Q. What is address resolution?

Answer: Mapping a name to an address or an address to a name is called address resolution.

Q. What are the different data structures supported by FTP?

Answer: FTP allows three different data structures namely file structure, record structure and page structure.

Q. Which file types can be transferred on FTP ?

Answer: The FTP can transfer ASCII file, EBCDIC file or image file. ASCII file is default format for text files. If one of two machines uses EBCDIC encoding, the EBCDIC file can be transferred using EBCDIC encoding. The image file is default format for transferring binary files.

Q. What is DNS?

Answer: DNS, or Domain Name System, is a system that translates human-readable domain names (like www.example.com) into IP addresses, which computers use to identify and locate each other on the internet. It acts as a directory for the internet, making it easier for users to access websites and services using familiar names instead of numerical IP addresses.

Q. Write a short note on SMTP.

Answer: SMTP, or Simple Mail Transfer Protocol, is a standard communication protocol used for sending and relaying electronic mail (email) messages over the internet. It serves as the foundation for the email delivery process, enabling the transfer of messages from a sender's email client to a recipient's mail server. It is a TCP/IP protocol that specifies how computers exchange electronic mail.

The Mail transfer is done by MTA or message transfer agents. SMTP uses commands and response to transfer messages between MTA client and MTA server. Commands are sent by client to server which consists of a keyword followed by zero or more arguments. Responses are sent from server to client which is a three digit code. SMTP facilitates message transfer, relaying, error handling and notifications, security and message formating.

Q. What is generic domain?

Answer: A generic domain, is a category of domain names in the Domain Name System (DNS) that consists of common and widely recognized terms. Generic domains have broader applicability and are not tied to a particular geographic location. Example: .com (commercial), .org (Organizations/ Non-profit), etc

Q. What is address resolution? Explain recursive and iterative resolution in DNS.

Answer: Mapping a name to an address or an address to a name is called as address resolution.

Recursive Resolution:

1) The client's DNS resolver sends a query to its designated DNS server.

2) The DNS server, if it doesn't have the answer, contacts other DNS servers on behalf of the client, obtaining the answer through multiple steps.

3) The final answer is returned to the client's DNS resolver, which then forwards it to the client. The client's resolver might also cache the answer for future use.

Iterative Resolution:

1) The client's DNS resolver sends a query to its designated DNS server.

2) The DNS server, if it doesn't have the answer, returns the best information it has to the client's resolver. It also provides a referral to other DNS servers.

3) The client's resolver continues the process, sending queries to the referred DNS servers step by step, until it obtains the final answer or reaches an authoritative server that provides the required information.

Q. What are the services provided by user agent?

Answer: The services provided by user agent are as follows:

1) Composing Message: It helps user compose or create an email by providing a template on the screen.

2) Reading Messages: It checks each mail and provides one line summary of every received email.

3) Replying to Messages: It allows the user to reply to original sender or to reply all recipients of the messages.

4) Forwarding Messages: It allows the receiver to forward the message with or without extra comments third party.

5) Handling Mail Boxes: It creates two mail boxes, inbox and outbox. Inbox keeps all the received emails until they are deleted by the user and outbox keeps the sent emails until user deletes them.

APPLICATION LAYER

Domain Name Syatem :

DNS is a clint server program . it helps other programs . the clint server program can be divided into two categories. DNS is a machnisum that assign a name to IP address. DOMAIN is a large group of computers on the interet

