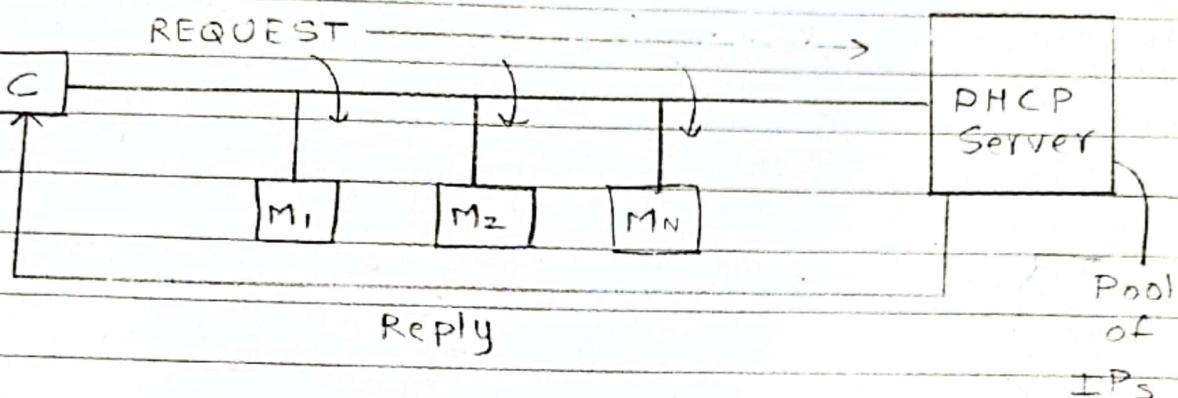


6. Application Layer

DHCP (Dynamic Host Configuration Protocol) -

- DHCP is an application layer service used for allocating IP address automatically.

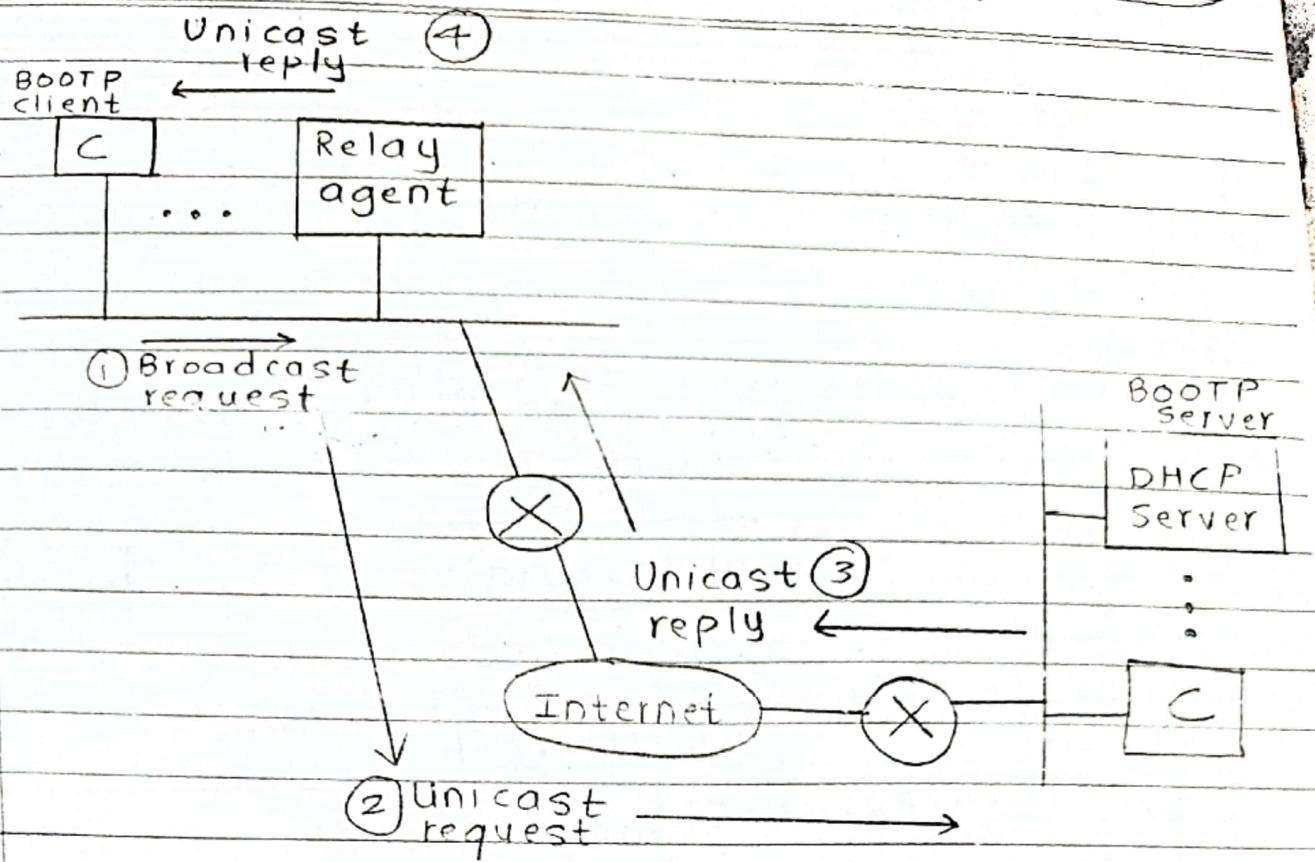


- As shown above whenever client needs IP address to be in a network, it sends a broadcast request and this is serviced only by DHCP server.
- DHCP server has pool of free IPs and after receiving request, it will fetch any random IP from the pool and give it as a reply to client.

There are 2 types of DHCP architectures -

- ① Client and Server in the same network (Sum. 15%)
- ② Client and server in different network

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- The client broadcasts a request for IP in the network. The server is present in a different n/w hence relay agent of the server accepts the request.
- The relay agent unicasts the request to the DHCP server.
- The server takes a random IP from the pool and gives it as an unicast reply to the relay agent.
- The relay agent gives an unicast reply to the client

