

APPLICATION LAYER

INTRODUCTION

- Application layer is the top most layer of the OSI and TCP/IP reference model.
- It allows the people to use the internet.
- The layer below the application layer provides the reliable transport but they do not perform any direct work for the user.
- It provides the services to the user directly.
- It receives the services from the transport layer.
- In the application layer we need the protocol to allow the real applications to function. These are
 - (1) Network Security
 - (2) DNS (Domain Name System)
 - (3) Network Arrangement/Management

1. **Security** : Security is needed to maintain the privacy of the data.
2. **DNS** : It deals with the naming of Internet.
3. **Network Management** : How to manage the Network and supports the protocol.

8.1 DNS (DOMAIN NAME SYSTEM)

- The DNS is used to convert the domain name into the IP addresses.

- To identify an entity, TCP/IP protocol use the IP address which uniquely identify the connection of a host to the internet.
- However, people prefer to use name instead of addresses.
- Therefore we need a system that can map a name to an address and conversely and address to a name. In TCP/IP this is the Domain Name System (DNS).
- A Domain Name is user own personal internet address with his own domain name his project a corporate identify that is solely your and not advertising the internet Services Provider (ISP).
- For the communication to take place successfully, the sender and receiver both should have address and they should known be to each other.
- The addressing in application program is different from that in the other layer. Each program will have its own address format.

For example

An email address is like

balsimar @rediffmail.com

where as the address to access the web page is like

[http://www.google.com./](http://www.google.com/)

- It is important to note that there is an alias name for the address of remote host. The application program uses an alias name instead of IP address.
- The alias has to be mapped to IP address. For this an application program is needed for the services to another entity.
- This entity is an application program called DNS. DNS is not directly used by the user. It is used by another application programs for carrying out the mapping.

8.1.1 DNS in Internet.

- A domain name is used in the internet. It is an organizational level within the internet.
- Domain may be connected together to create a unique identifier for an organization, computer system or individual user.
- When connected together the domain name always proceed left to right, from most specific to most general.
- The Domain name is divided into three different sections.

