CN Module 5 Important Topics

1. What is transport layer..? What are the functions of transport layer..?

- The transport layer is responsible for the delivery of a message from one process to another
- A transport layer protocol can be either connectionless or connection-oriented.
- In the transport layer, a message is normally divided into transmittable segments.

Transport Layer Services

- Process to Process communication
- Addressing: Port Numbers
- Encapsulation and Decapsulation
- Multiplexing and Demultiplexing
- Flow Control
- Error Control
- Connectionless and connection oriented service

2. What is TCP? Write the TCP packet format..?

- TCP is a connection-oriented, reliable protocol
- TCP is the most common transport-layer protocol in the Internet
- Uses Checksum,Timers, Cumulative,selective acknowledgments,Retransmission of lost or corrupted packets
- A packet in TCP is called Segment

TCP segment format

a. Segment

b. Header
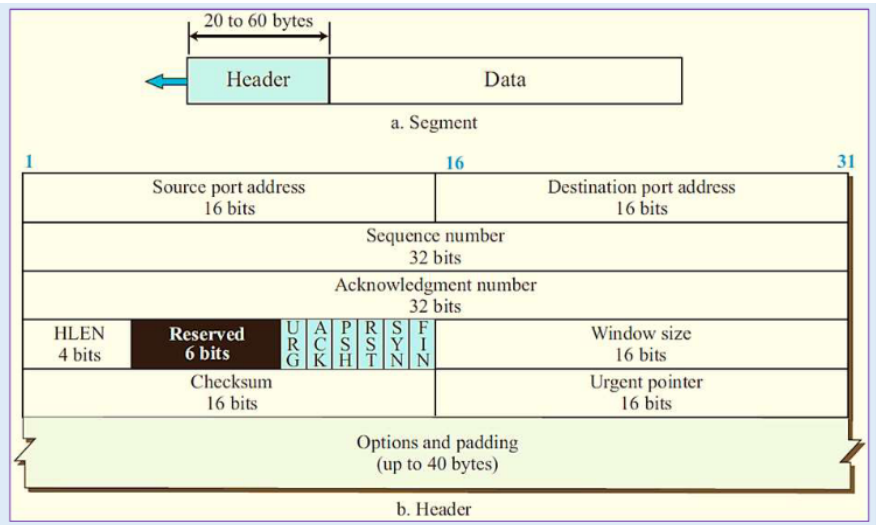
- The packet format consists of the following
  - Source port address
  - Destination
  - Sequence number
    - 32 bit field
    - Defines the number assigned to the first byte of data contained in the segment
    - Random number generator is used to create the initial sequence number
  - Acknowledgment number
    - Byte number that the receiver is expecting, for acknowledgement
  - Header length
  - Control
    - 6 different control bits or flags
  - Window size
    - Window size of the sending TCP in bytes
  - Checksum
  - Urgent pointer
    - Valid when urgent flag is set

3. Discuss how the connection is established and released in the TCP.

Connection establishment

- TCP transmits data in full-duplex mode. When two TCPs in two machines are connected, they are able to send segments to each other simultaneously

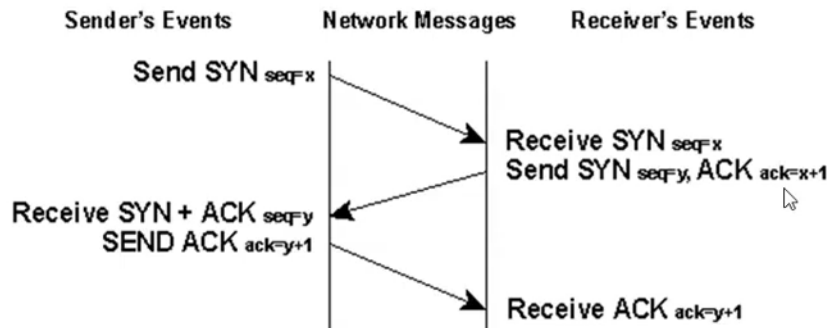- Connection establishment in TCP is called 3 way handshaking

