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Class: B.Sc. Computer Science (Entire)- III   **Semester : 6**

Course Title: Computer Network

UNIT IV- Application Layer

- **Application Layer**
- ➢ The application layer in the OSI model is the closest layer to the end user which means that the application layer and end user can interact directly with the software application. The application layer programs are based on client and servers.
- **The Application layer includes the following functions:**
1. **Identifying communication partners:** The application layer identifies the availability of communication partners for an application with data to transmit.
2. **Determining resource availability:** The application layer determines whether sufficient network resources are available for the requested communication.
3. **Synchronizing communication:** All the communications occur between the applications requires cooperation which is managed by an application layer.

- **Services of Application Layers:**

1. **Network Virtual terminal:**

➢ An application layer allows a user to log on to a remote host.

➢ To do so, the application creates a software emulation of a terminal at the remote host.

➢ The user's computer talks to the software terminal, which in turn, talks to the host.

➢ The remote host thinks that it is communicating with one of its own terminals, so it allows the user to log on.

2. File Transfer, Access, and Management (FTAM):

➢ An application allows a user to access files in a remote computer, to retrieve files from a computer and to manage files in a remote computer.

➢ FTAM defines a hierarchical virtual file in terms of file structure, file attributes and the kind of operations performed on the files and their attributes.

3. Addressing:

➢ To obtain communication between client and server, there is a need for addressing.

➢ When a client made a request to the server, the request contains the server address and its own address.

➢ The server response to the client request, the request contains the destination address, i.e., client address.

➢ To achieve this kind of addressing, DNS is used.

4. Mail Services:

➤ An application layer provides Email forwarding and storage.

5. Directory Services:

➤ An application contains a distributed database that provides access for global information about various objects and services.

6.Authentication:

➤ It authenticates the sender or receiver's message or both.

- **Application Layer Protocols:**

1. Domain Name System (DNS)

2. Simple Mail Transfer Protocol (SMTP)

3. File Transfer Protocol (FTP)

4. Hyper text Transfer Protocol (HTTP)

5. Terminal Network (TELNET **)**

1. Domain Name System (DNS):

➤ An application layer protocol defines how the application processes running on different systems, pass the messages to each other.

➤ DNS stands for Domain Name System.

➤ DNS is a directory service that provides a mapping between the name of a host on the network and its numerical address.

➤ DNS is required for the functioning of the internet.

➤ Each node in a tree has a domain name, and a full domain name is a sequence of symbols specified by dots.

➤ DNS is a service that translates the domain name into IP addresses. This allows the users of networks to utilize user-friendly names when looking for other hosts instead of remembering the IP addresses.

➤ For example, suppose the FTP site at EduSoft had an IP address of 132.147.165.50, most people would reach this site by specifying ftp.EduSoft.com. Therefore, the domain name is more reliable than IP address.

➤ DNS is a TCP/IP protocol used on different platforms.

➤ The domain name space is divided into three different sections: generic domains, country domains, and inverse domain.

Inverse domain   Generic domains   Country domains
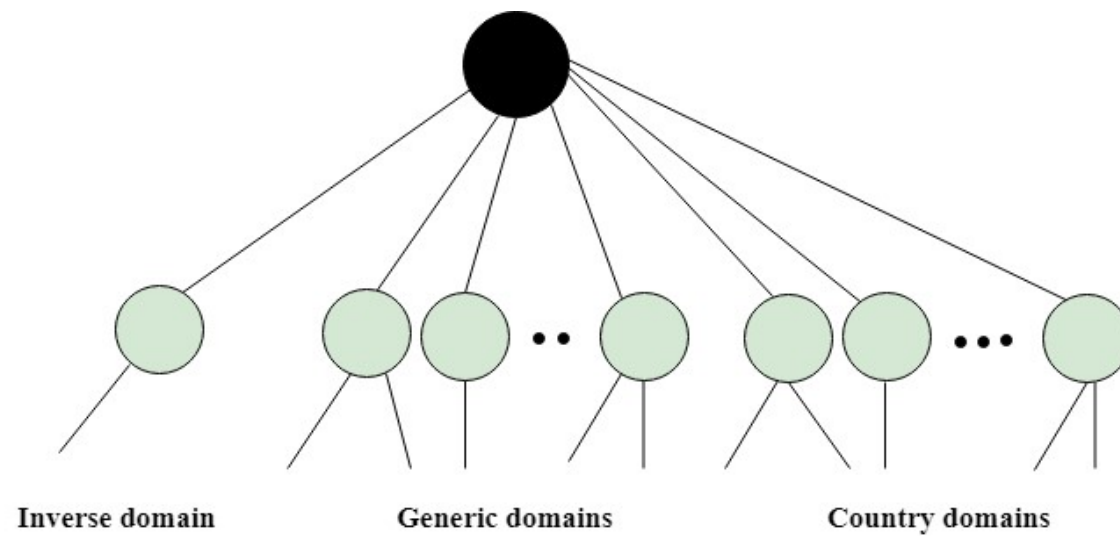
- **Generic Domains**

➤ It defines the registered hosts according to their generic behaviour.

