

COMPUTER NETWORK:-

A Computer network is a set of computers connected together for the purpose of sharing resources. The most common shared resources ~~share~~ today is commonly internet. Other shared resources can include a printer or a file server.

* Goals of CN

- Several machines can share printers, tape drives etc.
- Reduced Cost
- Resource & load sharing
- Programs do not need to run on a single machine
- High Reliability
- If a machine goes down, another can take over
- Mail & Communication.

* Components of CN:-

A data communication system has five components.

R.T.O.

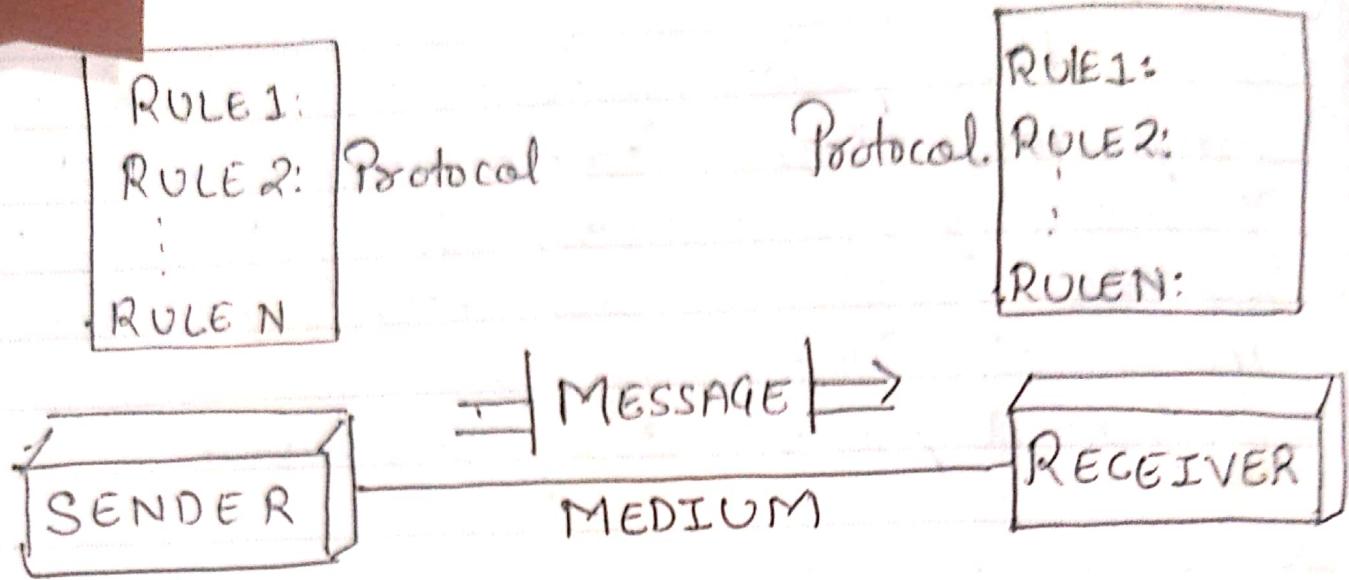


Fig → COMPUTER NETWORK
COMPONENTS.

- 1) MESSAGE:- The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
- 2) SENDER:- The sender is the device that sends the data ~~message~~ message. It can be a Computer, workstation, telephone handset, Video camera, & so on.
- 3) RECEIVER:- The receiver is the device that receives the message. It can be a

Computer, workstation, telephone,
handset, television & soon.



4) Transmission MEDIUM:-

The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted pair wire, coaxial cable, fibre-optic cable, & radio waves.

5) Protocol:-

A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating.

CLASSIFICATION & TYPES OF CN

There are 3 types of network
Classification

- 1) LAN (Local Area Network)
- 2) MAN (Metropolitan Area Network)
- 3) WAN (Wide Area Network)

⇒ LAN:-

LAN is a group of the computers placed in the same room, same floor, or the same building so they are connected to each other to form a single network to share their resources such as disk drives, data, CPU, modem etc.

LAN is limited to some geographical area less than 2 Km. Most of LAN is used widely is an Ethernet system of the bus topology.

* Characteristics:-

- 1) LAN connects the computer in a single building block and they are working in any limited area less than 2 Km.
- 2) Media access control methods in a LAN, the bus-based Ethernet and token ring.
- 3) Metropolitan Area Network (MAN):-

MAN is a large computer network that expands a Metropolitan area or campus. Its geographic area between a WAN and LAN. It expands around 50 Km. Devices used are modem and wire/cable.

* Characteristics of MAN:-

- 1) It covers the towns & cities (50km)
- 2) MAN is used by the communication medium for optical fibre cables, it also used for other media.

3) Wide Area Network (WAN)

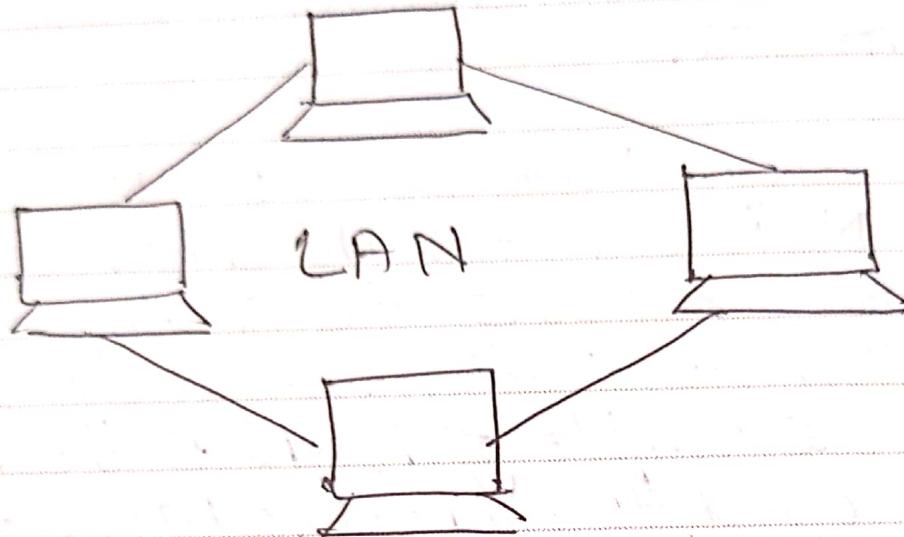
WAN is a network which connects the countries, cities or the continents, it is a public communication links. The most popular example of WAN is the internet. WAN is used to connect LAN, so the users of the computers in the different location can communicate with each other.

* Characteristics of WAN

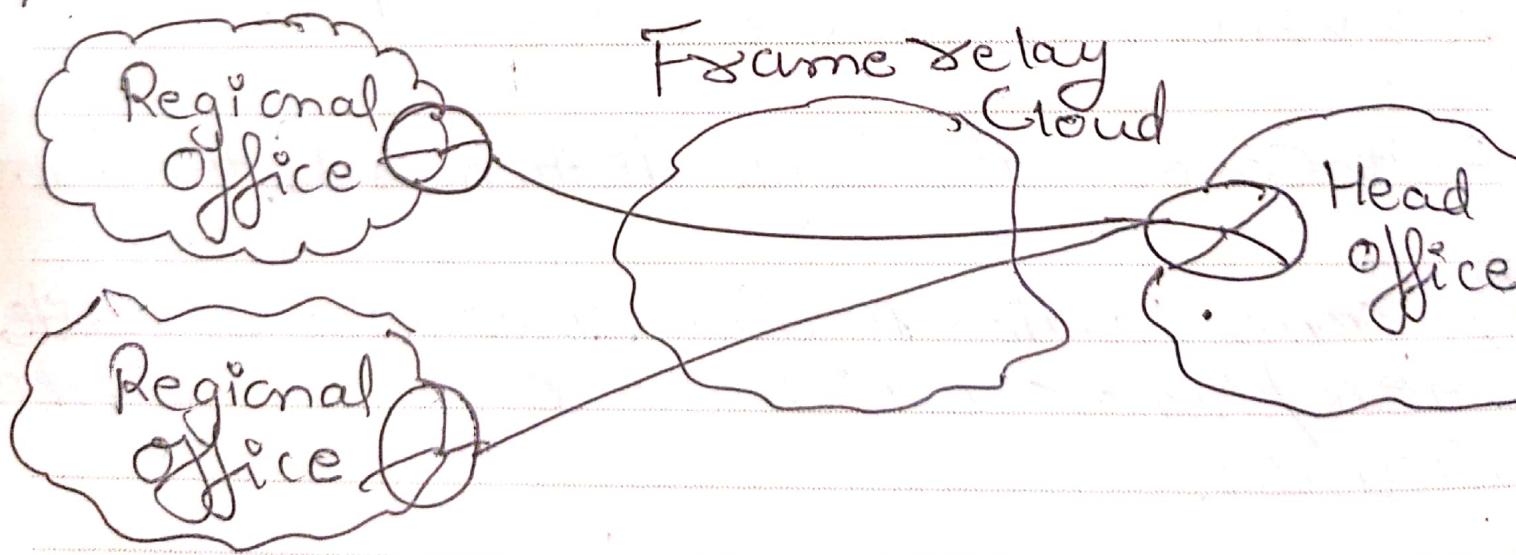
- 1) It covers the large distances (More than 100km)
- 2) Communication medium used are satellite telephones which are connected by the routers.

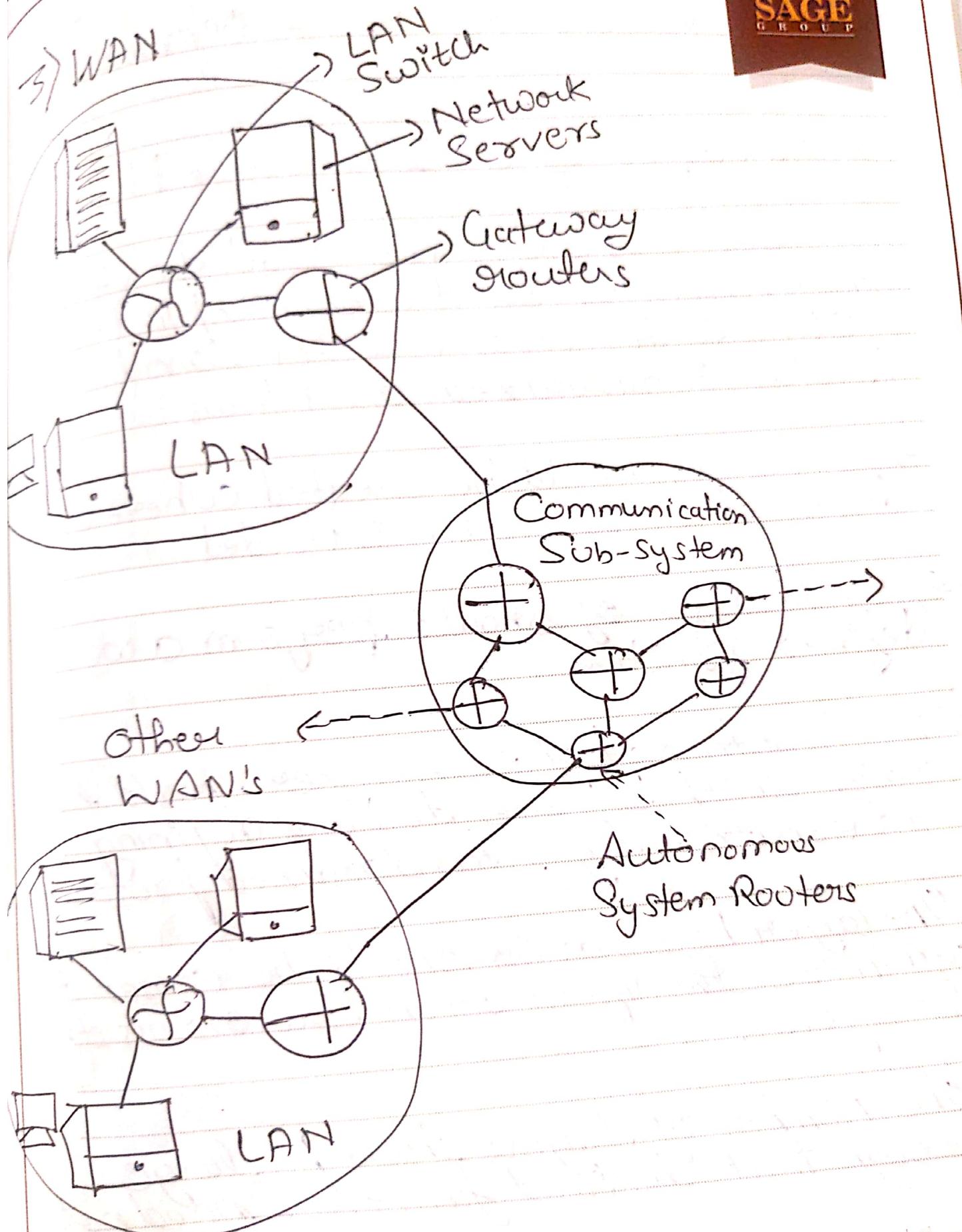
Figures of LAN, MAN, & WAN

1) LAN



2) MAN





ISO-OSI Reference Model

* Principles of OSI Reference Model

The OSI Reference Model has 7 layers. The principles that were applied to arrive at the seven layers can be briefly summarized as follows

- 1) A layer should be created where a different abstraction is needed
- 2) Each layer ~~of~~ should perform a well-defined function
- 3) The functions of each layer should be chosen with an eye toward defining internationally standardized protocols.
- 4) The layer boundaries should be chosen to minimize the information flow across the interfaces.
- 5) The number of layers should be large enough that distinct functions need not



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be thrown together in the same layer out of necessity & small enough that architecture does not uncwidely.