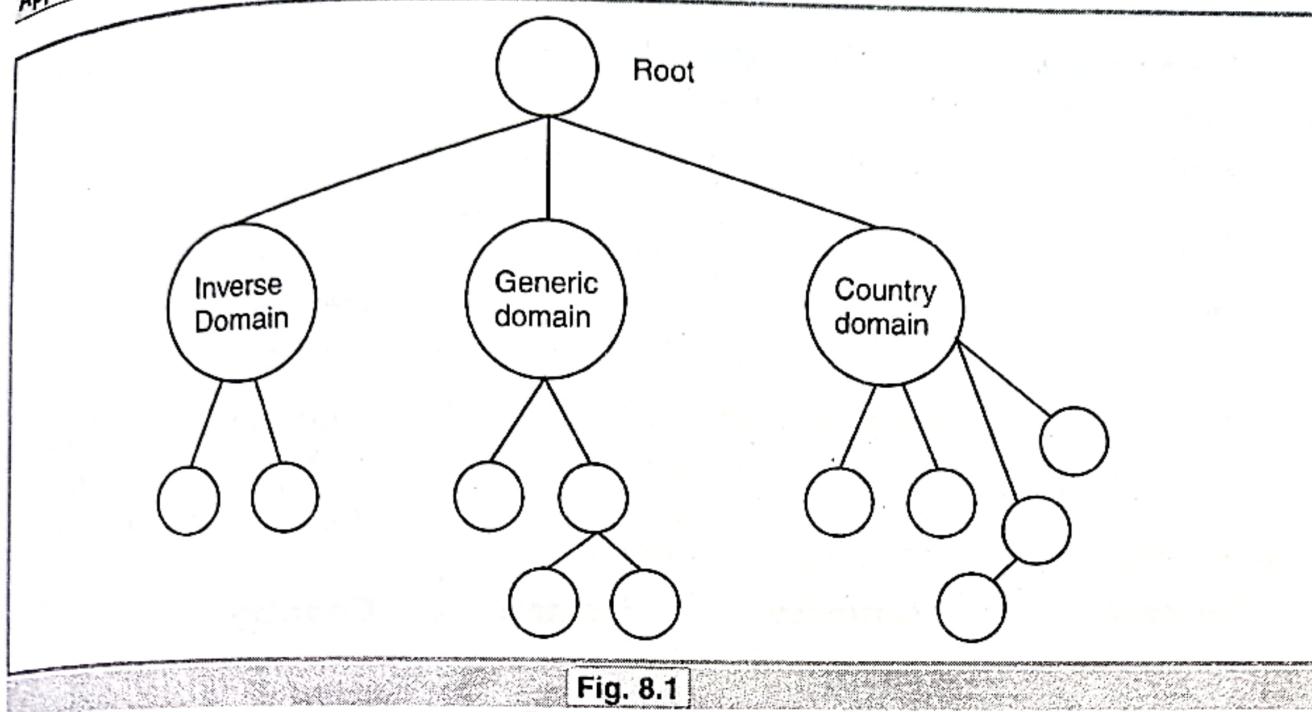


Fig. 8.1

1. Generic Domain
2. Country/Geographic Domain
3. Inverse Domain

1. Generic Domain. The generic domain defines registered host according to their generic behaviour.

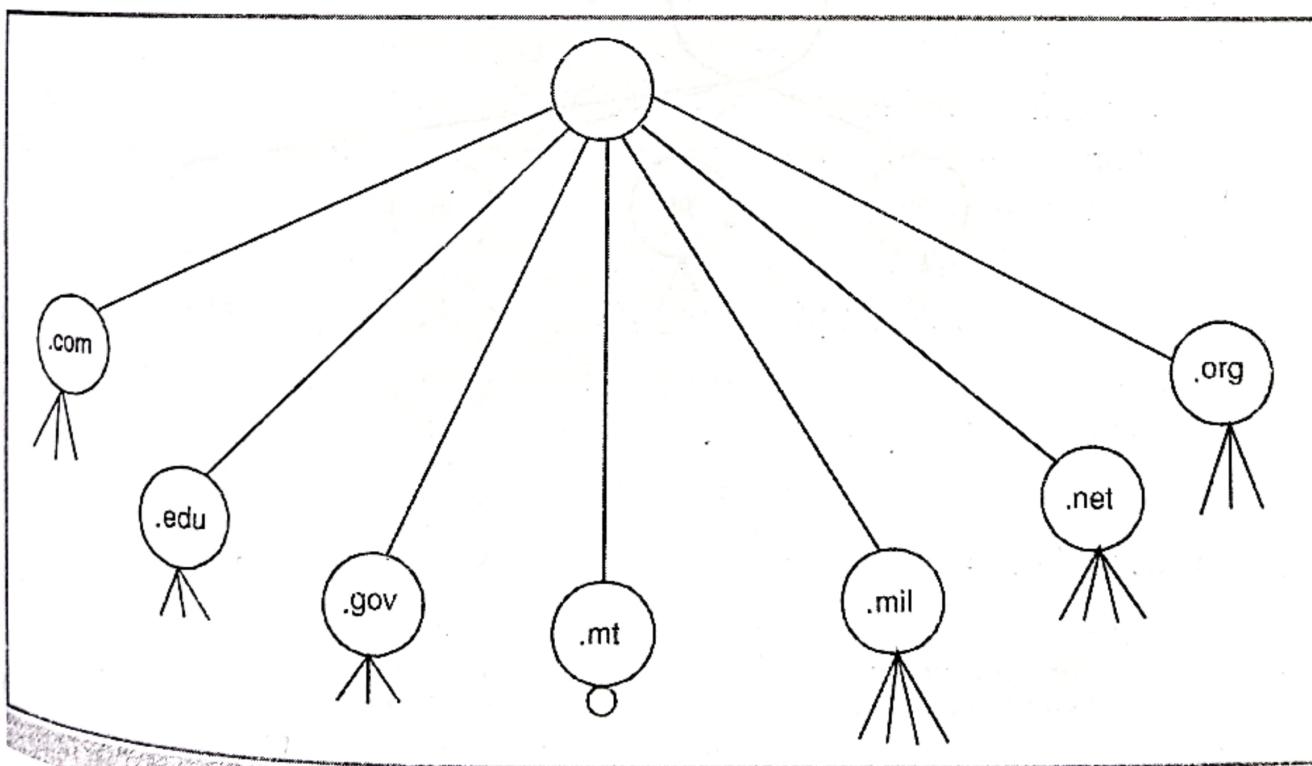


Fig. 8.2

The code indicates type of organization to which domain belongs. In this way you can see at a glance the type of the system to which network belongs. This code is consist of three characters.

Domain level	Generic Domains
	Description
.com	Commercial Organization
.edu	Educational Institution
.gov	Government Organization
.mil	Military group
.net	Network Support Centre
.org	Non Profitable Organization

2. Country/Geographic domain. In case of outside the United State, a code is included that indicates to which country it belongs. This code is consist of two characters which represents international country codes. The few common geographic domain are :

Domain	Country	Domain	Country
au	austroialia	in	India
ca	Cania	it	Itely
ch	Switzerland	mx	Maxico
dk	Denmark	jp	Japan

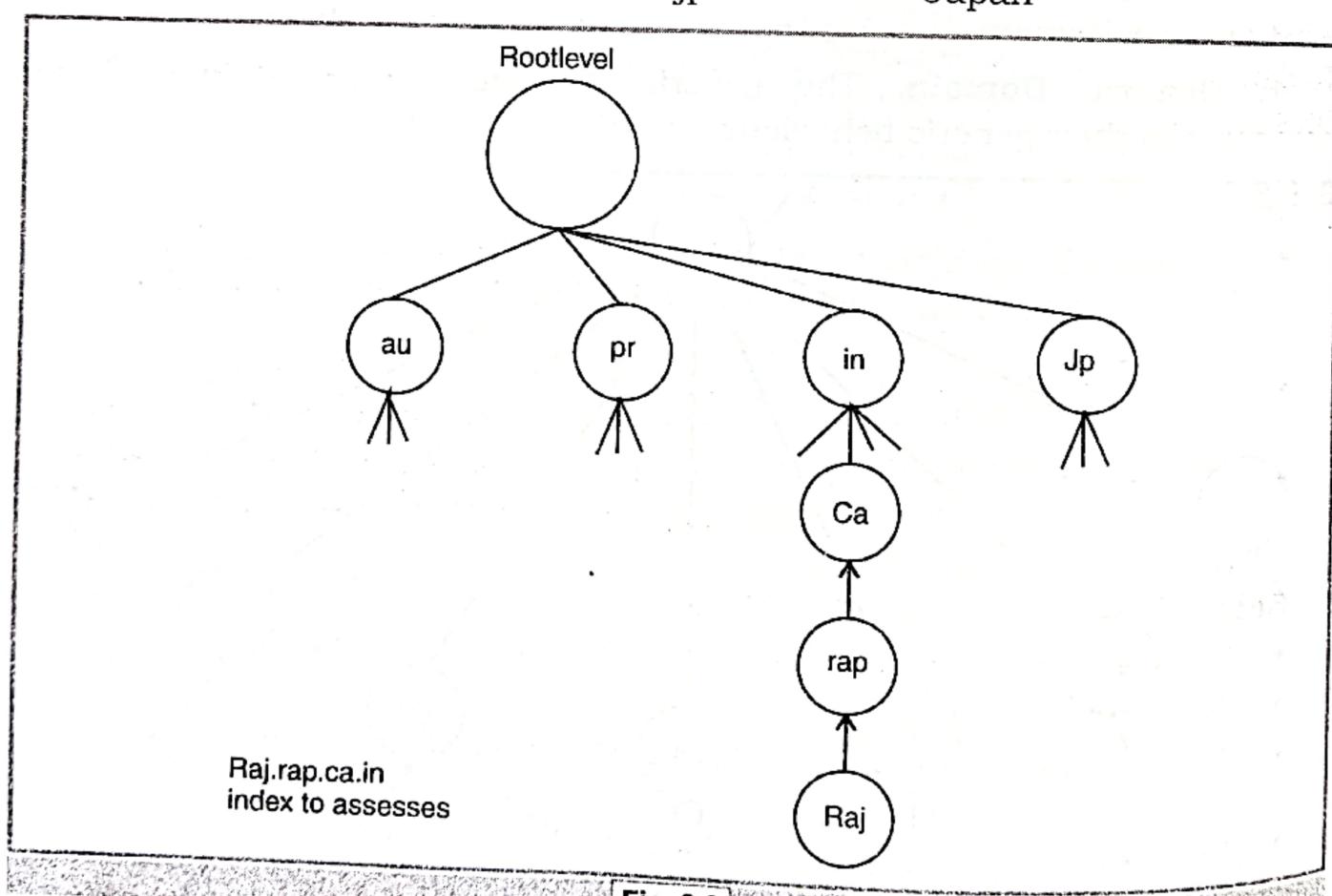


Fig. 8.3

3. Inverse Domain. It is used to map an address to a name. This may happen, for example when a server has received a request from a client to do a task. Where so the server has a file that contains