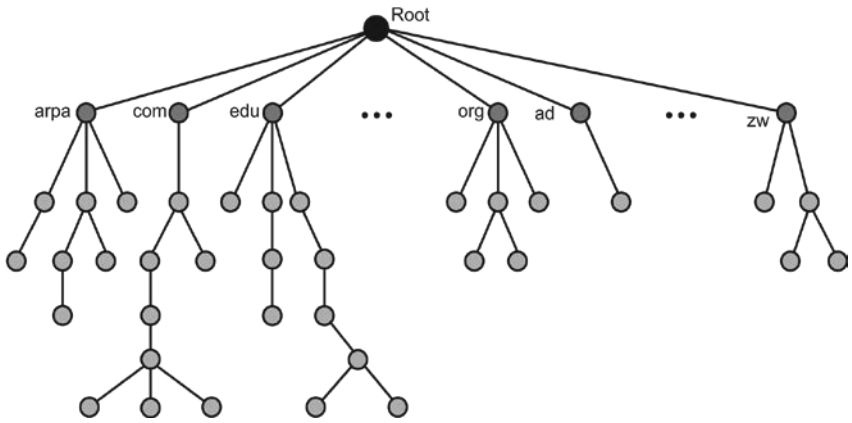
Flat Name Space :

In a flat name space a name is assign to an address . a name In this space is a sequence of character without structure . this name space can not be used In internet because of ambiguity

Hierarchical Name Space :

In hierarchical name space every name is made up of serveral parts . first part can define a nature secont part define a name of organization and third part define deparmets in the orgization. These name are unique and can not be duplicate

DOMAIN NAME SPACE :



- In this space the names are defined in the tree structure with root
- each node In the tree has a lable , the root lable is null string
- a lable has a string with maximum of 63 charecters

Domain Name :

Every name in the tree has a domain name . a **full domain** is a sequence of lable seprated by dots(.) . domain name is always reed from the root node.

Fully Qualified Domain Name :

If a lable is terminating by null string then it call fully qualified domain name (FQDN)

Partially Qualified Domain Name :

If a lable is not terminating by null string then it call partially qualified Domain name(PQDN)

DOMAIN :

A domain is a subtree of the domain name space , the name of the domain is the domain name of the root node , a domain may be divided into sub-domains

Q. Explain hierarchial name space.

Answer:

Flat Name Space:

1) In a flat name space, items are assigned names without any grouping or hierarchy. All names are stored in a single directory.

2) Each entity receives a unique name, but as the number of entities grows, searching for specific items becomes inefficient due to the lack of structure.

3) This approach lacks organization, making it challenging to manage and locate items efficiently, especially in larger systems.

Hierarchical Name Space:

1) In a hierarchical name space, names are organized in a tree structure with various levels, reflecting categories or domains.

2) The hierarchy includes top-level domains, subdomains, and so on. This arrangement simplifies management and navigation by narrowing down the scope of the search.

3) Users navigate through levels to find resources, aiding in efficient organization and retrieval of items, particularly in complex systems.

Q. Write a short note on SMTP.

Answer:

SMTP, or Simple Mail Transfer Protocol, is a standard communication protocol used for sending and relaying electronic mail (email) messages over the internet. It serves as the foundation for the email delivery process, enabling the transfer of messages from a sender's email client to a recipient's mail server. It is a TCP/IP protocol that specifies how computers exchange electronic mail.

Q. What is difference between SMTP, POP and IMAP?

Answer: SMTP is a push protocol which pushes the message from client to server so it is used in first and second stage of mail delivery.
Third stage needs pull protocol from receiver to mail server, so they need MAA (message access agents) which is POP and IMAP. These both retrieve mails at receiver's side.

Q. What is POP3?

Answer: Post office protocol is an application layer internet standard protocol used by local email clients to retrieve email from remote sever over tcp ip connection.

Q. What is IMAP4?

Answer: Internet mail access protocol is similar to POP3 but more compelx and more powerful. It provides following functions:
1) user can check email header before downloading
2) use can search email contents before downloading
3) User can partially download email
4) use can create, delete or rename mailboxes.
5) use can create hierarchy of mailboxes in folder for storage.

ZONE :

If any server accept responsibility for a domain and does not divied a domain into sub-domains then this server call ZONE.