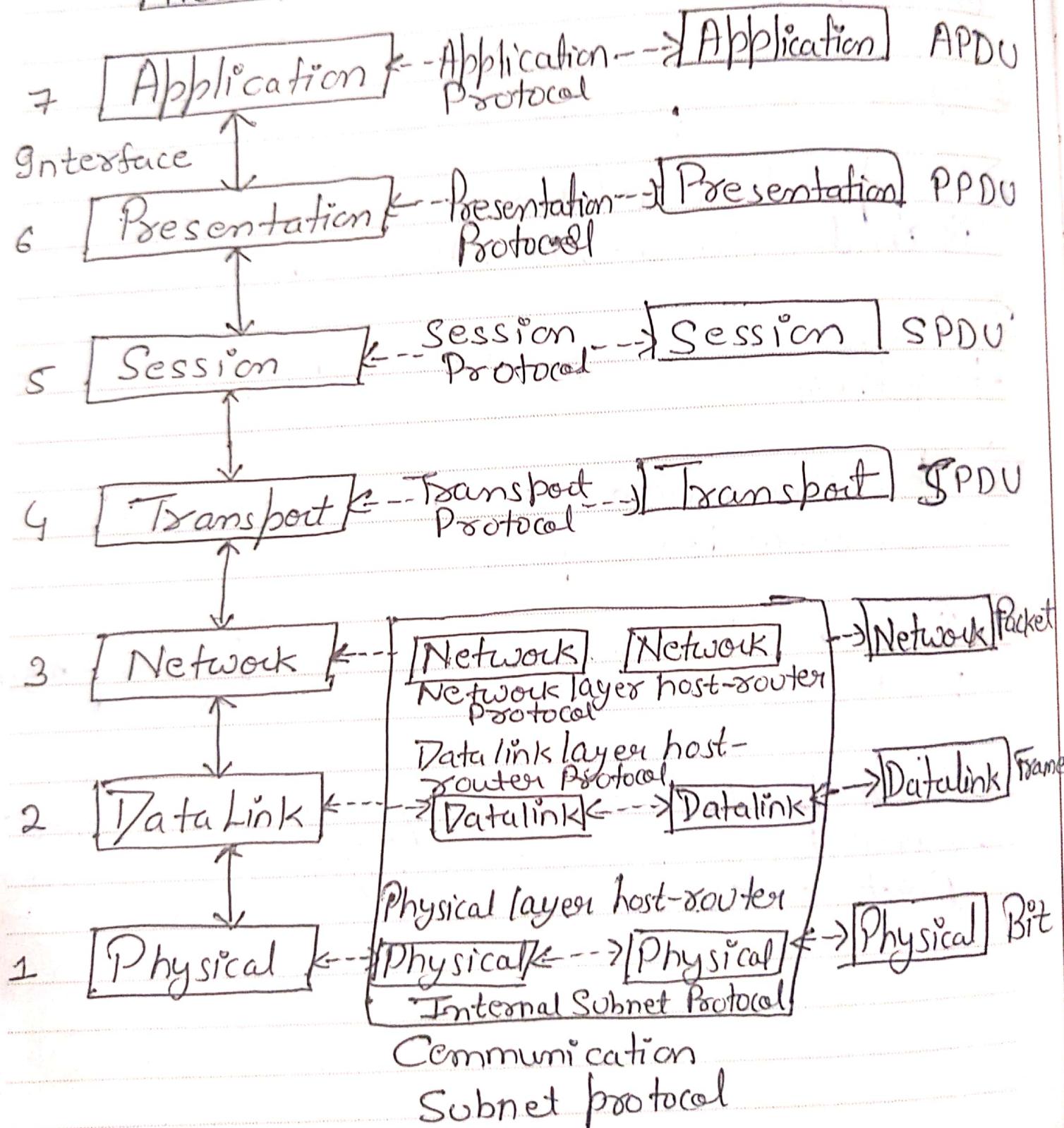
* Features of OSI Model:-

- 1) Big picture of Communication over network is understandable through this OSI Model
- 2) We see how hardware & software work together
- 3) We can understand new technologies as they are developed
- 4) Troubleshooting is easier by separate networks
- 5) Can be used to compare basic functional relationships on different networks.

Host A

Host B

Name of
Child Exchange



* Description of Different Layers:

1) Layer 1: The Physical Layer

- It is the lowest layer of OSI Model
- It activates, maintains and deactivates the physical connection
- It is responsible for transmission & reception of the unstructured raw data over network
- Voltages and data rates needed for transmission is defined in the physical layer.
- It converts the digital/analog bits into electrical signals or optical signals.
- Data encoding is also done in this layer.

2) Layer 2: The Data Link Layer

- It synchronizes the information which is to be transmitted over the physical layer.
- The main function of this layer is to make sure data transfer is error free from one node to another, over the physical layer.
- Transmitting & receiving data frames sequentially

is managed by this layer.

- This layer sends & expects acknowledgement for frames received & sent respectively. Resending of non-acknowledgement received frames is also handled by this layer.
- This layer establishes a logical layer between two nodes & also manages the Frame traffic control over the network. It signals the transmitting node to stop, when the frame buffers are full.

3) Layer 3: The Network Layer

- It routes the signal through different channels from one node to other.
- It acts as a network controller. It manages the subnet traffic.
- It decides by which route data should take.
- It divides the outgoing messages into packets.



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Assembles the incoming packets into messages for higher levels.

Layer 4: The Transport Layer

- It decides if data transmission should be on parallel path or single path.
- Function such as Multiplexing, Segmenting, or Splitting on the data are done by this layer
- It receives messages from the Session layer above it, converts the message into smaller units and passes it onto the Network layer
- It can be very complex, depending upon the network requirements.

Layer 5: The Session Layer

- It manages & synchronize the conversation between two different applications.
- Transfer of data from source to destination, session layer streams of data are marked and are resynchronized properly, so that

the ends of the message are not cut prematurely, & data loss is avoided.

6) Layer 6: The Presentation Layer.

- It takes care that the data is sent in such a way that the receiver will understand the information (data) and will be able to use the data.
- While receiving the data, presentation layer transforms the data to be ready for the application layer.
- Languages (syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role of translator.
- It performs Data compression, Data encryption, Data conversion etc.

7) Layer 7: Application Layer

- It is the topmost layer
- Transferring of files disturbing the results to the user is also done in this layer. Mail services, Directory services, Network resource etc are services provided by application layer.
- This layer mainly holds application programs to act upon the received & to be sent data.

* Merits of OSI Reference Model

- OSI model distinguishes well ~~behave~~ between the services, interfaces & protocols.
- Protocols of OSI model are very well defined
- Protocols can be replaced by new protocols as technology changes.
- Supports Connection-oriented services as well as Connectionless service

* Demerits of OSI Reference Model:

- Model was devised before the invention of protocols.
- Fitting of protocols is tedious task
- It is just used as a reference model.

Types Of Network Topology

> Mesh Topology

Every device is connected to another device via a particular channel

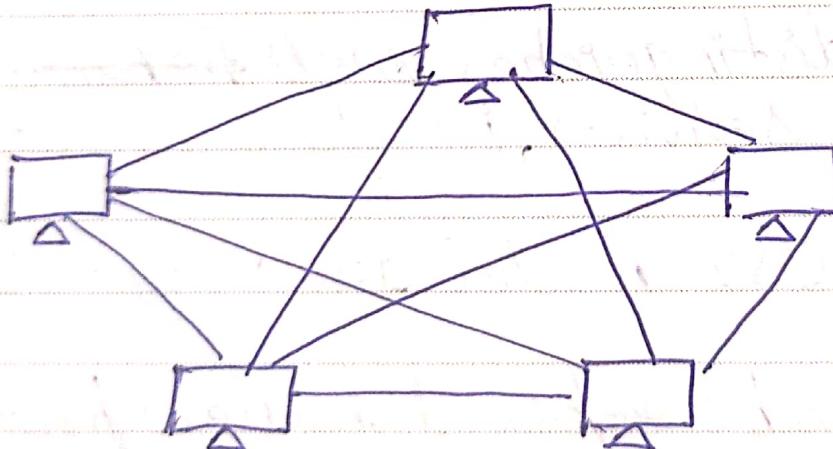


Fig) Every device is connected with another via dedicated channels. These channels are known as links.

- Suppose, N nos. of devices are connected with each other in a mesh topology, the total nos. of ports that are required by each device is $N-1$
- Suppose, N nos. of devices are connected with each other, then total nos. of dedicated links required to connect them is $\frac{N(N-1)}{2}$
i.e. $\frac{N(N-1)}{2}$
- Total number of ports required is $N*(N-1)$

For ex There are 5 devices.

$$\text{Ports} = 4$$

$$\text{Links} = \frac{5(5-1)}{2} = 10$$

Advantages:-

- 1) It is robust
- 2) The fault is diagnosed easily. Data is reliable because data is transferred among the devices through dedicated channels or links
- 3) Provides security & privacy



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* Disadvantage

- 1) Installation & Configuration are difficult
- 2) The cost of cables is high as bulk wiring is required, hence suitable for less number of devices.
- 3) The cost of maintenance is high.

2) STAR Topology:

All the devices are connected to a single hub through a cable. This hub is the central node & all other nodes are connected to the central node.

The hub can be passive in nature that is not an intelligent hub such as broadcasting device at the same time the hub can be intelligent known as active hub because active hub have repeaters.

* Advantages:

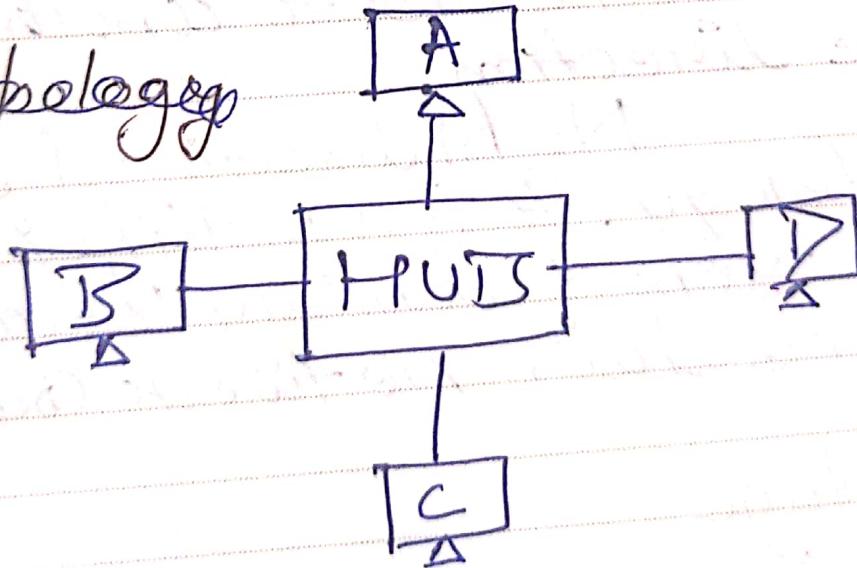
- 1) If N devices are connect the number of cable required to connect them is N . So its easy to setup.

2) Each device requires only 1 port

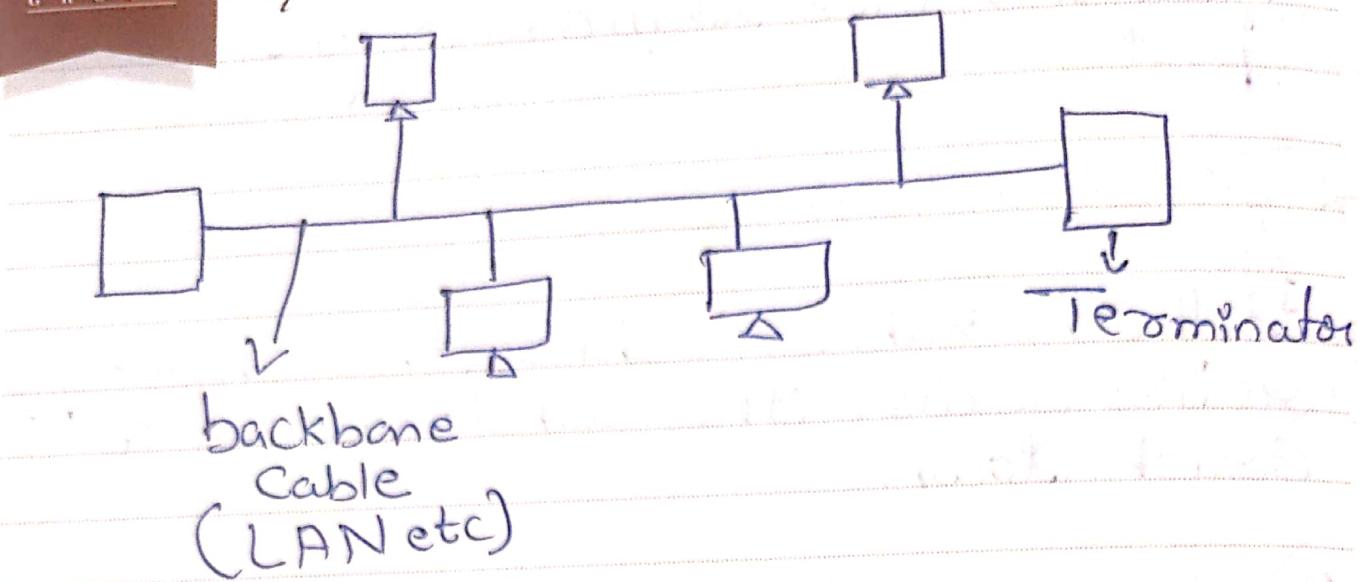
Disadvantage

- 1) If the hub on which the whole topology relies fails, the whole system will crash down
- 2) The cost of installation is high.
- 3) Performance is based on the single hub.