3 way handshaking

Sender's Events   Network Messages   Receiver's Events

Send SYN seq=x

Receive SYN seq=x
Send SYN seq=y, ACK ack=x+1

Receive SYN + ACK seq=y
SEND ACK ack=y+1

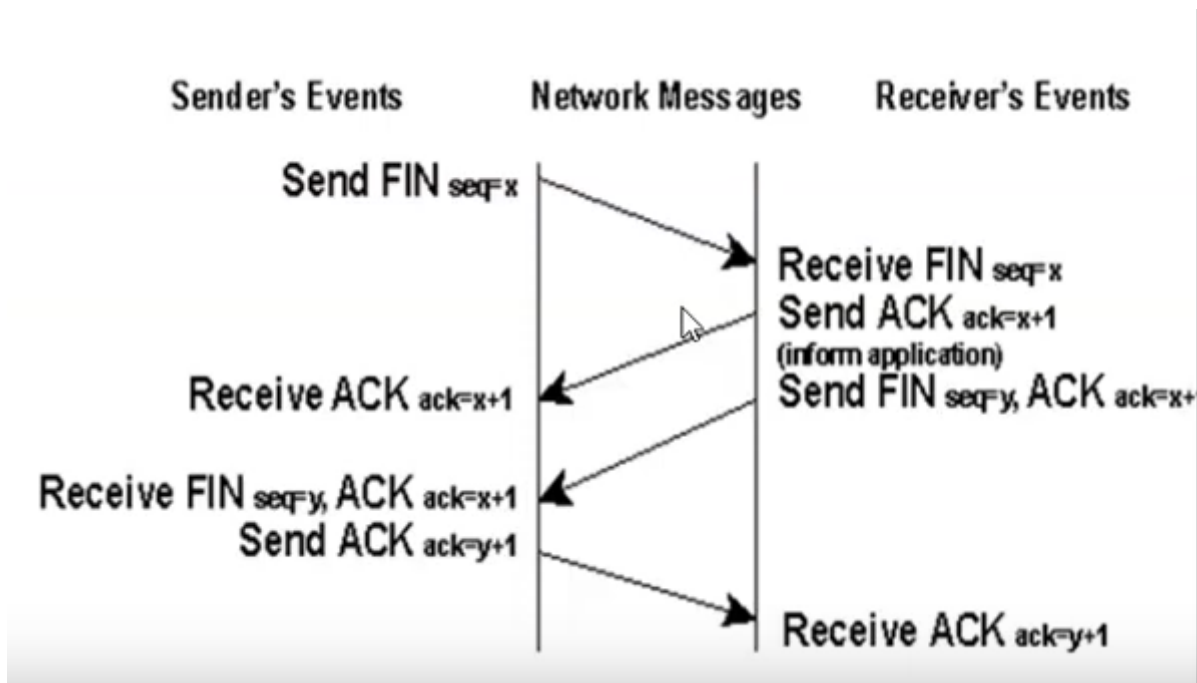Fig: Three way handshaking

Receive ACK ack=y+1

- The process starts with the server. The server program tells its TCP that it is ready to accept a connection. This request is called a passive open. Now the server TCP is ready to accept a connection from any machine in the world

1. The client sends an SYN Packet with sequence number x
2. Receiver responds with SYN Packet with sequence number y and ACK with sequence number x+1
3. After receiving both SYN and ACK, the sender responds with ACK packet with sequence number y+1

Data Transfer

- After connection is established, bidirectional data transfer takes place

Connection termination

1. Initiator (sender) sends FIN Flag (FIN = Finish), with current sequence and acknowledgement number
2. Receiver Receives FIN, Responder informs the application program
    1. It will receive no more data
    2. It sends acknowledgement of the packet
3. One side is closed, now Receiver closes its side
    1. Sends FIN to sender
    2. sender acknowledges
    3. Receiver receives acknowledgement

Sender's Events   Network Messages   Receiver's Events

Send FIN seq=x

Receive FIN seq=x
Send ACK ack=x+1
(inform application)
Send FIN seq=y, ACK ack=x+

Receive ACK ack=x+1

Receive FIN seq=y, ACK ack=x+1
Send ACK ack=y+1

Receive ACK ack=y+1

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4. What is UDP.? Also explain the UDP header format..?