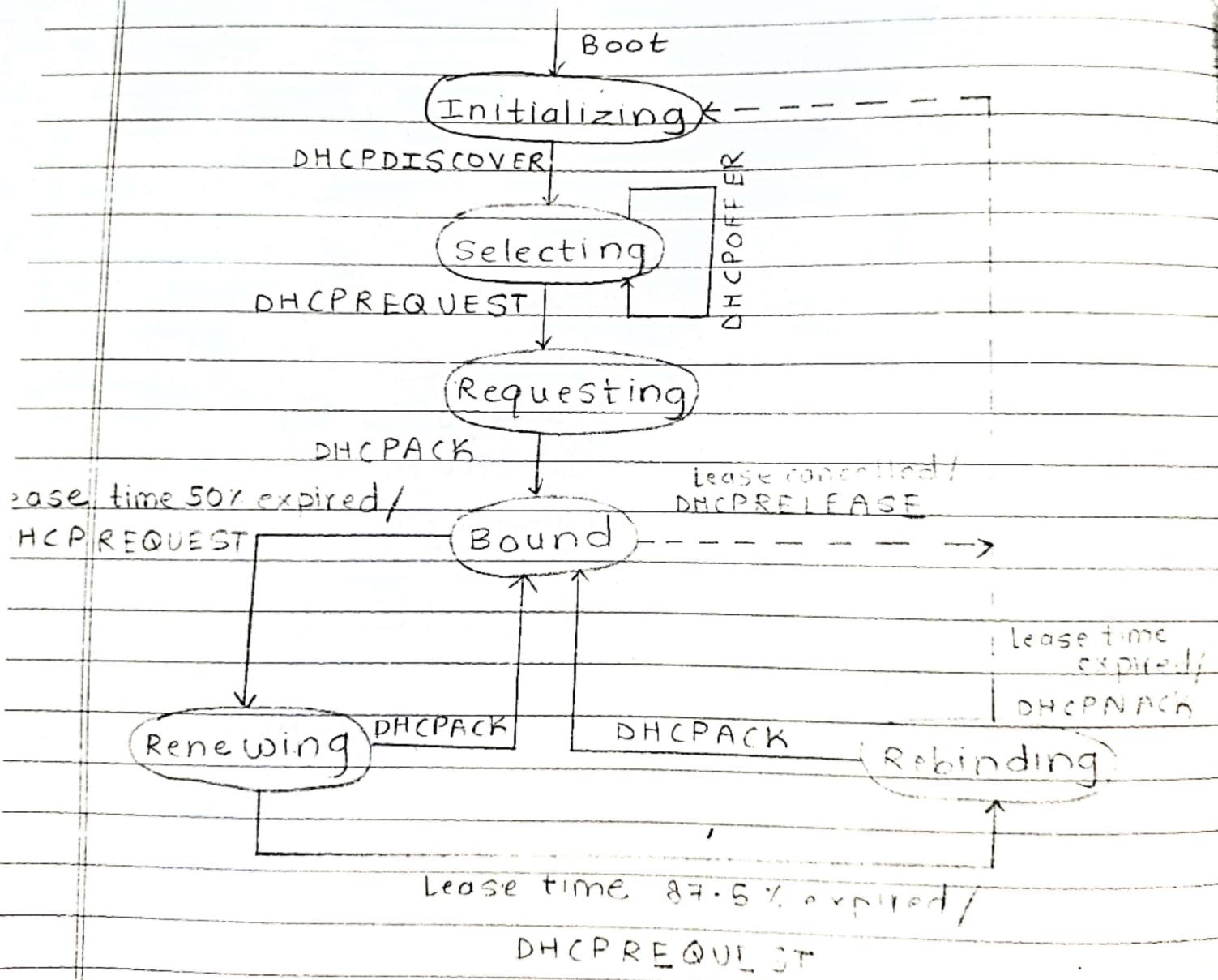
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Note:-

why the name dynamic?

→ Everytime client won't get the same IP.

DHCP state transition diagram:-



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Date _____
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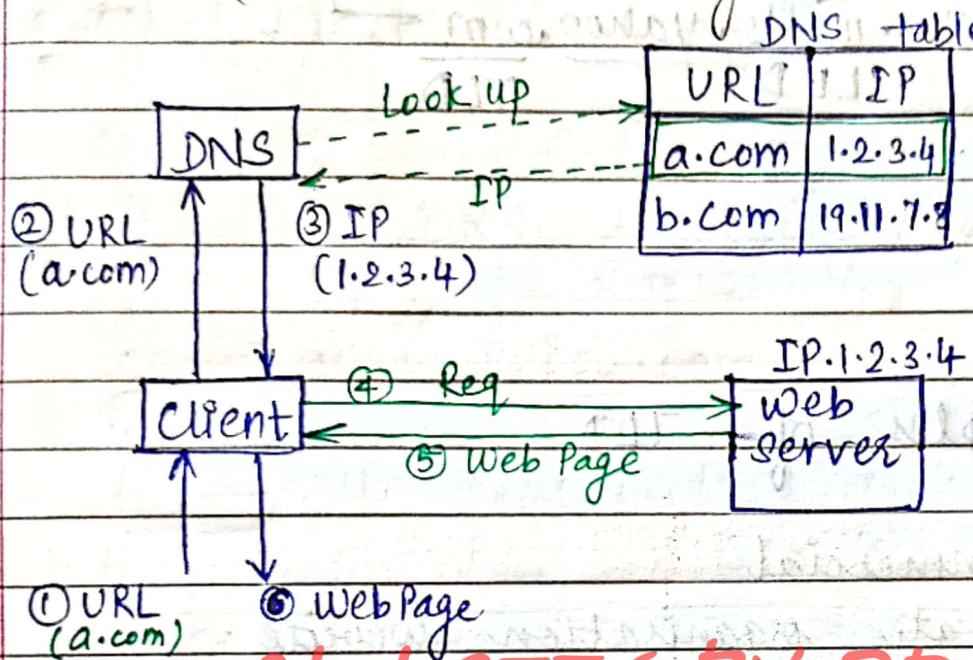
- Initially when the system BOOTS , the client goes in a **INITIALIZING** state and starts sending broadcast request to DHCP server i.e. DHCPDISCOVER and goes in **SELECTING** state.
- Now the client starts getting reply from the server i.e. DHCPOFFER and client selects the best suited offer and goes in **REQUESTING** state by sending DHCPREQUEST to server.
- If server is ready to give IP, it sends DHCPCACK and client goes in **BOUND** state.

Note:- Default lease time is 3600 sec
Maximum lease time is 36000 sec

- When the lease time is over i.e. LEASE CANCELLED DHCP client releases the IP by sending DHCPRELEASE and client goes back in **INITIALIZING** state.
- If client wants to renew the time, it sends DHCPREQUEST after LEASE TIME 50% EXPIRED and goes in **RENEWING** state. If server sends DHCPCACK i.e. time renewed client goes back in **BOUND** state. If there is no reply, client again sends DHCPREQUEST after LEASE TIME 87.5% EXPIRED and goes in the **REBINDING** state. If server sends reply DHCPCACK client goes back in **BOUND** state, else finally after LEASE TIME EXPIRED all IPs are released by sending DHCPCNACK.

DNS (Domain Name System) :-

DNS is a service maintained in every network for mapping a human oriented name (URL) to a system oriented name (IP).



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Need of DNS :

Humans are comfortable working with names rather than numbers whereas system deals with numbers.

Hence, there is a need to map a URL to its equivalent IP for which DNS is required.

Understanding the domains & the URL structure :

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Date: 11

Types of DNS Server:

(1) Primary / Master:

Maintained by ISP and it is the main DNS server used for resolving.