~~Star Topology~~



→ Bus Topology



It is a network type in which every computer and network devices is connected to a single cable. It transmit the data from one end to another to a single direction.

No bidirectional feature in this topology. It is a multi-point connection & non robust topology because if the backbone fails network crashes.

* Advantage

1) If N devices are connected to each other then the nos. of cable required to connect them is one which is known as backbone

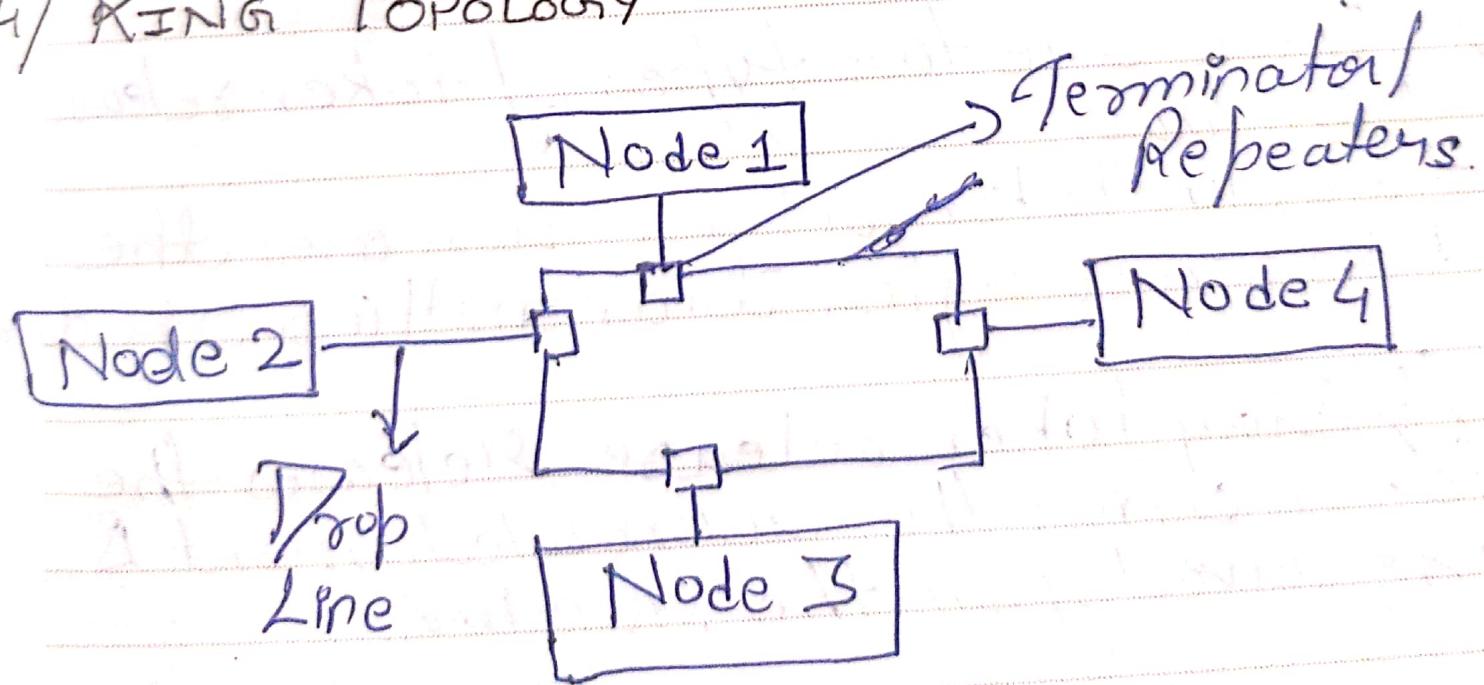
Cable & N drop lines are required.

2) The cost of the cable is less but it is used to build small network.

A Disadvantage

- 1) If the common cable fails then the whole system will crash down.
- 2) Security is very low.
- 3) If the network traffic is heavy, it increase collision on the network.

4) RING TOPOLOGY



The following operations take place in ring topology are:-

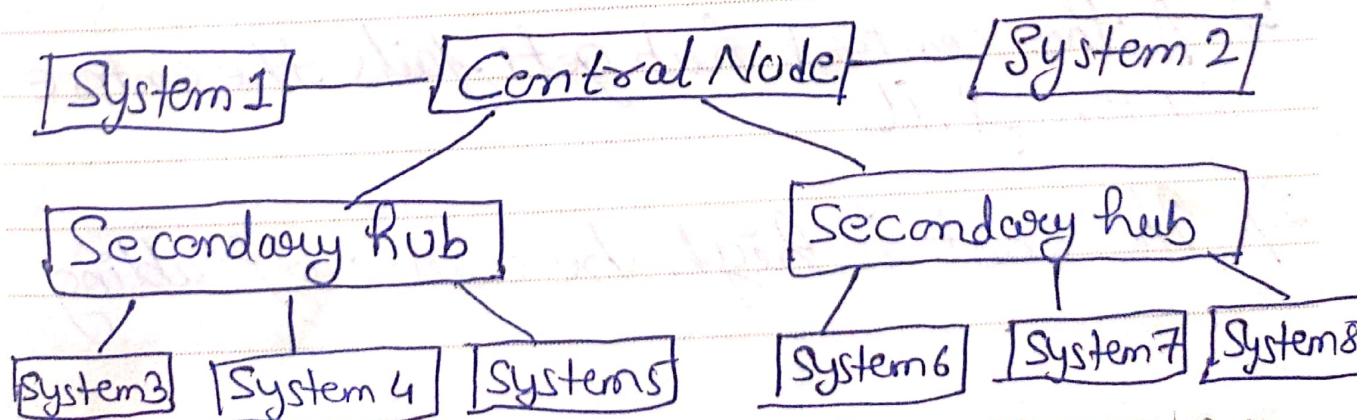
- A) One station is known as Monitor Station which takes all the responsibility to perform the operations.
- B) To transmit the data, the station has to hold the token. After the transmission is done, the token is to be released for other stations to use.
- C) When no station is transmitting the data, then the token will circulate in the ring.
- D) There are two types of token release techniques
 - Early token release releases the token just after transmitting the data.
 - Delay token release releases the token after the acknowledgment is received from the receiver.

* Advantage:

- 1) The possibility of collision is minimum in this type of topology.
- 2) Cheap to install & expand.

* Disadvantage

- 1) Troubleshooting is difficult.
 - 2) The addition of stations in between or removal of stations can disturb the whole topology.
 - 3) Less Secure.
- 5) TREE TOPOLOGY.
It is the variation of Star topology.
It has a hierarchical flow of data.



As, the various secondary hubs are connected to the central hub which contains the repeater. In this data flow from top to bottom i.e. from the central hub to secondary & then to the devices or from bottom to top P.e. devices to the Secondary hub & then to the central hub. It is a multipoint connection & non-robust topology.

* Advantage

- 1) It allows more devices to be attached to a single central hub thus it decreases the distance that is travelled by the signal to come to the devices.
- 2) It allows the network to get isolate & also prioritize from different computers.

* Disadvantage

- 1) If the central hub gets fails the entire system fails.
- 2) The cost is high because of cabling.

Transmission FUNDAMENTALS.

* TRANSMISSION MEDIA:-

It is a communication channel that carries the information from the sender to the receiver. Data is transmitted through the electromagnetic signals.

Some factors need to be considered for designing the transmission media.

1) Bandwidth:- All the factors are remaining constant, the greater the bandwidth of a medium, the higher the data transmission rate of a signal.

2) Transmission Impairment:- When the received signal is not identical to the transmitted one due to the transmission impairment. The quality of the signals will get destroyed due to transmission impairment.

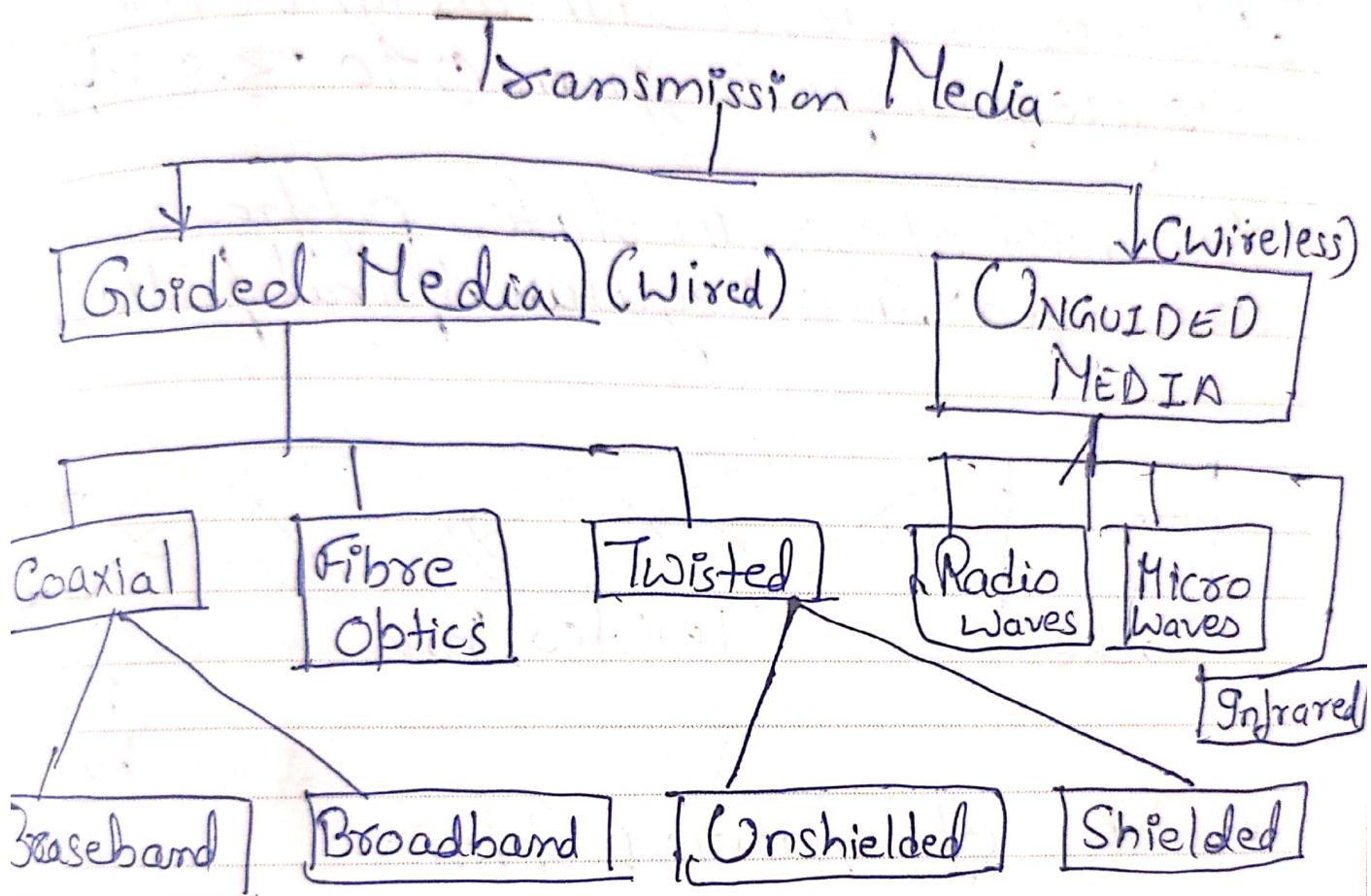
3) Interference:- It is defined as the process of disrupting a signal when it travels over a communication medium.

on the addition of some unwanted signal.

* Causes of Transmission Impairment

- 1) Attenuation:- It means loss of energy, ie. the strength of the signal decreases with the increasing the distance which causes the loss of energy.
- 2) Distortion:- It occurs when there is a change in the shape of the signal. This type of distortion is examined from different signals having different frequencies.
- 3) Noise:- When data is travelled over a transmission medium, some unwanted signal is added to it which create the noise.

* CLASSIFICATION OF TRANSMISSION MEDIA



1) GUIDED MEDIA

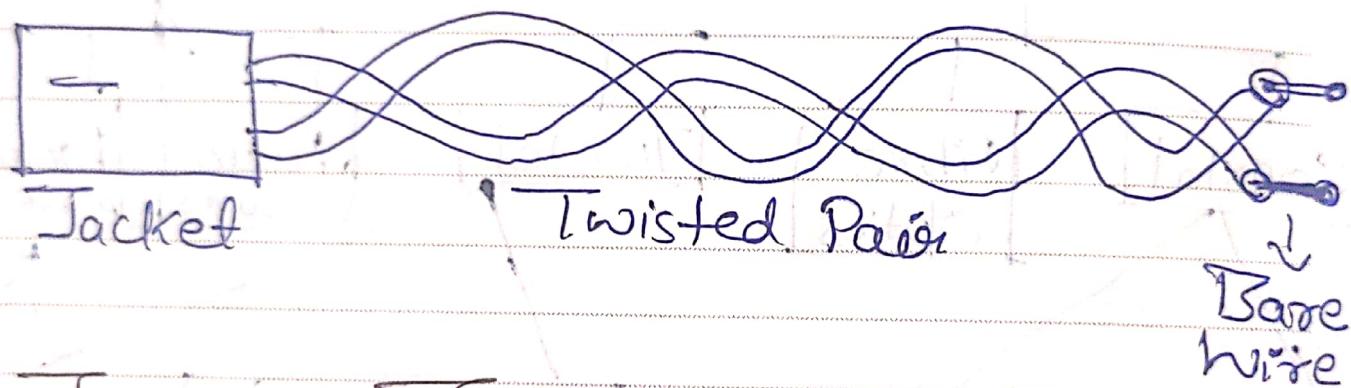
It is defined as the physical medium through which the signals are transmitted. It's known as Bounded media.

