

Data Communication - process of sending / receiving data.

Network of Computers is an interconnected collection of autonomous (no computer can start, stop or control). Computers.

Components of Data Communication -

1) Message - Piece of info to be shared.

Eg - txt. file, audio file etc.

2) Sender - Device which sends data message.

Eg - Computer, mobile, workstation etc.

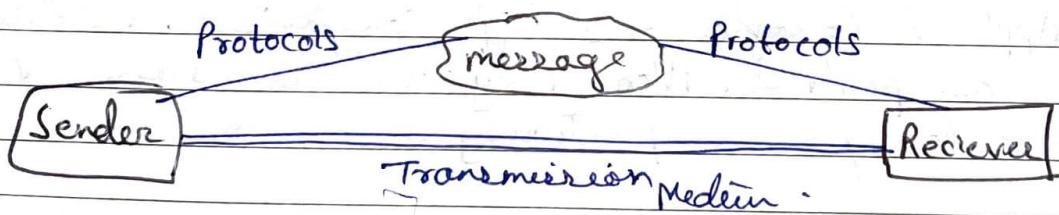
3) Receiver - Device which receives data message.

Eg - computer, mobile, workstation etc.

4) Transmission Medium / Communication Channels - Medium that connects two or more Workstation.

Eg - wireless or wired. Eg - bluetooth, satellite etc.

5) Set of rules (Protocol) - Data send should be understandable to receiver. else else its meaning less.



Protocols - established set of rules that determine how data is transmitted b/w device in network.

[Regardless of structure difference in structure, internal process]
(What, How & when)

① Syntax - Structure / format of data OR Order in which data is presented.

Eg - Protocol - ~~8 bits (odd of sender), 2nd 8 bits~~

Ex - 1st 8 bits is Sender's address, 2nd 8 bits is Receiver & Rest is Message / data itself.

① Semantics - Meaning of each section of bits, which field defines what action.

② Timing - When data should be sent & what speed.

Standards - Set of rules for data communication that are needed for exchange of info ~~also~~ among devices. Guideline to ensure compatibility.

③ De Facto Standards - "By Fact" or "By Convention" Standards not approved by organizations but have been adopted as standards because of its widespread use.

Ex - Apple & Google - 2 diff companies, established own rules on product. Also they use same standard ~~set~~ rules for manufacturing products.

④ De Jure Standard - "By Law" or "By Regulation". Standard approved by officially recognized body like ANSI, ISO, IEEE etc.

Ex - All data communication standard protocols - SMTP, TCP, IP.

→ Diff b/w Protocol & Standard

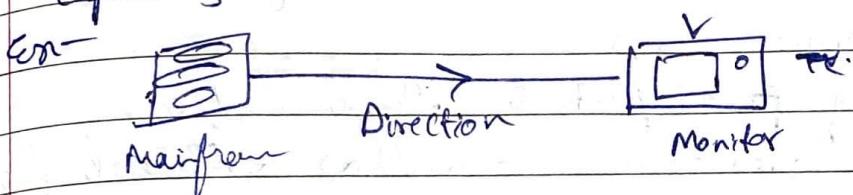
① Guideline to follow when new design is formulated

② Working set of rules & specifications that are used to make something happen

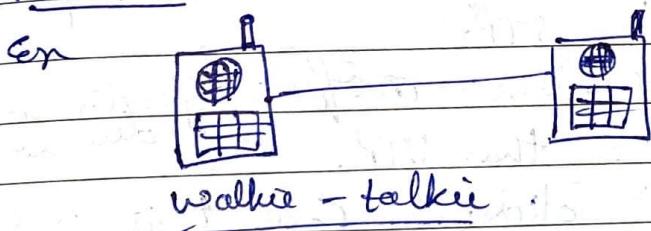
Types of Data Communication

(Transmission Mode)

- 1) Simpler Communication - one-way / unidirectional
in which one device only receives & another device only sends data. Device use entire capacity in transmission.