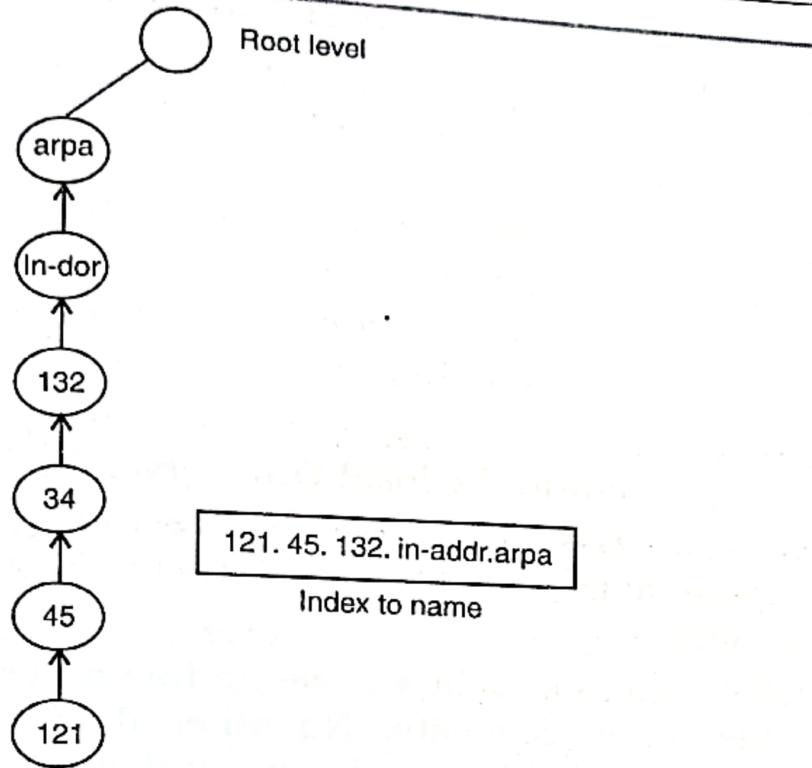


Fig. 8.4

a list of authorised clients, the server lists only the IP address of the client. To determine if the client is on the authorised list, it can send a query to the DNS server and ask for a mapping of address to name.

8.1.2 How does DNS Work ?

- To map a name into IP address, an application program calls a library procedure called the resolver. The name is passed on the resolver as a parameter.
- The resolver sends the packet to the local DNS server which looks up the name and returns the corresponding IP address to the resolver.
- The resolver then sends this address to the caller. Then the program can establish a TCP connection with destination or sends the UDP packets.

Some Important Tips about Domain

- Domain name can be of two types absolute or relative.
- Absolute and relative domain name.
- An absolute domain name always ends with a dot (or is called period).
- Relative does not end with (.) or period.
- Domain name are not **case sensitive** i.e. **.COM.** or **.com** both are same.

8.1.2.1 Address Resolution

- The process of mapping a name to an address or an address to a name is called address resolution.

8.1.2.2 Resolver

- DNS is the client server application a host which want to map a name to address or vice versa called as resolver.
- The resolver gives a domain name to the server and requests for corresponding IP address. The server checks the generic or country domain to get the mapping.
- If the domain name is from the generic domain section that the resolver receive a domain name such as
aaa.bbb.ccc.edu
- The query is sent to the local DNS server for resolution by resolver.
- If the local server does not resolve the query, it will refer to the resolver to the other server or ask them directly.

DNS Examples

- The DNS system is a data base, and no other database on the planet gets this many requests. No other data base on the planet has millions of people changing it every day, either. That is what makes the DNS system so unique.
- The most common domain name as COM, EDU, GOU, MIL, NET, ORG and INT

8.3 INTERNET WORKING

- An inter connected set of network from a user point of view may appear simply as a larger network.
- If each of the constituent network retain identity in identity and special mechanism are needed for communicating across multiple networks, then the entire configuration is often referred to as an **internet**.
- Each constituent network in an internet supports communication among the devices attached to that network, These devices are referred to in the ISO documents as Intermediate systems.(IS)
- IS provide a communication path and perform the necessary relaying and routing function so that data can be exchanged between devices attached to different networks in the internet.
- Two Types of IS of particular interest are bridges and routers.
- The differences between them have to do with the types of protocol used for the internet working logic.
- A bridge operates at layer 2 In OSI seven layer architecture.
- And acts as a relay of frames between similar networks.

- A router operates a layer 3 of OSI architecture and router packets between potentially different networks.
- Both the bridge and the routers assume that the same upper -layer protocols are in use.

8.3.1 Principle of Internetworking

The overall requirement for an internetworking facility are as follow:

1. Provide a link between networks. A minimum physical and link control connection is needed.
2. Provide for routing and delivery of data between processes on different networks.
3. Provide an accounting service that keep track of the use of the various networks and routers and maintains status information.
4. Provide the service just listed in such a way as not to require modification to that internetworking facility must accommodate a number of differences among networks including the following:
 - a. Different addressing scheme: The network may use different endpoint names and addresses and directory maintains scheme . Some form of the global network addressing must be provided , as well as directory service.
 - b. Different maximum packet size :Packet from one network may have to be broken up into smaller pieces for another . This process is referred to as segmentation, or fragmentation.
 - c. Different network access mechanism: The network access mechanism between station and network may be different for station on different networks.
 - d. Different time out: Typically , a connection -oriented transport service will await an acknowledgement until a time out expires , at which time it will retransmit its block of data . In general , longer times are required for successful delivery across multiple networks. Inter network timing procedure must allow successful transmission that avoids unnecessary retransmission.
 - e. Error recovery: Network procedures may provide anything from no error recovery up to reliable end to end service. The inter network service should not depend on nor be interfered with by the nature of the individual network's error recovery capability.

- f. Status reporting: Different networks report status and performance differently. Yet it must be possible for the internetworking facility to provide such information on internetworking activity to interested and authorized processes.
 - g. Routing technique: Intra network routing may depend on fault detection and congestion control technique peculiar to each network. The internet working facility must be able to coordinate these to route data adaptively between station on different networks.
 - h. User access control: Each network will have its own user access control technique . these must be invoked by inter network facility as needed. Further, a separate inter network access control technique may be required.
 - i. Connection, connectionless: Individual networks may provide connection oriented or connectionless service. It may be desirable for the internetwork service not to depend on the nature of the connection service of the individual network.
- Many different networks exists including LANs, MANs and WANs.
 - Various kinds of protocol are in widespread use in every layer.
 - When there are two or more networks are connected together, it form inter network.
 - A variety of different networks will always be around for following reasons.
 - First of all, the installed base of different network is large and growing.
 - ATM system are starting to be wide spread and specialized protocols are often used on satellite, cellular and infrared networks.
 - Different networks have radically different technology, so it should not be surprising that as new hardware developments that as new hardware developments occur, new software will be created to fit the new hardware.
 - Other appliances all to be networked together and can be controlled remotely.
 - This technology undoubtedly bring new protocol.
 - As a consequence of these various networks and facilities, the following scenarios are easy to imagine:

1. LAN-WAN
2. LAN-LAN
3. WAN-WAN
4. LAN-WAN-LAN

- In each case, it is necessary to insert a "black box" at the junction between two networks to handle the necessary conversions as packets move from one network to other.
- The name used for the black box containing two networks depends on the layer that does the work.
- Some common names are given below.

Layer 1: Repeaters copy individual bits between cable segments.

Layer 2: Bridge store and forward data link frames between LANs.

Layer 3: Multi protocol routers forward packets between dissimilar networks.

Layer 4: Transport gateways connect bytes streams in the transport layer.

Above 4: Application gateways allow inter working above layer 4.

(a) Gateway : Gateway term is used for the device that connects two or more dissimilar networks.

(b) Repeaters: Repeaters are low level device that just amplify or regenerate weak signals. They are needed to provide current to drive long cable.