➤ Each node in a tree defines the domain name, which is an index to the DNS database.

➤ It uses three-character labels, and these labels describe the organization type.

Label	Description
aero	Airlines and aerospace companies
biz	Businesses or firms
com	Commercial Organizations
coop	Cooperative business Organizations
edu	Educational institutions
gov	Government institutions
info	Information service providers
int	International Organizations
mil	Military groups
museum	Museum & other nonprofit organizations
name	Personal names
net	Network Support centers
org	Nonprofit Organizations
pro	Professional individual Organizations

Root level

com edu gov int mil net org

fhda

atc

chal

chal.atc.fhda.edu
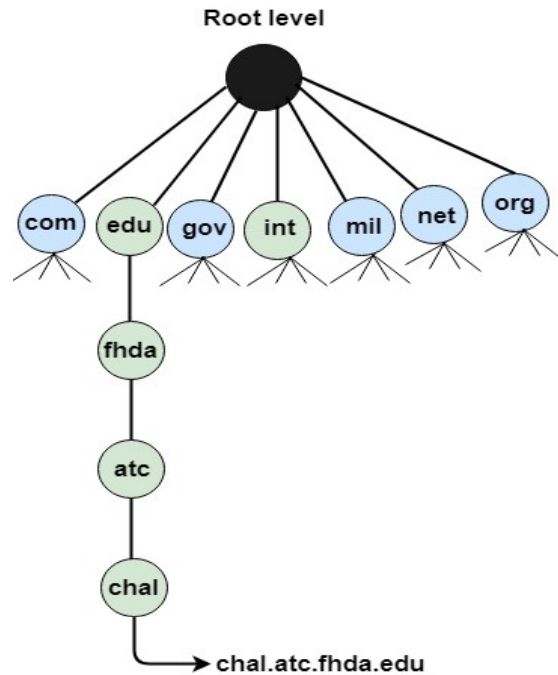
- **Country Domain**

➤ The format of country domain is same as a generic domain, but it uses two-character country abbreviations (e.g., us for the United States) in place of three character organizational abbreviations.

- **Inverse Domain**

➤ The inverse domain is used for mapping an address to a name. When the server has received a request from the client, and the server contains the files of only authorized clients.

➤ To determine whether the client is on the authorized list or not, it sends a query to the DNS server and ask for mapping an address to the name.

- **Working of DNS:**

1. DNS is a client/server network communication protocol. DNS clients send requests to the. server while DNS servers send responses to the client.

2. Client requests contain a name which is converted into an IP address known as a forward DNS lookups while requests containing an IP address which is converted into a name known as reverse DNS lookups.

3. DNS implements a distributed database to store the name of all the hosts available on the internet.

4. If a client like a web browser sends a request containing a hostname, then a piece of software such as **DNS resolver** sends a request to the DNS server to obtain the IP address of a hostname.

5. If DNS server does not contain the IP address associated with a hostname, then it forwards the request to another DNS server. If IP address has arrived at the resolver, which in turn completes the request over the internet protocol.

2. 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:

    1. It can send a single message to one or more recipients.

    2. Sending message can include text, voice, video or graphics.

    3. 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
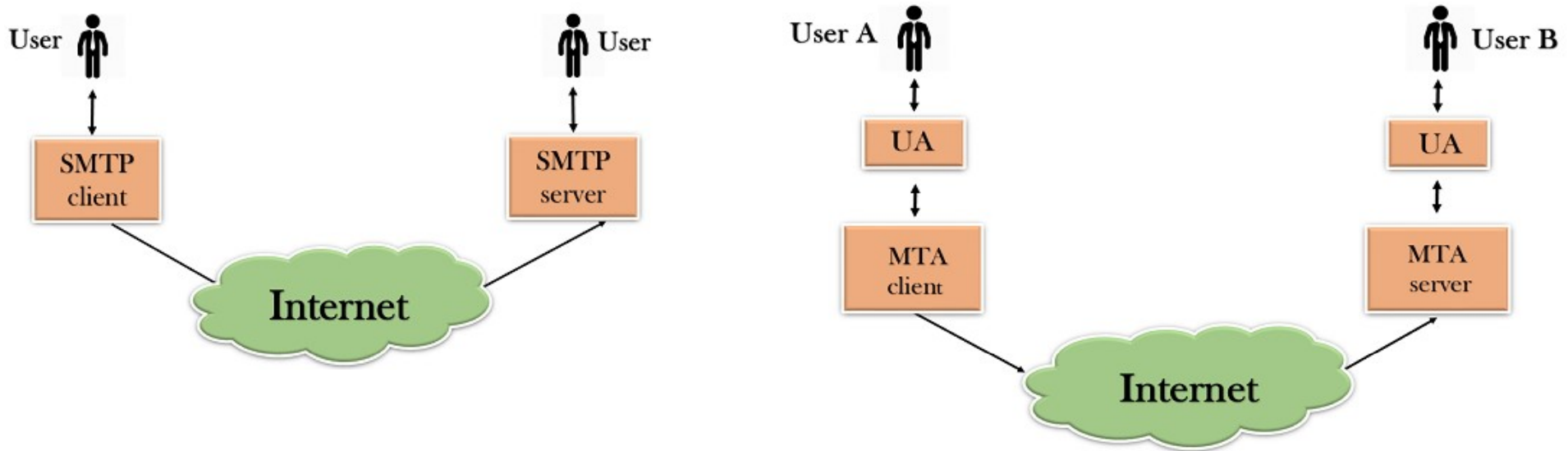
➢ First, we will break the SMTP client and SMTP server into two components such as user agent (UA) and mail transfer agent (MTA).

➢ 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.
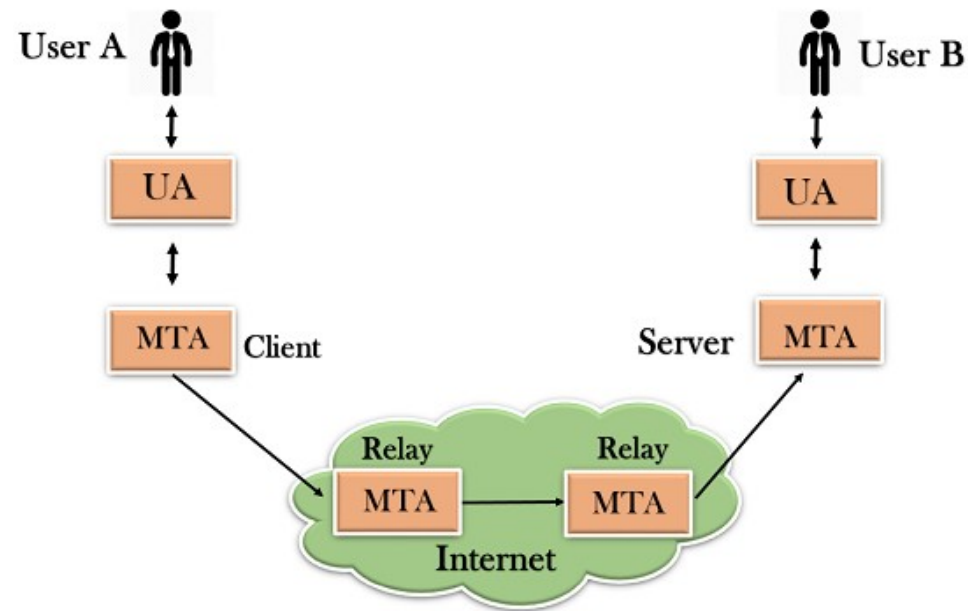
➤ The relaying system without TCP/IP protocol can also be used to send the emails to users, and this is achieved by the use of the mail gateway.

➤ 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.

3. File Transfer Protocol (FTP):

➢ FTP stands for File transfer protocol.

➢ FTP is a standard internet protocol provided by TCP/IP used for transmitting the files from one host to another.

➢ It is mainly used for transferring the web page files from their creator to the computer that acts as a server for other computers on the internet.

➢ It is also used for downloading the files to computer from other servers.

• **Objectives of FTP**

1. It provides the sharing of files.

2. It is used to encourage the use of remote computers.

3. It transfers the data more reliably and efficiently.

• **FTP Clients**

➢ FTP client is a program that implements a file transfer protocol which allows you to transfer files between two hosts on the internet.

➢ It allows a user to connect to a remote host and upload or download the files.

➢ It has a set of commands that we can use to connect to a host, transfer the files between you and your host and close the connection.

➢ The FTP program is also available as a built-in component in a Web browser. This GUI based FTP client makes the file transfer very easy and also does not require to remember the FTP commands.

