit switch is a device with *n* input and *m* output.
That creates a temporary connection between an input link and output link.The number of input does not have to match the number of output.
Circuit switching can use two technologies. [1]Space division switching [2]Time divisionswitching.

Space division switching: -

1. In space division switching, the paths in the circuit are separated from each other.
2. This technology was developed for analog network.
3. But now a day this technology is used with both analog and digital networks.
4. Consider the following figure:

Time division switching: -

1. Time division switching uses time division multiplexing for switching.
2. There is one popular method for switching is time-sot-interchange (TSI).
3. The TSI consist of random access memory (RAM) with several memory locations.
4. The size of each location is the same as the size of single time slot.
5. The RAM fills up with incoming data from time slot.
6. The control unit take the decision for send out the data.

Packet switching: -

In a packet switching network data are transmitted in block known as packet.The length of packet is established by network.
Large amount of data are broken up into packets.
Each packet contains data and header with control information.The packets are sent over the network node-to-node.
There are two popular approaches to packet switching: [1] Datagram approach [2] Virtual circuitapproach.

Datagram approach: -

1. In the datagram approach each packet is treated as independent packet from all others.
2. Packet in this technology is known as datagram.
3. Each pair is connected to node with multiple channels.
4. Each channel is capable of carrying datagram either from several different sources or from one source.
5. FDM and TDM are used in datagram approach.

□ **Virtual circuit approach: -**

1. In the virtual circuit approach to packet switching, the relationship between all packets belonging to a message.
2. There is only one route is chosen between sender and receiver for all packet.
3. When all data are sent, they are transmitted in one by one manner.
4. The virtual circuit is implemented in two ways: [1] Switched virtual circuit (SVC) [2] permanent virtual circuit (PVC)
5. In SVC method a virtual circuit is created when it is required.
6. In PVC method a virtual circuit is provided between two users on continuous basis.

Message switching: -

The message switching is also known as store and forward switching.
In this method a node receives a message and stored it until the appropriate route is free.There is no direct link between the sender and receiver for transmission.
A message is delivered to the node along one path then routed along to its destination.The messages are stored and relay from secondary storage.
While in the packet switching the packets are stored and forward from primary storage.The primary uses have been to provide high level network services.