(c) Bridges :

- Bridges are store and forward devices.
- A bridge accepts an entire frame and passes it up to the data link layer where the checksum is verified.
- Then the frame is sent down to the physical layer for forwarding on a different network.
- Bridges can make minor changes to the frame before forwarding it, such as adding or deleting some fields from the frame header.

(d) Multi protocol Routers :

- Multi protocol Routers are conceptually similar to bridges, except that they are found in network layer.
- They just take incoming packets from one line forward them on another, just as all routers do, but lines may belong to different

networks and use different protocol like IP,IPX and OSI connectionless packet protocol, CLNP.

- Like all routers,multi protocol routers operate at level of the network layer.

(e) Transport Gateways :

- Transport Gateway make a connection between two networks at the transport layer.
- This possibility later when we come to concatenated virtual circuits.

(f) Application Gateways :

- Application Gateways connect two parts of an application in the application layer.
- If one send mail from Internet Machine using the Internet mail format to an ISO MOTIS mailbox, one could send message to a mail gateway.
- The mail gateway would unpack the message, convert it to MOTIS format, and then forward it on the second network using network and transport protocol using there.
- A router knows very well whether it is an IP router, an IPX router, a CLNP router, or all three combined.
- It examines these header send make decision based on the addresses found there.
- On the other hand, when a pure router hands off a packet to the data link layer, it does not know or care whether it will be carried in an Ethernet frame or a token ring frame, that is the data link layer's responsibility.

8.4 WORLD WIDE WEB (WWW)

- The World wide web is an architectural framework for accessing linked documents and repository of information spread all over the internet.
- The WWW uses the concept of hypertext.
- In a hypertext system information is stored in a set of documents.
- The documents are liked together by pointers.
- An item can be linked with another document using the pointers.
- The user who is browsing through a document can move to other documents by clicking the links to other documents.

- A hyper text available on the web is called a page. The main page for the organization or an individual is called home page.

(i) Client Side

- The Web consists of a vast, worldwide collection documents, usually just called pages.
- Each page may contain links to others, related pages anywhere in the world. Users can follow a link which then takes them to the pages pointed to.
- This process can be repeated indefinitely, possibly traversing hundred of linked pages while doing so. Pages that point to other pages are said to use hypertext.
- Pages are viewed with a program called browser, of which Mosaic and Netscape are two popular ones.
- The browser fetches the page requested, interpret the text, formatting commands that it contains and displays the page, properly formatted on the screen. Like many web pages, this one starts with a title, contains some information and ends with emails address of the page maintainer.
- Strings of text that are links to other pages, called **hyperlink**.
- Although non-graphical browser, such as Lynx exists they are not as popular as the graphical browsers.
- Voice based browsers are also being developed.
- Most browsers have numerous buttons and features to make it easier to navigate the web.
- Many have a button for going back to previous page, a button for going forward to the next page and a button for going straight to user's own home page.
- In addition to having ordinary text and hypertext.
- Web pages can also contain icons, line drawing, maps and photographs.
- Each of these can be linked to another page. Clicking on one of these elements causes the browser to fetch the linked page and display it, the same as clicking on the text.
- With images such as photos and maps, which page is fetched next many depends on which part of the image on which next may depends on what the part of the image was clicked on.

- When hypertext was mixed text was mixed with hyper media same browser can display all the kind of hypermedia, Normally, the configuration files gives the name of the program called external viewer or helper application.
- To host a web browser,a machine must be directly on the internet or at least have a SLIP or PPP connection to a route or other machine that is directly on the internet.
- The requirement exists because the way a browser fetches a page is to establish a TCP connection.
- If it cannot establish a TCP connection to an arbitrary machine on the internet,a browser will not work.

(ii) Server Side

- Every Web site has a server process listening to for incoming connection from clients.
- After a connection has been established the clients sends one request and the server send one reply.
- Then the connection is released.
- The protocol that defines the legal requests and replies is called HTTP.
- The steps that occurs between user's click and the page being displayed are as follows:
 1. The browser determines the URL.
 2. The browser asks DNS for IP address of the site.
 3. DNS replies with IP address.
 4. The browser makes TCP connection to port on IP Address.
 5. It then sends GET main page command.
 6. The server send the main file.
 7. The TCP connection is released.
 8. The browser displays all the text of main page.
- Many browser displays which steps they are currently executing in a status line at the bottom o the screen.
- In this way,when the performance is poor, the user can see if it is due to DNS not responding, the server not responding, or simply network congestion during page transmission.
- HTTP is an ASCII protocol like SMTP, it is quite easy for a person at a terminal to directly talk to Web servers.

- All that is need a TCP connection to the server.
- The simplest way to get the such a connection is to use the Telnet Program.
- Not all the servers speak HTTP. Many older servers use FTP, Gopher or other protocols.