- The User Datagram Protocol (UDP) is a connectionless, unreliable transport protocol.
- If a process wants to send a small message and does not care much about reliability, it can use UDP
- Sending a small message using UDP takes much less interaction between the sender and receiver than using TCP

UDP Packets

- UDP packets, called user datagrams, have
  - a fixed-size header of 8 bytes made of four fields, each of 2 bytes (16 bits)

UDP Header Format
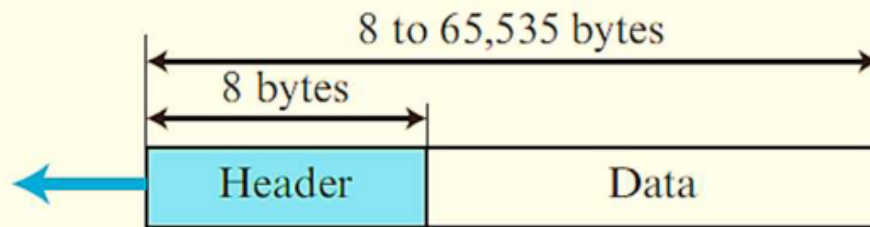
a. UDP user datagram

b. Header format

- Source port number
- Destination port number
- Total Length of user datagram (header + data)
- Checksum for checking errors

Services Provided by UDP

- Process to Process communication
- Connectionless service
- No Flow control
- No error control
- No congestion control
- Multiplexing and demultiplexing

Applications of UDP

- Interactive real time applications
- Used in Routing information protocol (RIP)

5. What is Application layer..? What are the functions of the application layer..?

- Application layer provides services to the user
- Its the layer through which users interact

Services provided

- File Transfer, access and management
- Mail services
- Directory services

6. What are the different TCP services.

Transport Layer Services

Process to Process communication

- A process is an application-layer entity (running program) that uses the services of the transport layer
- A transport-layer protocol is responsible for delivery of the message to the appropriate process.

Addressing: Port Numbers

- For communication, we must define
  - local host
  - local process
  - remote host
  - remote process
- The local host and the remote host are defined using IP addresses
- In the TCP/IP protocol suite, the port numbers are integers between 0 and 65,535

- Internet Corporation for Assigned Names and Numbers **(ICANN)** divided the port numbers into three ranges
  - **Well-known ports -** The ports ranging from 0 to 1,023 are assigned and controlled by ICANN. These are the well-known ports.
  - **Registered ports -** The ports ranging from 1,024 to 49,151 are not assigned or controlled by ICANN. They can only be registered with ICANN to prevent duplication.
  - **Dynamic ports -** The ports ranging from 49,152 to 65,535 are neither controlled nor registered. They can be used as temporary or private port numbers.

- Socket address is the combination of IP address and port number
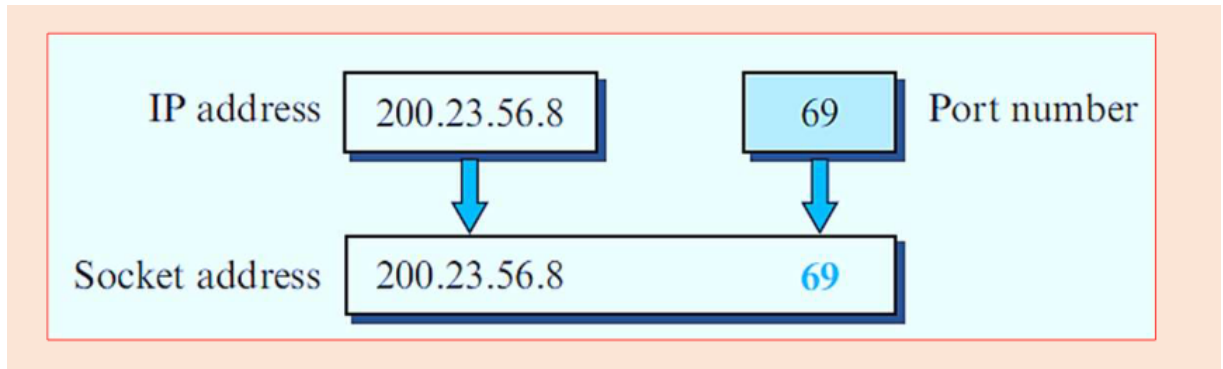
Encapsulation and Decapsulation

