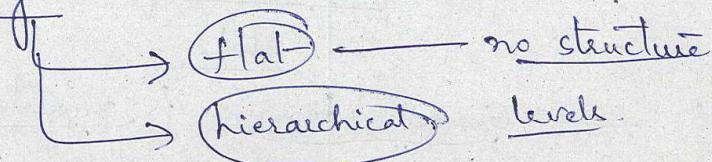
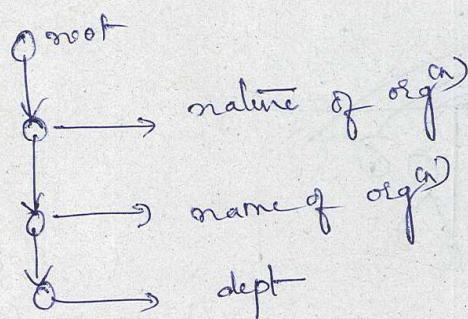


Name Space — maps each address to a unique name can be organized in 2 ways.



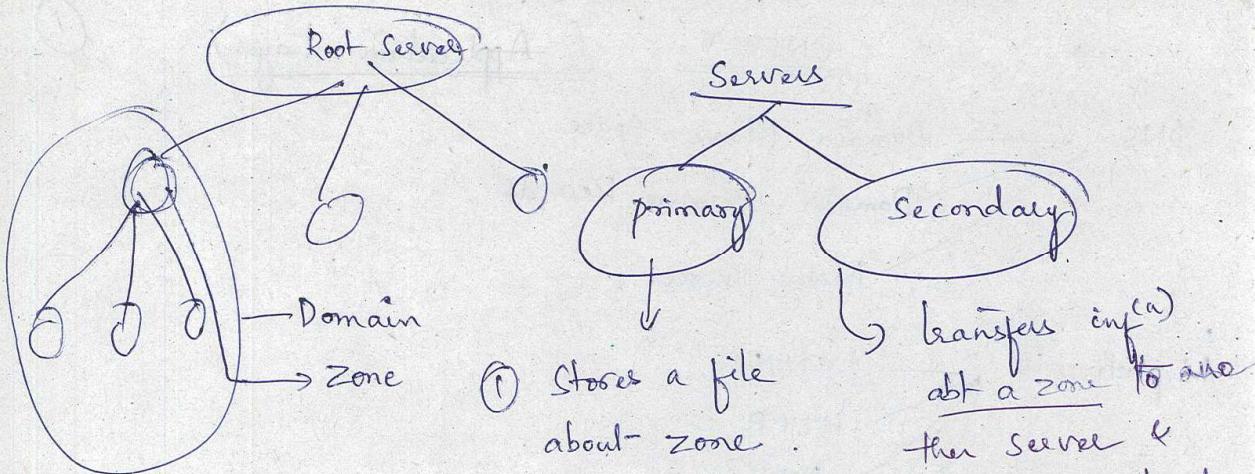
DNS is a host name used for IP address translation services.



DNS — label — node in the tree

— domain name — sequence of labels separated by dots.

fully qualified — read from node to root
partially — last label is root (null).



① Stores a file about zone.

transfers info
about a zone to another server &

② responsible for

Stores in local disk.

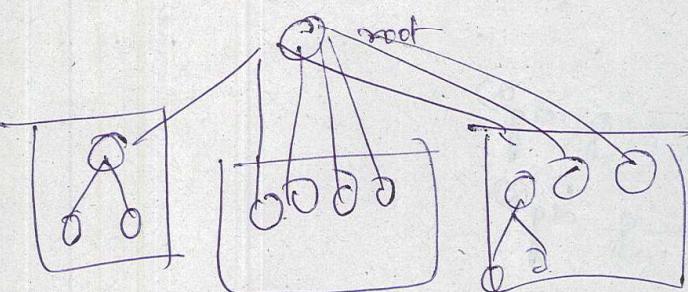
creating, maintaining & won't update, create
updating zone file.

* Stores zone file on local disk

DNS — Generic domain (registered host)