ROOT SERVER :

Root server is the top level sserver which consist of entire DNS tree

PRIMARY SERVER :

Primary server stores a file about the zone

SECONDARY SERVER :

Is a server that transfer all information from the primary server

GENERIC DOMAINS :

The generic domains define registered host according to their generic behavior. In generic domains each node in the tree defines a domain

Inverse Domain:

The inverse domain is used to map an address to a name.

**RESOLUTION

- Maping a name to an address or maping a address to a name called address resolution

RESOLVER : when a host requires mappig of a name to an address

Maping Name to address :

The resolver gives a domain name to the server and ask for the correct address . the server check domain is geeric or country for the mapping . query is send by resolver to the local DNS server

Maping Address to Name :

- The clint can sent an IP address to a server to mapped to the domain name
- There are two type of resolver (recursive resolver) (iterative resolver)

Recursive Resolver :

If a clint sends a recursive query to the DNS server to supply the final answer if the server is the Authority for the domain name then it checks the database and responds. If the server is not Authority then it sends the requwest to the another server . now if this server is authority the it response otherwise it sends the query to the aother server This is colled Recursive Resolution

Caching :

When a server asks for a mapping from another server and recive the response it store the information in the cache memory before sending it to the clint.

c) Define Jitter and Translation.

Answer:

Jitter:

Definition: Jitter refers to the variation in the delay of received packets in a communication system. It is the irregularity in the timing of data packets, leading to fluctuations in the arrival time of consecutive packets.

Translation:

Definition: Translation is the process of converting data or messages from one format or protocol to another. It involves adapting information to be compatible with different systems or networks.

b) What is streaming audio/video? Also write examples.

Answer: Streaming Audio/Video: Streaming audio/video is the continuous delivery of multimedia content over the internet. Users can start playing the content without waiting for the entire file to download. Streaming enables real-time consumption of media.

Examples:

YouTube: Users can stream videos on YouTube without downloading the entire video file beforehand.

Spotify: Streaming music on Spotify allows users to listen to songs without downloading them first.

Netflix: Streaming movies and TV shows on platforms like Netflix enables users to watch content as it is delivered in real-time.

c) Explain Streaming Stored Audio / Video first approach: using a web server, with advantages and disadvantages.

Answer:

Approach:

In this approach, stored audio or video content is delivered to users in real-time, but the content is pre-recorded and stored on a web server.

Advantages:

1) On-Demand Access: Users can access content whenever they want, providing flexibility.

2) Bandwidth Efficiency: Users don't need to download the entire file, reducing bandwidth requirements.

3) Content Management: Easier management of pre-recorded content on servers.

**DNS Message :

- DNS has two types of messages that is (Query) , (response) both type of message has same format.
- the **query message** consist of a header and question records
- the **response message** consist of a header, question records, answer records, authoritive records and additional records

Header :

The header is 12 bytes .

***Fields OF header** :

Idetification : is a 16 bit field used by clint to match the response with the query

Flags : is a 16 bit field consisting of a subfields

QR (query/respoce) : is a 1 bit subfield that defies the type of message. If it is 0 the message is a query , if it is 1 the message is a response.

OP CODE : is a 4 bit subfields that defies the type of query or response (0 if standards, 1 if inverce, 2 if server status req)

AA(authoritative Answer) : is a 1 bit subfield. It only used in a respose message

TC(TrunCated) : is a 1 bit subfields. It is used when DNS uses the service of UDP

RD(recursion Desired) : is a 1 bit subfields. It sets In the query message and response messages.

RA(recursion Avilable) : is a 1 bit subfields. It is set only In the response message.

Reserved : is a 3 bit subfields set to 000

Rcode : is a 4bit field that shows the status of the error in the response .

