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Assignment :- Computer Network (2nd Assignment)

Q-1 Explain the Concept of framing in elementary data link protocols. Discuss Different framing types and list out the causes of errors and methods that can be handled by data link protocols
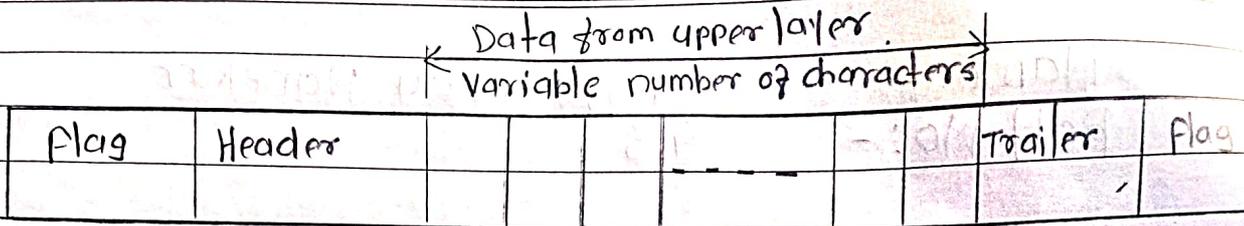
→ framing :-

- framing is the process of dividing a stream of data into smaller, manageble units called frames for transmission over a network.

- Each frame Consists of Control information such as headers, trailers, error-checking bits, and payload data.

- framing ensures that data is transmitted and received Correctly and help detect errors.

Types of framing
i) Character Count framing
- The first field in the frame specifies the total number of characters (bytes) in the frame
- issue: If the Count field is Corrupted, the receiver loses Synchronization
ii) character - oriented framing :-

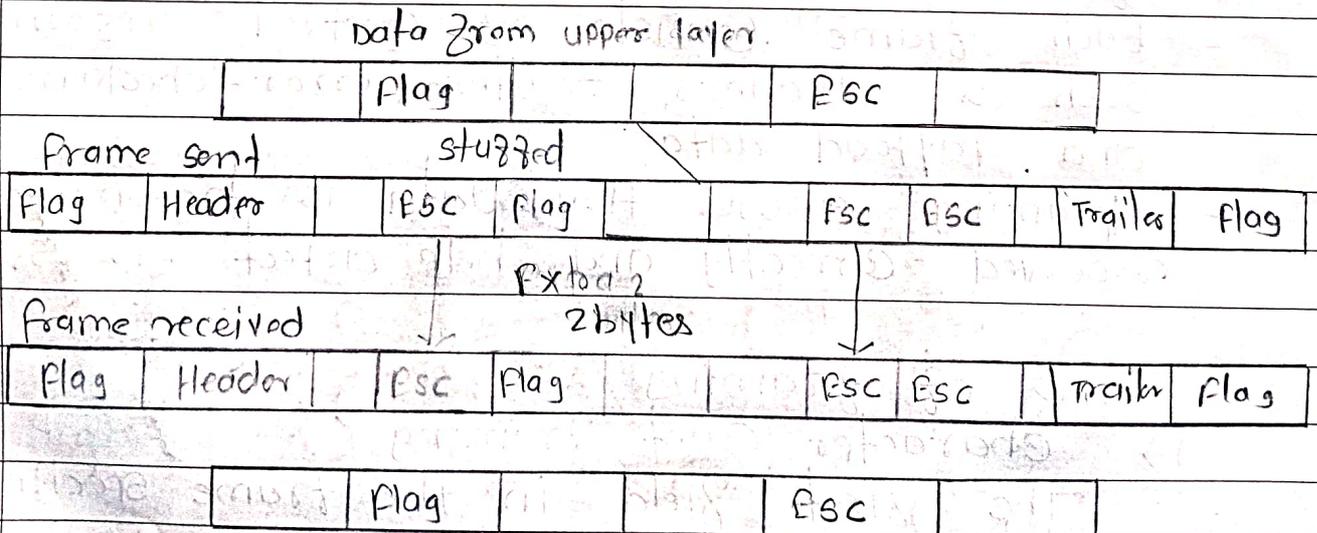| Flag	Header						Trailer	Flag

Data from upper layer.
Variable number of characters

- Uses special characters (like STX and ETX) to indicate the start and end of a frame
- issue :- If the special characters appear in the data, extra escape characters are needed (Byte stuffing).