- **Encapsulation** happens at the sender site
- When a process has a message to send
    - it passes the message to the transport layer along with
        - a pair of socket addresses
        - Some other information
- Transport layer receives this
    - Adds the transport layer header
- **Decapsulation** Happens at the Receiver site
- When message arrives at destination transport layer
    - Header is dropped
    - Transport layer delivers the message to application layer

Multiplexing and Demultiplexing

- Whenever an entity accepts items from more than one source, this is referred to as multiplexing (many to one)
- whenever an entity delivers items to more than one source, this is referred to as demultiplexing (one to many).

Flow Control
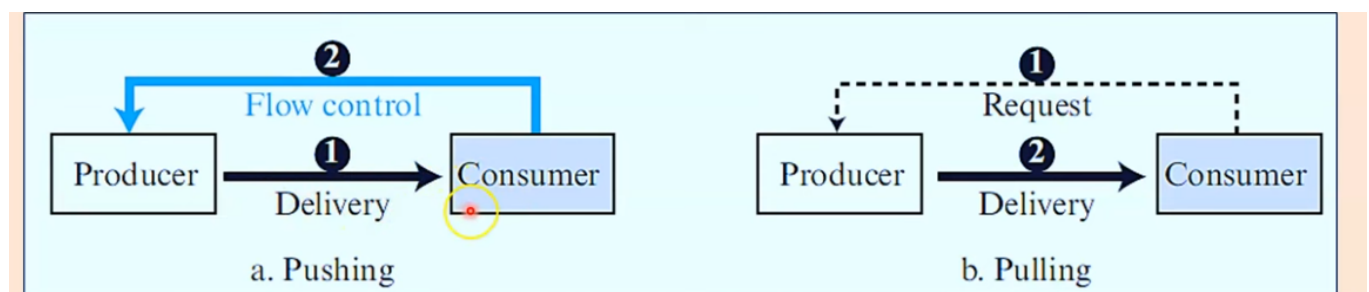
a. Pushing   b. Pulling

- Delivery of items from producer to consumer can happen in 2 ways
    - Pushing
    - Pulling
- In Pushing, The sender delivers items when they are produced without prior request from consumer
    - When pushing, the consumer can become overwhelmed, causing it do do flow control to prevent losing of packets
- In Pulling, the sender delivers items when they are requested from the consumer

Error Control

Error control is responsible for

- Detecting and discarding corrupted packets
- Keeping track of lost and discarded packets
- Recognizing duplicate packets and discarding
- Buffering out of order packets until missing packets arrive

Connectionless and connection oriented service

- In connectionless service
    - The transport layer treats each chunk as a single unit without any relation between them
- In connection oriented service
    - Server first establishes a logical connection between client and server
    - Data exchange can only happen after connection establishment
    - After data exchange the connection needs to be torn down

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7. What is Domain Name Space (DNS).? What is the format of the domain name.?