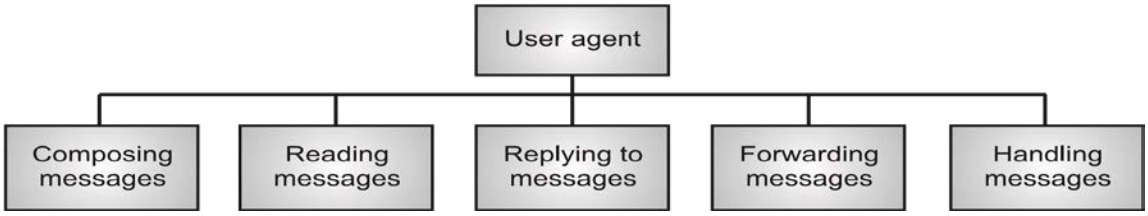
*E – MAIL :

- Email is most popular application of interenet
- the short form of email is electronic mail.

*User Agent :

- The first component of e-mail system is **User Agent**. It provide service to the user to make the process of **sending** and **reciving** the messages

**Service provided by user Agent :



- The user Agent is a software that provide a service of Composing Messages, Reding Messages, Reply To Messages, Forwardig Messages, Hadling Messages.

Composing Message : compose means Create

Disadvantages:
1) Limited Interactivity: Limited interactivity as the content is pre-recorded, lacking real-time engagement.
2) Storage Requirements: Requires significant storage space for storing large volumes of multimedia content.
3 Latency: Some latency may be present as the server needs time to transmit the content to users.

a) Explain Real-Time Interactive Audio / Video with diagram.
Answer:

Real-time interactive audio/video involves the transmission of live content between users in real-time. This is often used in video conferencing, online meetings, or gaming.
1) Users A and B: Represent two users engaging in a real-time audio/video interaction.
2) Audio/Video Streams: Bidirectional streams show the exchange of audio and video data between users.
3) Server (Optional): In some cases, a server may facilitate the communication, especially in larger-scale applications.

Key Features:
1) Low latency for real-time communication.
2) Bidirectional data flow for interactive engagement.
3) Suitable for applications like video conferencing, live streaming, or online gaming.

Q. What is Cipher?

Answer: A cipher is an algorithm for performing encryption or decryption. It is a series of steps that can be followed as a procedure.

Q. What is encryption?

Answer: Encryption is a process of converting plaintext into ciphertext using key.It is a technique of translation of data into a secret code called cipher text.

Q. What is steganography?

Answer: The word steganography means secret writing. It is the process of concealing a message, file, image , or video within another file in order to hide its existence.

Q. What is transposition cipher.

Answer: It is a type of cryptographic algorithm that rearranges the positions of characters in a plaintext message to create ciphertext. They only change the order of characters unlike substitution cipher which replace each letter with another letter.

These are less secure than substitution cipher.

- A user Agent Helps the user to create an e-mail , in some editor built In spell checking , grammer checking , cut, copy, past etc formatting functions

Reading message : -

- the next function of user agent is to reed the icoming messages. User agent first check the mail in the incoming mail box

Reply to message :

- after reading a icommig message user sent reply by using user agent ,
- the user agent allows the user to reply the origal message

Forwarding Messages :

- user agent allow the reciver to forward the message with or without extra coment to anyone that he know.

Handling mail Box :

- user agent can create two mail boxes ie. Inbox & outbox
- inbox ca keeps all recived e-mails until they are deleted by user & the outbox keeps all the sent e-mails until the user deletes them.

User Agent Can Be of two types -

1) Command Driven A command driven agent accept one character from the keyword to perform its task

2) GUI based : Modern users are GUI agent

**MIME :

- the Multipurpose Internet Mail Extension (MIME) is a protocol that allow seding non-ASCII data through the e-mail

- The MIME transform non-ASCII data at sender site to NVT(network virtual terminal)

Need : suppose user A wants to sent an email through user agent and it is non-ASCII format so there is a MIME protocol that convert the non-ASCII value into 7-bit NVT ASCII format.