— Country domain

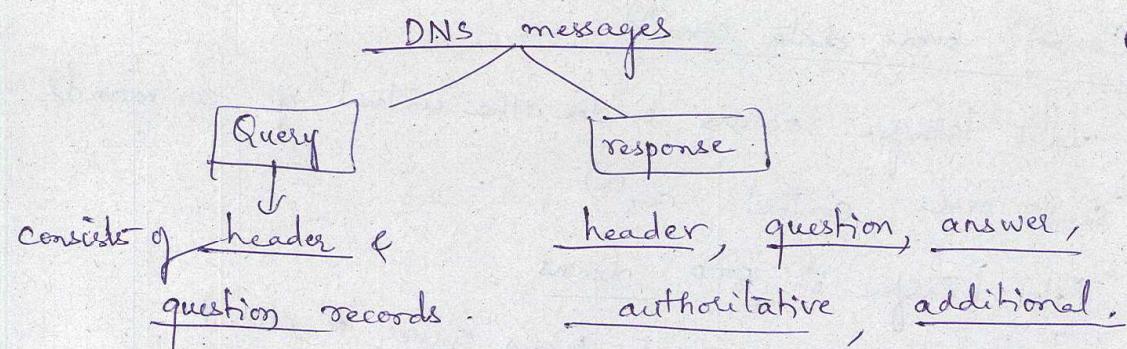
— Inverse domain



generic (3rd) edu, net, gov, mil, org, com, biz, int-

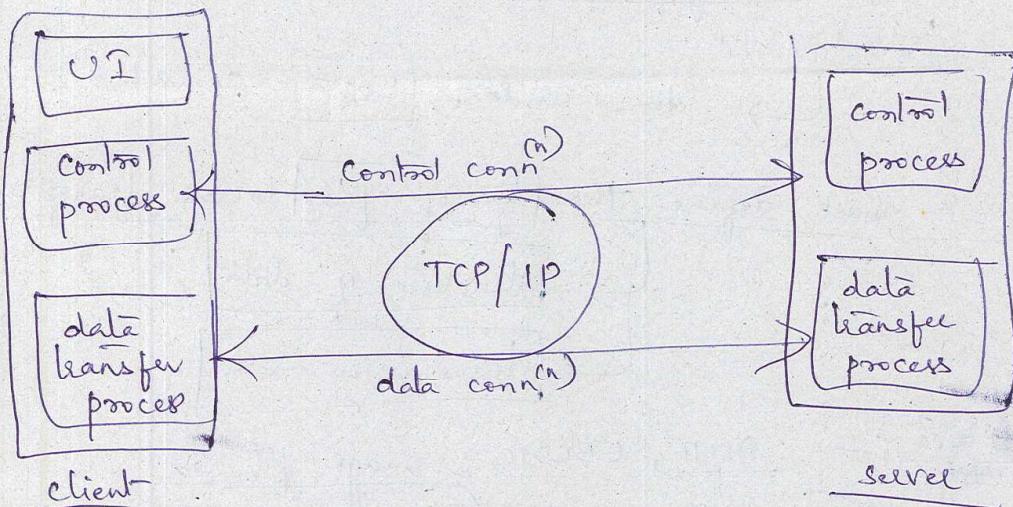
country (2nd) us

inverse used to map an address to name.



FTP (File Transfer Protocol)

- FTP uses the services of TCP
- FTP uses 2 connections b/w hosts
 - (1) used for data transfer
 - (2) used for control conn⁽ⁿ⁾ (commands & responses)
- more efficient bcoz of above
- uses 2 TCP ports
 - (20) → data connection
 - (21) → control connection



- Conn⁽ⁿ⁾ Control remains connected during entire FTP Session
- data conn⁽ⁿ⁾ opened & closed for each file transferred
- ① Comm⁽ⁿ⁾ over control conn⁽ⁿ⁾:
 - FTP uses 7-bit ASCII character set
 - Comm⁽ⁿ⁾ achieved through Commands or responses
 - each line ends with end-of-line token.

② Comm⁽ⁿ⁾ over data conn⁽ⁿ⁾ :-

- data transfer occurs under the control of commands sent over control conn⁽ⁿ⁾.
- File transfer in FTP means
- ① file is to be copied from server to client
→ called as retrieving a file.
It is done under the supervision of **RETR** command.

② file copied from client to server

- storing file
→ done under **STOR** command.

③ list of directory / file names sent from server to client

- done under **LIST** command.

* Client must define the type of file to be transferred,

- structure of data,
→ transmission mode.

① file type :- ASCII, EBCDIC → image file.
→ def → transf → binary files.
→ eq → compiled programme.
→ for text file.

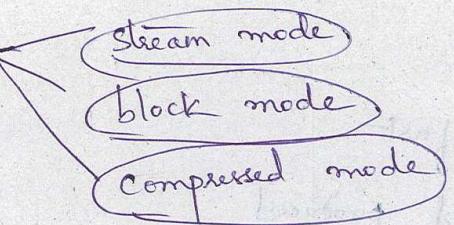
② data structures → file structure → stream of bytes.

→ used with text files → record structure → file divided records
→ page structure → divided into pages.

→ pages can be accessed randomly → each page contains
sequentially → page no., page header

(3)

② Transmission mode:



Stream mode

→ default mode.
data transfer from $\text{FTP} \rightarrow \text{TCP}$ as stream of bytes (continuously)

Block mode

→ data transfer in block

→ block preceded by a 3-byte header

first byte — block descriptor

next 2 bytes — defines size of block

Compressed mode

→ if file is too big, it can be compressed.

→ compression method is run-length encoding

Continuous data is replaced by
one data and no of repetitions.

* On text file, spaces } compressed.
* binary file — null character }

Features :-

- stateful (multiple connections)
- conn^{ctn} oriented
- can transfer one file at a time.

* advt.

- simple & fast
- widely used protocol
- more efficient

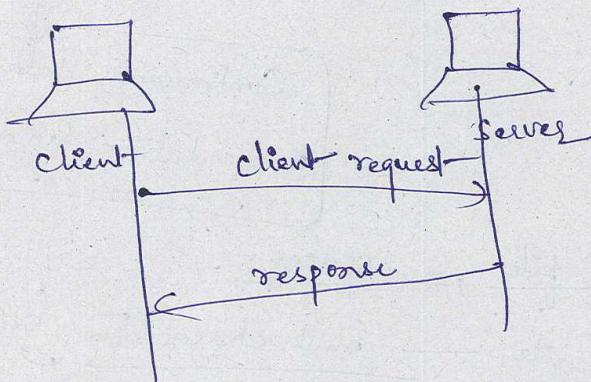
* disadvt.

- no security while transferring data.
- doesn't allow server to server copy.