- 2) Half-Duplex communication - two-way / bi-directional
in which both devices send & receive but not at same time. When one send other receives vice-versa.



- 3) Full-Duplex communication - two-way / bi-directional
in which both devices send & receive at same time.

Ex Mobile, landline.

Communication Channels - Medium that connects two or more workstations.

- 1) Guided Media - Physical link is created using wire or cables b/w systems devices.

1) Twisted pair cable - ① Most common form. of wire.

② Two identical wires wrapped together in double helix.

* ③ Twisting reduces cross-talks.

④ Known as the ~~leaking~~ leaking of a signal from one wire to another due to which signals can corrupt and cause errors.

⑤ Twisting profit protects the wires from internal cross-wires as well as external form of signal interference.

⑥ Unshielded Twisted Pair - Used in Telephone, Computer.

⑦ No external shielding.

⑧ Does not protect from external interference.

⑨ Cheaper than STP.

⑩ Shielded Twisted Pair - ⑪ Offers greater protection due to shielding.

⑫ Heavier & costlier than UTP.

2) C coaxial Cable - ⑬ Solid wire core that is surrounded by one or more foil ~~or~~ or wire shield.

⑭ Inner carrier signal, outer provides the ground.

⑮ Television, Security systems.

⑯ Better than Twisted pair but expensive.

3) Optical fiber - ⑰ Large amt. data at high speed.
∴ used for Internet.

⑱ has a core, cladding, sheath

2) Unguided Media - ⑲ Signals are propagated from one device to another device wirelessly.

⑳ Through air, water & vacuum.

㉑ Transmits in all direction (signal)

1) **Microwave** - ① without use of cables, long-distance communication.
② transmitter, receiver & atmosphere.

③ Parabolic antennas are mounted on tower.
to send to other antenna. (height of tower
increases the range).

2) **Radio wave** - ① carried out by radio frequency.
② Offer mobility. ③ Transmitter & receiver.
④ Use antenna to radiate & capture signal.

3) **Infrared** - ① short distance communication
② TV-remote, wearables etc.

in order

• **Network** - Two or More Computers linked to share resources. / allow electronic communication.
Eg - Satellite, radio waves, etc.

~~Two types~~ (compared on the basis of distance)

~~LAN (Local Area Network)~~ - ① Confined to small area.
~~Ethernet & wifi~~

The links connecting nodes are communication channels.

→ Task is distributed in Computer Network.

② Security - ~~with~~ limited interaction with System

Eg - ATMs allows us to withdraw without accessing entire bank database

③ Faster problem solving - As Multiple computer can solve problems faster.

① Security through redundancy - Multiple computer running same code at same time - if 1 is corrupted next can work.

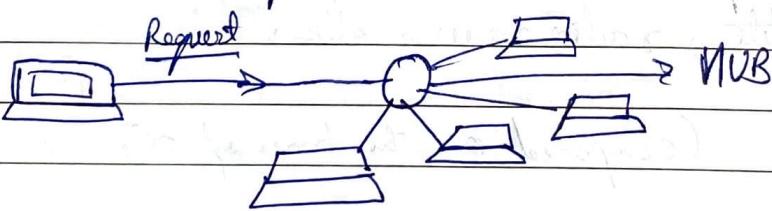
Network.

NIC - Network Interface Card. - helps comp. to convert hardware address, datalink layer protocol to identify system.

Wireless NIC - use Radio wave technology (Antenna) in Motherboard

Wired NIC - Cables are the wired NIC to transfer.

HUB - Central device that splits the network connection into multiple devices.