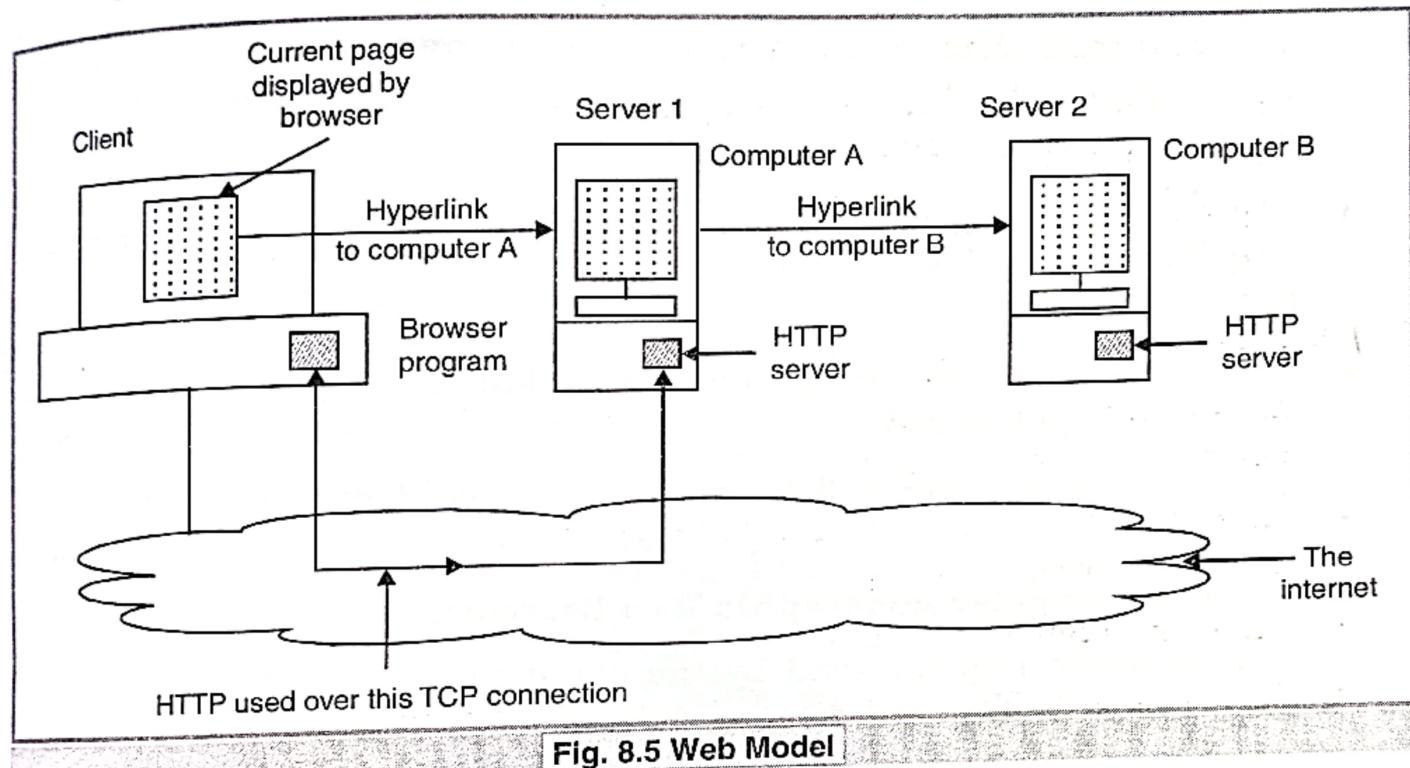


Fig. 8.5 Web Model

(iii) Common Gateway Interface (CGI) :

- The word **common** in CGI shows that this standard defines some rules which are common to any language.
- The word **gateway** indicates that a CGI program is a gateway which can be used to access other resources such as databases and graphic packages.
- Lastly the word **interface** in CGI indicates the presence of a set of terms, calls and variables which can be used in any CGI program.
- CGI is the name of a technology which creates the dynamic documents and handles them too.
- CGI is in fact a set of standards. It defines the way in which a dynamic document should be written, the way in which input data be supplied to the program and how the output result be used.
- Note that CGI is not a new language. It allows the user to use the existing language such as C, C++, Perl etc. However CGI defines rules and terms which are to be followed by the programmers.

8.4.1 Web Browser

- A web browser is the software program which is used to access the world-wide web, the graphical portion of the internet.
- The WWW clients the software that enables you to access resources on web-are called browser.
- **The software that enable you to go from one resource to another by following the hyper link is known as a web browser.** The most popular browsers are :
 - (i) **Netscape Navigator**
 - (ii) **Internet Explorer**
 - (iii) **Mosaic**
- If the computer you are using cannot handle graphics, you require non graphical browser.
- This type of browser will be able to retrieve document that contain graphics.
- **Lynx is a popular nongraphic Web Browser.**
- The resource request send by the client to server are in the form of URL (Uniform Resource Locators).
- URL are strings of characters that determine which of thousands of servers to connect to and which resource on that server to find.
- After the server locates the resource specified by the URLs the server sends the resource to the client which display it for you to work with, print or save.
- The documents sent by the server to the client are written in a language called HTML (Hyper Text Markup Language).
- HTML is a language designs to transmit the documents that contain different media format in the same document, text, graphics, movies, sounds and hyper text links to other document from other resources.
- Hyper text uses the links also called hyperlink.
- You may be reading a hypertext document and come across a link.
- It is then your choice to continue in the document or follow the link.
- This link could so to another part of the document or to another document entirely. If you have many document, all linked to many other documents you have a network (or web) of text, with in fixed beginning, no fixed ending, and no fixed way to browse the text.

- Data is moved within a network or between the networks according to established rules, called protocols.
- The Protocol of world-wide web is called HTTP hyper text transfer protocol.
- A document or file you create that can be accessed by a web browser is called web page or web site.
- The tool which is used to build the web page is called HTML.
- When you “surf the net” with a web browser you do not require a web page of your own.

8.4.2 “Surfing” The Net

- The easiest thing to do on the internet is to follow hyperlinks in an almost random fashion.
- This is sometimes referred to as a “surfing”.
- The internet of Net.
- There are only two things to keep in mind.
- First be adventures and second have a patience.
- For internet surfing, You have to make the connection on the internet service provider.
- In most of the web browser, when you run them it will come up to a default page.
- That is, they will automatically take you to the specific place on the internet, a place that's been preprogrammed by the browser company on ISP for you.
- When you are surfing the web you can choose from millions of the websites.
- Your browser has several ways of allowing you to do this.

8.4.3 Web or WWW Documents

World Wide Web documents can be grouped into three general categories. The category is based on the time when the contents of the document are determined. The three categories are Static documents. Dynamic documents and active documents.

1. Static Documents

- The contents of static documents are fixed. They are created and stored at the server. If required client can get a copy of static documents.
- It is possible to change the contents of the static document at the server but the user can not change them.
- The contents of the static documents are not changed when it is used.

2. Dynamic Document :

- The dynamic documents are not present in a predefined format, like static documents. A dynamic document is created by a web server whenever a browser requests for the document.
- Refer Fig. 8.6 to understand how a dynamic document is created and passed on to the client.
- First the client sends a request to the web server. After receiving this request, the web server will execute an application program to create a dynamic document.
- The server returns the dynamic document as a response of the request to the client.

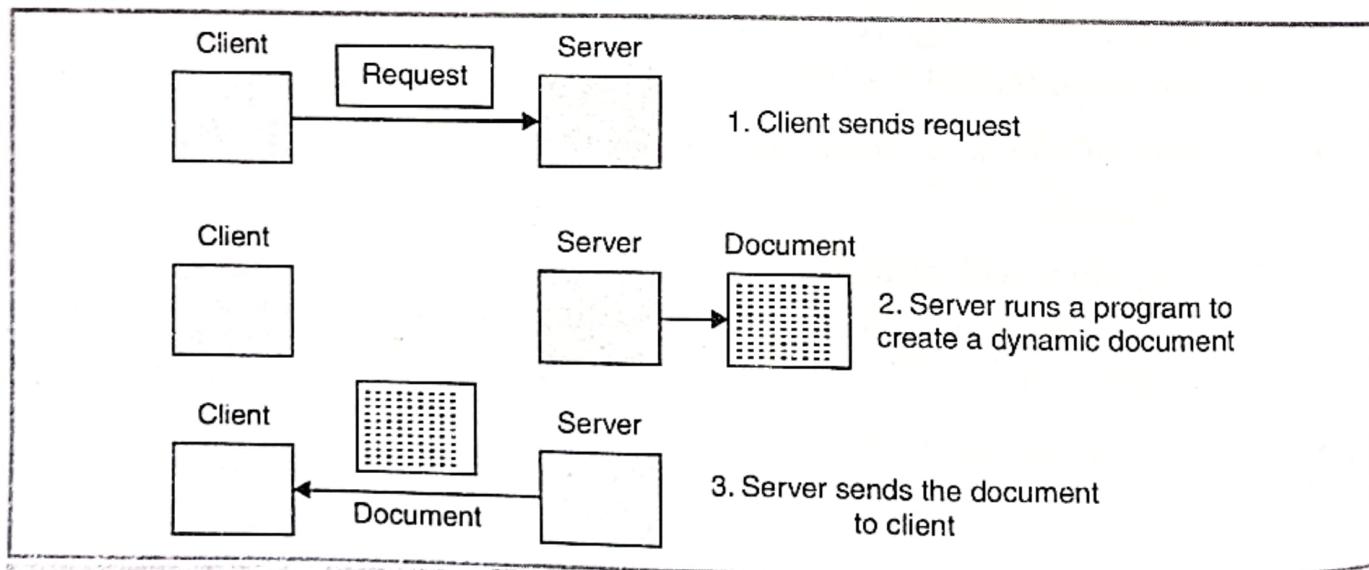


Fig. 8.6 Dynamic document

- The contents of a dynamic document will be different corresponding to every request. A simple example of a dynamic document is to get time and data from the server.
- A server follows the steps given below to handle dynamic documents :
 1. The server checks the URL in order to find if it has defined a dynamic document.