HTTP

Hyper Text Transfer Protocol

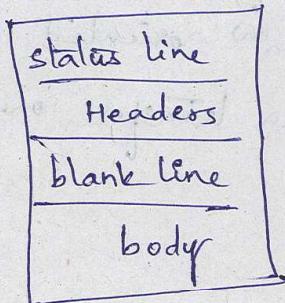
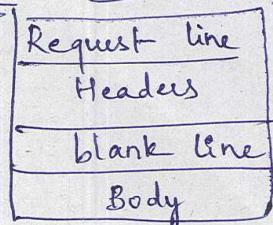
- used to access data on WWW.
- combination of FTP & SMTP
- it uses the services of TCP. (port no. 80)
- HTTP model



client initializes tx by request.

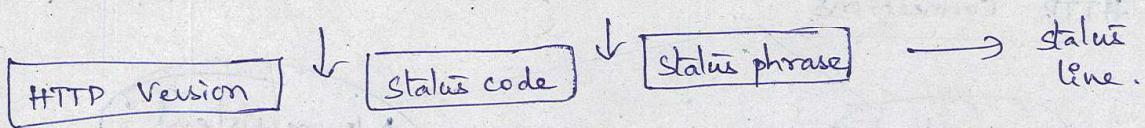
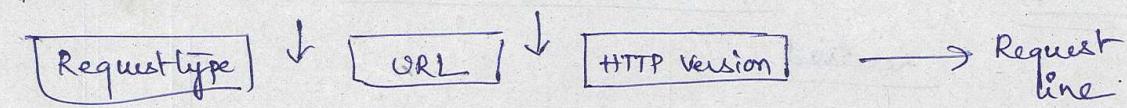
Server replies by response.

Request & response messages



Request & status lines

(4)



(1) Request type — Version 1.1

↳ is categorized into methods

GET — requests document from server

POST — sends some info^(a) from client to server

PUT — sends doc. from server to client

HEAD — requests info^(b) about document
(not the doc. exactly)

TRACE — echoes the incoming request

CONNECT — reserved

OPTION — inquires about available options.

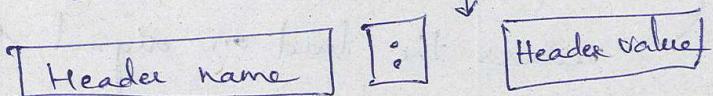
(2) URL (Uniform Resource Locator)

(3) Version — Most current version is 1.1

(4) Status code — 100 — 500 (status of response)

(5) Status phrase — explains status code in text form

Header : format



types general header — general info abt msg.

request header — client's configuration

response header — server's configuration

entity header — gives info abt body of document.

Body

it contains the document to be sent or received.

* HTTP Connections

persistent

- ① Server leaves the conn^(a) open for more requests after sending response.

- ② Server closes conn^(a) after the request of client / time-out.

Nonpersistent

one TCP conn^(a) is made for each request/response.

- ① Client opens TCP conn^(a) & sends request.
- ② Server sends response & closes conn^(a).
- ③ Client reads the data until EOF, then closes the conn^(a).

* HTTP Version 1.1

Specifies a persistent conn^(a)

by default

* HTTP supports proxy servers

A computer that keeps copies of responses to recent requests.

→ reduces the load on original server, decreases traffic & improves latency.

* Features :-

- ① stateless
- ② simple
- ③ extensible
- ④ connectionless.

* Advantage :-

- ① Connectionless
- ② platform-independent
- ③ No runtime support
- ④ reports the errors before closing connection.

* Disadvantage :-

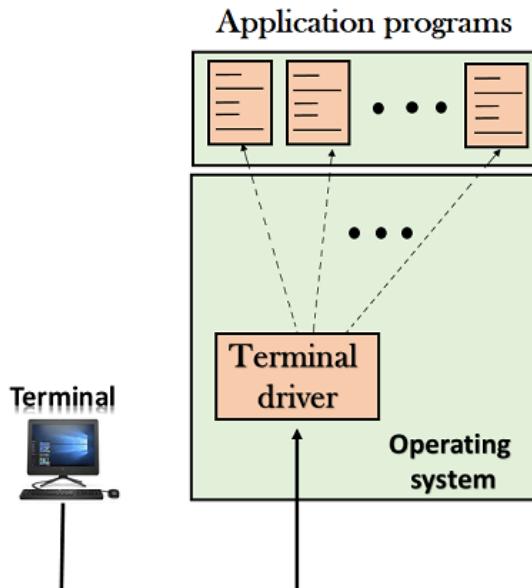
- ① Works for point-to-point connections
- ② Not optimized for mobile.
- ③ It doesn't have additional capabilities.

TERMINAL NETWORK (TELNET)

- ❖ The main task of the internet is to provide services to users. For example, users want to run different application programs at the remote site and transfers a result to the local site. This requires a client-server program such as FTP, SMTP. But this would not allow us to create a specific program for each demand.
- ❖ The better solution is to provide a general client-server program that lets the user access any application program on a remote computer. Therefore, a program that allows a user to log on to a remote computer. A popular client-server program Telnet is used to meet such demands. Telnet is an abbreviation for Terminal Network.
- ❖ Telnet provides a connection to the remote computer in such a way that a local terminal appears to be at the remote side.