3) Bit - oriented framing :-
- Uses a specific bit pattern (like a flag 01111110) to mark the begining and end of a frame.
- Issue :- If the flag pattern appears in data , Bit stuffing is used to avoid misinterpretation

Data from upper layer.

	Flag			ESC	

Frame sent   stuffed

Flag	Header		ESC	Flag			ESC	ESC		Trailer	Flag

Extra 2bytes

Frame received

Flag	Header		ESC	Flag			ESC	ESC		Trailer	Flag

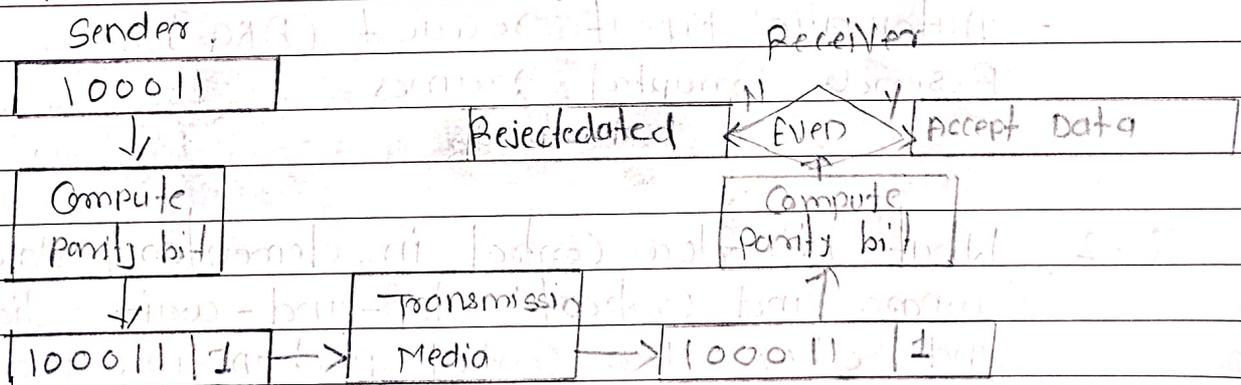|	Flag			ESC	

Data to upper layer

Cause of Error in Data link protocols:
1) Noise in Transmission Media (e.g. electrical interference, cross-talk)
2) Attenuation (signal weakening over long distances)
3) Synchronization issues (misalignment of frames)
4) Bit Errors (caused by environmental factor like temperature fluctuations)

Error Handling Methods:-
1) Error Detection:-
i) Parity Bits:-
- Simple-bit parity is a simple error detection method that involves adding an extra bit to a data transmission. Various techniques of it works as.
 • 1 is added to the block if it contains an odd Number of 1's and
 • 0'is added if it contains an even number of 1's
- This scheme makes the total number of 1's even that is called Even parity checking

Sender   Receiver

[100011]   Rejected data ← (EVEN) → Accept Data
   ↓   N   Y
[Compute   [Compute
 Parity bit]   Parity bit]
   ↓   ↑
[100011|1] → Transmission Media → [100011 | 1]

2) Two-dimensional parity check
- In this bits are calculated for each row, which is equivalent to a simple parity check Bit, parity check bits are also calculated for all columns, then

both are sent along with the data At the receiving end, these are Compared with the parity bits calculated on the received data.

original Data

10011001	11100010	00100100	10000100

Row Parities

1	0	0	1	1	0	0	1	0
1	1	1	0	0	0	1	0	0
0	0	1	0	0	1	0	0	0
1	0	0	0	0	1	0	0	0
1	1	0	1	1	0	1	1	0

Column Parities →

10011001 0	111000100	001001000	100001000	110110110

Data to be sent

2) Cyclic Redundancy check

Error Correction :-
- Hamming Code : Adds redundancy bits to Correct errors
- Automatic Repeat request (ARQ) :-
Resends Corrupted frames