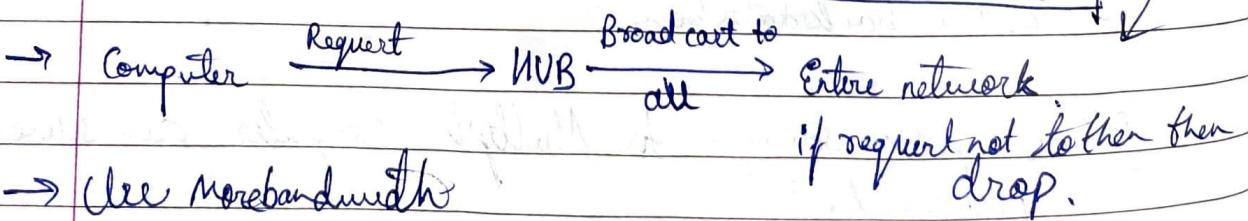
distributor
→ request to interconnected comp.

- At physical layer of OSI Model.
- Non-Intelligent / cannot filter data. Send to all comp.
- Half-duplex. → passive (No software associated).

① Passive, ② Active, ③ Intelligent Hubs. 4/12 ports

→ 10, 100 or 1000 Mb/s

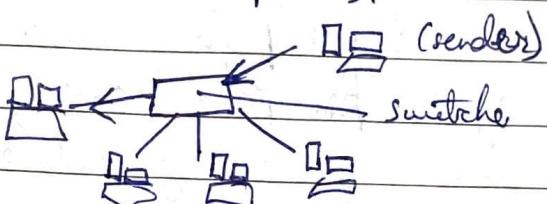
→ MAC address is encoded in Network card chip.
Stored in PROM (Programmable read only memory).



SWITCHES - groups all devices together over the network to transfer data to one another.

Switcher > HUB (as does not broadcast to all devices only to needed place).

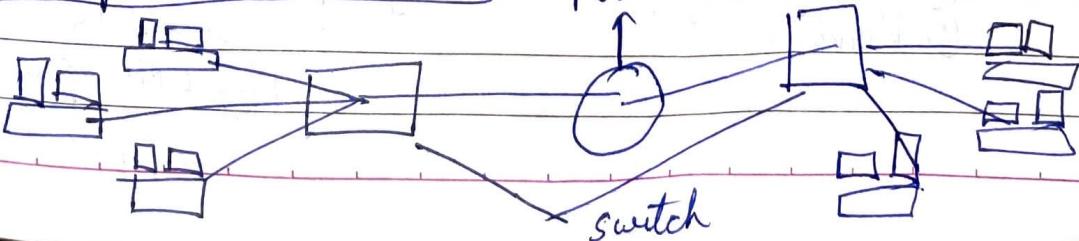
Multiple port



- Layer 2, data link of OSI Model.
- Intelligent network device which conceived as ~~multiple~~ multiport network bridge
- Uses ~~MAC~~ MAC addresses (medium access control) to send data
- Packet switching is used receive & forward data packet.
- Support uni, multi, broad cast.
- full duplex.
- Can perform error checking — 24/48 ports
- Managed, LAN, PoE & Managed Switch.

ROUTER - Network device at layer 3 - Network layer of OSI Model.

- ① Responsible for receiving & receiving, analysing & forwarding data packets among connected.
- ② Packet arrives → Inspect ~~address~~ destination add → Consult routing table to decide optimal route → transfer via that route.



Routing table?
Sub types?

MAC - Media Access Control.

Page No.
Date

- ① Transfer data in IP packet.
 - ② Used in LAN & WANs, expensive than hub & switch.
 - ③ have a Routing table in it refreshed periodically according to changes in network.
- Consults the table before choosing.
- ④ Routed against ~~for~~ Broadcast form!
 - ⑤ Router share info among each other.

Modem ① Allows the computer to connect to the internet over existing telephone line.

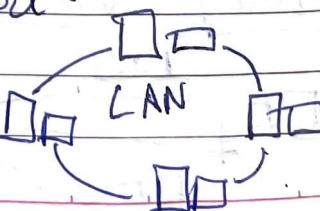
- ② Not integrated with motherboard ~~rather~~ rather than it is installed on the PCI slot.
- ③ Modulator / Demodulator
- ④ Converts digital data into analog signal over telephone lines.