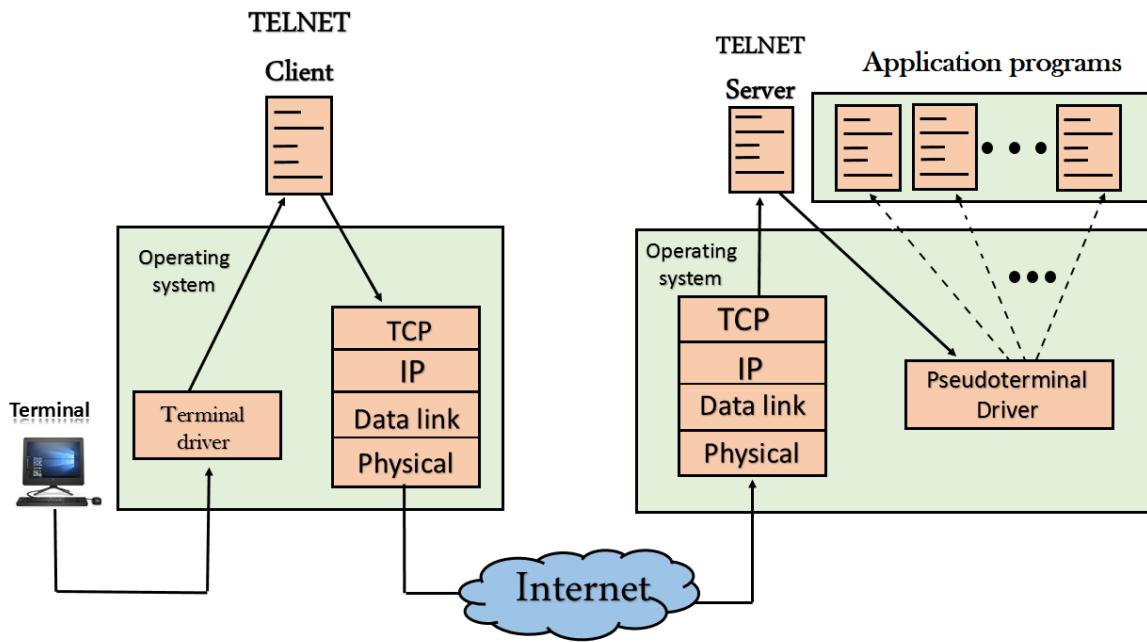
There are two types of login:-

Local Login



- ❖ When a user logs into a local computer, then it is known as local login.
- ❖ When the workstation running terminal emulator, the keystrokes entered by the user are accepted by the terminal driver. The terminal driver then passes these characters to the operating system which in turn, invokes the desired application program.
- ❖ However, the operating system has special meaning to special characters. For example, in UNIX some combination of characters have special meanings such as control character with "z" means suspend. Such situations do not create any problem as the terminal driver knows the meaning of such characters. But, it can cause the problems in remote login.

Remote login



- ❖ When the user wants to access an application program on a remote computer, then the user must perform remote login.

How remote login occurs

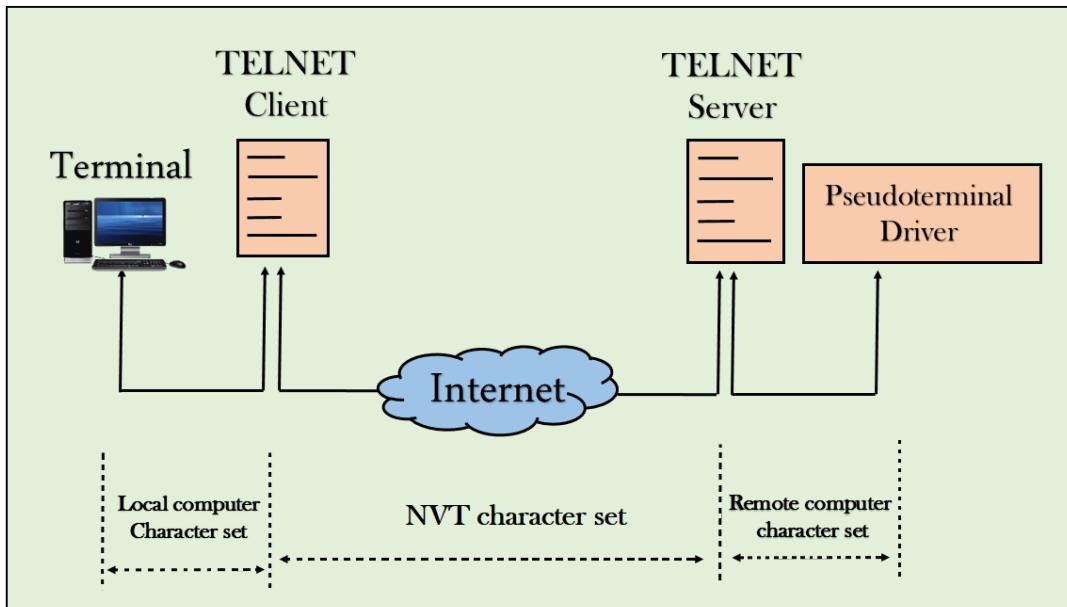
At the local site

The user sends the keystrokes to the terminal driver, the characters are then sent to the TELNET client. The TELNET client which in turn, transforms the characters to a universal character set known as network virtual terminal characters and delivers them to the local TCP/IP stack

At the remote site

The commands in NVT forms are transmitted to the TCP/IP at the remote machine. Here, the characters are delivered to the operating system and then pass to the TELNET server. The TELNET server transforms the characters which can be understandable by a remote computer. However, the characters cannot be directly passed to the operating system as a remote operating system does not receive the characters from the TELNET server. Therefore it requires some piece of software that can accept the characters from the TELNET server. The operating system then passes these characters to the appropriate application program.