* Types of Guided Media:-

A) Twisted Pair:- It's a physical media made

up of a pair cables twisted with each other. Its cheap as compared to other transmission media. Installation of it is easy & its a lightweight cable. Its frequency is from 0 to 3.5 kHz.

It consists of two insulated copper wires arranged in a regular spiral pattern.



→ TYPES OF TWISTED PAIR:-

→ UNSHIELDED TWISTED PAIR:-

Its widely used in telecommunication. Following are the categories of the unshielded twisted pair cable

→ Category 1:- It is used for telephone lines that have low-speed data

→ Category 2:- It can support upto 4Mbps

→ Category 3:- It can support upto 20Mbps.

→ Category 4:- It can support upto 200Mbps

* Advantage

- 1) It's Cheap
- 2) Installation is easy
- 3) It can be used for high-speed LAN.

* Disadvantage

- 1) This cable can only be used for shorter distance because of attenuation.

2) Shielded Twisted Pair

It is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.



* Characteristics

- The cost of cable is not very high & Not very low
- An installation of STP is easy
- It has higher capacity as compared to UTP

→ It has a higher attenuation
→ It provides the higher data transmission rate.

A) Disadvantages

- It is more expensive as compared to UTP & coaxial cable
- It has a higher attenuation rate

B) Coaxial Cable

→ It is commonly used for transmission media for ex → TV wire is usually a coaxial cable

→ It contains two conductors parallel to each other

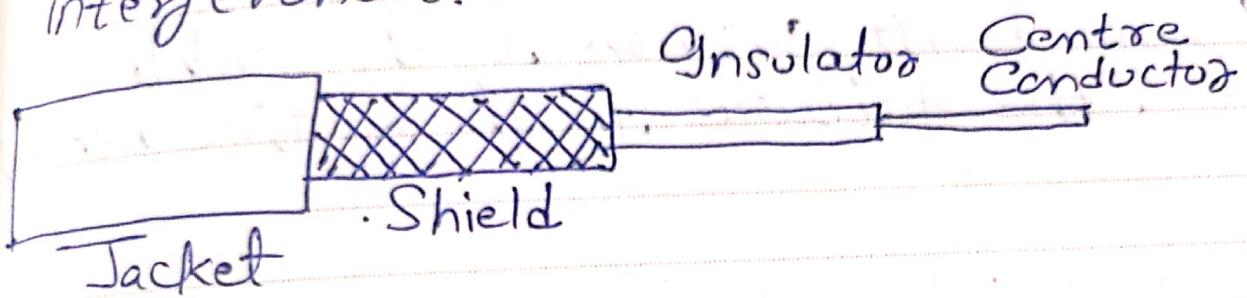
→ It has higher frequency as compared to twisted pair cable

→ The inner conductor of the coaxial cable is made up of copper, & the outer conductor is made up of copper mesh.

* Bandwidth - the max amount of data transmission over an internet. It's a volume.



→ The middle core is responsible for the data transferring whereas the copper mesh prevents from the EMI (Electromagnetic Interference).



★ TYPES OF Coaxial Cable

- 1) Baseband Transmission:- It's defined as the process of transmitting a single signal at high speed.
- 2) Broadband Transmission:- It is defined as the process of transmitting multiple signals simultaneously.

★ Advantages

- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

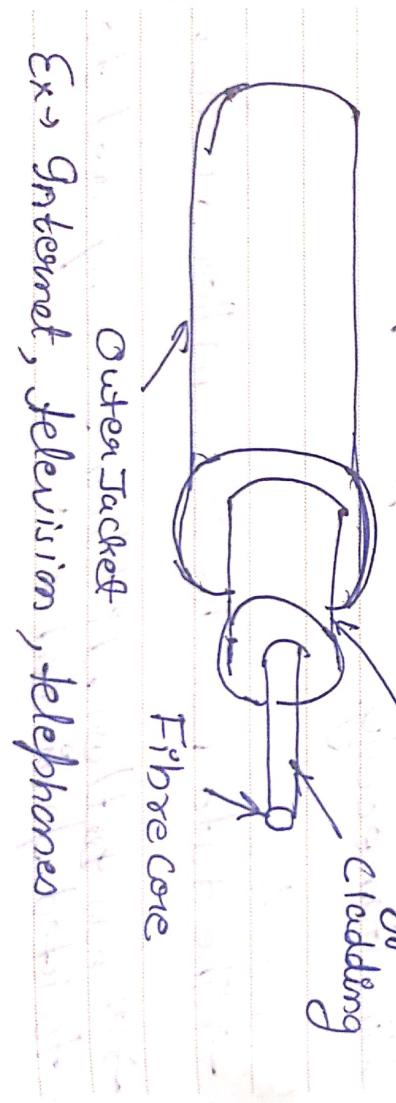
→ It's advantages
 → It is more expensive as compared
 To twisted pair cable

→ If any fault occurs in the cable
 cables & the failure in the entire network

c) Optical Fibre Cable

It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It's used for the transmission of large volumes of data.

The cable can be unidirectional or bidirectional.



Ex - Internet, television, telephones

* Advantages

- 1) Increased Capacity & bandwidth
- 2) Lightweight
- 3) Less Signal Attenuation (unwanted noise)
- 4) Immunity to electromagnetic interference
- 5) Resistance to corrosive materials.
[ability to protect environmental by chemical reaction]

* Disadvantages

- 1) Difficult to install & maintain
- 2) High cost
- 3) Fragile. (optical)

2) UNGUIDED MEDIA

It's also referred to as wireless or unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

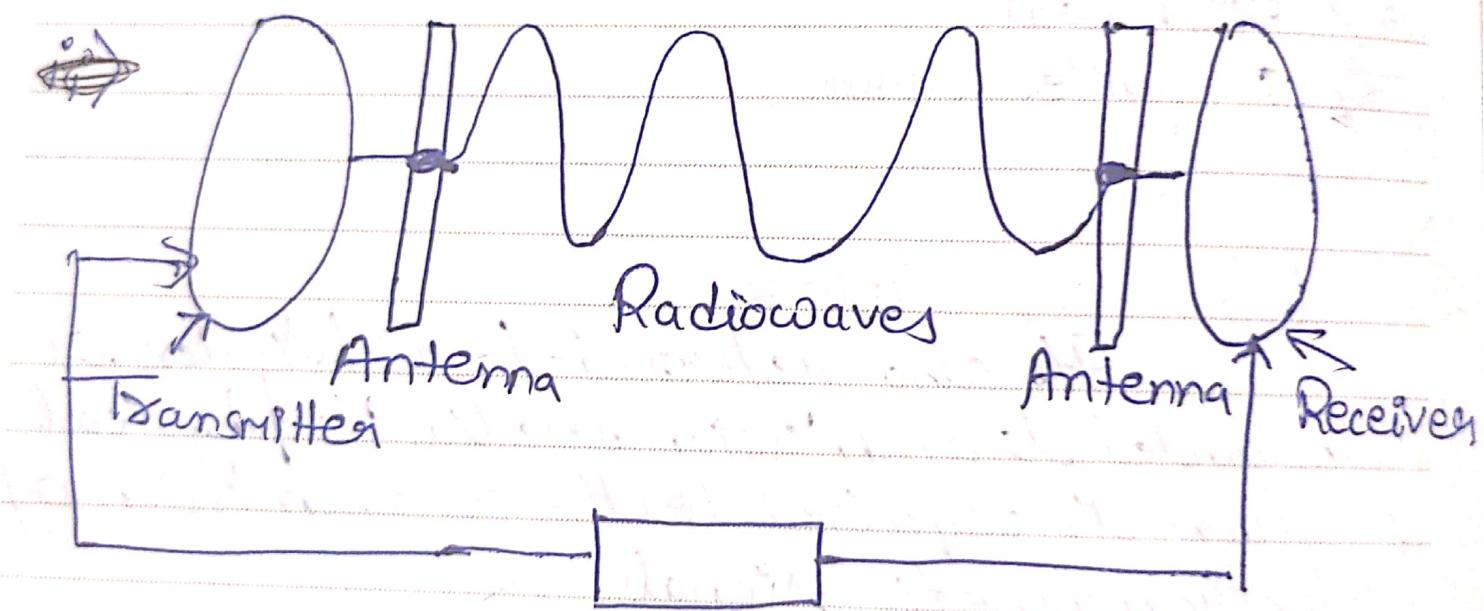
Features:-

- The signal is broadcasted through air
- Less Secure
- Used for Larger distances.

There are 3 types of Signals transmitted through unguided media

i) Radiowaves (Mobile phones)

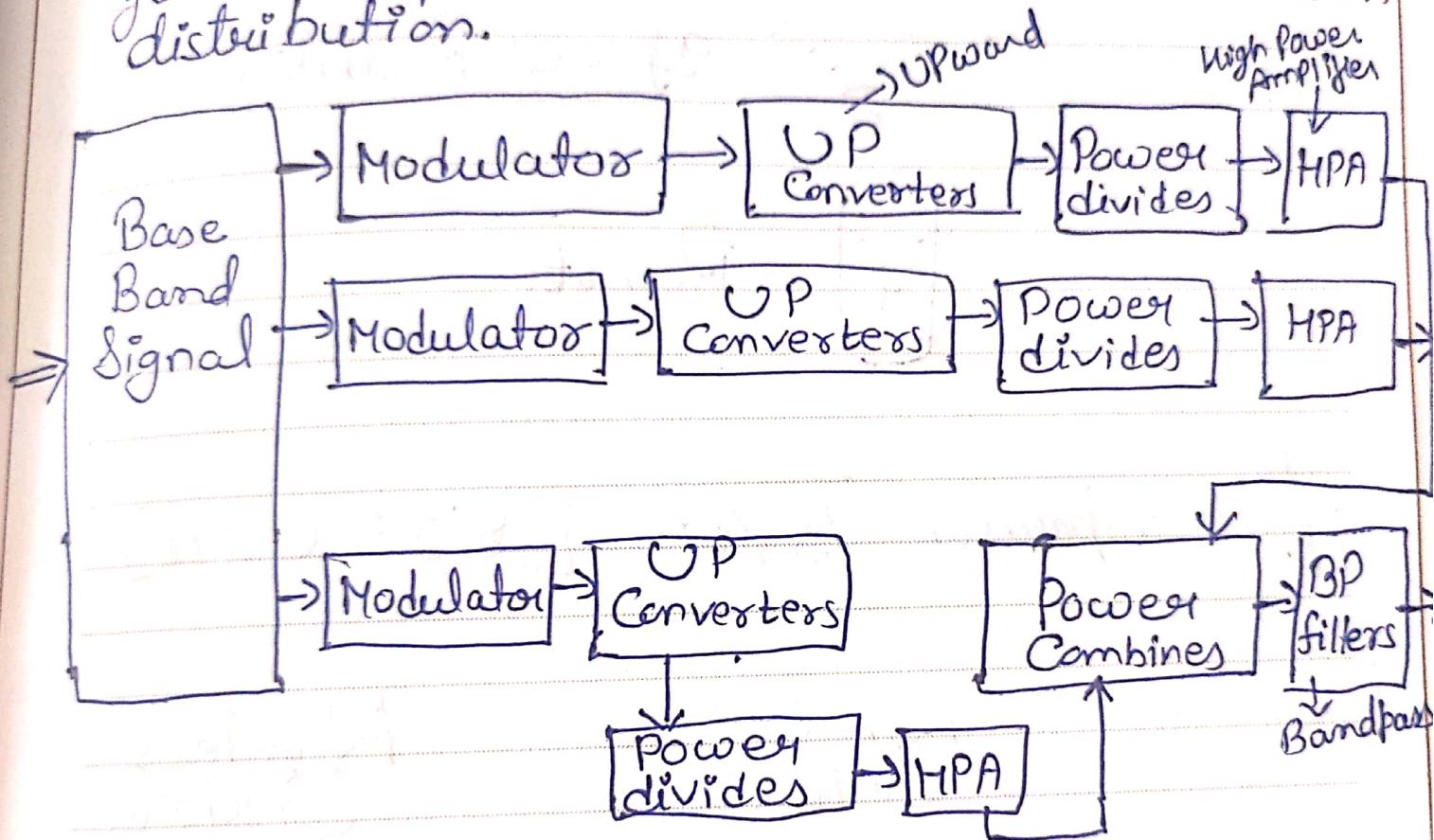
These are easy to generate & can penetrate through buildings. The sending & receiving antennas need not be aligned. Frequency Range: 3KHz-1GHz. AM & FM radios and cordless phones use radiowaves for transmission.



ii) Microwaves (tower)

It's a line of sight transmission i.e. the sending & receiving antennas need to be properly aligned & with each other.

The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range 1GHz - 300GHz. These are majorly used for mobile phone communication & television distribution.

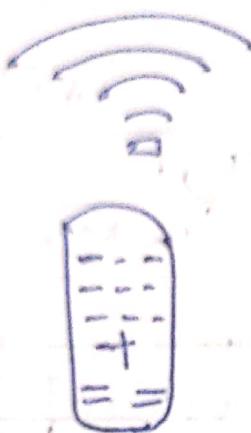


iii) Infrared:- (remote control)

Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range: 300 GHz - 400 THz. It is used in TV remotes, wireless mouse, keyboard, printer etc.