- **Mechanism of FTP**
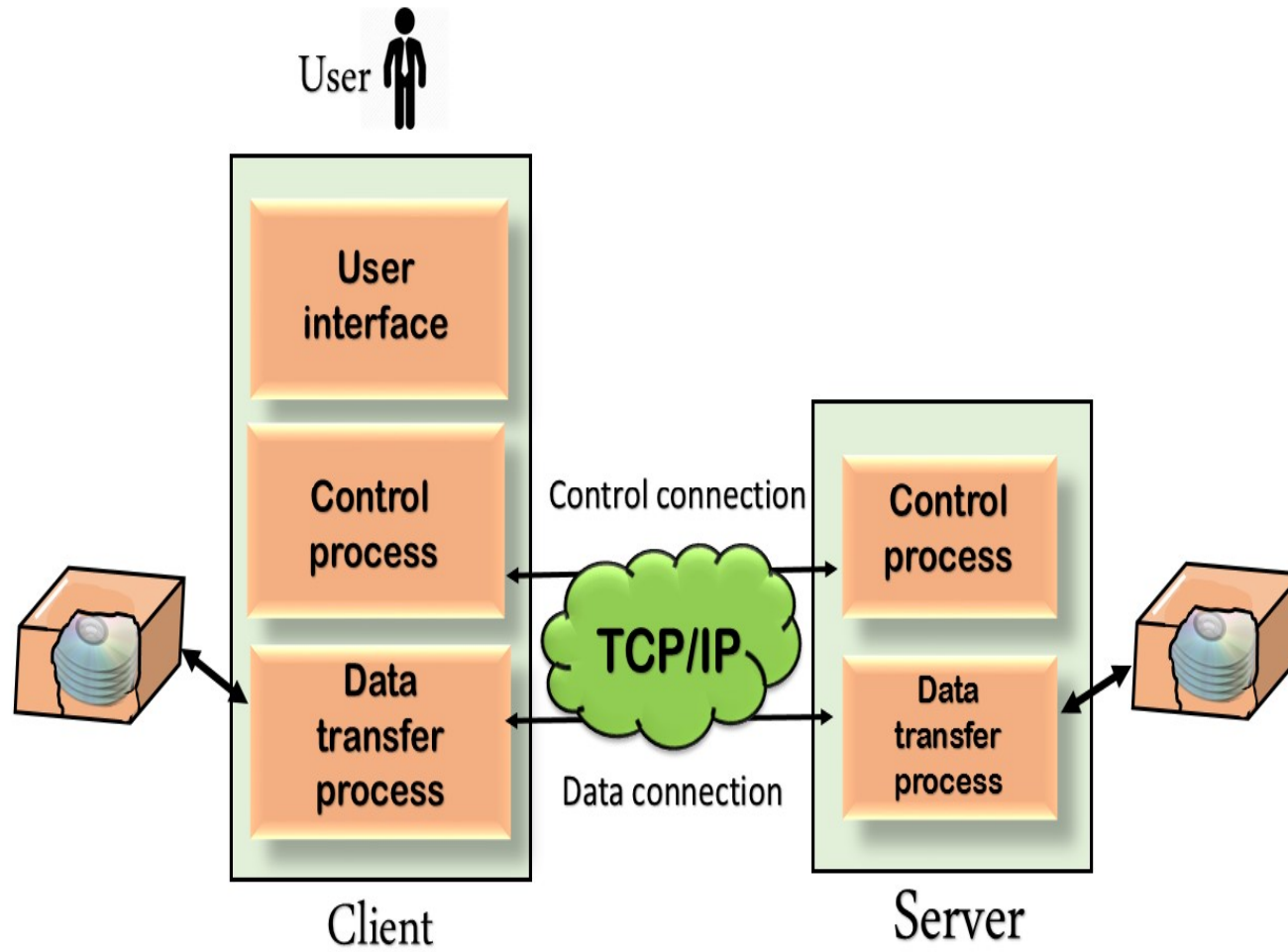
- **Advantages of FTP:**

1. **Speed:** One of the biggest advantages of FTP is speed. The FTP is one of the fastest way to transfer the files from one computer to another computer.

2. **Efficient:** It is more efficient as we do not need to complete all the operations to get the entire file.

3. **Security:** To access the FTP server, we need to login with the username and password. Therefore, we can say that FTP is more secure.

4. **Back & forth movement:** FTP allows us to transfer the files back and forth. Suppose you are a manager of the company, you send some information to all the employees, and they all send information back on the same server.