Network Virtual Terminal (NVT)



- ❖ The network virtual terminal is an interface that defines how data and commands are sent across the network.
- ❖ In today's world, systems are heterogeneous. For example, the operating system accepts a special combination of characters such as end-of-file token running a DOS operating system *ctrl+z* while the token running a UNIX operating system is *ctrl+d*.
- ❖ TELNET solves this issue by defining a universal interface known as network virtual interface.
- ❖ The TELNET client translates the characters that come from the local terminal into NVT form and then delivers them to the network. The Telnet server then translates the data from NVT form into a form which can be understandable by a remote computer.

TELNET Commands

Commands of Telnet are identified by a prefix character, Interpret As Command (IAC) with code 255. IAC is followed by command and option codes.

The basic format of the command is as shown in the following figure :



TELNET Command Format

Following are some of the important TELNET commands:

Character	Decimal	Binary	Meaning
WILL	251	11111011	1. Offering to enable. 2. Accepting a request to enable.
WON'T	252	11111100	1. Rejecting a request to enable. 2. Offering to disable. 3. Accepting a request to disable.
DO	253	11111101	1. Approving a request to enable. 2. Requesting to enable.
DON'T	254	11111110	1. Disapproving a request to enable. 2. Approving an offer to disable. 3. Requesting to disable.

Following are some common options used with the telnet:

Code	Option	Meaning
0	Binary	It interprets as 8-bit binary transmission.
1	Echo	It will echo the data that is received on one side to the other side.
3	Suppress go ahead	It will suppress go ahead signal after data.

Code	Option	Meaning
5	Status	It will request the status of TELNET.
6	Timing mark	It defines the timing marks.
8	Line width	It specifies the line width.
9	Page size	It specifies the number of lines on a page.
24	Terminal type	It set the terminal type.
32	Terminal speed	It set the terminal speed.
34	Line mode	It will change to the line mode.

Uses of TELNET

- Remote Administration and Management
- Network Diagnostics
- Understanding Command-Line Interfaces
- Accessing Bulletin Board Systems (BBS)
- Automation and Scripting

Advantages of TELNET

- It provides remote access to someone's computer system.
- Telnet allows the user for more access with fewer problems in data transmission.
- Telnet saves a lot of time.
- The oldest system can be connected to a newer system with telnet having different operating systems.

Disadvantages of TELNET

- As it is somehow complex, it becomes difficult to beginners in understanding.
- Data is sent here in form of plain text, that's why it is not so secured.
- Some capabilities are disabled because of not proper interlinking of the remote and local devices.

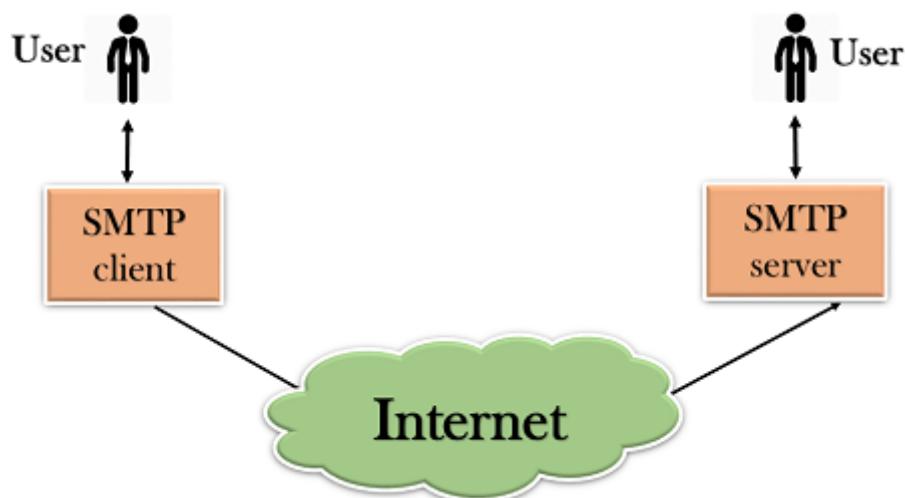
Modes of Operation

- Default Mode: If no other modes are invoked then this mode is used. Echoing is performed in this mode by the client. In this mode, the user types a character and the client echoes the character on the screen but it does not send it until the whole line is completed.
- Character Mode: Each character typed in this mode is sent by the client to the server. A server in this type of mode normally echoes characters back to be displayed on the client's screen.
- Line Mode: Line editing like echoing, character erasing, etc. is done from the client side. The client will send the whole line to the server.

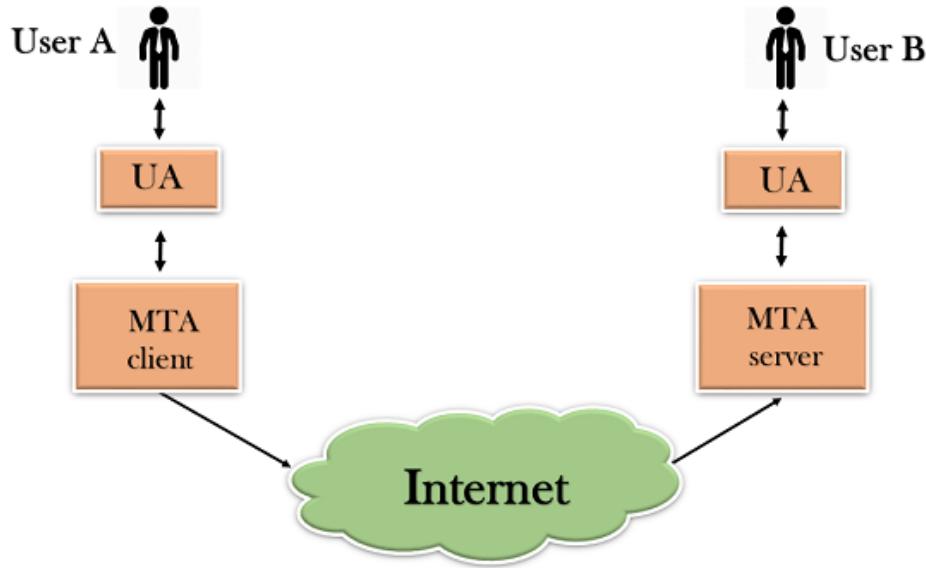
SIMPLE MAIL TRANSFER PROTOCOL (SMTP)