Television



Infrared Radiations

Remote

Comparison B/w [SIA CUTE]

Parameters

Wired OR
Guided

Wireless OR
UnGuided

1) Signal -

The signal energy
is contained &
guided within
a solid medium

The signal energy
propagates in
the form of
unguided electro
magnetic waves

2) Installation - It is costly,

Installation needs

Parameters

Wired OR
Guided

Wireless
OR Unguided

time Consuming,
Complicated

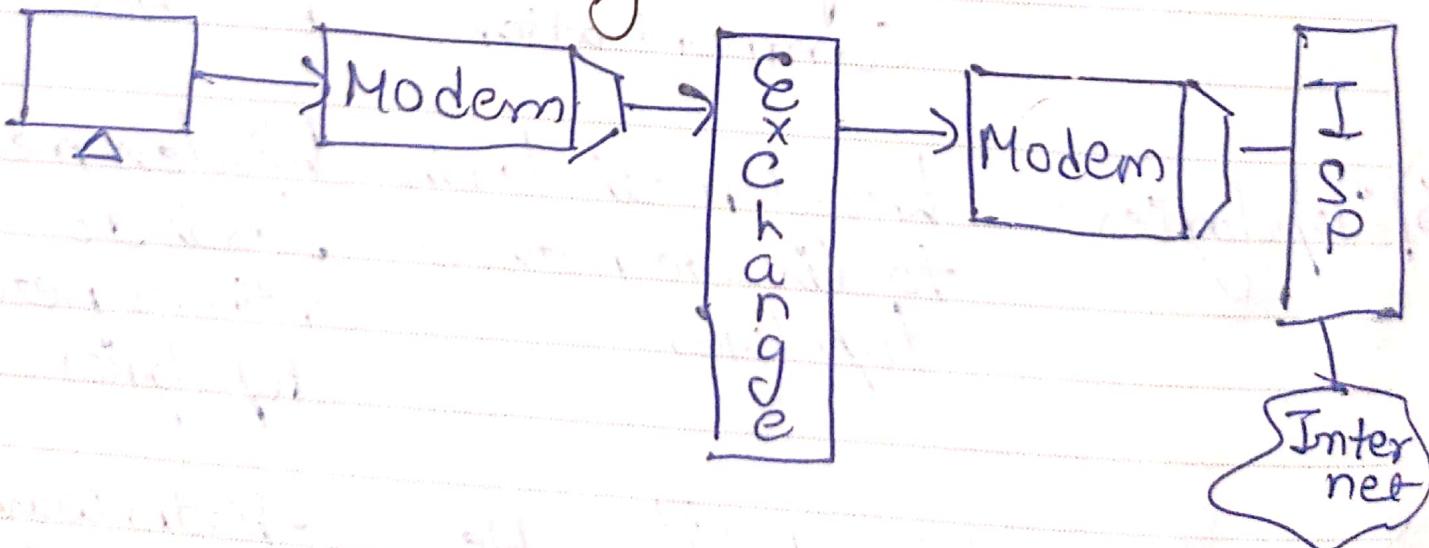
Less time & money

- 3) Attenuation - It depends exponentially on the distance.
- It is proportional to square of the distance.
- 4) Capacity - Additional capacity can be obtained by adding wires.
- It is not possible to obtain additional capacity.
- 5) Used for - Used for point to point communication.
- Used for radio broadcasting in all directions.
- 6) Topologies - Wired media leads to discrete network topologies.
- Wireless media leads to continuous network topologies.
- 7) Examples - Twisted Pair cable
Coaxial Cable
Fibre optic
- Radio waves
- Infrared light
- Microwave

ISDN [Integrated Service Digital Network]

- ISDN (Integrated Service Digital Network)
- It was first introduced & defined in CCITT Redbook in 1988.
 - It is a telephone network based infrastructure that allows the transmission of video, audio, and data simultaneously at high speed.
 - Before ISDN one could use either internet or telephone.

~~Traditional Systems~~



→ ISDN is a set of protocols that is based on high-speed fully digitized telephone service.

→ The main aim of ISDN is to provide a fully integrated digital service to the users.

* Principles of ISDN

Following are the principles of ISDN are:-

- It supports both circuit switching & packet switching with the connection of at 64 kbps
- In ISDN layered protocol architecture is used for specification
- ISDN services provides maintenance
- ISDN services includes some network management functions
- In ISDN network several configurations are possible for implementing.

* ISDN Services

TeleServices

Telephony

Telefax

Teletex

○ ○ ○ Teleconferencing ○ ○ ○

Bearer Services

Circuit Switching

Packet Switching

Frame Switching

Call Waiting

Reverse Charging

Message handling

Supplementary Services

There are 3 type of ISDN Services

1) Bearer Services

This type of services is used to transfer information such as voice, data & video between the users without manipulating the content of the network information. It belongs to the first 3 layers of the OSI reference model.

2) Tele Services

In this type of services, the network may change the content of the data.

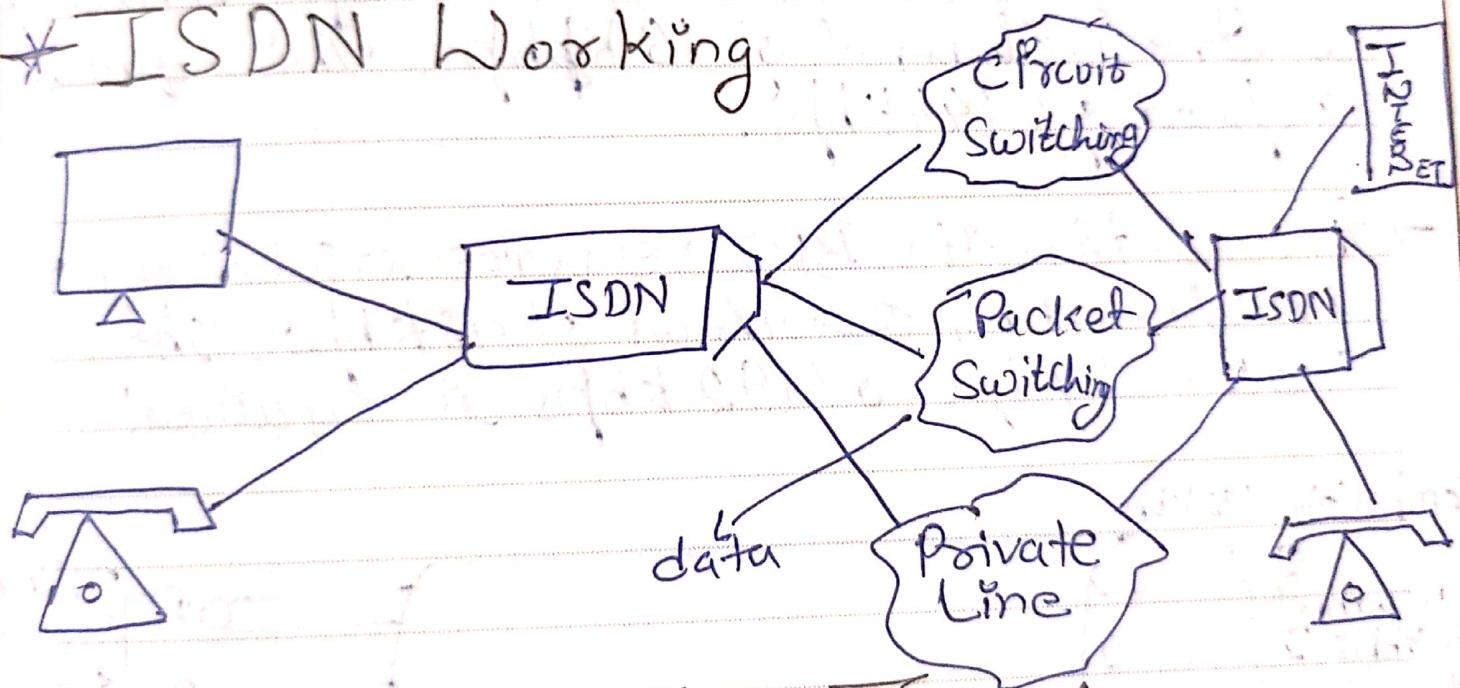
It belongs to the last 4 layers of the OSI reference model. It includes telephony, Telefax, etc.



3) Supplementary Service

It provides additional functionality to the bearer services & teleservices. Some of the examples are reverse charging, call waiting, & message handling.

* ISDN Working



* TYPES OF ISDN Interface.

- 1) BRI (Basic Rate Interface):
→ In this two data bearing channels (B channels) and one signalling channel



CD channel) in BRI to initiate connections.

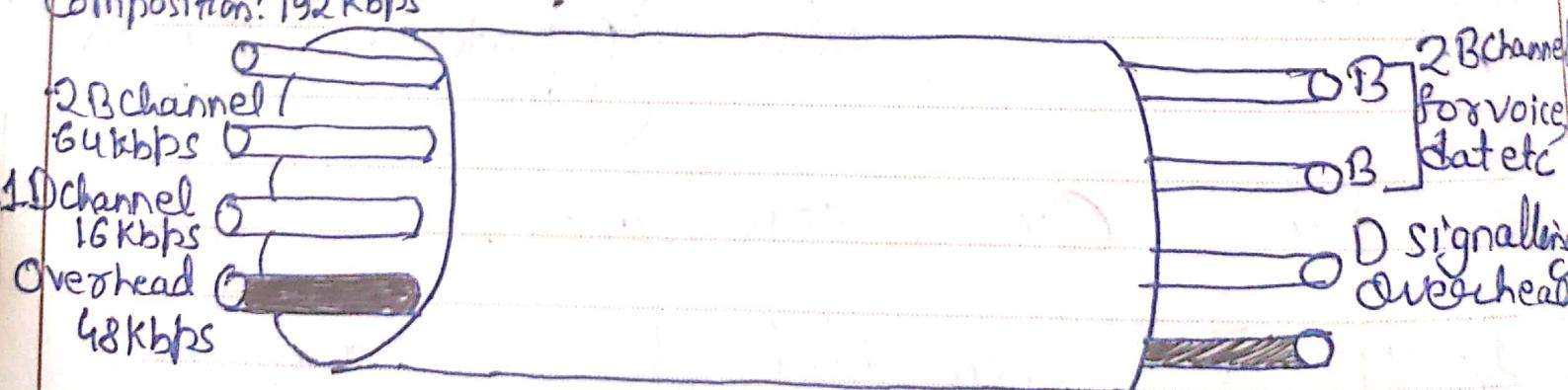
→ The B channels operate at a maximum of 64 kbps while D channel operate at a maximum of 16 kbps.

→ The two channels are independent of each other

→ In BRI, it specifies a digital pipe consist of two B channel of 64 kbps ~~and~~ each + one D channel of 16 kbps. This equals a speed of 144 kbps.

→ In addition, the BRI service itself require an operating overhead of 48 kbps. Therefore a digital pipe of 192 kbps is required.

Composition: 192 kbps

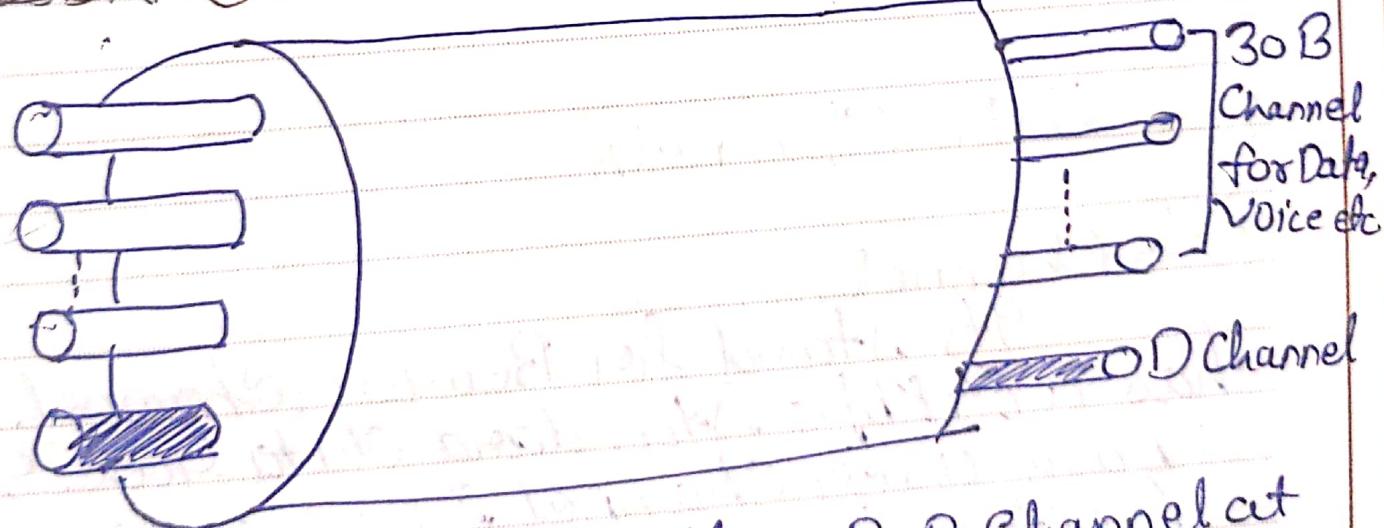


Basic Rate Interface (BRI)

2) PRI (Primary Rate Interface)

- It consists of one D channel and either 23 B or 30 B channels depending upon the country.
- A digital pipe with 30 B channels of 64 kbps each & one D channel of 64 kbps equals to 1.536 Mbps.
- The PRI service uses 8 kbps of overhead also. Therefore, PRI requires a digital pipe of 1.544 Mbps.