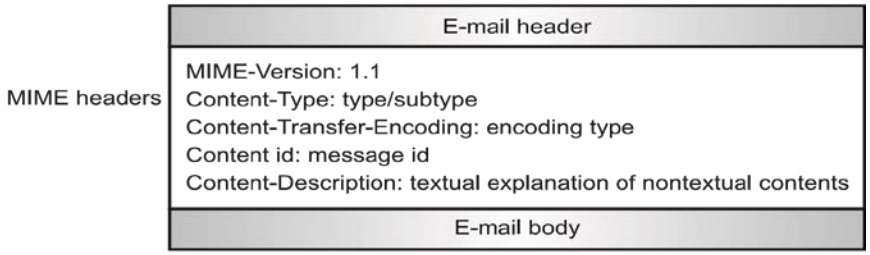


Fig. 1.26: MIME Headers

***Header** :

- Header is basically inserted at the beginning of any email.

- MIME defies five headers MIME-version, Content-type, Content type-encoding, Content-id, content-Description

- that five headers added into the original email header to define the transformation

Q. What is cryptography.

Answer: Cryptography is made of greek words which means secret writing. It is a process of encryption and decryption of messages using secret keys.

Q- Plain text

Answer: The original message, before being transformed is called plain text.

Q- Cipher text

Answer: After the message is transformed using cryptography, it is called ciphertext. It is made using plaintext and key.

Q- Encryption

Answer: It is a process which transforms the original message into an unrecognizable or unreadable form. It consists of algorithm or steps that performs various substitutions and transformations on plaintext.

Q- Decryption

Answer: It is the process of converting encrypted message to its original form. The ciphertext is changed into original plain text.

e) What is VPN (Virtual Private Network)?

Answer: VPN (Virtual Private Network): VPN is a technology that enables a secure and encrypted connection over the internet, allowing users to access a private network from a remote location as if they were directly connected to it.

g) Write advantages of packet filter firewall.

Answer: Advantages of Packet Filter Firewall:

1) Simplicity: Packet filters are relatively simple and operate at the network layer, making them efficient for basic traffic control.
2) Low Latency: They introduce minimal latency to network communication.
3) Scalability: Well-suited for large networks as they can handle a high volume of traffic.
4) Resource Efficiency: Requires less processing power compared to more complex firewall types.

Q. What is packet filter./

Answer: Packet Filter: A packet filter is a type of firewall that examines packets of data based on predefined rules. It filters network traffic at the network layer (Layer 3) of the OSI model, making decisions to allow or block packets based on criteria such as source/destination IP addresses and port numbers.

b) What is firewall? Explain packet firewall.

Answer: Firewall: A firewall is a network security device that monitors and controls incoming and outgoing network traffic based on predetermined security rules. It acts as a barrier between a trusted internal network and untrusted external networks, such as the internet.

c) Explain in detail packet filter firewall, also write it's advantages and disadvantages.

Answer: A packet firewall specifically operates at the network layer and filters packets based on attributes like source/destination IP addresses and port numbers. It makes decisions to allow or block packets, providing a basic level of network security.

Disadvantages:

1) Limited Inspection: Lacks the ability to inspect the contents of packets beyond the header.
2) Vulnerability to Spoofing: Susceptible to IP address spoofing attacks.
3) No State Awareness: Lacks awareness of the state of connections, making it challenging to handle complex protocols.

j) A proxy firewall is also called application gateway. Write true or false and also justify.

Answer: Answer: True.

Justification: A proxy firewall, also known as an application gateway, is designed to provide a higher level of security by acting as an intermediary between internal and external networks. It operates at the application layer of the OSI model. The term "application gateway" reflects its ability to understand and control specific applications, making the statement true.

(g) What is Role of packet filter ?

Answer: The role of a packet filter is to check packets of data as they pass through a network interface and make decisions about allowing or blocking them based on predefined rules. Packet filters analyze the header information of each packet, such as source and destination addresses, ports, and protocol types, to determine whether the packet should be permitted or denied.

a) What is firewall? Explain with diagram.