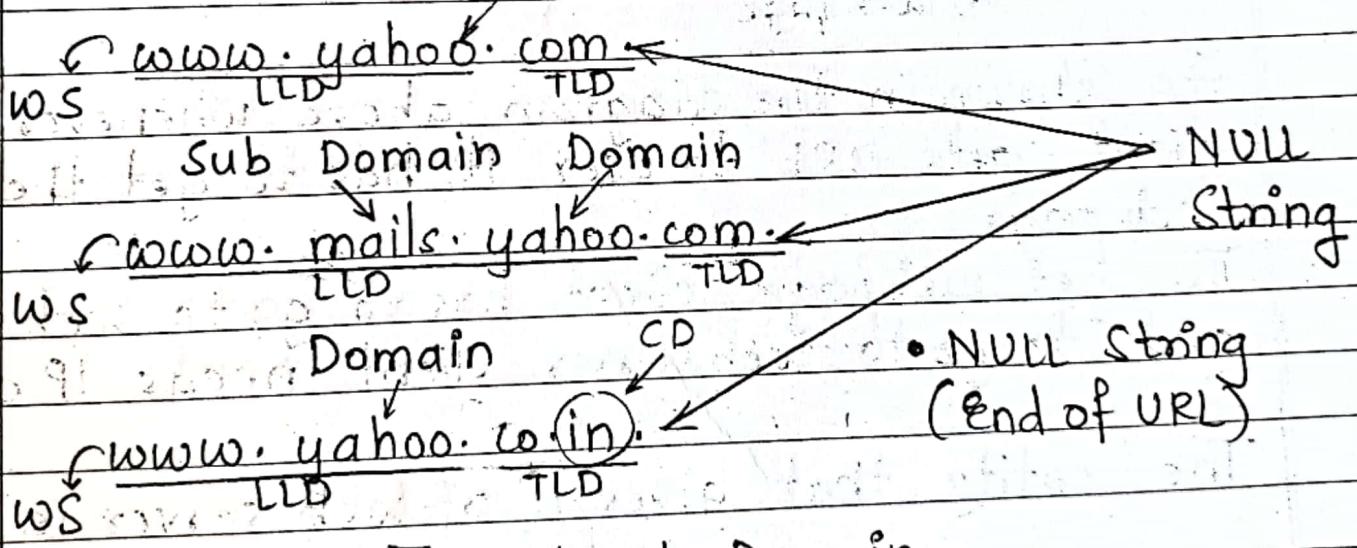
(2) Secondary / Slave:

It is replica of primary and it is used as a back up server.

(3) Caching / Hint:

It is maintained in a client to cache IP of frequently visited URL.

Understanding URL structure:



TLD : Top Level Domain

LLD : Low Level Domain

CD : Country Domain

WS : Web Server

(PQDN = Partially Qualified Domain Name.)

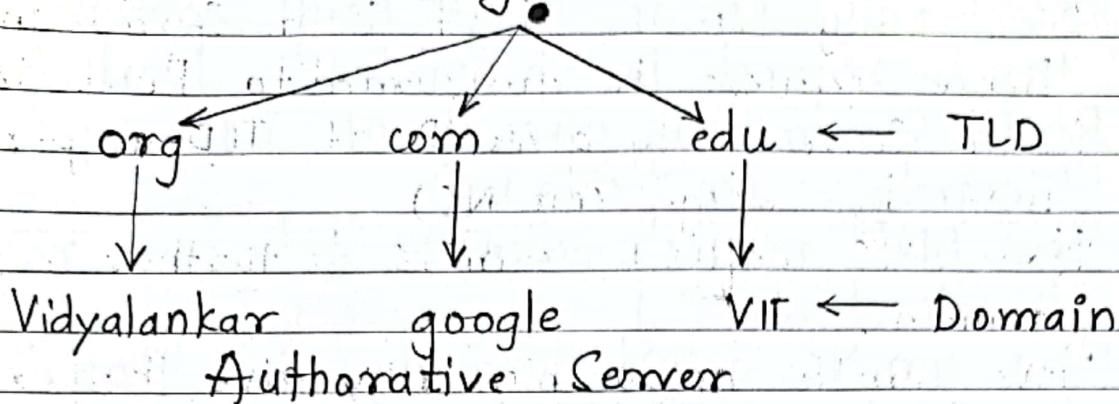
(e.g. **www.yahoo.com**)

FQDN = Fully Qualified Domain Name.
(e.g. **www.yahoo.com.**)

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Page No. _____
Date: _____

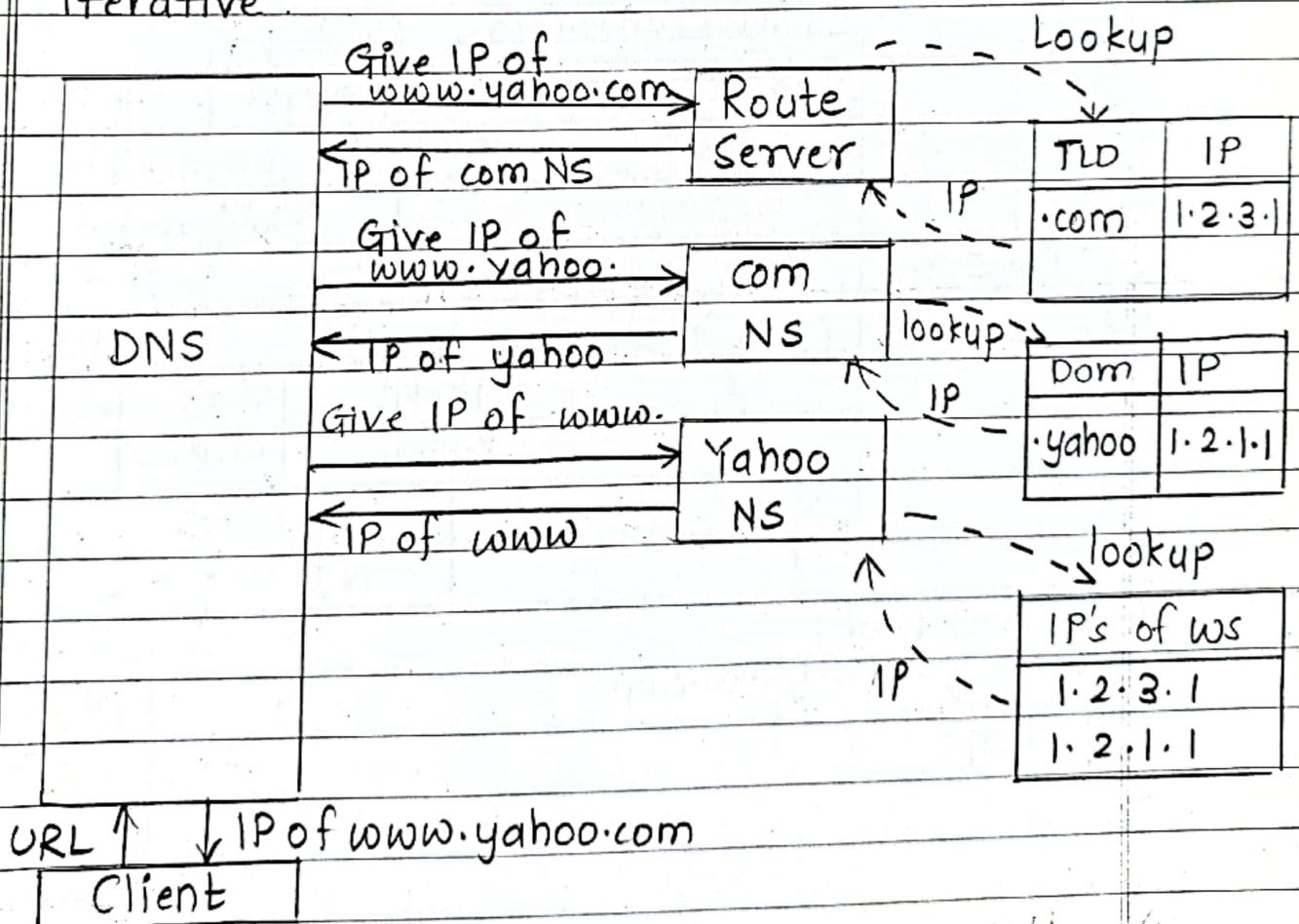
DNS Hierarchy:



Resource Records: (Refer PDF)

DNS Name Resolution:

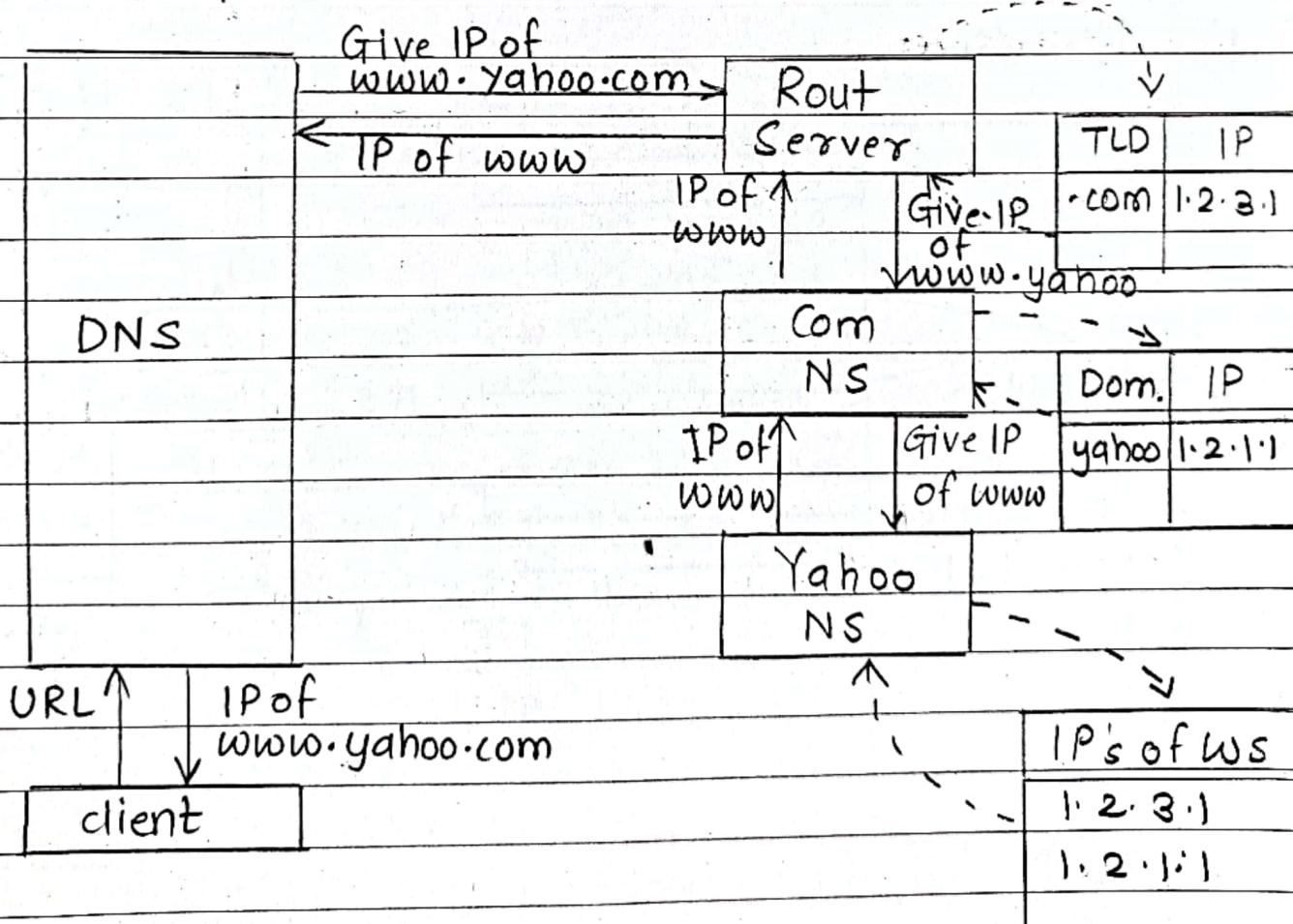
1) Iterative



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- 1) Client request DNS to give IP by giving URL
- 2) DNS only knows IP of Root Server and hence request is forwarded to Root Server.
- 3) Route Server only gives IP of TLD as per hierarchy (eg. com NS)
- 4) Now DNS request comNS to further resolve domain.
- 5) Now comNS as per hierarchy give IP of domain i.e. yahoo.
- 6) The request is then given to yahooNS to give IP of web server.