~~3) DS0 & DS1~~



Composition: 2.048 Mbps: 30 B channel at 64 kbps each
 1 D channel at 64 kbps
 1.544 Mbps: 23 B channel at 64 kbps each
 1 D channel at 64 kbps

3) B-ISDN (Broadband)/Narrowband ISDN

- As narrowband ISDN has been designed to operate over the current communications infrastructure, which is heavily dependent on the copper cable. Its rate is at 64 kbps.
- However, B-ISDN relies mainly on the evolution of fibre optics.
- It is best described as a service requiring transmission channels capable of supporting rates greater than the primary rate. It generally works on 2 Mbps - 1 Gbps.

* ISDN Channels

1) B Channel

It stands forBearer Channel. It has a 64 kbps standard data rate. It is a basic user channel & can carry any digital information in full-duplex mode.

In this transmission rate does not change.



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not exceed 64 kbps. It can carry digital voice, digital data, & any other low data rate information.



2) D channel:-

It stands for Data channel. This channel carries Control Signal for bearer services. This channel is required for Signalling or packet-switched data & all controlling signals such as establishing calls, ringing, call interrupt etc.

3) H channel:-

It stands for hybrid Channel. It provides user information at higher bit rates.

There are 3 types of H-Channel depending on the data rates. Following are

- H Channel 0 with 384 kbps data rate
- H Channel 11 with 1536 kbps data rate
- H Channel 12 with 1920 kbps data rate.

Advantage

- ISDN is a mature technology, & it has been since late 1980's. It has been tried, tested & works.
- A worldwide set of standards governs it.
- It offers symmetrical transfer rates - the transmit rate is same as the receiving rate.
- It has consistent transfer rates.

Disadvantage

- An external power supply is required. The telecommunication doesn't supply power of ISDN lines. If the power fails, the mobile phones won't work.
- Unique digital phones are necessary or a terminal adapter to talk to the existing plain old telephone set devices.

- It is costly to upgrade a central office switch to ISDN
- If the ISDN fails; the phone fails.

ATM (Asynchronous Transfer Mode)

- It is an ITU-telecommunication Standard
- It is a switching technique that uses TDM for data communications
- ATM networks are connection-oriented networks for cell relay that support voice, video & data communications.
- It encodes data into small, fixed size cells so that they are suitable for TDM and transmit them over a physical medium.
- The size of ATM cell is 53 bytes i.e. 5 byte header & 48 byte payload (data).
- There are two different cell formats - user-network interface (UNI) & network-

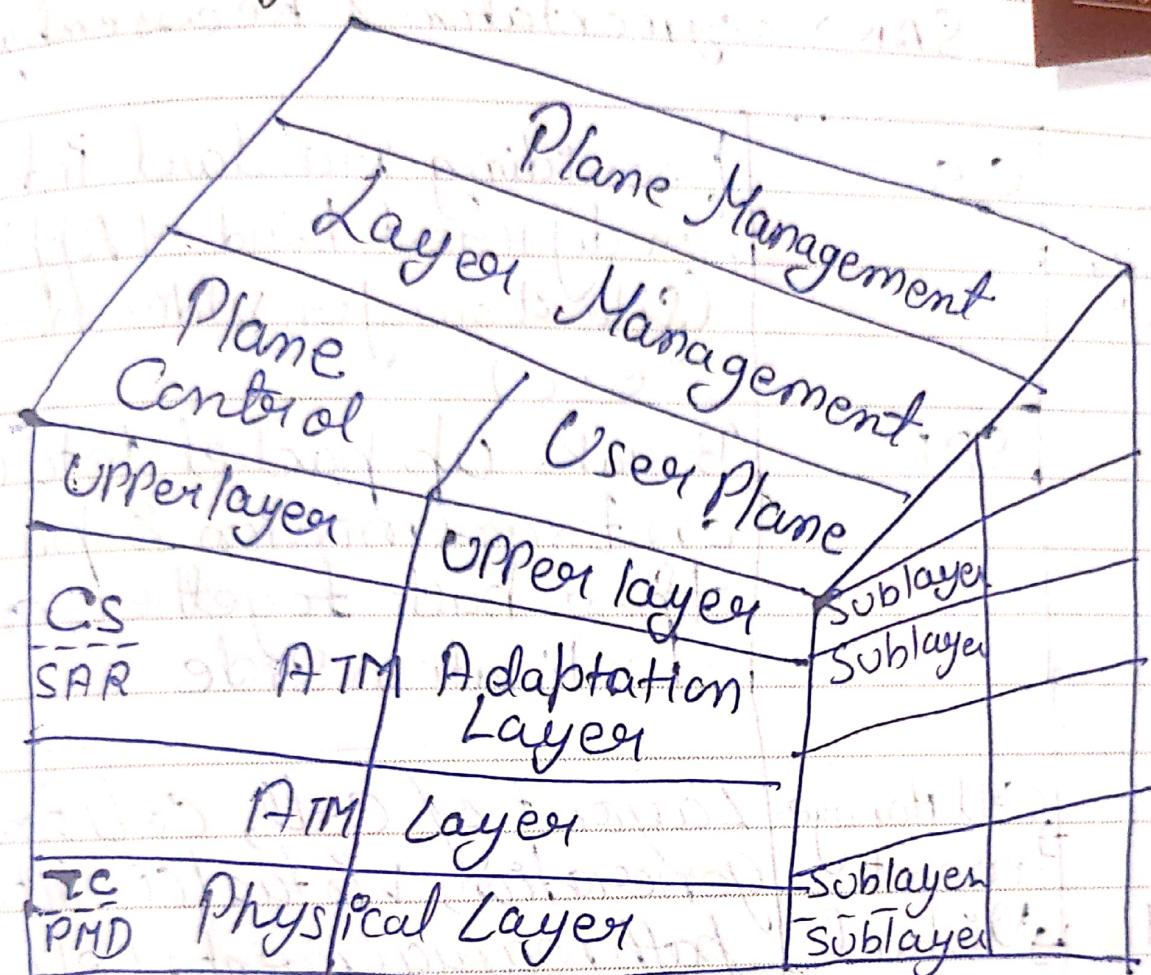
network interface (NNI).

- It delivers the packets in order
- It operates 155 Mbps & 622 Mbps.

* Benefits of ATM

- It provides the dynamic bandwidth that is particularly suited for bursty traffic.
- Since all data are encoded into identical cells data transmission is simple, uniform & predictable.
- Uniform packet size ensure that mixed traffic is handled efficiently.
- Small sized header reduces packet overhead, thus ensuring effective bandwidth usage.
- ATM networks are scalable both in size & speed.

* ATM Reference Model



- It has a 3D Model
- It has mainly 3 layers
 - Physical layer
 - ATM Layer
 - ATM Adaptation layer
- * User plane → Data transport, flow control, error correction

* Control plane → Connection Management

TC → Transmission Convergence
 PMD → Physical Medium Dependent
 CS → Convergence Sublayer
 SAR → Segmentation & Reassembly

AAL (Adaptability quality)	CS	providing standard interface for different kind of Application (file transfer, video making etc)
	SAR	Breaks up packet into cell on transmission & puts them back together on the destination side
ATM	Cell Management ↳ Virtual Ckt established ↳ Congestion Control	Layout of cell, cell header generation, virtual circuit, path management, cell multiplexing / demultiplexing
Physical Layer	TC	to convert bit stream to cell stream
	PMD	Bit timing, bit streams , voltage, physical network access

Network Virtual Terminal



* Remote Login:-

It is a process in which user can login into Remote Site i.e. Computer & use service that are available on the Remote Computer.

With the help of Remote Login, a user is able to understand result of transferring result of processing from the remote computer to the local computer.

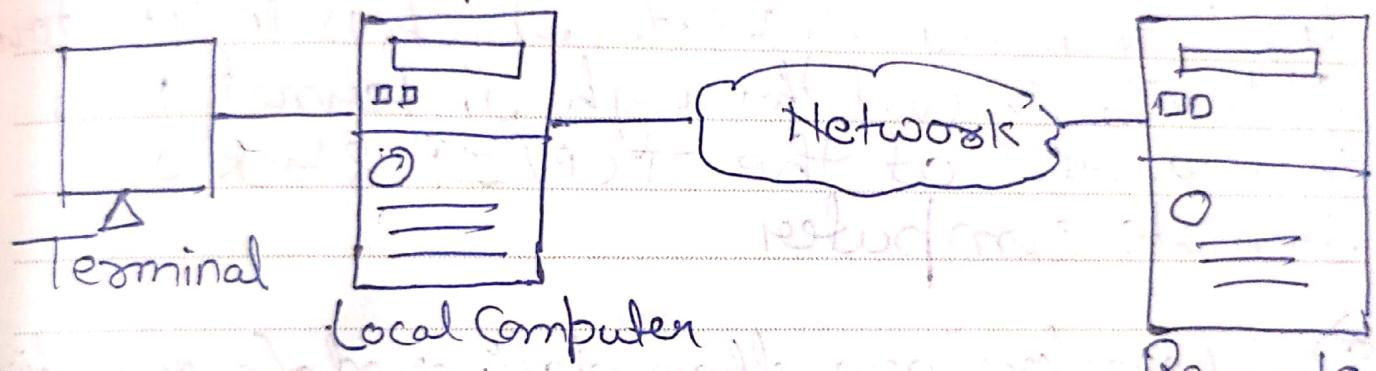


Fig. Remote Login.

It's implemented using TelNet.

* Procedure of Remote Login

- 1) When the user types something on local Computer, then local operating system accept Character.

2) Local computer does not interpret the characters, it will send them to TELNET Client.

3) TELNET Client transforms these characters to a universal character set called Network Virtual Terminal (NVT) characters & it will pass them to the local TCP/IP protocol stack.

4) Commands or text which is in the form of NVT, travel through Internet & it will arrive at the TCP/IP stack at remote computer.

5) Characters are then delivered to operating system and which later on passed to TELNET Server.

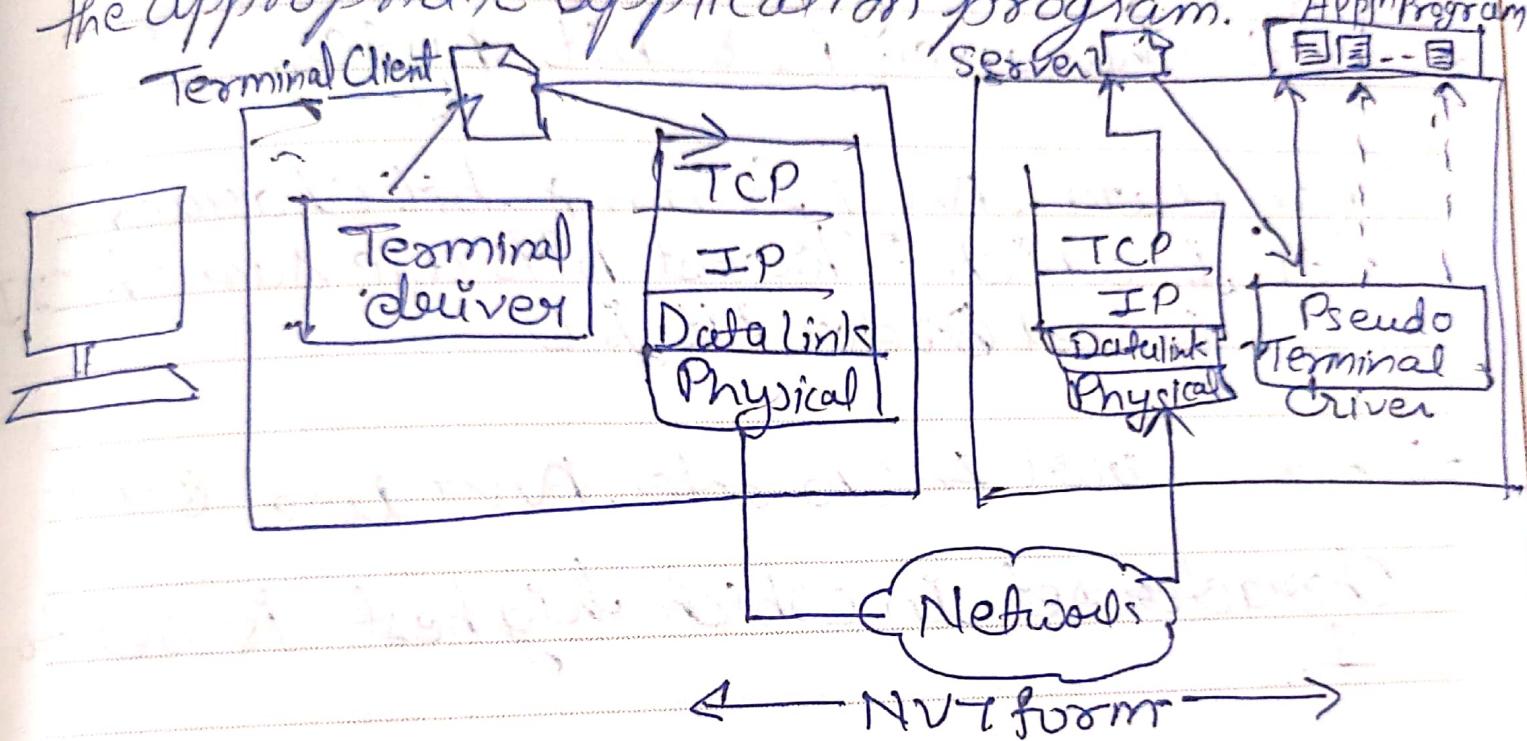
6) Then TELNET server changes that characters to characters which can be understandable by remote computer.

7) Remote operating system receives characters from a pseudo-terminal ~~adapter~~ driver, which is a piece of s/w

that pretends that characters are coming from a terminal.



