



Cn 1

Computer networks (Guru Gobind Singh Indraprastha University)

(1960) ARPANET → First working network

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A computer network is a set of devices connected through links.

↓

optical fibre,
coaxial cable,

Twisted pair,

wireless (radio, satellite; etc.)

computers,

printers,

mobile, router,
etc.

- Share resources from one computer to another.
- Create files and store them in one computer, access those files from the other computer connected over the internet.
- Connect a printer, scanner or a fax machine to one computer within the network and let other computers of the network use the machines available over the network.

Goals of CN

- Resource sharing
- Resource availability and reliability
- Performance management
- Cost savings
- Increased storage capacity
- Streamlined collaboration & communication
- Reduction of errors
- Secured remote access.

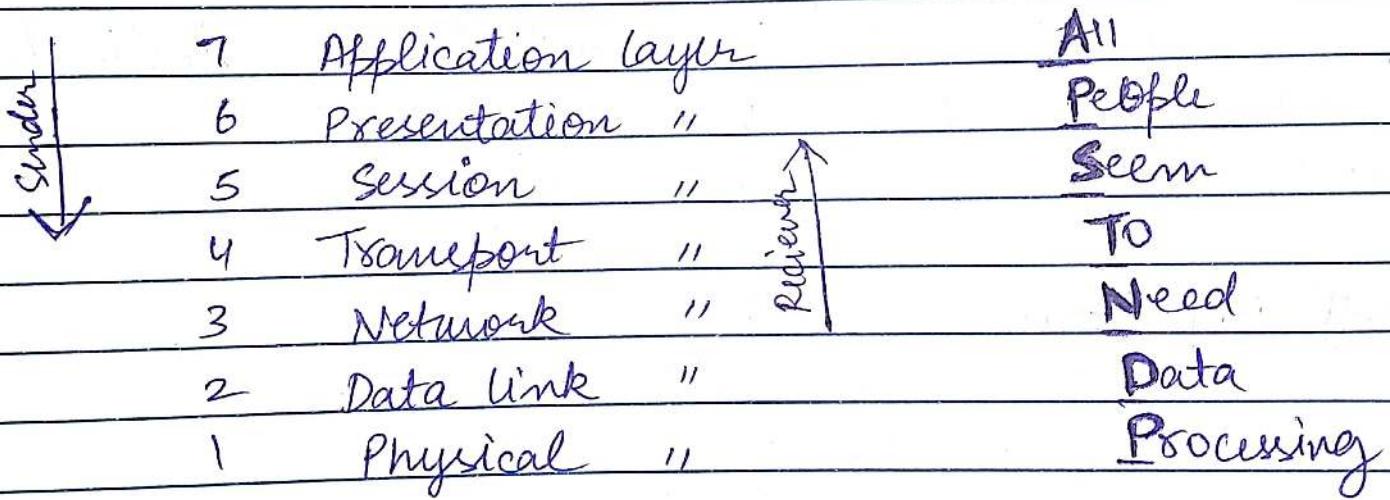
Applications of CN

- Marketing & Sales
- Financial Services
- Teleconferencing
- Cable Television
- Information services → www
- Email
- Telephone

OSI Reference Model

(late 1970s)

- It is a layered framework for the design of networks system that allows communication between all types of computer networks
- 7 separate layers
- Each layer calls upon the service of the layer just below it.



(i) PHYSICAL LAYER

(To send bits from one node to next)

→ convert bits into electronic signals for outgoing messages.

→ Converts e signals into bits for incoming messages.

→ Functions →

* Transmission Media

* Type of Encoding

* Data Rate (no. of bits sent per sec)

* Synchronization of bits.