2. If the URL has defined the dynamic document, then the server executes the program.
3. The output of this program is the dynamic document. It is returned back to the client.

3. Active Documents :

- Active document can be defined as the program, that is needed to be run at the client side.
- The examples of active documents are the programs creating animated graphics on the screen or the one which helps interaction with the user.
- Refer Fig. 8.7. It shows that whenever a browser requests for an active document, the server will send a copy of document in the form of byte code. The active document will then be run at the browser (client) site.

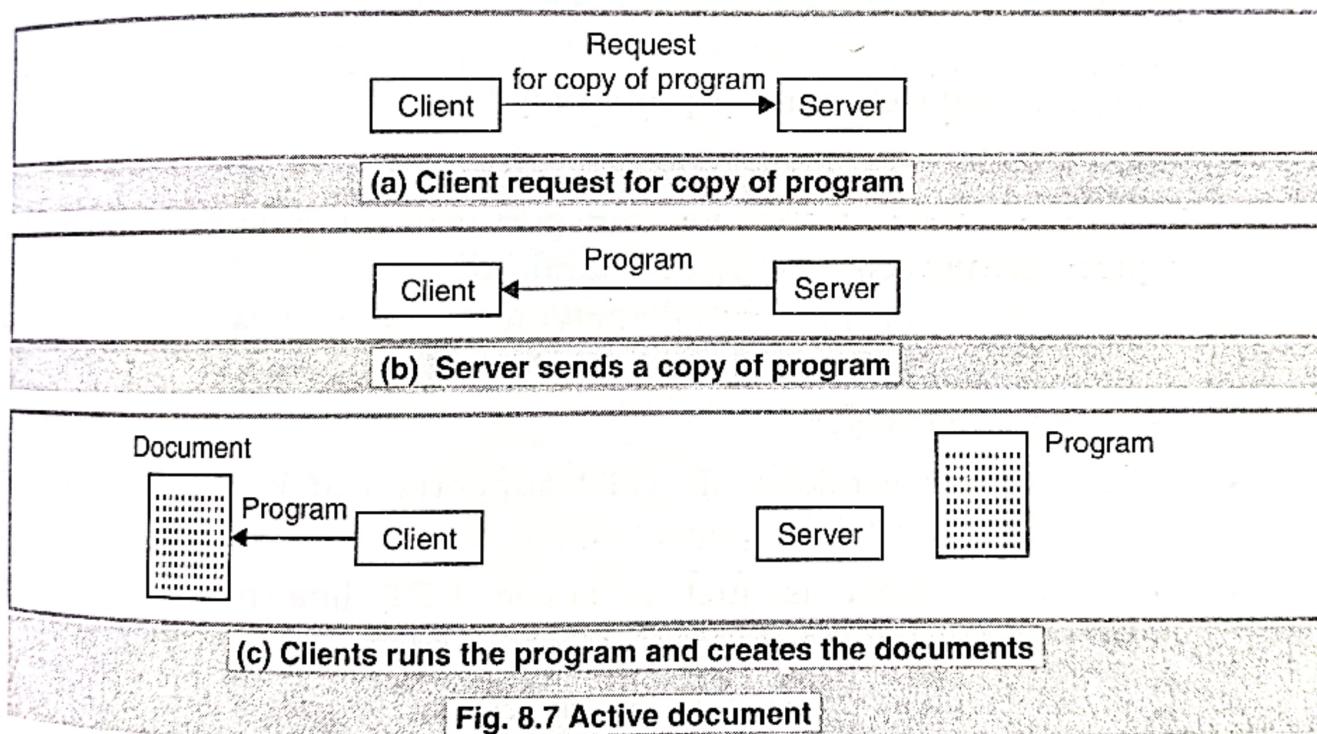


Fig. 8.7 Active document

- The server stores the active document in the form of a binary code. The active document is stored on the server but it is not run on the server.
- The client receives the document and stores it, and can run it as many times as required without repeating the request.
- The server sends the active document to the client in the binary form. So it can be compressed at the server's site and decompressed at the client's site.
- This will save the bandwidth as well as the transmission time.

Step in creation of an active document :

Refer Fig. 8.7 understand the creation, compilation and execution of an active document.

1. At the server, a program is written in source code and stored in a file.
2. Then the program is compiled and binary code is created and stored in a file at the server's site.
3. A client (browser) requests for a copy of program as shown in Fig. 8.7 (a). This program is transported from the server to the client in the compressed form.
4. The client converts the received program from binary code into executable code using its own software.
5. The client runs the program to create a result which can include animation or interaction with the user.

8.5 HTTP-HYPER TEXT TRANSFER PROTOCOL

- The Standard web transfer protocol is HTTP.
- Each interaction consists of one ASCII request.
- Although the use of TCP for transport connection is very common, it is not formally required by the standard.
- The HTTP protocol consists of two fairly distinct items, the set of requests from browsers to servers and the set of the responses going back the other way.
- All the newer versions of HTTP supports two kinds of requests : Simple request and full requests.
- A simple request is just a single GET line naming the page desired. The response of just RAW page.
- The full request contains the command the page desired and the protocol /version.
- HTTP was designed for use in the web, it has been intentionally made more general than necessary with an eye to future object -oriented applications.
- The first word on the full request line is simply the name of the method to be executed on the web page.
- The GET methods requests the server to send the page.
- Using this mechanism, a browser that is asked to display page can conditionally ask for it from the server, giving the modification time associated with the page.

- The HEAD Method just asks for the message header without the actual page.
- This method can be used to get a page's time of last modification to collect information to collect the indexing purposes or just test a URL for validity.
- The PUT method is reverse of GET instead of reading the page, it writes the page.
- This method makes it possible to build a collection of web pages on the remote server.

8.5.1 URL(Uniform Resource Locator)

- To access a web page one requires an address.
- For easy access of documents distributed all over the world WWW uses the concept of locator.
- The uniform resource locator is a standard for defining any kind of information on the internet. URL defines only three things : method, host, computer and path name.

Method: The method is a protocol used to retrieve the document. There are several different protocol that can retrieve a document. Gopher, FTP, HJTP, NEWS and TELNET are such protocol.