8) Operating system then passes character to the appropriate application program.



Remote Login procedure

* NVT Character Set

- With NVT character set, TELNET clients translates characters in NVT form & deliver to Network
- TELNET Server translates data & commands from NVT form to the other form that

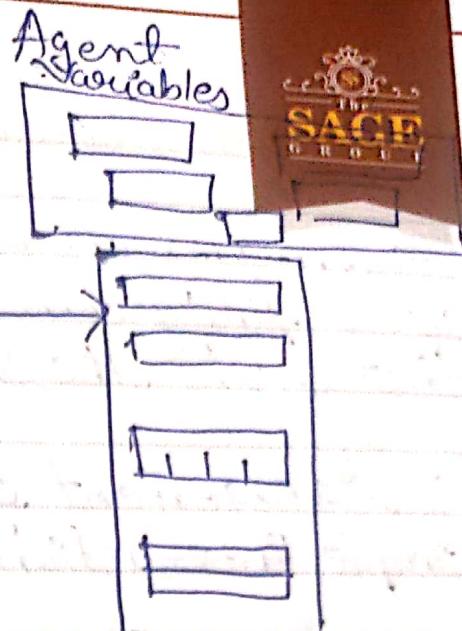
will be understandable by remote computer.

- NVT uses 2 sets of characters, one for data & other for Control. Size of both characters is 8-bit bytes.
- For data, NVT is an 8-bit character set in which 7 lowest bits are same ASCII & highest Order bit is 0.
- For control A. Character, NVT uses 8-bit character set in which highest is set to 1.

SNMP (Simple Network Management Protocol)

- It is a framework used for managing devices on the internet.
- It provides a set of operations for monitoring & managing the internet.

#A SNMP Concept



Agent

Manager

- SNMP has two Components Manager & Agent
- The manager is a host that controls & monitors a set of agents such as routers
- It is an application layer protocol in which a few manager stations can handle a set of agents.
- It is designed at the application level can monitor the devices made by different manufacturer and installed on different physical networks.
- It is used in a heterogeneous network made of different LANs & WANs connected by routers or gateways.

* Managers & Agents

→ A manager is a host that runs the SNMP client program while the agent is a router that runs the SNMP server programs.

→ Management of the Internet is achieved through simple interaction between a manager & agent

→ The agent is used to keep the information in a database while the manager is used to access the values in the database.

For ex:- A router can store the appropriate variables such as a number of packets received & forwarded while the manager can compare these variables to determine whether the router is congested or not.

→ Agents can also contribute to the management process. A server program on the agent checks the environment, if something goes wrong, the agent sends a warning message to the manager.

* Management with SNMP has 3 basic ideas

- A manager checks the agent by requesting the information that reflects the behaviour of the agent
- A manager also forces the agent to perform a certain function by resetting values in the agent database
- An agent also contributes to the management process by warning the manager regarding an unusual condition.

Email:-

Email is a service which allows us to send the message in electronic mode over the internet. It offers an efficient, inexpensive & real time means of disturbing information among people.

* Email Address:-

Each user of email is assigned a unique name for his email account. This name is known as E-mail address. Different users can



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Send & receive messages according to the e-mail address.
Email is generally of the form
username@domainname.

★ Email - Message Components

Email message comprises of different components. Email header, Greeting text, & signature.

i) Email Header

The first five lines of an E-mail message is called Email header. The header part comprises of following fields.

→ ~~From, Date, To, Subject~~

→ **From** :- The From field indicates the sender's address i.e. who sent the e-mail.

→ **Date** :-

The Date field indicates the date when the e-mail was sent.

→ **To** :-

The To field indicates the ~~recei~~ recipient's address i.e. to whom the e-mail is sent.

→ Subject:-

The Subject field indicates the purpose of e-mail. It should be precise & to the point.

→ CC:-

CC stands for Carbon Copy. It includes those recipient addresses whom we want to keep informed but not exactly the intended recipient.

→ BCC:-

BCC stands for Black Carbon Copy. It is used when we do not want one or more of the recipients to know that someone else was copied on the message.

→ Greeting:-

It is the opening of the actual message.

Eg. Hi Sir etc.

→ Text:-

It represents the actual content of the message.



→ Signature:-

This is the final part of an e-mail message. It includes Sender, Address & Contact Number.

* Advantages

Email has ~~to be~~ proved to be powerful & reliable medium of communication. Some Benefits are as follows

→ Reliable:-

Many of the mail system notify the sender if e-mail message was undeliverable.

→ Convenience:-

There is no requirement of stationery & stamps.

→ Speed:-

It is very fast. However speed depends upon the underlying network.

→ Inexpensive:-

The cost of sending e-mail is very low.

→ Pointable:-

→ It is easy to obtain a hardcopy of an e-mail. Also an electronic copy of an e-mail can also be saved for records.

→ Global:-

Email can be sent & received by a person sitting across the globe.

→ Generality:-

It is also possible to send graphics, programs and sounds with an e-mail.

Disadvantages

Apart from several benefits, Email also exists some Cons are:-

→ Forgery:-

Email doesn't prevent from forgery i.e. someone impersonating the sender, since sender is usually not authenticated in any way.

→ Overload:-

Convenience of Email may result in a flood of mail.



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→ Misdirection:-
It is possible that you may send e-mail to an unintended recipient.

→ Junk:-

Junk emails are undesirable & inappropriate emails. It is referred to as Spam also.

→ No Response:-

It may be frustrating when the recipient does not read the e-mail & respond on a regular basis.

MULTIMEDIA:-

→ It is an interactive media & provides multiple ways to represent information to the user in a powerful manner.

→ It provides an interaction between users & digital information. It is a medium of communication.

→ It is a representation of information in an attractive & interactive manner with the use of a combination of text, audio,

video, graphics & animation. OR



→ It is a computerized method of presenting information combining textual data, audio, visuals (Video), graphics & animations.

For ex → Email, Yahoo Messenger, Video Conferencing & Multimedia Message Service (MMS).

→ Multimedia as the name suggests is the combination of Multi & Media i.e. many types of media (hardware / software) used for communication of information.

* Components of Multimedia

Following are the components of multimedia

- i) Text:- It can have many type of fonts & sizes for the presentation of multimedia software
- ii) Graphics:- It more often used than text to explain a concept, present background information etc.

iii) **Audio**:- A multimedia application may require the use of speech, music & sound effects. These are called audio or sound element. of multimedia.

iv) **Video**:- It refers to the moving picture, accompanied by sound such as picture in television. It gives lot of information in small duration of time.

v) **Animation**:-

It is a process of making a static image look like it is moving. An animation is just a continuous series of still images that are displayed in a sequence.

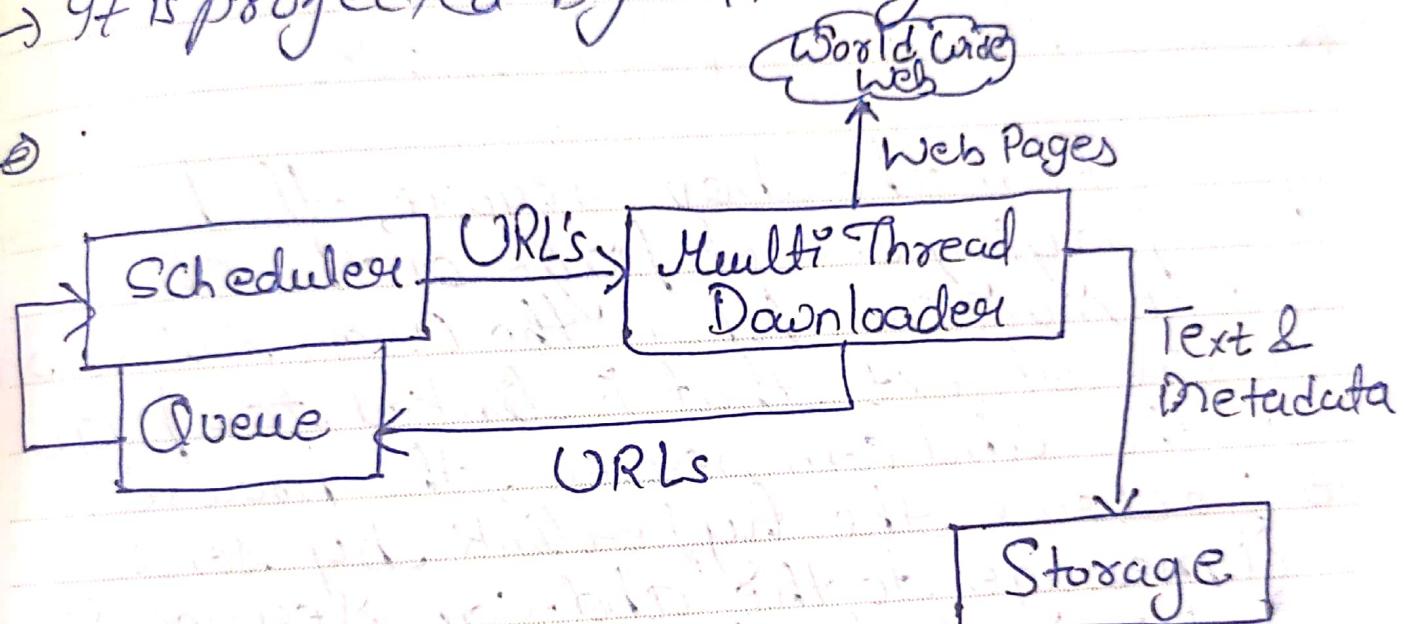
* Applications of Multimedia

- i) **Business**
- ii) **Marketing & Advertising**
- iii) **Entertainment**
- iv) **Education**
- v) **Bank**
- vi) **Hospital**
- vii) **Communication Technology & Multimedia Services**

WWW [World Wide Web]



- It was initiated by CERN (European Library for Nuclear Research) in 1989.
- It is projected by Timothy Berners Lee.

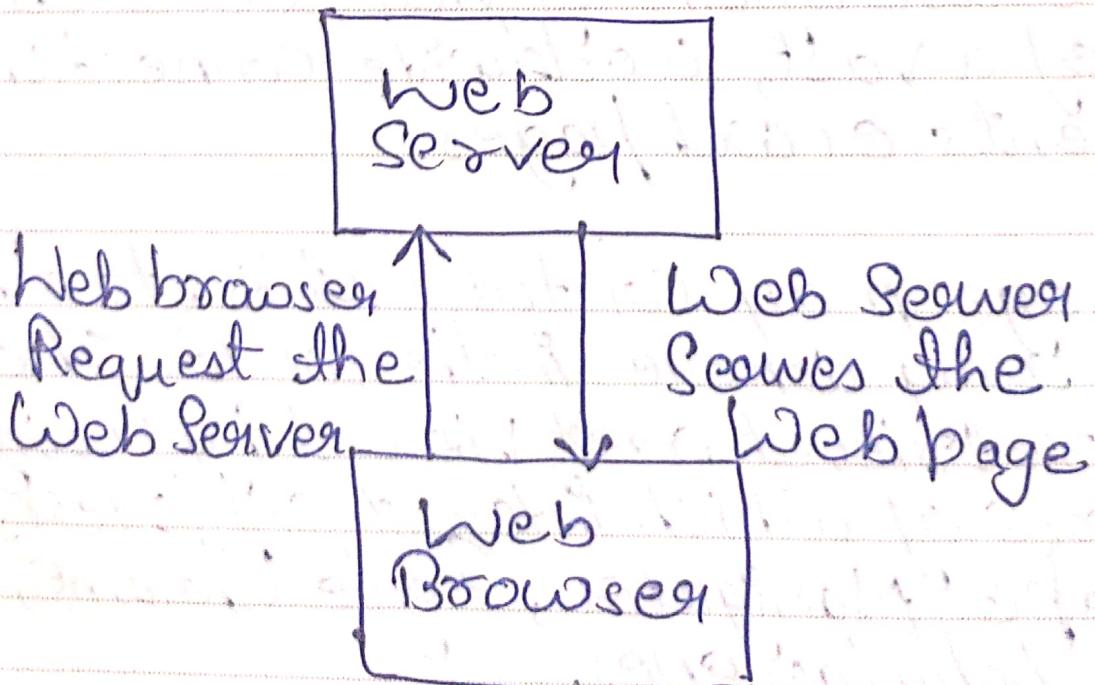


- From the user's point of view, the web
- consists of a vast, worldwide connection of documents or web pages.
 - Each page may contain links to other pages anywhere in the world. The pages can be retrieved and viewed by using browsers, of which Internet Explorers, Netscape Navigator, Google Chrome, etc are the popular ones.

→ The browser fetches the page requested interprets the text and formatting commands on it, & displays the page, properly formatted on the screen.

* Basic Model of Web Works:

From the above figure, the browser is displaying a web page on the client Client machine. When the user clicks on a line of text that is linked to a page on the abd.com server, the browser follows the hyperlink by sending a message to the abd.com Server asking it for the page.



A Working of WWW

It is based on several different technologies: Web browsers, Hypertext Markup language (HTML) & Hypertext Transfer Protocol (HTTP).

A Web browser is used to access webpages.

Web browser can be defined as programs

⇒ which display text, data, pictures, animation & video on the Internet.

Hyperlinked resources on the WWW can be accessed using software interface provided by web browsers.

Initially web browsers were used only for

⇒ surfing the Web but now they have become more universal.

Web browsers can be used for several tasks

⇒ including Conducting Searches, mailing, transferring files, & much more. Some commonly browsers are Internet Explorer, Opera Mini, Google Chrome.

A Features of WWW

- Hypertext Information System
- Cross Platform
- Distributed
- Open Standards & Open Source
- Uses Web browsers to provide a single interface for many services.
- Dynamic, Interactive & Evolving
- Web 2.0.