* Line Configuration → Point to point
→ Multipoint

* Topology

- Star
- Bus
- Ring
- Mesh

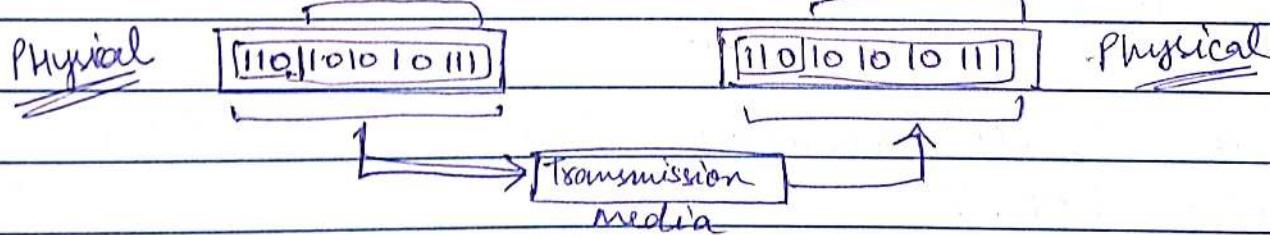
* Transmission Mode

Simplex	Half Duplex	Full Duplex
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→ It is the bottom layer of OSI Model.

(From Data Link)

(To Data Link)



ii) Data Link Layer

→ It transforms the physical layer into a reliable link.

→ Free of errors

- It breaks up the input data into data frames.
 - At receiving end, layer packages data into data frames to deliver to network layer.
 - At sending end, the layer converts data into data formats that are understood by Physical layer.
- Functions:
- * Framing [conversion of bits to frames]
 - * Physical Addressing [Header is added to frame]
 - * Flow Control
 - * Error Control
 - * Access Control

(iii) NETWORK LAYER

- Responsible for source to destination delivery of packets.
 - It controls the operation of subnet.
- Functions:
- * Logical Addressing
(Header to packet coming)
 - * Routing (Routing algorithms) (Static tables)

(IV) TRANSPORT LAYER

→ Responsible for process to process delivery.

→ Functions :

- * Service Point addressing (Port address)
- * Segmentation and Reassembling (sending) (Receiving)



- * Connection control → connectionless
→ connection oriented

- * Flow and error control .

Layer 1 to 3 → chained	
Layer 4 to 7 → end to end	

(V) SESSION LAYER

→ It allows users on diff. machines to establish sessions between them .

→ Functions :

- * Dialog Control (keeping track of whose turn is to transmit)
 - Half Duplex
 - Full Duplex

* Token Management

(preventing two parties attempting the same operation at the same time)

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* Synchronization

Synchronization (check pointing long transmission to allow them to continue from where they were after a crash)

(vi) PRESNTATION LAYER

→ It deals with the syntax and semantics of the information exchanged between two systems.

→ Functions :

* Translation (converting a msg to compatible bit stream)

* Encryption (converting plain text to cipher text)

* Compression (Reducing no. of bits contained in info.)

(vii) APPLICATION LAYER

→ Responsible for providing services to the user.

→ Functions :

- * Network Virtual Terminal
(Remote host login is facilitated)
- * File Transfer , access and management .
- * Email Services
- * Directory Services .



Summary

A	(user access)
Presentation	(encrypt , compress)
S	(manage sessions)
T	(process to process delivery)
N	(source to dest . , Routing)
D	(frames , Flow / error control)
Physical	(Data rate , nodes , mode)

Ethernet

→ It is the family of computer networking technologies for LANs and MANs.

- System communicating over Ethernet divide a stream of data into shorter pieces called frames.
- Each frames consists source and destination addresses and error-checking data so that damaged data can be detected and re-transmitted.