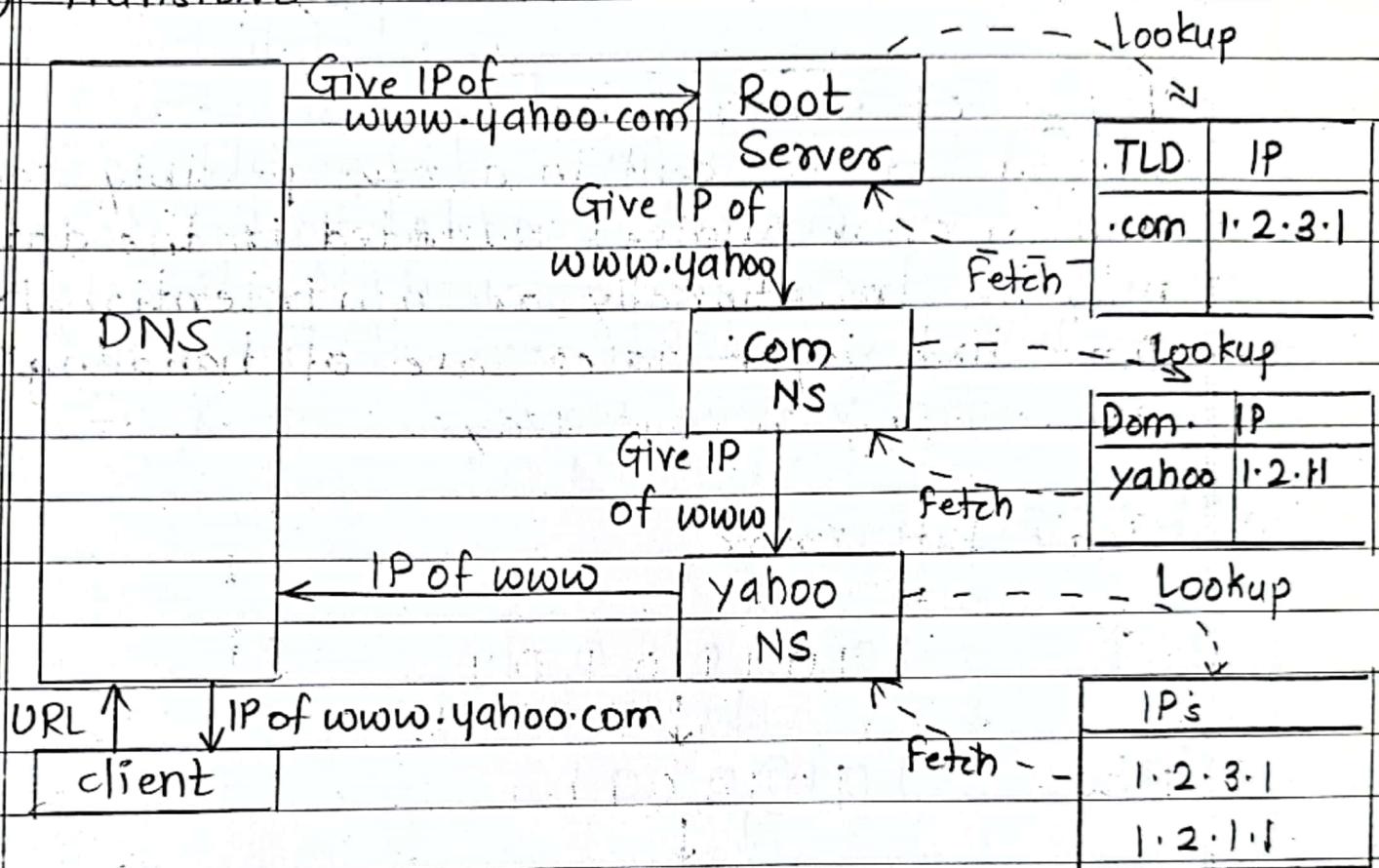
2) Recursive



- 1) It is same as Iterative but the only difference is DNS is not completely involved in REQ

- 2) Every server calls the other server and only DNS gets involved in getting final reply.

- ### 3) Transitive:



If is same as Recursive, only difference is the last server will send final reply to DNS.

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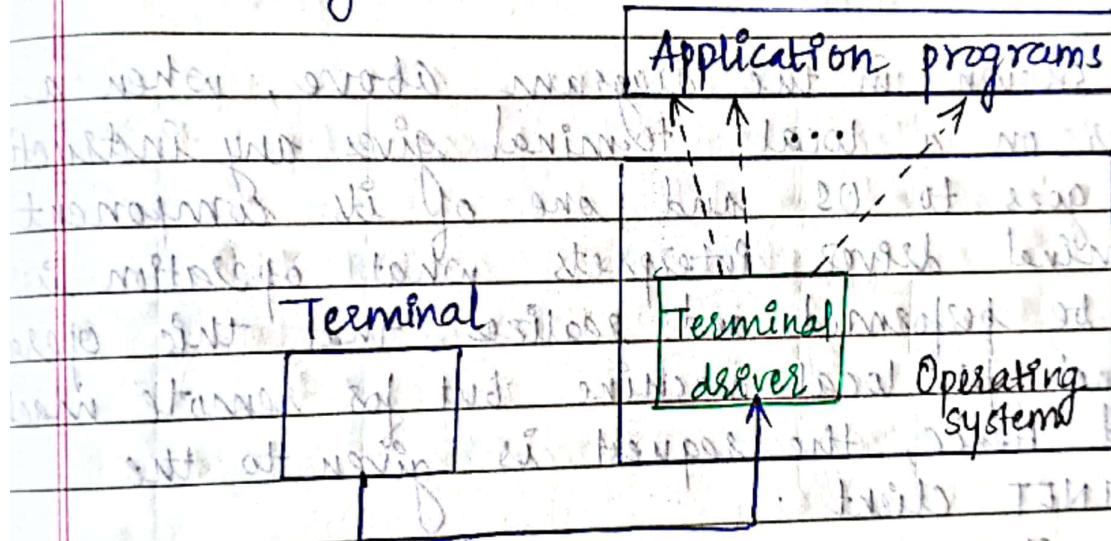
TELNET AND NVT

TELNET is one of the most commonly used and universally accepted standard for connecting local machine to a remote machine.

To understand the operation of TELNET, following two models are required.

- 1) Local Login
- 2) Remote Login (TELNET)

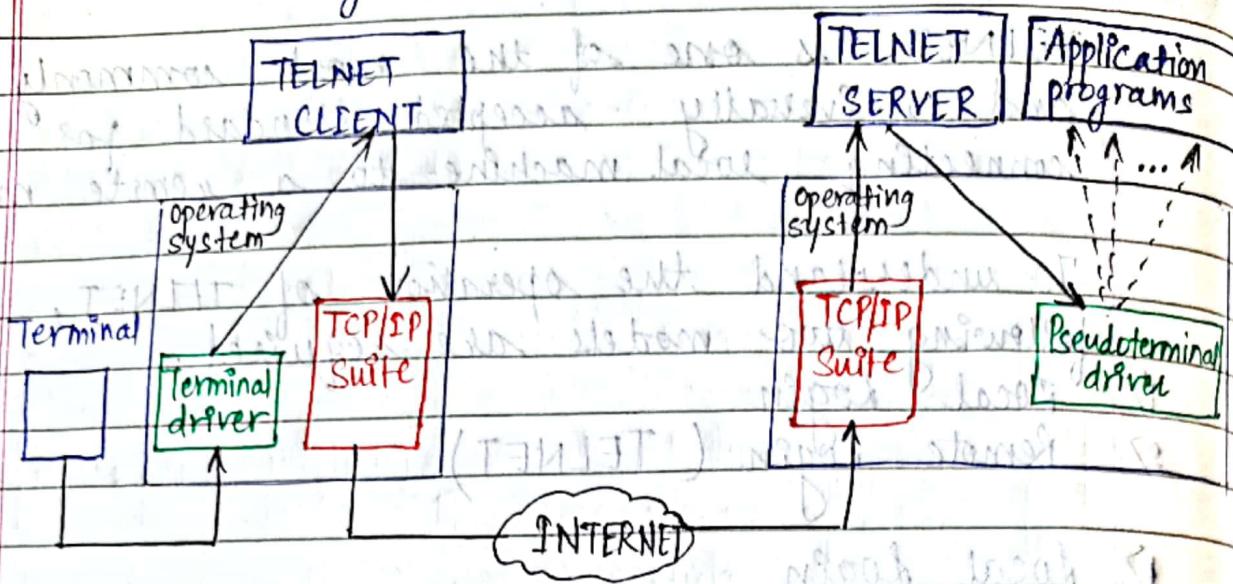
1) Local Login



- As shown in the diagram above, many instructions executed in the local Node goes to operating system, one of the component of an OS terminal interprets what operations is to be performed & required application program is activated.