Disadvantages of FTP:

1. The standard requirement of the industry is that all the FTP transmissions should be encrypted. However, not all the FTP providers are equal and not all the providers offer encryption. So, we will have to look out for the FTP providers that provides encryption.

2. FTP serves two operations, i.e., to send and receive large files on a network. However, the size limit of the file is 2GB that can be sent. It also doesn't allow you to run simultaneous transfers to multiple receivers.

3. Passwords and file contents are sent in clear text that allows unwanted eavesdropping. So, it is quite possible that attackers can carry out the brute force attack by trying to guess the FTP password.

4. It is not compatible with every system.

4. HyperText Transfer Protocol (HTTP) :

➢ HTTP stands for **HyperText Transfer Protocol**.

➢ It is a protocol used to access the data on the World Wide Web (www).

➢ The HTTP protocol can be used to transfer the data in the form of plain text, hypertext, audio, video, and so on.

➢ This protocol is known as HyperText Transfer Protocol because of its efficiency that allows us to use in a hypertext environment where there are rapid jumps from one document to another document.

➢ HTTP is similar to the FTP as it also transfers the files from one host to another host. But, HTTP is simpler than FTP as HTTP uses only one connection, i.e., no control connection to transfer the files.

➢ HTTP is similar to SMTP as the data is transferred between client and server.

➢ The HTTP differs from the SMTP in the way the messages are sent from the client to the server and from server to the client.

➢ SMTP messages are stored and forwarded while HTTP messages are delivered immediately.

- **Features of HTTP:**

1. **Connectionless protocol:**

➢ HTTP is a connectionless protocol.

➢ HTTP client initiates a request and waits for a response from the server.

➢ When the server receives the request, the server processes the request and sends back the response to the HTTP client after which the client disconnects the connection.

➢ The connection between client and server exist only during the current request and response time only.

2. Media independent:

➢ HTTP protocol is a media independent as data can be sent as long as both the client and server know how to handle the data content.

➢ It is required for both the client and server to specify the content type.

3. Stateless:

➢ HTTP is a stateless protocol as both the client and server know each other only during the current request.

➢ Due to this nature of the protocol, both the client and server do not retain the information between various requests of the web pages.

- **HTTP Transactions**
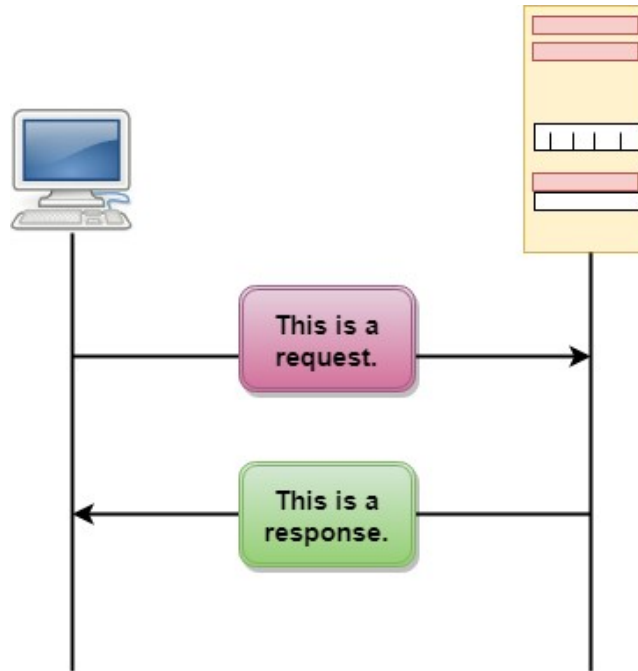
➤ The above figure shows the HTTP transaction between client and server.

➤ The client initiates a transaction by sending a request message to the server.

➤ The server replies to the request message by sending a response message.

- **Uniform Resource Locator (URL)**

➢ A client that wants to access the document in an internet needs an address and to facilitate the access of documents, the HTTP uses the concept of Uniform Resource Locator (URL).

➢ The Uniform Resource Locator (URL) is a standard way of specifying any kind of information on the internet.

➢ The URL defines four parts: method, host computer, port, and path.

1. **Method:** The method is the protocol used to retrieve the document from a server. For example, HTTP.

2. **Host:** The host is the computer where the information is stored, and the computer is given an alias name. Web pages are mainly stored in the computers and the computers are given an alias name that begins with the characters "www". This field is not mandatory.

3. **Port:** The URL can also contain the port number of the server, but it's an optional field. If the port number is included, then it must come between the host and path and it should be separated from the host by a colon.

4. **Path:** Path is the pathname of the file where the information is stored. The path itself contain slashes that separate the directories from the subdirectories and files.

5. 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.

THANK YOU…