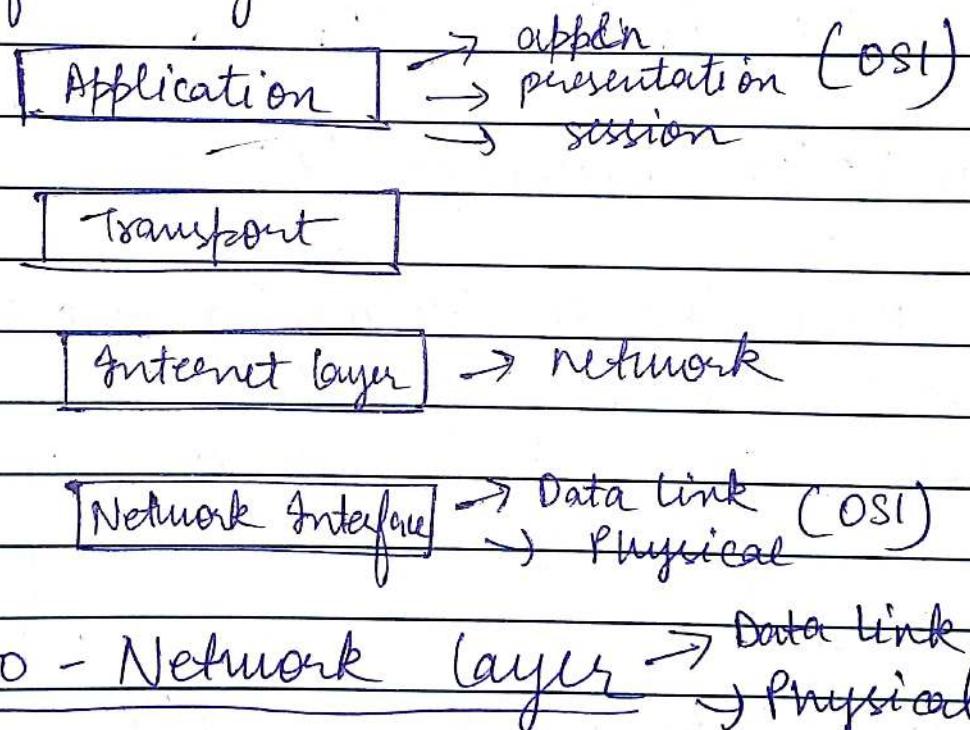
Token Ring (LAN)

- It is a protocol which resides at a data link layer of OSI Model.
- It uses a special three byte frame called token that travels around the ring in a loop.
- Empty frames are circulated on the ring. When a computer has a message to send, it seizes the token and then computer will send the frame.

TCP / IP Protocol Suite

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The layers of TCP / IP contains relatively independent protocols that can be mixed and matched depending upon the needs of the system.



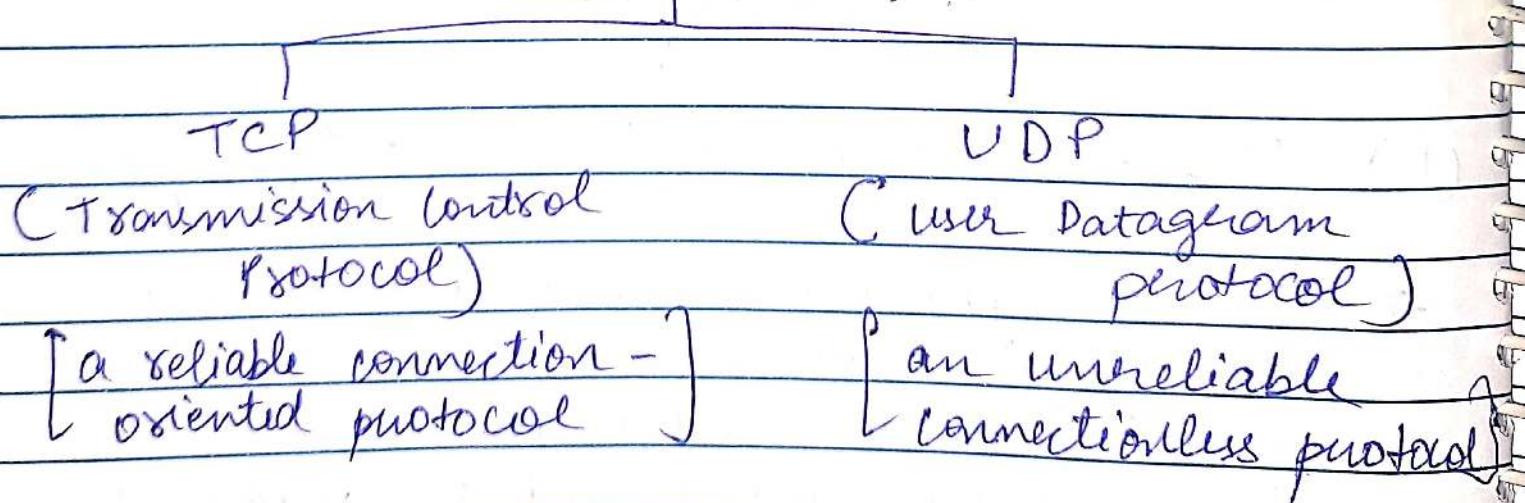
- This model just points out that the host has to connect to the network using some protocol so it can send IP packets over it.
- This protocol is not defined and varies from host and network to network.