Cable - to transmit signal

(computer network - group of computers communicate with each other. 4 types based upon size of network.)

→ LAN (Local Network Area Network)

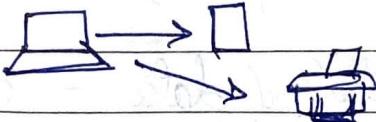
- ① Group of Computer Connected in Small area as building
- ② Two or more Comps through a communication medium such as twisted pair, coaxial cable.
- ③ less costly, extremely fast.
- ④ Highly Secure



~~The Internet~~

→ PAN (Personal Area Network)

- ① Range within an individual person, 10 m.
- ② for personal use
- ③ Thomas Zimmerman 1st Sixth. → area of 80 feet.
- ④ Bluetooth, airdrop.



Wireless PAN

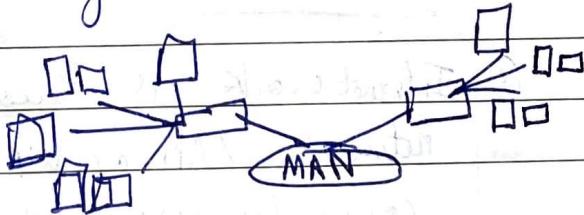
- ① low range, ② swift. → Bluetooth
- ③ wired PAN
- ④ USB

- ① Offline network, ② Small Home Office.

→ MAN (Metropolitan Area Network)

- ① Covers larger geographical network by connecting different LANs to form larger network.
- ② Higher Range than LAN
- ③ Need by govt.

Ex.



- ① Communicate b/w banks of diff cities.

- ② Spans over a large geographical area through a telephone line, satellite links.
- ③ Used for Business, education, game.

WAN (Wide Area Network)

- ① Network extending over States or countries
- ① Bigger than LAN. / Not limited to single location through telephone line, satellite link, optic cable
- ① Internet = WAN.
- ① Business, govt, education.
- ① Centralized data - centralized data
- ① Get updated info - live server
- ① Global business - connection
- ① High bandwidth - data transfer
- ① Security issue - As MAN & LAN are together.
- ① Need Firewalls & antivirus
- ① High cost & troubleshooting problem.

Internet work

- ① Internet work is two or more network computer network LAN or WAN or computer network segment connected using devices, configured by a local addressing scheme. This process is called internet working.
- ① Connection b/w public, private, govt.
- ① Are internal protocol
- ① Reference model - Open System Interconnection (OSI)

introduction to networking
atmvpd notes
subject notes (2)

Computer Network Model

Communication System - complex piece of hardware & software.

ISO developed layered approach approach.
Networking concept is divided in several layers.

Networking task depends upon the layers.

Layered architecture

- ① To divide design into small pieces.
- ② Each layer adds its service to higher layer, to provide full set of services.
- ③ provides modularity & clear interface, i.e b/w subsystems.
- ④ Ensure independence b/w layers by providing the services. from lower to higher layer, any modification in a layer will not affect other layer.
- ⑤ No. of layer, function, content vary from network to network. purpose of layer is to provide the service from lower to higher layer and hide details.

→ Service - It is a set of actions that a layer provides to the higher layer.

→ Protocol - Set of rule that a layer uses to exchange the info. with peer entity.

→ Interface - It is a way through which the message is transferred from one to another layer.