- SMTP stands for Simple Mail Transfer Protocol.
- SMTP is a set of communication guidelines that allow software to transmit an electronic mail over the internet is called **Simple Mail Transfer Protocol**.
- It is a program used for sending messages to other computer users based on e-mail addresses.
- It provides a mail exchange between users on the same or different computers, and it also supports:
 - It can send a single message to one or more recipients.
 - Sending message can include text, voice, video or graphics.
 - It can also send the messages on networks outside the internet.
- The main purpose of SMTP is used to set up communication rules between servers. The servers have a way of identifying themselves and announcing what kind of communication they are trying to perform. They also have a way of handling the errors such as incorrect email address. For example, if the recipient address is wrong, then receiving server reply with an error message of some kind.

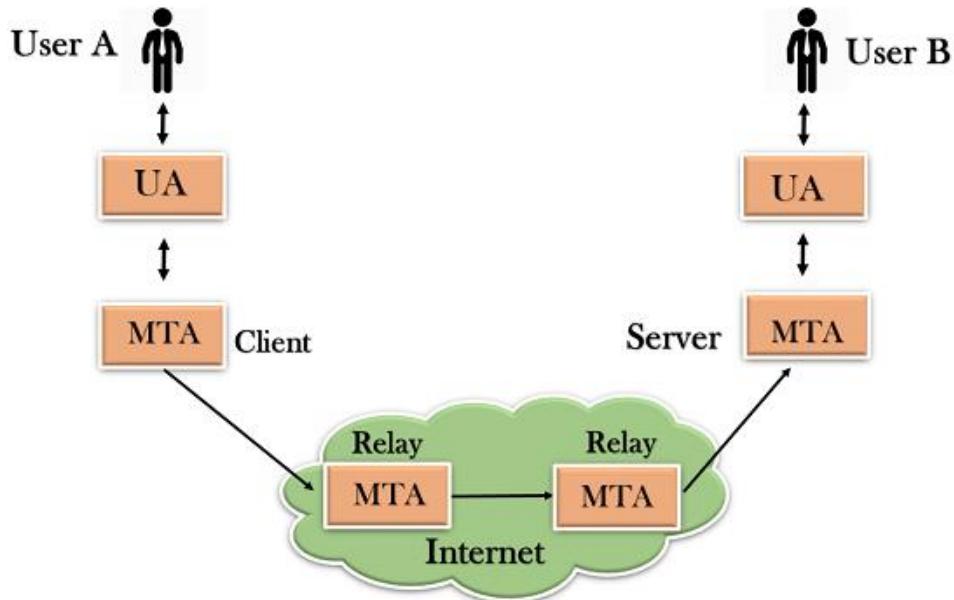
Components of SMTP



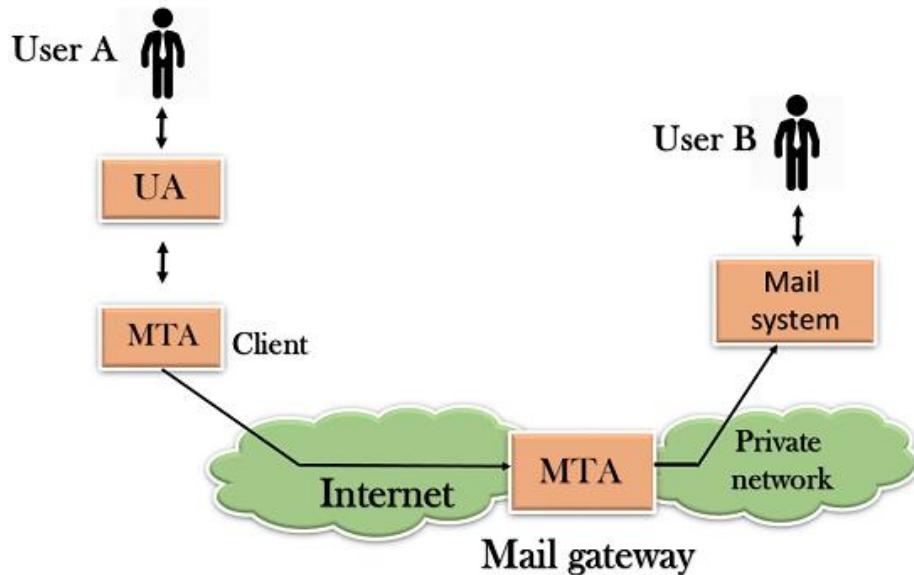
- First, we will break the SMTP client and SMTP server into two components such as user agent (UA) and mail transfer agent (MTA). The user agent (UA) prepares the message, creates the envelope and then puts the message in the envelope. The mail transfer agent (MTA) transfers this mail across the internet.