- Each internet host is assigned a host name and an IP Address

    - Host names are character strings

    - Example www.google.com

    - IP addresses are 32 bit integers

    > DNS is the naming service of the internet that resolve host names to IP addresses

- DNS allows users of internet applications to refer to remote hosts by name rather than address

DNS name resolution
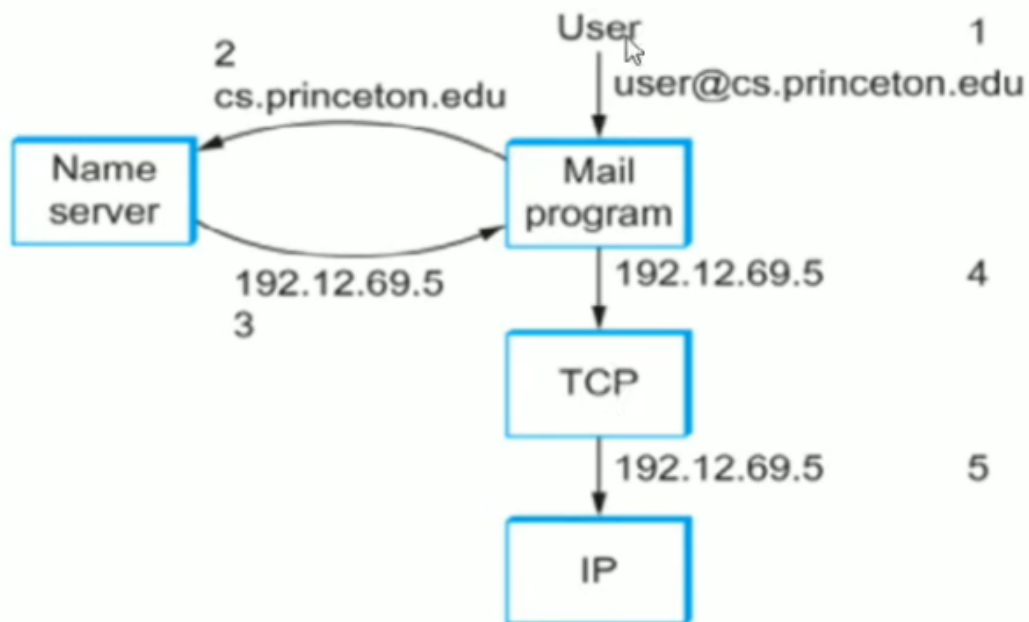
Host name translated into IP address. The numbers 1–5 show the sequence of steps in the process

DNS Namespace

Names in DNS name space are called domain names

- Domain names are strucutured names, so they consist of multiple components
  - example: ieee.org
- DNS Name space is represented by a tree with 2 types of nodes
  - Leaf nodes -> Hosts
  - Non Leaf nodes -> Domains

8. What is Email? What are the different e-mail Protocols? List them.

- Email is a digital mechanism for exchanging messages through internet
- Emails are transmitted between

- Sender
  - Receiver
- Email messages consists of 3 components
    - Message envelope
        - Emails electronic format
    - Message header
        - sender/receipient info
    - Message body
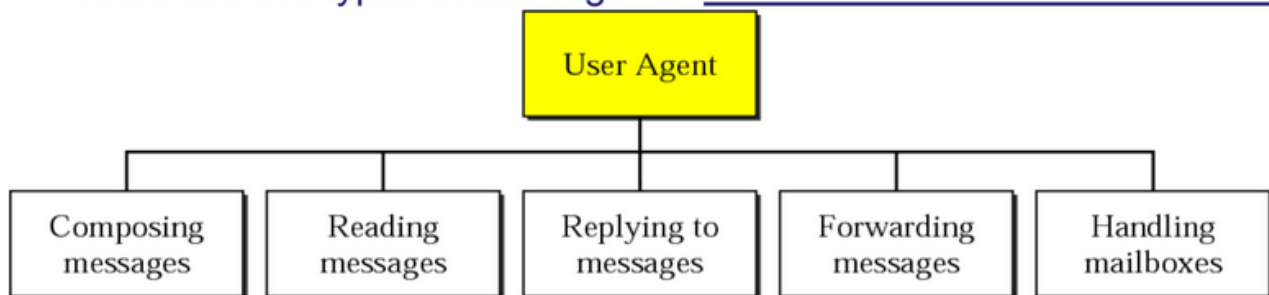   - text, image and file attachments

Email sending Components

- User agent
- Mail transfer agents
- Protocol that controls mail delivery

User Agent

Email Scenarios

- First scenario: When the sender and the receiver of an e-mail are on the same mail server
- Second scenario: When the sender and the receiver of an e-mail are on different mail servers, we need two UAs and a pair of MTAs (client & server).
- Third scenario: When the sender is connected to the mail server via a LAN or a WAN, we need two UAs and two pairs of MTAs (client and server).
- Fourth scenario: When both sender and receiver are connected to the mail server via a LAN or a WAN, we need two UAs, two pairs of MTAs (client and server), and a pair of

MAAs (client and server).