OSI - Open System Interconnection

Page No. _____

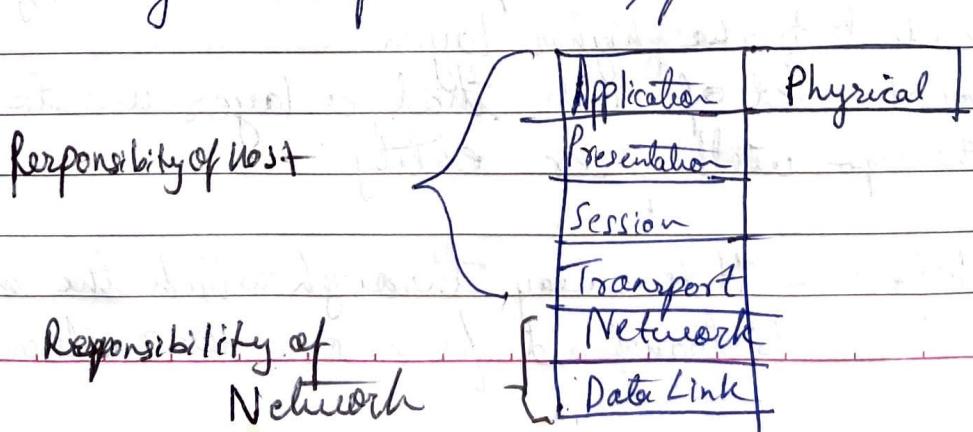
ISO - International Organization for Standardization

- For layer n on 1 machine to communicate with layer m of another machine he has to go through all the layers in b/w. This is layer-n-protocol.
 - Unmanageable tasks are divided into small-small tasks.
 - Set of layers & protocols is known as network architecture.
- () Divide & conquer - large to small task
- () Modularity - Independent b/w layers.
- () Easy to modify
- () Easy to test.

OSI Model (Open System Interconnection)

- describes how information from a software application in one computer moves through a physical medium to software application in other computer.
- OSI - 7 layers, each perform particular network function (By ISO - International Org. for Standardization).

each layer is self contained & for Modularity,



upper layer - deals with application related issues,
implemented only in the software.
Application layer is closest to end user.

lower layer - deals with transport data transport issue.
implemented in both software & hardware.
physical layer closest to physical medium.
Responsible for placing the information on physical medium

Application - provider service to user.

Presentation - responsible for translation, compression encryption

Session - to establish, manage & terminate session.

Transport - reliable message delivery from process to process

Network - move packets from source to destination process

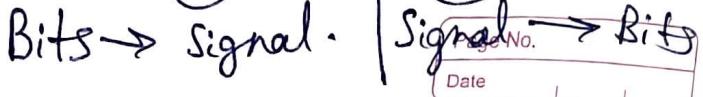
Datalink - for error free transfer of frame data frames

Physical - physical medium through which bits are transmitted

OSI model is theoretical model & TCP/IP is actual implementation by AR PANET.

Access to process	Application layer.	Application layer Presentation layer Session layer.	Application layer
Host to Host	Transport layer.	Transport Layer Network Layer	Transport layer.
Sources to sources	Network layer.	Network Layer	Internet layer.
Data link layer	Data Link layer	Data Link Layer	Network Access Layer
Physical layer	Physical layer	Physical layer	
Layer	OSI	4 layer	

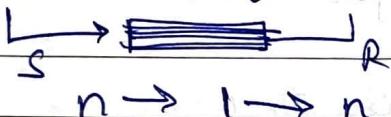
like stack 1st in - last out.



Physical layer - ~~1st layer the last ani~~
Sender the last ani Receiver the 1st layer
Through transmission media. (like wires, hardware)
Mostly only Hardware.

Topology

Multiplex - frequency is divided so that multiple users can use the channel at same time.



Encode - to send direct
or encode.

(multiple) \rightarrow 1 \rightarrow (multiple)

Data Link Layer - Help in transmission of data.

→ Hop to Hop , Node to Node - Responsible to send it to proper node / Router . It guides step by step to the final node .

2) Flow control - diff protocols are used to control the flow.

Star/
wall

GBN

SR

(I control flow on every node).

3) Error control - from hope to hop (CRC, checksum)
on every step. method.

h) Access control - (Aloha / CSMA/CD) - used to manage who will access the pass to avoid collision.

5) Physical address - ~~48~~ (48 address bit) - MAC
(Media Access Control)

MAC used to communicate b/w same network.

Frame - (Term used in Data Link layer from Network layer).