Answer: : A firewall is a network security device that monitors and controls incoming and outgoing network traffic based on predetermined security rules. It establishes a barrier between a trusted internal network and untrusted external networks, such as the internet.

e) Write note on IPSec modes.

Answer: IPSec (Internet Protocol Security) operates in two modes:

Transport Mode: In this mode, only the payload (data) of the IP packet is encrypted and/or authenticated. The original IP header is left intact. Transport mode is often used for end-to-end communication between devices.

Tunnel Mode: In tunnel mode, the entire original IP packet is encapsulated within a new IP packet with a new IP header. This mode is commonly used for securing communication between networks. It provides a way to create virtual private networks (VPNs) by encrypting and authenticating all traffic between the participating networks.

MIME Vision : this header defines version of MIME. It has the parameter value 1.1

Content-Type : this header defies what type of data used in the message. The data can be text, image, audio, video

Content-Type-Ecoding – this header defines the method that encode the message into 0s & 1s

Content-ID – This header is used for uniquely identifying the whole message in a multiple message eviromet

Content-Description – This header defines whether the body is actually image, video or audio

**MESSAGE TRANSFER AGENT (SMTP) :

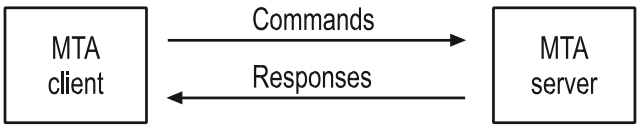
- the mail transfer is done by message transfer agent (MTA)

-** **Simple Mail Transfer Protocol :**

- (SMTP) is a protocol that defines communication between MTA of clint & MTA of server
- SMTP is a push protocol it pushes the message from the clint to the server.
- SMTP is used In first and second stage of mail delivery
- The SMTP is a TCP/IP protocol that specifies how computer can exchange electronic mail
- SMTP is a push protocol and is used to send mail

Commands And Response :

- SMTP use commands and response to transfer message between MTA clint & MTA server



.

- commands are sent by clint server, commands consist of zero or more arguments
- SMPT use 14 commads

* Message Access Aget : POP3 & IMAP4 :

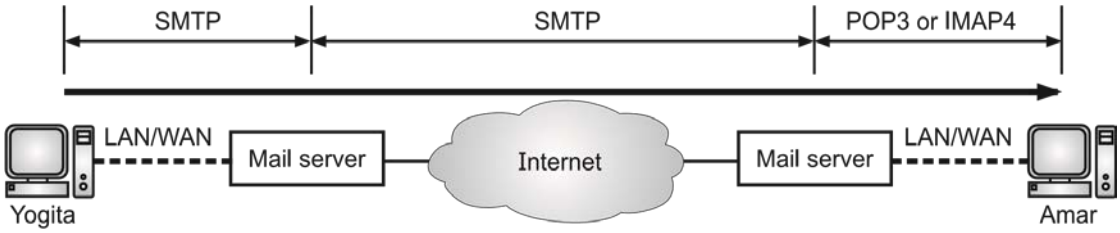


Fig. 1.29

- SMTP is a push protocol is used to send the mail and the POP (**post office protocol**) and IMAP (**internet message access protocol**) are used to recive these mails.
- in simple words POP3 & IMAP4 is used to recive the mails from the mail server.

* **POP3 :**

- POP stands for Post office protocol.

- POP3 is an application layer standard protocol used by the local clints e-mail to retrieve e-mail form a remote server over a TCP/IP connection.

h) What is the purpose of IPSec?
Answer: The purpose of IPSec is to provide a set of rules for securing communication over IP networks. IPSec ensures the confidentiality, integrity, and authenticity of data by using encryption, authentication, and key management. It is commonly used to establish Virtual Private Networks (VPNs) and secure communication between network devices.