Host: The Host is the computer at which the information is available. However, the name of the computer can be alias. Web pages are usually stored in computers given alias names begin with www.

Path : Path is the path name of the files where the information is located. Path can contain slashes that separate directories from subdirectories and files in the UNIX operating system.

URL : URL has three parts

1. Name of the protocol (e.g. http.).
2. Name of the machine where the page in located.
3. The name of the file containing the page.

The example of URL is as follows.

<u>http:// www.w4.org / h y p e t e x t / w w w / p r o j e c t . h t m l</u>		
Protocol	Machine name	File name containing the page

Protocol Machine Name File name containing the page.

Steps between the user's click and page being displayed :

1. The browser determines the URL.

2. Browser ask the DNS for IP address for the specified machine.
3. DNS sends the IP address.
4. Browser establishes the TCP connection.
5. Browser sends a command reading.
6. The specified machine sends the file.
7. TCP connection is released.
8. Browser displays all the text.
9. Browser fetches all the images.
10. HTTP is an ASCII Protocol. So it is easy for a person at a terminal to directly take to the servers. All that is needed a TCP connection on the server and to get such a connection for that TELNET is used.

8.5.2 PROXY SERVER

- Proxy server is a gateway which speaks HTTP to the browser but FTP, Gopher or some other protocol to the server.
- It receives HTTP requests from a browser, convert them in FTP or gopher requests and sends them to the FTP server.

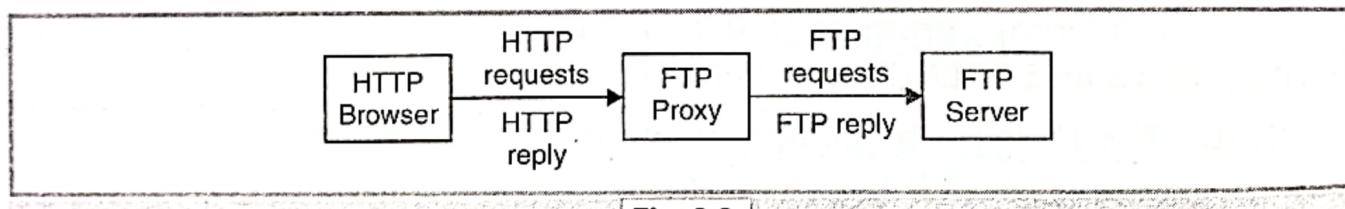


Fig. 3.8

- Proxy server can be program running on the same machine working as a browser or it can be a free standing machine.
- The user can configure their browser with proxies for protocol that browser cannot speak.
- One of the most important features of a proxy server is caching. A caching proxy server collects and stores all the pages which pass through it.
- When a user asks for a page, the proxy sever is to see if it has page stored with it.
- If the page is there then it will see if the page is upto date.
- If the page is current, it passes the page to the user otherwise a new copy of page is fetched.

A proxy server can be put inside a firewall. The user can access the web but he is not allowed the full internet access.

8.6 E-MAIL PROTOCOL

- As with any client server application e-mail software has communication standards in regard to transmitting messages and attachment.

8.6.1 POP & SMTP

- Internet mail uses the Post Office Protocol(POP), which describes how e-mail clients interact with e-mail servers and the simple Mail Transport Protocol (SMTP), which describes how e-mail servers transfer e-mail messages to their standard recipient.
- SMTP is the standard protocol for transferring mail between hosts in the TCP/IP suite.
- Mail is created by a user agent program in response to use agent program in response to user input.
- Each created message consists of a header that includes the recipient e-mail address and other information, and a body containing the message to be sent.
- These messages are then queued in some fashion and provided as input to an SMTP sender Program, which is typically an always – present server program on the host.
- The SMTP sender takes messages from the out going mail queue and transmits them to the proper destination host via SMTP transactions over or more TCP connection the target hosts.
- A host may have multiple SMTP senders active simultaneously if it has a large volume of outgoing mail, and should also have the capability of creating SMTP receives on demand so that mail from one host can not delay mail from another.
- The SMTP protocol is used to transfer a message from the SMTP sender to the SMTP receiver over a TCP connection.
- SMTP attempts to provide reliable operation but does not guarantee to recover from lost message.
- No end to end acknowledgement is returned to a message originator that a message is successfully delivered to the message recipient, and error indication are not guaranteed to be returned either.
- The SMTP based mail system is generally considered reliable.

- The SMTP receiver accepts each arriving message and either places it in the appropriate user mailbox or copies to the local outgoing mail queue if forward is required.
- The SMTP receiver must be able to verify local mail destination and deal with error, including transmission errors and lack of disk file capacity.

8.6.2 X.400 and X.500

- Some cross platform e-mail system use the ITU(International Telephony Uniformerly the CCITT) X.400 messaging protocol and the X.500 directory server protocol to implement mail standards.
- These protocols are international standards, but they are not the predominant e-mail protocols.

8.6.3 MHS

- Message handling Service (MHS) is the Novell Netware e-mail standard.
- It is similar to X.400 but it does not follow X.400 standards.
- Many older local area networks use the MHS e-mail standard.

8.6.4 MAPI

- Message Application Programming Interface (MAPI) is the standard for messaging in Microsoft networks and is the internal mail standard used by Exchange.
- Microsoft Exchange now supports both MAPI and the Internet protocols, but it uses MAPI for its internal storage and message generated by application.

8.6.5 USENET

- One of the most popular application of computer networking is the world wide system of newsgroup called net news.
- Often net news is referred to as USENET, which works back to a separate UNIX-to-UNIX physical network that once carried the traffic using a program called UUCP.
- USENET and the Internet are not the same. Some internet sites do not get news and other sites get net news without being on internet.

8.6.6 X.25

- X.25 is most popular used in ISDN.

- It defines the procedure for data transmission between a DTE(Data Terminal Equipment) to DCE(Data Communication Equipment).

X.25 specifies three layer that corresponds to the OSI Model. The layer are:

1. The Physical Layer.
2. The link access procedure balanced (LAPB) layer.
3. The packet level protocol (PLP) layer which is the Network layer.

The LAPB and PLP layers perform both flow and error control.

- The network layer, PLP, handles connection establishment and termination, data transfer and packet creation protocol.
- The PLP Creates two types of packets –information packet and control packets.
- X.25 offers several advantages including the protocol that handles resizing of messages.
- As many as 4096channels can be multiplexed at the PLP level.x.25 uses a virtual circuit approach to packet switching (SVC and PVC) rather than a datagram approach and uses asynchronous TDM for multiplexing packet.
- X.25 is widely used in Wide Area Network because of its simplicity and easy interfacing with equipment networks.

Features

- (a) Virtual circuit switching and dynamic virtual routing to transport self-contained, self-addressed messages packets.
 - (b) Ability to use any available network channels or links.
 - (c) Ability to use any redundant error checking at every node.
- X.25 allows various devices called data terminal equipment (DTE) to talk to the public data network (PDN).
 - The PDN is called data communication equipment(DCE) like modems, packets,switches and other parts. Hardware/software devise, such as terminals, hosts and routers that deliver data are DTE.
 - The X.25 protocol is a DTE to DCE synchronous interface.
 - To start communication, one DTE device called another DTE with a request for data exchange session.
 - The DTE called can accept or refuse the request.