(ii) THE INTERNET LAYER

- The official packet format and protocol at this layer is called IP (Internet Protocol).
- Its job is to inject IP Packets into and network and have them travel independently to destination.
- (Similar to OSI's Network layer)

(iii) THE TRANSPORT LAYER

- Responsible for delivering whole message.
- Unit of communication is called segment.
- Two end-to-end protocols.



(iv) The Application layer

- combination of session, presentation and application layer of OSI model.
- contains all the higher level protocols.
- unit of communication is message.

OSI vs TCP/IP

- OSI is a general model whereas that is not the case with TCP/IP.
- OSI is a 7 layer model whereas TCP/IP is a 5 layer model.
- OSI architecture came first and then the protocols whereas its' reverse in TCP/IP and hence its hard to replace the protocols.
- OSI provides connection oriented as well as connectionless services at network layer and only connection oriented at transport layer whereas TCP/IP provides connectionless services at network layer as well as Transport layer.

Computer Network Criteria

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(i) Performance \rightarrow Transit time t
 \rightarrow Response time t

(ii) Reliability
(iii) Security

Types of connection Topology

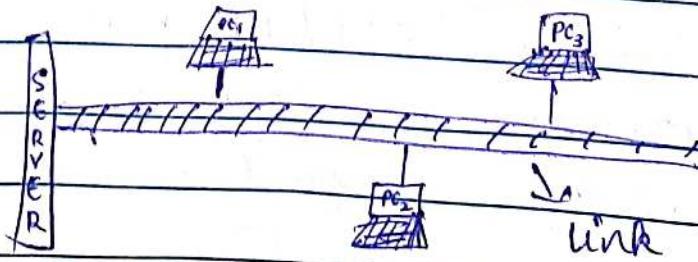
(i) Point-to-point

Dedicated link between two points.



(ii) Multipoint connection

More than two devices share a single link.

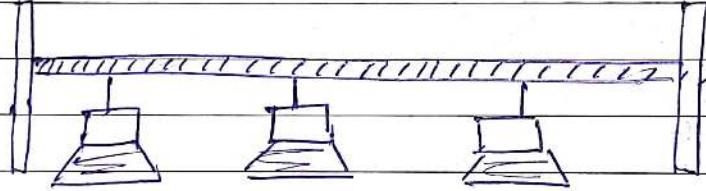


Types of Network Topology

Topology describes appearance of network.

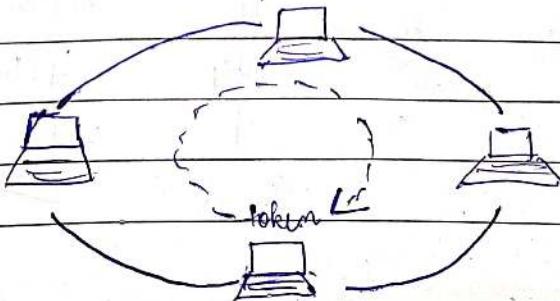
(i) Bus Topology

- Multipoint
- Easy to install, used for small networks.
- cheap
- Easy to expand
- Slow speed as only one system can transmit at a time.
- Faulty cable bring down whole network.