(ii) List and explain the fundamental services offered by DNSec
Answer: DNSec (Domain Name System Security Extensions) provides the following fundamental services:

1) Data Origin Authentication: DNSec ensures that the data received from DNS servers is authentic and has not been tampered with during transit.
2) Data Integrity: It guarantees that the DNS data remains unchanged and has not been modified by malicious entities.
3) Authenticated Delegation: DNSec ensures that the information about which name servers are authoritative for a particular domain is authentic and has not been compromised.

b) Write note on Real-Time Transport protocol (RTP).
Answer: Answer: RTP (Real-Time Transport Protocol) is a protocol used for delivering real-time audio and video over IP networks. Key features include:

1) Payload Type Identification: RTP identifies the type of data being carried, allowing receivers to properly interpret and process the incoming streams.
2) Sequence Numbering: RTP assigns sequence numbers to packets, aiding in the reconstruction of the original data sequence at the receiving end.
3) Timestamps: RTP includes timestamps to synchronize audio and video data at the receiver.
4) Header Extensions: RTP allows for the inclusion of header extensions to convey additional information, such as codec changes or encryption parameters.

a) Explain PGP certificates.
Answer: PGP (Pretty Good Privacy) certificates are used in the PGP encryption system for secure communication. The key components include:
1) Public Key: Used for encryption and available to anyone. It can be distributed openly or through a keyserver.
2) Private Key: Kept secret and used for decryption. It must be securely stored and should never be shared.
3) User ID: Identifies the user associated with the key.

4) Digital Signature: Provides authentication and ensures that the public key is associated with the correct user.

- POP3 ca supports simple download-and-delete reqwriments , is a simple protocol with limited functionality

- POP3 has two modes first one is delete mode and second one is keep mode

- POP4 protocol can not Allow the user to partialy check the content of mail before the dowloding.

* **IMAP4 :**

- IMAP stands for Internet mail Access Protocol.

- IMAP4 protocol is similar as to the POP3 protocol but IMAP4 is more powerful and more complex.

- IMAP4 protocol also can not Allow the user to partialy check the content of mail before the dowloding.

- **it provide the functions** :

  - user can check email header before downlodig.
  - user can search the content of the e-mail for a specific string before the downlo.
  - user can partially download e-mail.
  - User ca create, delete, rename the mailbox.

**FTP (File Trasfer Protocol) :

- FTP is a standard mechanism provided by the TCP/IP protocol for copying the file from one host to another.

- FTP can transfer the files between ay computer that have an internet connection.

- UPLODING : transfer the file from a clint computer to the server computer colled “Uploding”.

- FTP is an clint/server application.

- FTP estabilishes connections betwn the host. One is conection and other is for control information.

***Clint Components :** user interface, clint control process, data transfer process.

***Server Components :** control process , data transfer process

- communication with the FTP server is done by the two connections ie. Control and data conection.

-FTP uses port 21 of TCP for control conection and port 20 used for the data connection

- FTP can transfer the ASCII file, Image file EBCDIC file.

- FTP has differet data structures ie. File structure , record structure , page structure.

- FTP hs different modes ie. Streem mode, block mode, compressed mode

**** Anonymous FTP :** to use FTP user neet acc. & pass. On remote server. Anonymous FTP allows user without having account on server.

b) Explain SSL services in detail.

Answer: Answer: SSL (Secure Sockets Layer) provides secure communication over the internet. Key services include:

1) Authentication: SSL ensures that the server is who it claims to be, preventing man-in-the-middle attacks.
2) Data Encryption: SSL encrypts data during transmission, making it unreadable to unauthorized parties.
3) Data Integrity: SSL ensures that the data remains unaltered during transmission.
4) Session Management: SSL manages sessions between a client and a server, allowing them to resume a previous session if desired.
5) Secure Key Exchange: SSL establishes a secure method for exchanging encryption keys between the client and server.