- If accepted, two systems begin full-duplex data transfer. Either side can terminate the connection at any time.
- X.25 is stable system. There are almost no data errors on x.25 network.
- The store and forward mechanism causes delays.
- On most single networks the turn around delay is about 6 seconds.
- This does not matter for large block transfer, but in transmission with extensive back and forth communication, the delay can be noticeable.
- Line speeds normally used with X.25 are too slow to provide most LAN applications services on a WAN.

8.7 ELECTRONIC MAIL (E-MAIL)

- E-mail is a private communication between two parties who have account on the internet.
- It is an electronic message sent from one computer to another.
 - You can send or receive personal and business related message with attachment, such as picture or formatted documents etc.
 - E-mail passes from one computer, known as a mail server to another as it travels over the internet.
 - Once it arrives at the destination mail server, it is stored in the electronic mail box until the recipient receives it.
 - This whole process can take few seconds, allowing you to quickly communicate with the people around the world at any time of the day or night.
 - To receive the mail you must have an account on a mail server.
 - This is similar to having an address where you receive letters.
 - One advantage over regular mail is that you can retrieve your e-mail from a remote location.
 - Once you contact your mail server, you can download your messages.
 - To send the e-mail you need an internet connection.
 - The standard protocol used for sending e-mail on the internet is called SMTP for standard mail transfer protocol.

- It works in the conjunction with POP server. POP stands for Post Office Protocol.
- Earlier you can send only the short messages. You can not at send attachments like formatted documents or graphics with unhelp MIME which stands multipurpose internet mail exchange you can send photographs, sound files, vedio files etc.

8.7.1 Structure of E-mail Message

E-mails message are similar to letters with two parts.

1. Header
2. Body of Message

1. **Header.** Header contains the name and address of the recipient, name and address of anyone who is being copied, subject of message.

2. **Body.** Body contains the message itself.

- Just like with letters, you need the correct address, if you me the wrong address or mistype it, your message will get bounce back to you-i.e. return back to sender.

8.7.2 Understanding E-mail Address

- An email address is read from left to right for example.
- It should be written in small letter balsimar @ yahoo. com is read as "balsimar at rate of yahoo dot.com."
- Here balsimar is the user name the person sending the e-mail.
- In addition to user name there is a domain. This is the ISP address.
- In the above address it is yahoo. com.
- The "@" symbol is the divider between the user name and the rest of e-mail addresses, which contains the information about which computer on the internet the person is located on.
- Electronic mail(e-mail) is an application that allow users connected to the some network to exchange files without having to be logged in at the same time.
- Users can compose e-mail message and send them to the mailbox some times called message box of any one with an e-mail accept on the network by including that users e-mail address in the address line of the e-mail message.
- E-mail send the way regular postal mail works, but because it is transferred electronically between e-mail servers(post office), it is nearly instantaneous, free of charge, and does not waste paper.

8.7.3 Components of an E-mail System

- A single application on your computer can provide the functionality of e-mail if it checks a central database stored on a server or on your client computer for new mail.
- This functionality can also be supplied by a client application that queries an e-mail server for mail functions.
- Small LAN and peer to peer networks typically rely on the first type, and larger networks and the Internet rely on the second type.
- Some e-mail application, such as Microsoft Exchange can work in either capacity.

(1) E-Mail Clients:

E-Mail Clients provide a view of each users mail box. They allows users to

1. Compose E-Mail
2. Read E-Mail
3. Forward E-Mail Messages to Other users
4. Save or Delete E-Mail Message
5. Attach files to message
6. Request a return receipt
7. Check for new mail(E-mail server system only)
8. Provide an " address book " or directory of e-mail users.

8.7.4 E-Mail Server:

RoV

- E-mail servers store and transfer messages on the network.
- e-mail works the servers as the post -offices of e-mail.
- In fact, the primary internet e-mail server protocol is called the Post Office Protocol(POP).
- E-mail servers also typically act as e-mail gateways to convert the message contents and attachments between different proprietary e-mail systems.
- You may need to convert mail from one system to another.
- For instance your network may use MHS and you want to receive mail from the Internet, which use SMTP or you are using an X.400 mail system and you need to connect to the MHS mail on the Novell network.

- A gateway is a device that converts mail from one standard to another. It is usually a dedicated computer, although it can be a program that is run on the network server.

SUMMARY

- Computer Networks are inherently insecure. To keep information secret key must be Encrypted. Encryption protocol falls into general classes secret key and public key.
- In addition to provide secrecy, cryptographic protocols can also provide authentication. Cryptography can also be used to allow messages to be signed in such a way that sender cannot repudiate them after they have been sent.
- Naming in the Internet uses a distributed database system, DNS. DNS holds records with IP addresses, mail exchanges, and other information. By querying a DNS server, a process can map the Internet domain name onto the IP address used to communicate with that domain.
- As networks grow larger, they become harder to manage. For this reason, special network management systems and protocols have been devised, the most popular of which is SNMP. This protocol allows managers to communicate with agents inside devices to read out their status and issue commands to them.
- Four major network applications are electronic mail, USENET news, the World Wide Web, and multimedia (video on demand and MBone). Most email systems use the mail system defined in RFCs 821 and 822. Messages sent in this system use system ASCII headers to define message properties. These messages are sent using SMTP. Two systems for securing email exist, PGP and PEM.
- USENET news consists of thousands of newsgroups on all manner of topics. People can join newsgroups locally, and then post messages all over the world using the NNTP protocol, which has some resemblance to SMTP.
- The World Wide Web is a system for linking up hypertext documents. Each document is a page written in HTML, possibly with hyperlinks to other documents. A browser can display a document by establishing a TCP connection to its server, asking for the document, and then closing the connection. When a hyperlink

is selected by the user, that document can also be fetched in the same way. In this manner, documents all over the world are linked together in a giant web.

- Multimedia is the rising star in the networking. It allows audio and video to be digitized and transported electronically for display. Most multimedia projects use the MPEG standards and transmit the data over ATM connections.

EXERCISE

SHORT ANSWER TYPE QUESTIONS

- What do you understand by DNS ?
- What is internet working ?
- What do you mean by Application Gate way ?
- What is client side in WWW ?
- What is hyper link ?
- Explain URL.
- What are the various component of E-mail ?
- What do you understand by POP ?
- What are the three layers of OSI model which are used in X.25 ?
- What are the uses of USENET ?
- What is MAPI ?

DESCRIPTIVE QUESTION

- Write a short note on Application Layer.
- What is electronic mail ? Explain the features of TCP/IP protocol.
- Define WWW. Explain the use of concept of locator in it.
- What are the different types of documents available in WWW documents ? Explain with the help of example.
- Write short note on :
 - URL
 - Proxy Server
 - POP and SMTP
 - Component of Email System
 - “Surfing” the net