↓
add header & tail In data link

Network Layer - Host to Host (source to Dest. Delivery)
OR Machine to Machine. → destination

Using Logical (IP) *
tell us.

Network and host

3) Routing - (RIR, OSRF) are standard protocol.
& Switches. we shorter distance to reach destination - They have inbuilt Routing protocol.

4) Fragmentation - When large Message - it is send into fragments.

5) Congestion Control - control the situation of contact. congestion.

Transport Layer - End to End delivery. (Port to Port)

Port No. (16-bit code).

Port A to Port B - Between machines
between machines talk

TCP - Transmission Control Protocol.

UDP - Used data gram protocol.

ARP protocol - Address Resolution Protocol.

Network layer protocol need to find physical address from the IP address.

2) ~~Reliability~~ Reliability - (4 hai \rightarrow to \rightarrow 4 he miles ga).
(Provided by TCP)

& In order.

LIVE \rightarrow EVIL X
(In)
LIVE ✓
(Out)

* No loss of data, In TCP (connection oriented).
(connection oriented)
makes secure connection before sending.

3) Error Control - used to detect & correct error. (checksum)
Ex- if checksum before == checksum after
it is valid message.

4) Flow control -

method -

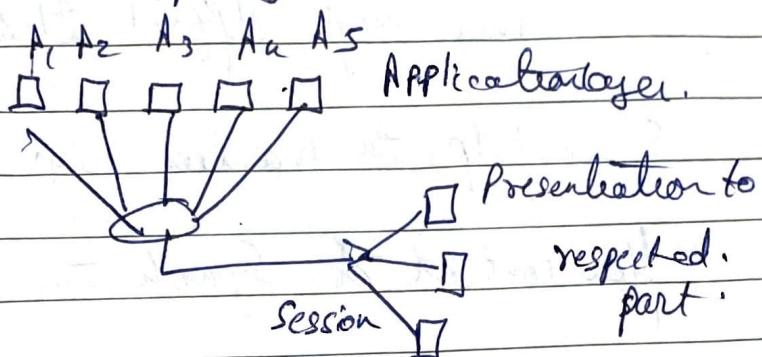
4) Congestion / 5) Flow Control (Stop & wait, SR, Go Back N).

- Receiver faheli ke ~~sends~~ sender ko capacity bol data hai.

\hookrightarrow (size and user size ke kis tarah message.)

Segment - Data from application value does not have defined value. It is continuous string. Transport layer make segment of these continuous flow].

6) Multiplexing / DeMultiplexing - Many to one

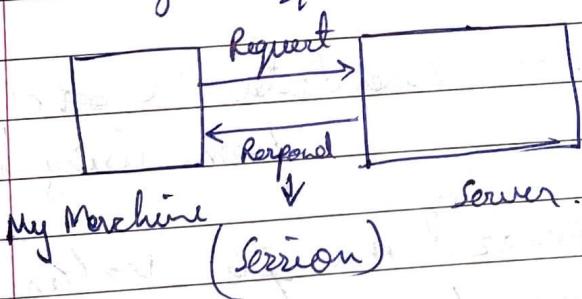


Session layer - 1) It creates sessions for the user.

2) Authentication - By entering username & password.

Ex - In Bank apps.

3) Authorization - Once it authorizes you it gives you authority.



Offer Session Recovery (checkpoint).

Ex - Mail In Mail - Once you if your session gets problem mail band zala ter you can restore but in Bank session once the session is interrupted you need to relogin.

4) Webinars - Many people are using voice & video. This might affect the Synchronization.

Session helps to maintain synchronization.

Flow control & Synchronization.

Session layer is not a responsibility of O.S.
It is responsibility of application.

Presentation Layer -

- 1) Code Conversion (Formatting data)
 - = ASCII to EBCDIC.
can be formatted to the favourable lang. of Application layer.
- 2) Encryption/Decryption - send data in cipher form. using key.
- 3) Compression - spacer & multiple values are compressed.