(ii) Ring Topology

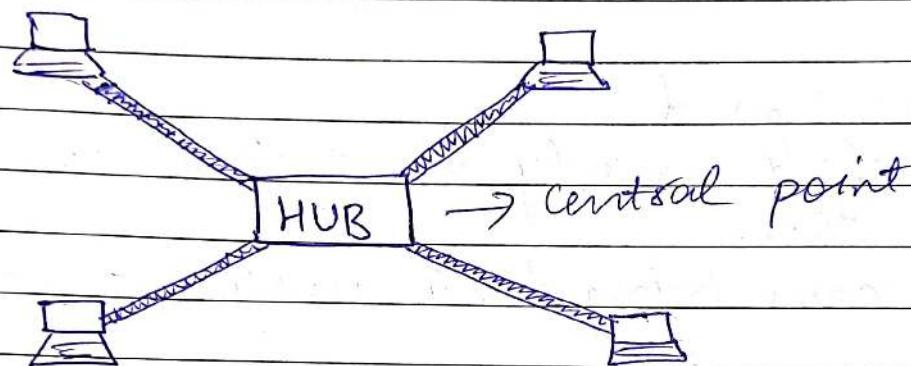
- In this, each computer is connected to the next computer with the last one connected to first.
- Multipoint
- Token passing is used.
- Fault in any link disables entire N/W
- Difficult to troubleshoot the ring.



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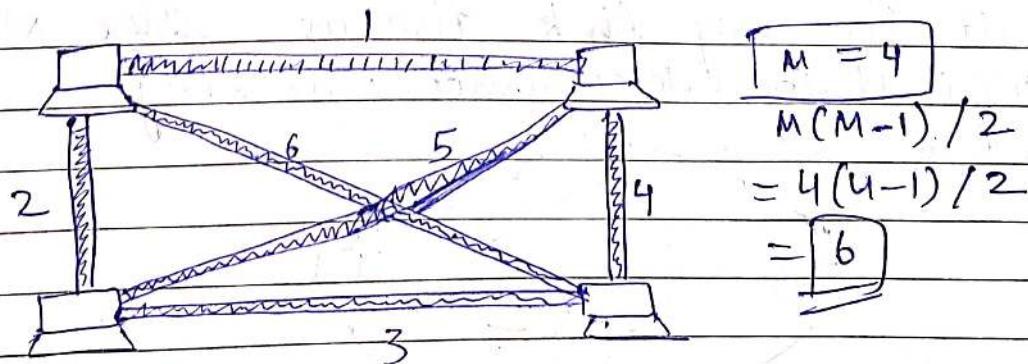
(iii) Star Topology

- All the wires from the computer go to a central location having a device called hub.
- All conn' goes through HUB.
- If central HUB fails, whole N/w fails.
- Cabling cost is more.



(iv) Mesh Topology

- In this topology, each device has a dedicated point to point link to every other device.
- Due to dedicated link, there is no traffic problem.
- Failure of one link doesn't affect entire N/w.
- More secure and private.
- Easy fault diagnosis (pt-to-pt)
- Expensive due to higher cabling cost.

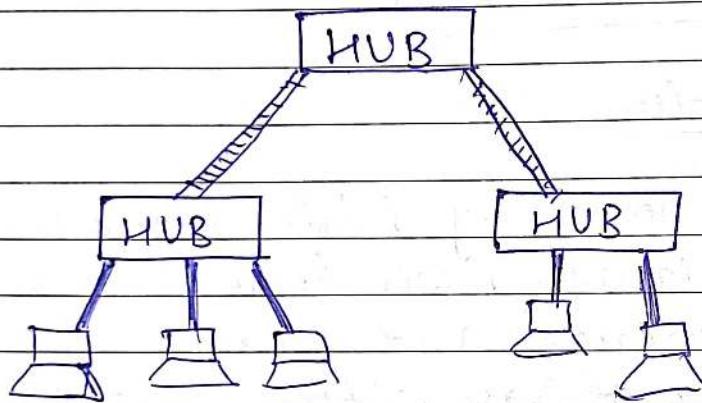


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(v) Tree Topology

Variation of star.