- Most common scenario

Email Protocols

- SMTP
- POP
- IMAP

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9. What is SMTP? Also explain the working of SMTP.

- SMTP is a simple ASCII Protocol
- The actual mail transfer is done thorough Mail Transfer Agents (MTA)
- To send Mail
  - The senter must have the client MTA
- To receive mail, the sender must have the server MTA
- The server starts by sending a line of text giving its identity and telling whether is prepared to receive mail
- SMTP defines 14 commands, first 5 are mandatory,next 3 are highly recommended, last 6 are seldom used
- Response is sent from the server to the client, A Response is a three digit code that may be followed by additional textual information

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10. Discuss about the MIME.

- Mime is multipurpose Internet Mail Extension
  - It allows non ASCII Values to be sent through SMTP
- MIME allows to
  - Contain symbols in text
  - Contain images, audio, video
  - Any language

Mime Headers

MIME defines five headers that can be added to the original e-mail header section to define the transformation parameters:

1) MIME-Version
2) Content-Type
3) Content-Transfer Encoding
4) Content-Id
5) Content-Description

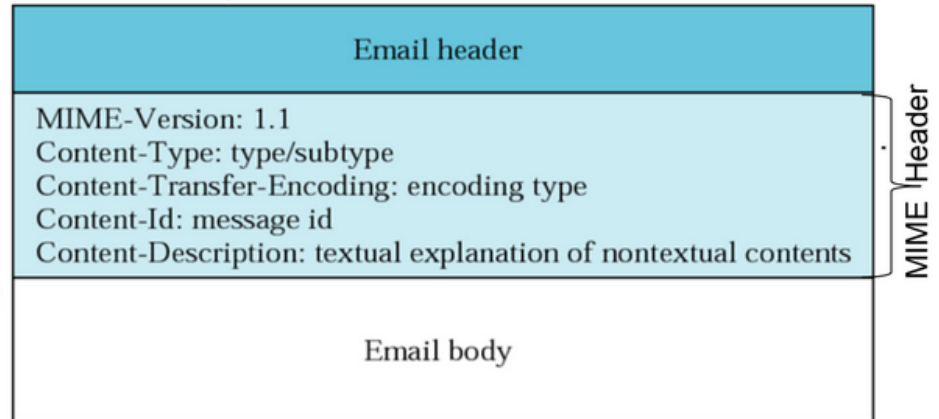| Email header |
| --- |
| MIME-Version: 1.1
Content-Type: type/subtype
Content-Transfer-Encoding: encoding type
Content-Id: message id
Content-Description: textual explanation of nontextual contents |
| Email body |

MIME Header

Fig 5-65: MIME Header

11. What is WWW? What are the main features of WWW?

- WWW is a way of exchanging information between computers on the internet, tying them together into a vast collection of interactive multimedia resources
- World Wide Web was created by Timothy Berners Lee in 1989 at CERN in Geneva. World Wide Web came into existence as a proposal by him, to allow researchers to work together effectively and efficiently at CERN. Eventually it became World Wide Web.

Components of WWW

1. Strucutural Components
    1. Browsers
    2. Servers
    3. Internet
    4. Caches
2. Semantic Components
    1. HTML
    2. HTTP
    3. XML
    4. URL

How WWW Works

WWW works on a client server approach

1. User enters url, example: https://www.google.com
2. Browser requests DNS for ip address of http://www.google.com
3. After receiving IP address
    1. Browser sends request for webpage to webserver
4. Web server receives request
5. It interprets and displays the webpage in the browsers window

6.