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2) Remote Login (TELNET Process)

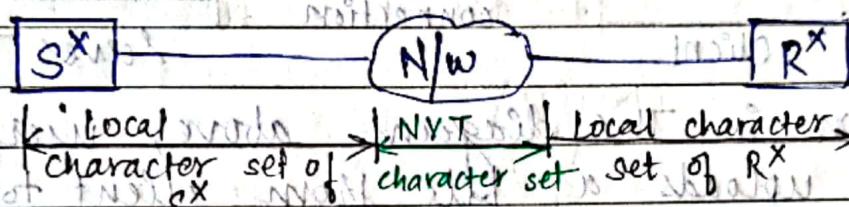


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- As shown in the diagram above, when a user on a local terminal gives any instruction, it goes to OS and one of its component terminal driver interprets what operation is to be performed and realizes that this operation is not for local machine but for remote machine and hence, the request is given to the TELNET client.
- The TELNET client forwards this request to TELNET Server through network.
- TELNET Server handover this request to the server's terminal driver i.e. pseudo terminal driver which interprets and calls the required application program.
- The p...

The problem with TELNET is a network with 'n' machines having 'n' different formats, every machine again needs to remember 'n-n' format for sending the data.

- So, a concept of common format is developed known as NVT (Network Virtual Terminal).
- NVT is a common character set.
- The TELNET client translates characters (data or commands) that come from the local terminal into NVT form and delivers them to the network. The TELNET server translates data and commands from NVT form into the form acceptable by the remote computer.



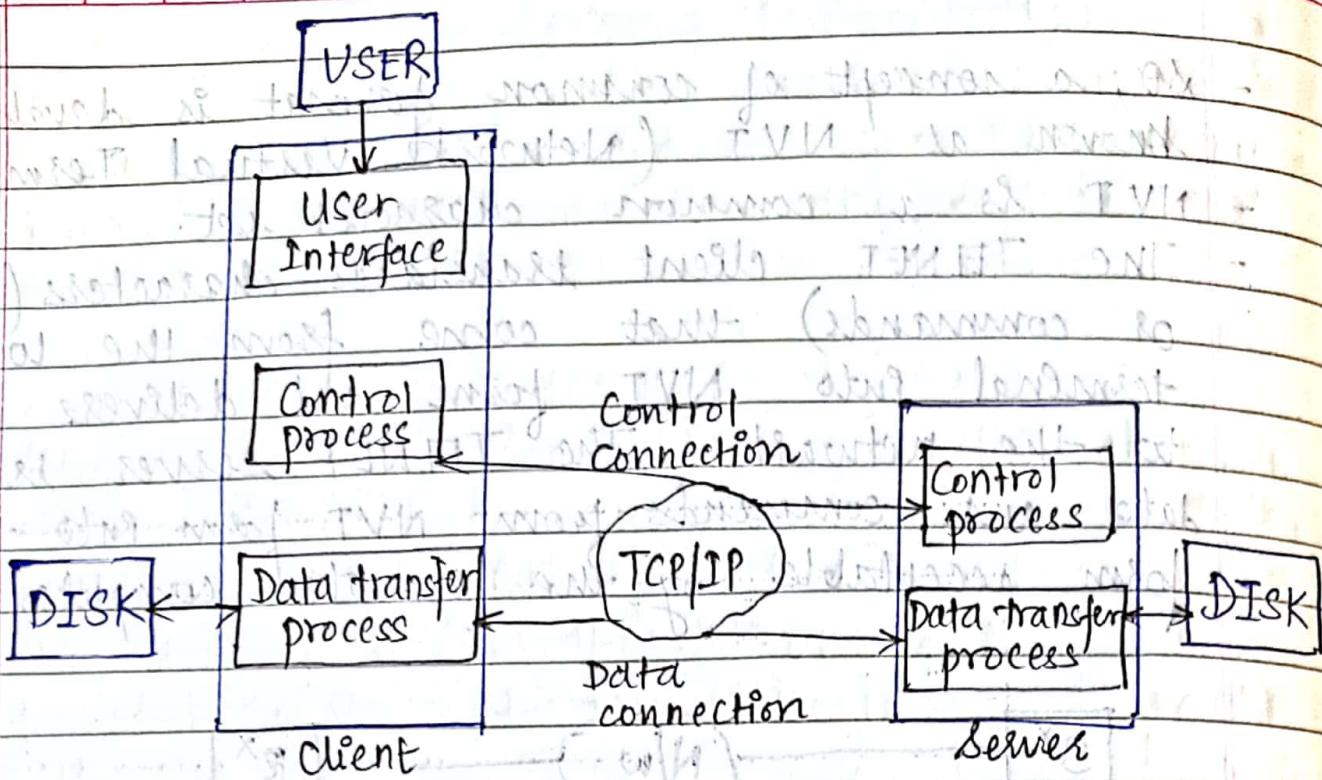
FTP (File Transfer Protocol).

- FTP is the most commonly used and universally accepted standard for transferring files between two hosts.
- FTP is responsible to open two different types of connection.
 - 1) Control connection on port no. 21.
 - 2) Data connection on port no. 20.

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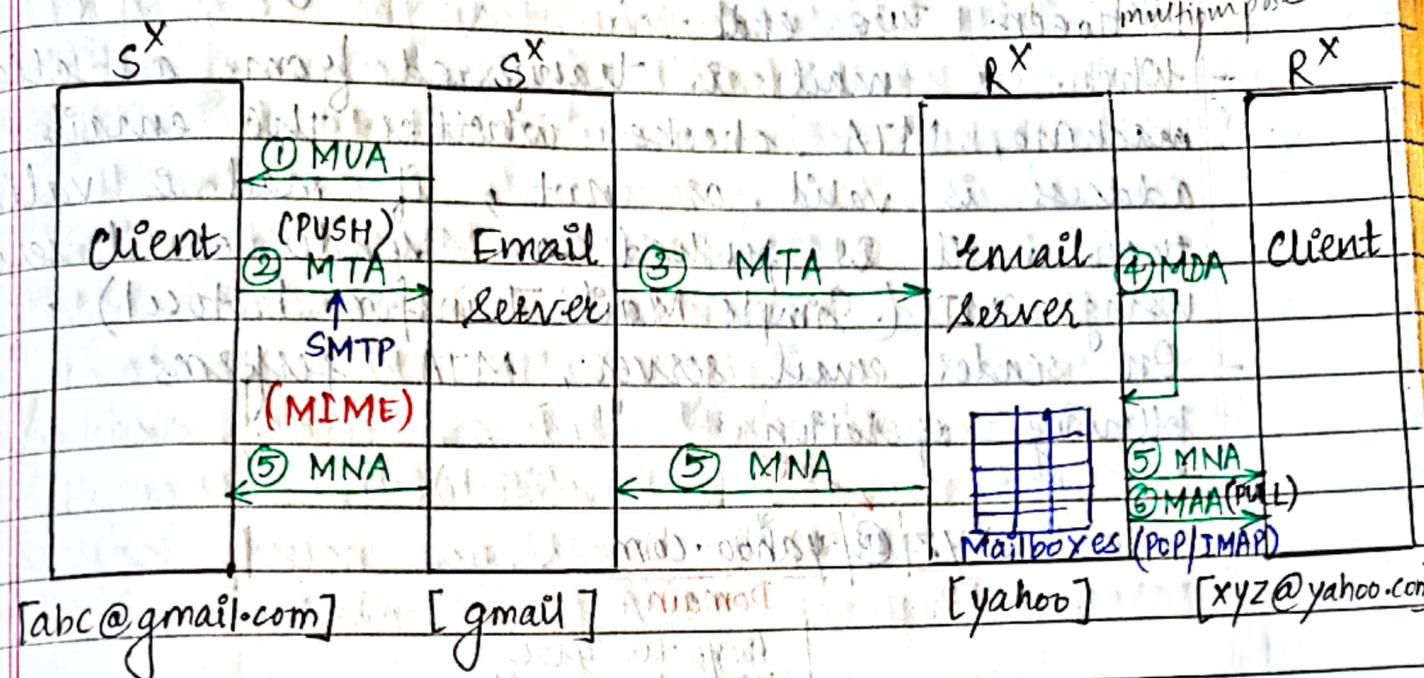
CN NOTES BY PROF. AKN