Q-2 What is flow Control in elementary data link protocols? Compare and Contrast Stop-and-wait, Sliding window, and other flow Control mechanisms, providing examples to illustrate their working

→ - Flow Control ensures that the Sender does not overwhelm the receiver with data. it regulates the data transmission rate between sender and receiver

flow Control mechanisms :-
1) Stop-and-wait Protocol :-
- The Sender transmits a frame and waits for an acknowlegment (ACK) before sending the next frame.
- Simple but inefficient due to idle waiting time
- only 1 frame transmit
- Sender window = 1
- Receiver window = 1
- formula for efficiency $\eta = \frac{1}{1+2x}$ where

$$x = \frac{TP}{T_t}$$

- Retransmission is 1

2) Sliding window Protofol
- Sender can send multiple frames before needing an acknowledgment increasing efficiency

Types
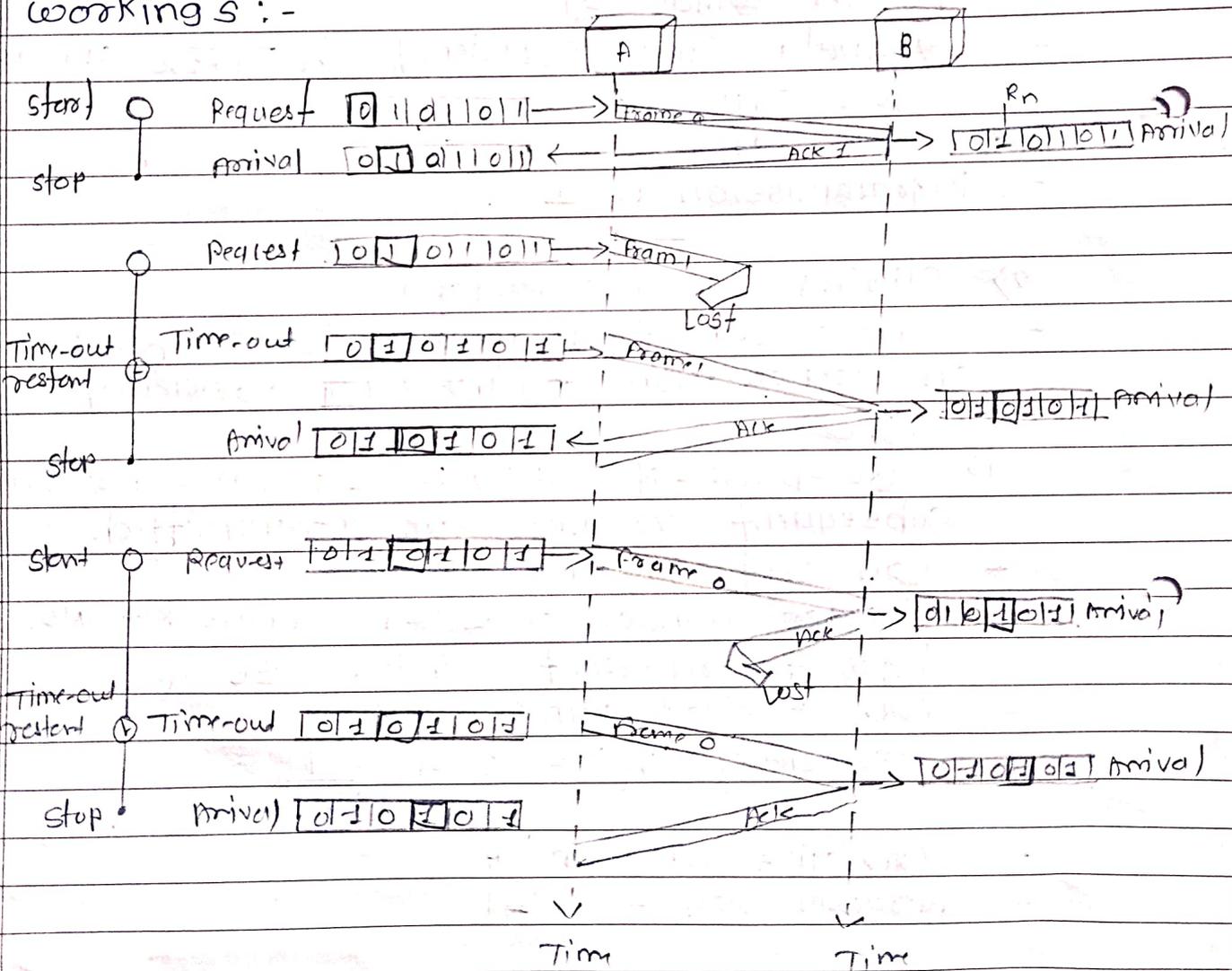i) Go-Back-N (GBN) :- If an error occurs, all subsequent frames are retransmitted.
- Can sent multiple frames
- Sender window = $2^{K}-1$ where K - No. of bits to represent window size
- Can Received window = 1
- efficiency $(\eta) = (2^{k}-1) \times \frac{1}{1+2x}$