- SMTP allows a more complex system by adding a relaying system. Instead of just having one MTA at sending side and one at receiving side, more MTAs can be added, acting either as a client or server to relay the email.



- The relaying system without TCP/IP protocol can also be used to send the emails to users, and this is achieved by the use of the mail gateway. The mail gateway is a relay MTA that can be used to receive an email.



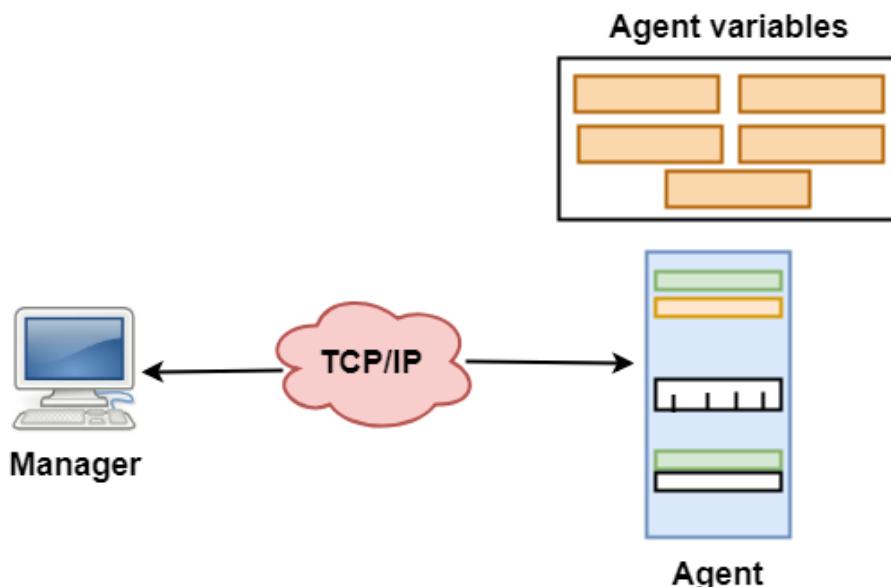
Working of SMTP

1. **Composition of Mail:** A user sends an e-mail by composing an electronic mail message using a Mail User Agent (MUA). Mail User Agent is a program which is used to send and receive mail. The message contains two parts: body and header. The body is the main part of the message while the header includes information such as the sender and recipient address. The header also includes descriptive information such as the subject of the message. In this case, the message body is like a letter and header is like an envelope that contains the recipient's address.
2. **Submission of Mail:** After composing an email, the mail client then submits the completed e-mail to the SMTP server by using SMTP on TCP port 25.
3. **Delivery of Mail:** E-mail addresses contain two parts: username of the recipient and domain name. For example, vivek@gmail.com, where "vivek" is the username of the recipient and "gmail.com" is the domain name. If the domain name of the recipient's email address is different from the sender's domain name, then MSA will send the mail to the Mail Transfer Agent (MTA). To relay the email, the MTA will find the target domain. It checks the MX record from Domain Name System to obtain the target domain. The MX record contains the domain name and IP address of the recipient's domain. Once the record is located, MTA connects to the exchange server to relay the message.
4. **Receipt and Processing of Mail:** Once the incoming message is received, the exchange server delivers it to the incoming server (Mail Delivery Agent) which stores the e-mail where it waits for the user to retrieve it.
5. **Access and Retrieval of Mail:** The stored email in MDA can be retrieved by using MUA (Mail User Agent). MUA can be accessed by using login and password.

SIMPLE NETWORK MANAGEMENT PROTOCOL (SNMP)

- SNMP stands for **Simple Network Management Protocol**.
- SNMP is a framework used for managing devices on the internet.
- It provides a set of operations for monitoring and managing the internet.

SNMP Concept



- SNMP has two components Manager and agent.
- The manager is a host that controls and 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.
- The protocol designed at the application level can monitor the devices made by different manufacturers and installed on different physical networks.
- It is used in a heterogeneous network made of different LANs and 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 program.
- Management of the internet is achieved through simple interaction between a manager and 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 example, a router can store the appropriate

variables such as a number of packets received and forwarded while the manager can compare these variables to determine whether the router is congested or not.

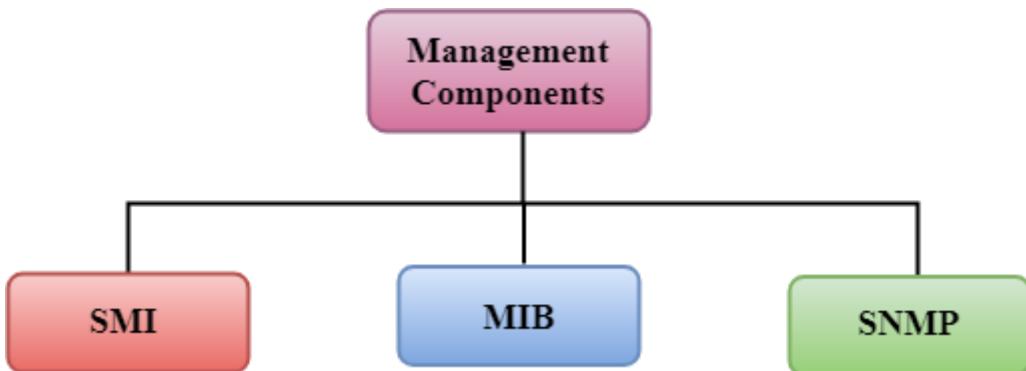
- Agents can also contribute to the management process. A server program on the agent checks the environment, if something goes wrong, the agent sends a warning message to the manager.