Page No. _____
Date _____



- As shown in the diagram above, user either uploads a file from client to server or downloads a file from server to client.
- FTP is a sophisticated architecture responsible for transferring files through data connection and request acknowledgements and other control information through control connection.
- Like TELNET, there is also a common character set required, i.e. known as NVT.

Email Architecture



MUA : Mail User Agent

SMTP : Simple Mail Transfer Protocol

MTA : Mail Transfer Agent

IMIME : Multipurpose Internet Mail Extension

MDA : Mail Delivery Agent

POP : Post office protocol

MNA : Mail Notification Agent

IMAP : Internet Mail Access Protocol

MAA : Mail Access Agent

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- Important components and agents of Architecture.

1. MUA - (Mail User Agent)

It is responsible to give the view of mailbox. It acts as an interface that enables the different features of mailbox.

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Page No.

Date

2. MTA - (Mail Transfer Agent)

- MTA is responsible for transferring a mail between two ends.
- When a mail is transferred from a client machine, MTA checks whether the email address is valid or not, if mail is valid then mail is pushed on sender email server using SMTP (Simple Mail Transfer Protocol).
- On sender email server, MTA performs following operation :-

To : xyz@yahoo.com

ID

Domain

Req. to give
IP of mail server

DNS

(Has IP of only web server)

Req. forwarded to MX

MX [Mail Xchanger]

(Has IP of mail server)

Gives IP of
mail server of
requested domain.

- Now, the mail is forwarded to receiver mail server.

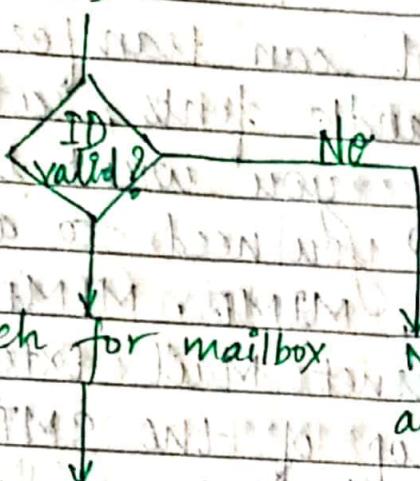
3. MDA - (Mail Delivery Agent)

It is responsible to accept the mail on receiver email server and deliver that mail in a respected mail box.

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Page No.	
Date	

To : xyz@ yahoo.com
ID



Deliver the mail

in mailbox

Notify Sx & Rx

4. MNA - (Mail Notification Agent)

It is responsible to notify the sender about delivery request of to receiver about arrival of new mail.

DR NAME: DR NOORI

5. MAA - (Mail Access Agent)

It is responsible to pull the mail from mail server on its own machine for which it uses (POP or IMAP). POP (Push Office Protocol) or IMAP (Internet Mail Access Protocol).

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• Introducing SMTP

The SMTP protocol can transfer only ASCII text. It can't handle fonts, colors, graphics, or attachments. If you want to be able to send these items, you need to add another protocol to SMTP, MIME. MIME stands for Multipurpose Internet Mail Extensions. MIME is implemented on top of the SMTP protocol and enables you to add colors, sounds, and graphics to your messages and still deliver them via SMTP. For MIME to work, you must have a MIME-compliant MUA (most are).

• Understanding POP

Two other protocols are part of the email process: Post office Protocol version 3, known as POP3, and Internet Message Access Protocol Version 4, known as IMAP4.

Without POP3 (or IMAP), and MUA and MTA can't communicate. That is, if you want to read your mail, need POP3 (or IMAP) to retrieve messages that arrive at your MTA while you're offline. POP3 uses the MTA's storage to hold messages until they are requested. When user want to check their email, they connect to the POP3 server and retrieve messages that were stored by the server. After retrieval, the messages are stored locally (that is, locally to the MUA) and

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Page No.			
Date			

use the MUA on your PC to read them at your leisure.

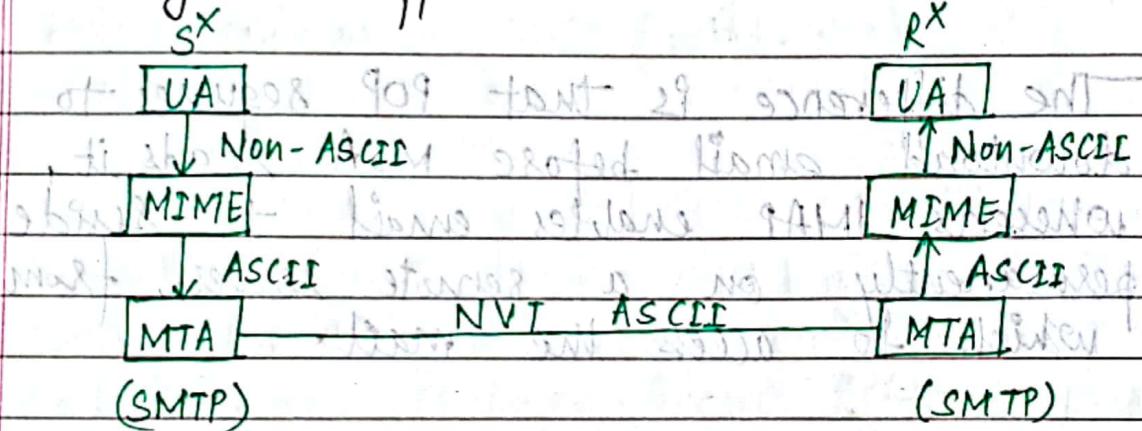
Understanding IMAP

The Internet Message Access Protocol (IMAP) provides much more sophisticated email-handling functionality than SMTP or POP does. IMAP has more features: IMAP enables to store email on a networked mail server, just as POP does.