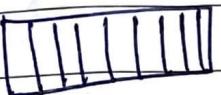
Responsibility of Application layer & not of O.S.

TCP - used by Transport layer when data arrives from application layer through presentation & session layer.

Page No.

Date

TCP - converts data stream to bytes / segments

P  Segment - collection of bytes.

2) Connection Oriented - Reliability: 3 way handshaking

→ Request to make connection
← OK!! I'm ready
→ I'm sending data

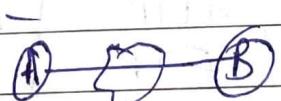
3) Full Duplex - (A) (B) Both can send data to one another.

4) Piggybacking → Selective repeat.

Same packet receive marker ch ka he acknowledgement here.

5) Error control - User should at least know that there is error.

6) Flow control - flow to be maintained so that buffer is maintained.

7) Congestion Control -

Takes care of B & N/w N/w.



Application Layer

TCP vs UDP

- | | |
|---|--|
| 1) Connection oriented | 1) Connection less |
| 2) Reliable (ordering) | 2) Less Reliable (No order) |
| 3) Error control is mandatory
(checksum is must) | 3) Error control is optional
(No checksum). |
| 4) Slow transmission | 4) Fast transmission |
| 5) More Overhead (20-60B)
(Extra info is added) | 5) Less Overhead. (8B) |
| 6) Flow control, Congestion control | 6) No EC, CC. |

(Reliable)

~~TCP~~

HTTP

FTP

UDP

DNS

BOOTP

NHCP

RIP

(Fast)

Application Layer - Layer closest to end user.
which means that application layer & end user can interact directly with software application.

Functions - ① Identifying communication partners - identifies the availability of communication partners for an application ^{data} to transmit.

② Determining resource availability - determines whether sufficient network resources are available for the requested communication.

③ Synchronizing communication - Communication b/w application requires cooperation.

Server -

- Network Virtual terminal - allows user to log on to a remote host. Application creates software simulation of a terminal at the remote host.
- Remote host thinks that it is communicating with one of its own terminals.
- FTAM - Allow user to access files in a remote comp.
- Addressing - To communicate address is required. Client request to server, has server address & its own. Server response to client request, it contains destination address. [To achieve this DNS is used]
- Mail server - used to provide E-mail functionality



Page No.

Date

Directory Service - Application contains a distributed database that provides access for global info. about various object & services.

Authenticator - Authenticator sends & receives messages.

Network Application Architecture - designed by application developer. & define how application should be constructed over various end systems.

① Client - server architecture - local machine send request to another application program (client) & a program that servers a request is (server).

② Client & server do not communicate directly to each other.

③ Server is fixed & well-known address (IP address) because the same is always on which client can always contact the server by sending a packet to its sender's IP.

disadvantage - Single server based arch. is incapable of holding all the request from the clients.

2) Peer to Peer (P2P) - ① No dedicated server in

② Peers communicate without passing a data center / direct message to dedicated server.

③ file sharing & internet telephony.

④ Self Scalability → ⑤ Cost effective.

Transfer home work to serve & any receiver client

Application Proto cols

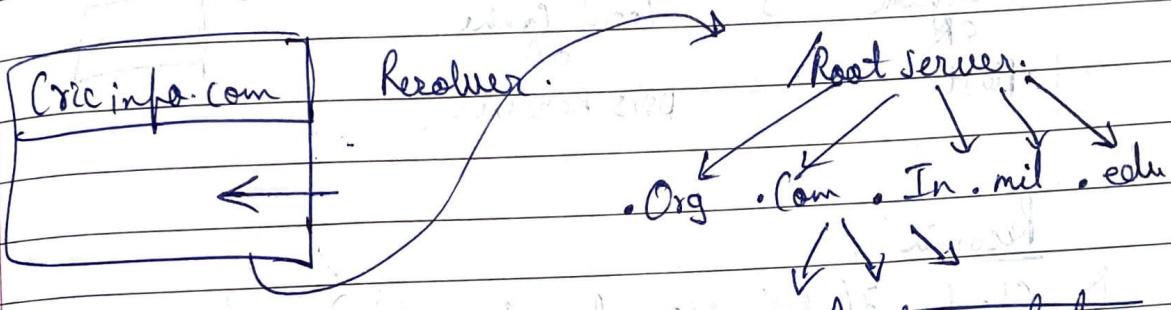
DNS - Domain Name System

User remember by domain name & not by IP address.

ex -

✓ Google.com ↳ Not Google. 16.7.8.4...