- Nodes in a tree are linked to a central hub.
- cost of cabling is more.
- On failure of central hub, entire N/W breaks down.



Networking Devices

-- (PHYSICAL LAYER) --

(i) HUB

- a central device that connects multiple computers on a single network.
- A network hub has I/O ports that can be used to link several networks together.
- In its basic form, a hub does nothing except provide a pathway for the electrical signals to travel along. → passive hub.
- providing a path for the data signals; regenerate the signal before it forwards it to all connected devices → active hub.

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(iii) CABLES

- In Wired Network Architecture (Ethernet), cables are used to interconnect ten devices.
- The type of cable chosen for a network is related to the networks' topology, protocol and size.

* TYPES OF ETHERNET CABLES

1. Coaxial Cables

- It is used to carry higher frequency electrical signals with low losses.
 - It uses 10Base2 and 10Base5 ethernet variants. It has copper conductor in the middle surrounded by dielectric insulator made of PVC which is surrounded by a metallic shield covered by plastic covering.
 - Maximum transmission speed is 10 Mbps
 - Used in telephone systems, cable TVs etc.
- * Hardline coaxial cable (high signal strength)
 * RG-6 coaxial cable (thick insulator)
 * Tri-axial cable (more bandwidth)

2. Twisted Pair Cable

- It is a copper wire cable in which two insulated copper wires are twisted around each other. It uses 10BaseT and 100BaseT variants.

* Shielded Twisted Pair Cable (STP)

In STP, the wires are covered by a copper braided covering that protects it against interference. They are used for longer distances and higher transmission rates.

* Unshielded Twisted Pair Cable (UTP)

- Most commonly used
- Two wires are twisted around one another
- helps in controlling interference

3. Optical Fiber cables

- made of glass cores surrounded by several layers of cladding material made of PVC or Teflon
- transmits data in form of light signals
- can transmit signals over a long distance than any other cable.

* SMF (Single-mode fiber)

- one single ray of light.
- used for long distance transmission.

* MMF (Multi-mode fiber)

- multiple light rays to transmit data.
- less expensive.

(iii) Modem

It stands for Modulator/De Modulator. A modem converts digital to analog signals and vice-versa.

(iv) Repeaters

- They are used to regenerate analog or digital signals distorted by transmission loss (Attenuation).
- Analog repeaters can only amplify the signal whereas a digital repeater can reproduce a signal to near its original quality.

DATA LINK LAYER

(v) Bridges

- It provides interconnection with other networks that use the same protocol, connecting two different networks together and providing communication between them.

(vi) Switches

- It connects network segments or devices.
- It has I/O ports that connect devices together.
- Unlike hub, switches are smart enough to **//vijeta//** know which device data packets are

meant for and only sends to that device.

(vii) Network Interface Card (NIC)

It is an electronic device that is mounted on ROM of the computer that connects to a network.

--- NETWORK LAYER ---

(viii) Routers

A router is a switch like device that creates/forwards data packets based on their IP addresses.

(ix) Brouters

A bridge router is a network device that works as a bridge and as a router.

The brouter routes packets for known protocols and simply forwards all other packets as a bridge would.

--- TRANSPORT LAYER ---

(X) GATEWAYS

→ Any device that translates one data format to another is called a gateway.

→ It can convert data packets from one protocol to another.

Date / /

(xi) FIREWALL

A firewall is a system designed to prevent unauthorized access to or from a private network.

- packet filtering
- proxy server.

Application layer

- PC's, Phones, Servers
- Gateways and Firewalls.