A Components of WWW

There are 3 components of Web

i) URL (Uniform Resource Locator):
Serves as system for resources on Web

ii) HTTP (Hyper Text Transfer Protocol):
Specifies communication of browser & server

iii) HTML (Hyper Text Markup Language):
Defines structure, organisation & Content of webpage.

DNS (Domain Name System)



→ DNS is a host name to IP address translation service. DNS is a distributed database implemented in a hierarchy of name servers. It is an application layer protocol for message exchange between clients & servers.

Requirements:

Every host is identified by the IP address but remembering numbers is very difficult for the people & also the IP addresses are not static, therefore a mapping is required to change the domain name to IP address. So DNS is used to convert the domain name of the websites to their numerical IP address.

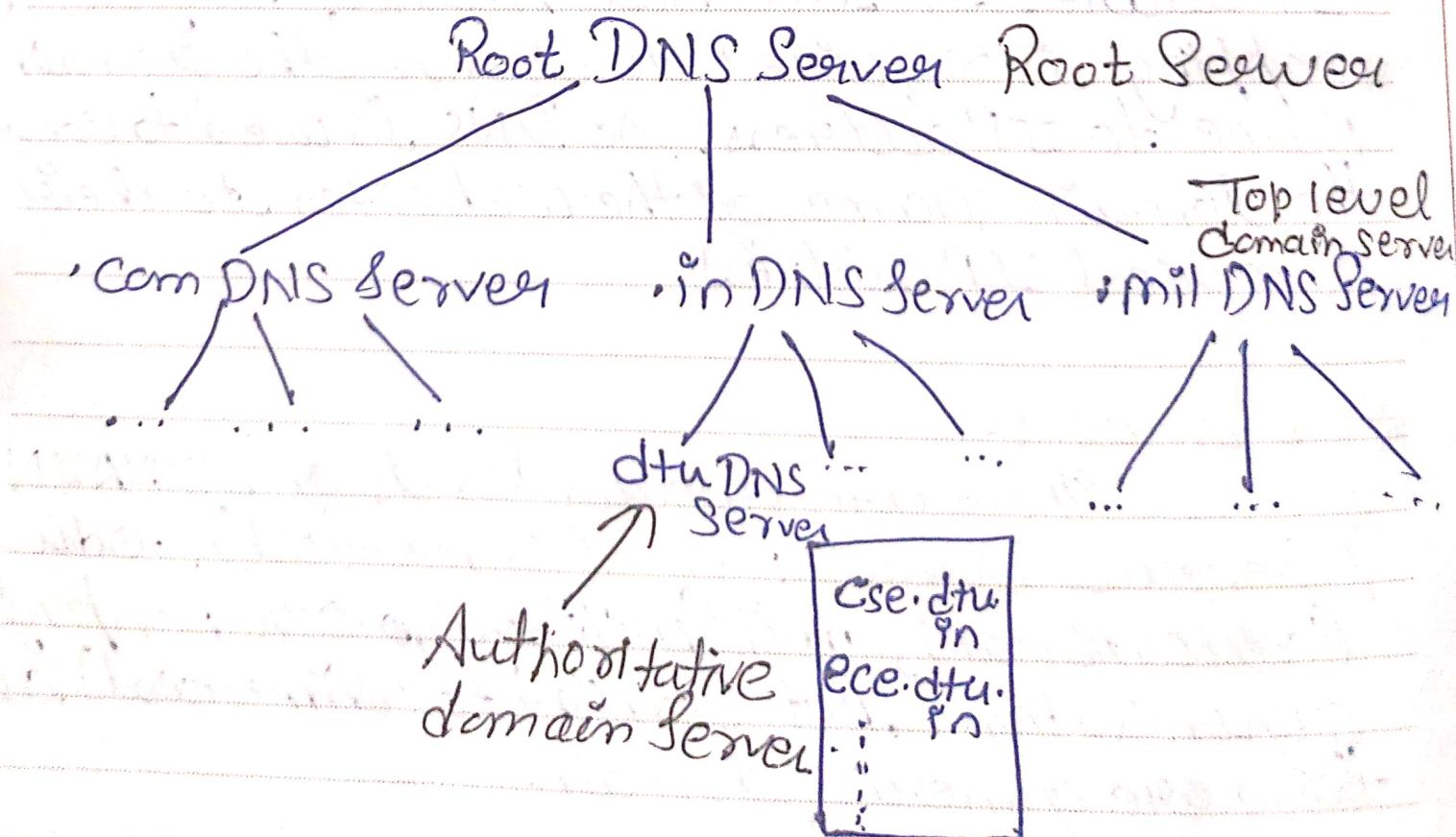
Domains:-

There are various kinds of DOMAIN
1) Generic Domain: .com (Commercial), .edu (Educational), .mil (Military), .org (non-profit organisation), .net (Similar to commercial). all these are generic domains.

ii) Country domain → .in (India), .us, .uk

iii) Inverse domain → If we want to know what is the domain name of the website. IP to domain name mapping, so DNS can provide both the mapping for ex. to find the IP addresses of greeksforgreeks.org then we have to type nslookup www.greeksforgreeks.org.

Organization of Domain



It is very difficult to find out the IP address associated to a website because there are millions of websites & with all those websites we should be able to generate the IP address. Immediately, there should not be a lot of delay for that to happen organization of database is very important.

i) DNS record:- Domain name, IP address.
What is the validity?? What is the time to live!! & all the information related to that domain name. These records are stored in tree like structure

ii) Namespace:- Set of possible names, flat or hierarchical. It maintains a collection of bindings of names to values. Given a name a resolution mechanism retrieves the corresponding value

iii) Name Server:-
It is an implementation of the resolution mechanism.
DNS = Name Service in Internet - Zone
is an administrative unit, domain is a subtree.



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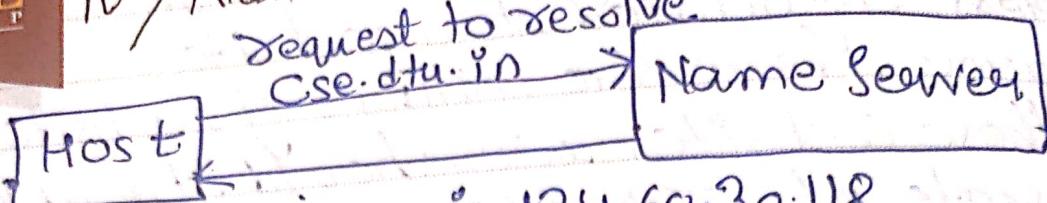


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iv) Name to Address Resolution



answer is 134.60.30.118

The host request the DNS name server to resolve the domain name & the name server returns the IP address corresponding to that domain name to the host, so that the host can future connect to that IP address.

* Hierarchy of Name Servers

i) Root Name Servers:-

It is contacted by name server that gets resolve the name. It contacts authoritative name server if name mapping is not known. It then gets the mapping & return an IP address to host.

ii) Top Level Servers:-

It is responsible for .com, .org, .edu etc. & all top level country domains like .uk, .fr, .ca, etc. They have info about

authoritative domain servers & know names & IP addresses of each authoritative name server for the second level domains.

iii) Authoritative name servers:-

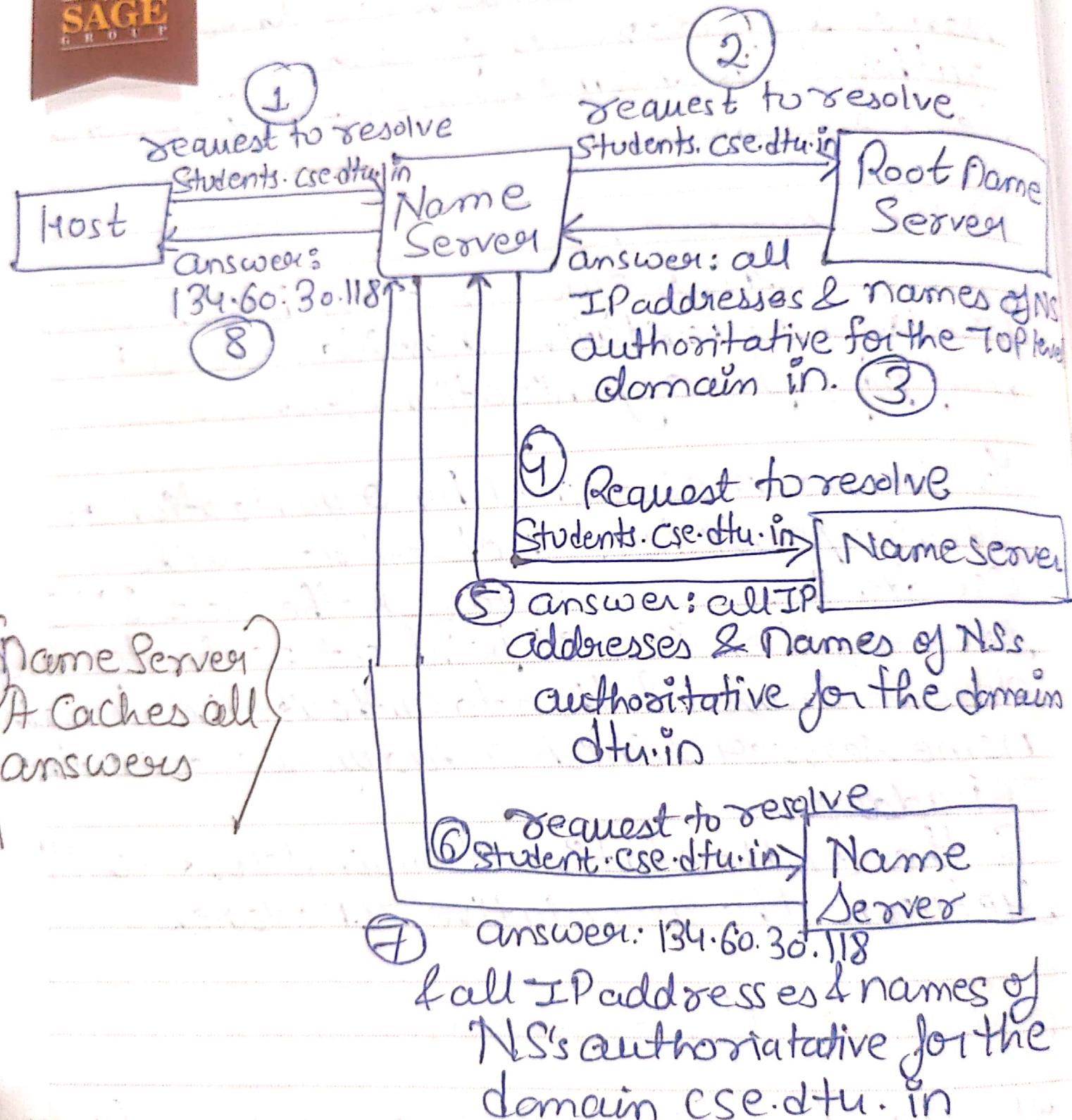
This is organization's DNS server, providing authoritative hostName to IP mapping for organization servers.

It can be maintained by organization or service provider. In order to reach Cse.dtu.in we have to ask the root DNS server, then it will point out to the top level domain server & then to authoritative domain name server which actually contains the IP address.

So the authoritative domain server will return the associative IP address.

A Domain Name Server:-

→ The client machine sends a request to local server, if root does not find the address in its database, sends a request to the root name server, which in turn, will route



the query to an intermediate or authoritative name server.

- The Root name server can also contain some hostname to IP address mappings.
- The intermediate name server always know the authoritative name servers.
- So finally the IP address is returned to the local name server which is turns returns the IP address to the host.

Network Security:-

It refers to the measures taken by any enterprise or organization to secure its computer network & data using both hardware & software systems.

This aims at securing the confidentiality & accessibility of the data & network. Every company or organisation that handles large amount of data, has a degree of solutions against many cyber threats.

The most basic example of Network Security

is password protection. Where the user of the network oneself chooses.

The network security solutions protect various vulnerabilities of the computer system are
Users, Locations, Data, Devices, Applications.

* Working of Network Security

→ The basic principle of network security is protecting huge stored data & network players that ensures a bedding rules & regulations that have to be acknowledged before performing any activity on the data.

1) Physical NS:-

It includes protecting data & network through unauthorized personnel from acquiring the control over the Confidentiality of the network. These includes external peripherals & cables might be used for cable connections.

The same can be achieved by using devices like bio-metric systems.

2) Technical NS:-

It primarily focuses on protecting the data stored in the network or data involved in transitions through the network. This type serves two purposes.

- Protection from the unauthorized users
- The other being protection from malicious activities.

3) Administrative NS:-

In this user behaviour like how the permission has been granted & how the authorization process take place. This also ensures the level of sophistication the network might need for protecting it through all the attacks. This level also suggests necessary amendments that have to be done over the infrastructure.

A) Types of NS:

1) Access Control:- Not every person

should have complete allowance to the accessibility to the network or its data. The one way to examine this is by going through each personnel's details. This is done through Network Access Control which ensures that only a handful of authorized personnel must be able to work with allowed amount of resources.

2) Antivirus & Anti-Malware Software:-

It ensures that any malicious software does not enter the network & jeopardize the security of data. The malicious software like viruses, Trojans, Worms are handled the same. This ensure that not only the entry of malware is protected but also that the system is well-equipped to fight once it has entered.

3) Cloud Security :-

As many organizations joining the bandwagon of cloud technology, where a large amount of data is stored over the internet. This data must

be protected and it should be ensured that this protection is not jeopardize over anything. This type of security ensures in creating gaps in visibility of the data.