We never say - 52.19.167.6 what..



We use this

hierarchical format to

convert domain name to
IP address

13 Root Server in world.

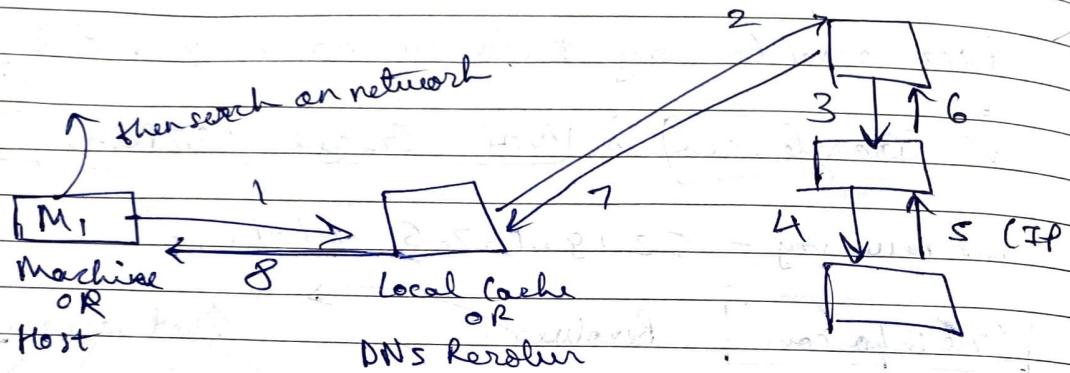
↙ further gets forwarded to server.
.com .mil .edu.

Resolver gets → IP ↪ from Authoritative server.

* If true search hata hai tabhi aapne
pe jaake hua fir vo cache mai store hata hua

To solve DNS query?

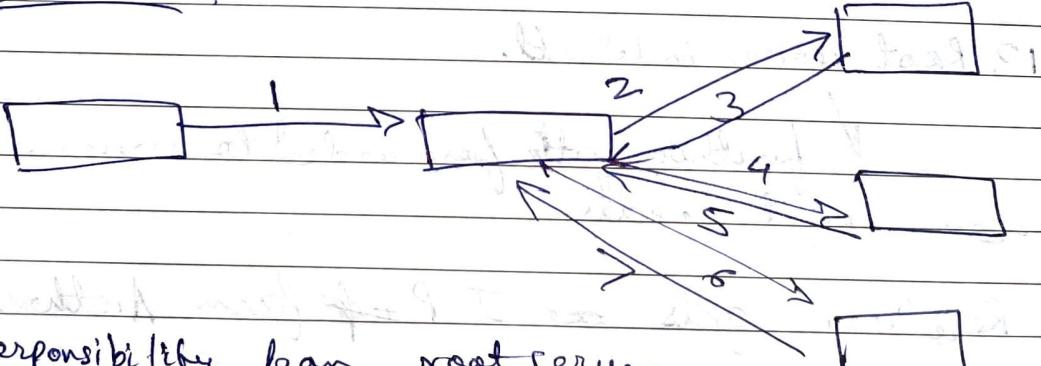
→ 2 ways recursive or iterative method



Recursive

- 1) Check if mila ya nahi (IP add.). If not then
- 2) Request to Rootserver. Then
- 3) To Top level Domain server. Then
- 4) To Authoritative server.

Iterative



- ① Responsibility from root server is reduce.

DNS use UDP protocol or it is fast.