Management with SNMP has three basic ideas:

- A manager checks the agent by requesting the information that reflects the behavior 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.

Management Components

- Management is not achieved only through the SNMP protocol but also the use of other protocols that can cooperate with the SNMP protocol. Management is achieved through the use of the other two protocols: SMI (Structure of management information) and MIB(management information base).
- Management is a combination of SMI, MIB, and SNMP. All these three protocols such as abstract syntax notation 1 (ASN.1) and basic encoding rules (BER).



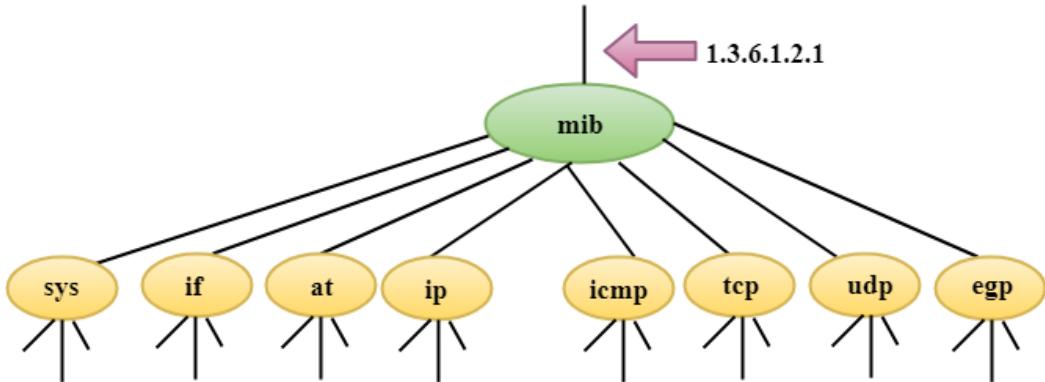
SMI

The SMI (Structure of management information) is a component used in network management. Its main function is to define the type of data that can be stored in an object and to show how to encode the data for the transmission over a network.

MIB

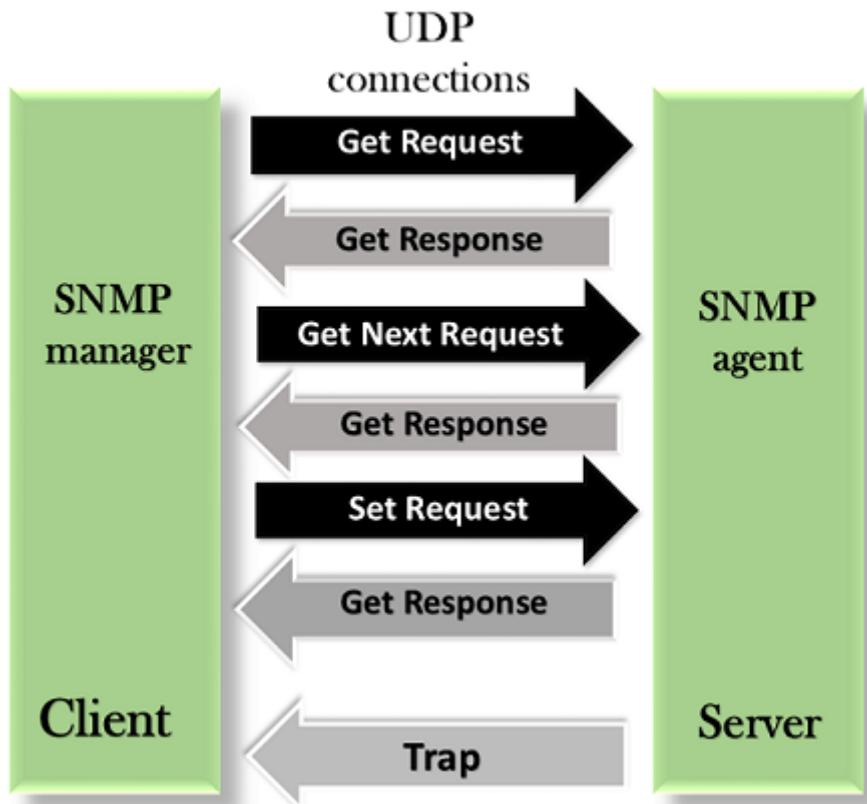
- The MIB (Management information base) is a second component for the network management.

- Each agent has its own MIB, which is a collection of all the objects that the manager can manage. MIB is categorized into eight groups: system, interface, address translation, ip, icmp, tcp, udp, and egp. These groups are under the mib object.



SNMP

SNMP defines five types of messages: GetRequest, GetNextRequest, SetRequest, GetResponse, and Trap.



GetRequest: The GetRequest message is sent from a manager (client) to the agent (server) to retrieve the value of a variable.

GetNextRequest: The GetNextRequest message is sent from the manager to agent to retrieve the value of a variable. This type of message is used to retrieve the values of the entries in a table. If the manager does not know the indexes of the entries, then it will not be able to retrieve the values. In such situations, GetNextRequest message is used to define an object.

GetResponse: The GetResponse message is sent from an agent to the manager in response to the GetRequest and GetNextRequest message. This message contains the value of a variable requested by the manager.

SetRequest: The SetRequest message is sent from a manager to the agent to set a value in a variable.

Trap: The Trap message is sent from an agent to the manager to report an event. For example, if the agent is rebooted, then it informs the manager as well as sends the time of rebooting.