The difference is that POP requires to download email before MUA reads it, whereas IMAP enables email to reside permanently on a remote server, from which to access the mail.

Need of MIME. (Multipurpose Internet Mail Extension)

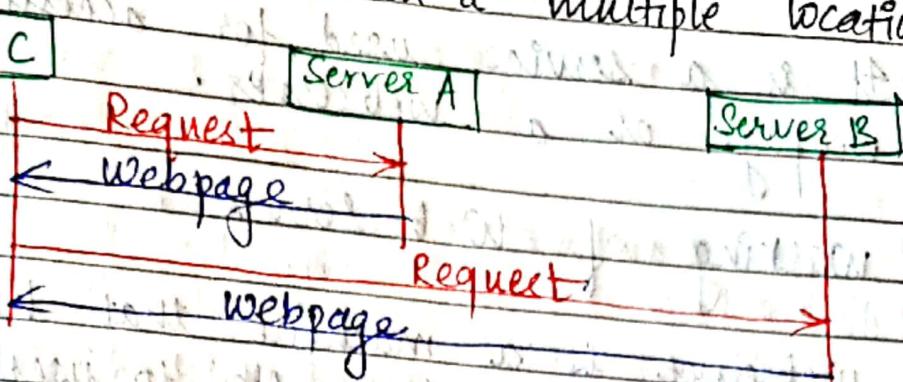
- The problem with SMTP is that it can only forward mail with simple text (ASCII form), so there is a need to handle all non ASCII format emails (text formatting, attachments, etc.). Into ASCII formats at sending side MIME is required.
- At the receiving side, MIME does the exactly opposite work.



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- In network, a common character set is used that is known as NVT.
- WWW and HTTP :- (world wide web & hyper text transfer protocol)
 - World wide Web which indicates a web server is a distributed client-server service for managing the web-server.
 - This service is said to be distributed because, the websites are not stored on a

single location but on a multiple location.



As shown in the diagram above, sometime a request is handled by server A and sometime by server B which indicates the architecture of the entire web server is distributed.

Types of Web Document

1) Static

A webpage whose content never changes.

2) Dynamic

A webpage whose content may change.

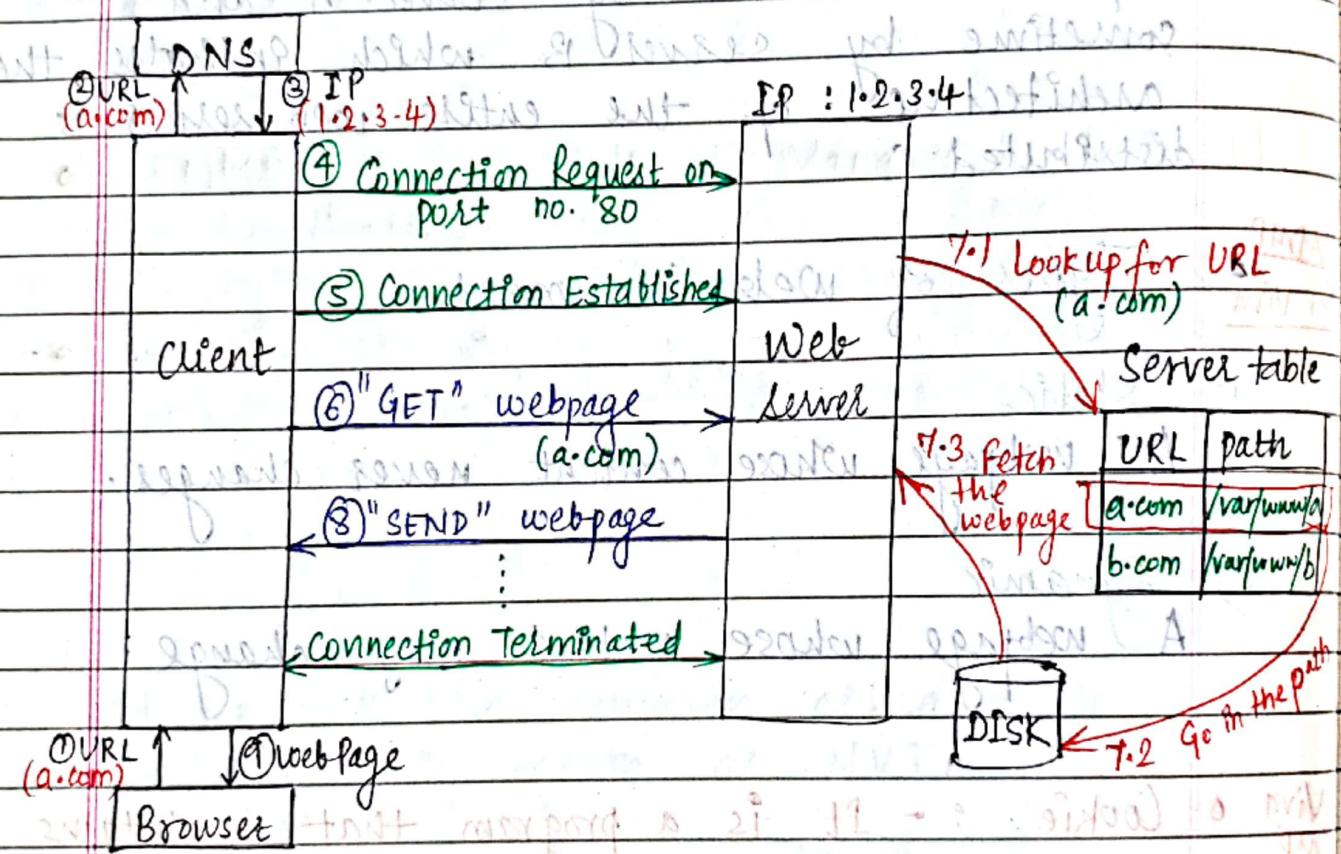
Cookie :- It is a program that maintains the session information

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- **HTTP : (Hypertext Transfer Protocol)**
It is a service used for accessing the webpage or a webserver.
- **Working of Web Server :**

Webserver is a machine that host the website and provide to user as and when required.



• Step 1 :

User presents the URL to get the webpage

• Step 2 :

Client to get the webpage need to know IP of web server and hence the request is

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Page No.

Date

forwarded to DNS

- Step 3 :
• DNS gives the IP of the required webserver to the client.
- Step 4 :
Now the client sends the connection request to web server on port no. 80.
- Step 5 :
If server is free, connection is established with client.
- Step 6 :
Now client sends a request for the webpage "GET" primitive.
- Step 7 :
Server side processing.
- Step 7.1 :
• Server lookup for the given URL in the server table.
- Step 7.2 :
Server searches for the given webpage in given path.
- Step 7.3 :
Server searches the webpage, if static gives it to the client, if dynamic, process it using dynamic web page technology.

CN NOTES BY PROF. AKN

Page No.	
Date	

- Step 8 :

Now, server gives the web page to the client using "SEND" primitive.

- Step 9 :

Client handing this web page to user (Browser).

This process of GET and SEND continues and finally the connection is terminated.