- Cumulative achnologmant
- Retransmission = $2^{k}-1$

ii) Selective Repeat (SR) :- only the erroneous frames are retransmitted

- multiple frames can transmites
- Sender window $= 2^{k-1}$
- Receiver window $= 2^{k-1}$
- efficiency $\eta = 2^{k-1} * \dfrac{1}{1+2x}$

- Cumulative and independent achnolegment
- Retransmission $= 1$

Workings :-

start) Request [0|1|d|1|0|1|→ frame o

stop   Arrival [0|1|a|1|0|1) ←

Rn
[0|1|0|1|0|1|] Arrival

ACK 1

Reqtest [0|1|0|1|0|1|→ frame 1

Lost

Time-out   Time-out [0|1|0|1|0|1|→ frame 1
restant

Arrival [0|1|0|1|0|1|←

[0|1|0|1|0|1] Arrival

Ack

stop

start   Reavest [0|1|0|1|0|1|→ frame o

Time-out
restant   Time-out [0|1|0|1|0|1] frame o

[d|b|1|0|1|1] Arrival

nck
lost

[0|1|0|1|0|1] Arrival

stop   Arrival [0|1|0|1|0|1]

Ack

Time   Time

Q-4 What is MAC addressing frame form Explain in detail format of MAC address?

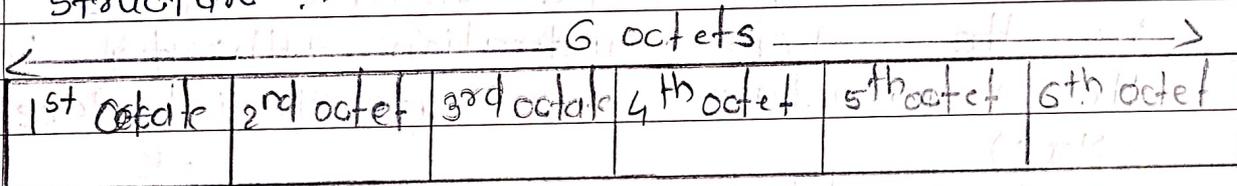→ A MAC (Media Access Control) address is a unique identifier assigned to network interfaces.

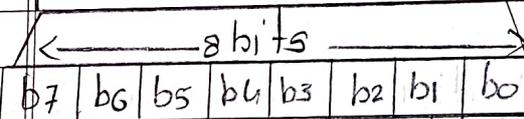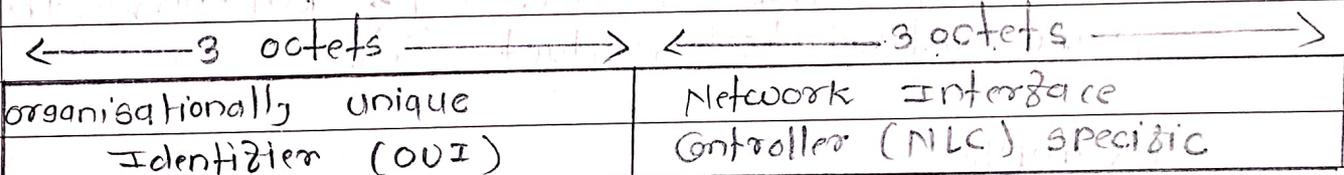- It is 48 bits long and typically represented in hexadecimal format as:

00: A1 : B2 : C3 : D4 : E5

Structure of MAC Address:

MAC address format :-
Structure :-

←――――――――――――― 6 octets ―――――――――――――→					
1st Octate	2nd octet	3rd octate	4th octet	5th octet	6th octet

OR

←――――― 3 octets ―――――→	←――――― 3 octets ―――――→
organisationally unique Identifier (OUI)	Network Interface Controller (NIC) specific

←――――― 8 bits ―――――→
b7	b6	b5	b4	b3	b2	b1	b0

0: unicast
1: multicast

0: globally unique
1: locally administered

Hexadecimal Representation :-

MAC addresses are represented using 12 Hexadecimal digits, where each pair of digits represents a byte (octet)

Separators :-

- These digits are given often separated by Colons (00: 1A : 2B : 3C : 4D : 5E) or hyphens (eg, 00-1A -2B -3C - 4D - 5E) for easier readability

Structure :-

- First 3 octets (18 bits) :- Represent the organizationally unique Identifier (OUI) assigned by the IEEE Registration Authority to identify the manufacturer of network interface Card (NIC)
- Last 3 octetes :- Are Vendor - Specific uniquely identify the specific N/C within that manufacturer's product line

Example : -

00 : 1A : 2B : 3C : 4D : 5E
00 : 1A : 2B : (OUI - Identifies the manufactures)
3C : 4D : 5E : (NIC - Specific part - identifies specific NIC)

MAC addressing in Ethernet Frames :

Data Link layer :-

MAC addresses are used in data link layer (layer 2) of OSI model

Ethernet Frames :-
In Ethernet Frames Source and destination MAC addresses are included in the header to identify Sender & recipient of the frame

Q-4 Explain the role of the transport layer in OSI and TCP/IP models Discuss its key features including Segmentation, flow Control and error Control with relevent example

→ The transport layer in both OSI and TCP/IP model ensures reliable end-to-end data delivery between applications, handling Segmentation, flow Control and error Control using Protocols like TCP and UDP

Role in OSI and TCP/IP models :-
i) OSI Model :-
The Transport layer (layer 4) bridges the network layer (layer 3) and session layer (layer 5), managing data transfer between application on different hosts.

ii) TCP/IP Model :-
The Transport layer (layer 4) sits between the Application layer (layer 5) and the Network layer (layer 3), providing similar end-to-end Communication service

Key-features :-

- **Segmentation :-**
  It breaks down large message from the upper layer into smaller units called as segments for efficient transmission.

- **Flow Control :-**
  It manages the rate of data transmission to prevent a fast sender from overwhelming a slow receiver, ensuring efficient resource utilization.

- **Error Control :-**
  It detects and corrects errors during transmission, ensuring reliable data delivery

- **Multiplexing | Demultiplexing :-**
  The transport layer enables multiple applications on a host to communicate simultaneously by using different port numbers.

- **Connection Management :-**
  protocols like TCP establish and terminate connections between applications, ensuring reliable and ordered data transfer.

Protocols :-

- **TCP (Transmission Control Protocols):-**
  Provides reliable, Connection-oriented communication with features like flow-Control, error control and sequencing

- **UDP (User Datagram protocol) :-**
  Offers faster, Connectionless communication without guaranteed delivery or error Control

Examples :-

1) web browsing :-
when you access a website the transport layer (using TCP) ensures that the web page's data arrives correctly and in right order at your browser

II) Email :-
Email applications use TCP to establish a connection with mail server & ensures that the email data is delivered correctly

III) Video streaming :-
UDP is often used for video streaming because it prioritizes speed over reliability allowing for smoother playback even with some packet loss

Q-5 what is multiplexing Explain the key aspects of multiplexing in context with transport layer along with benifit of multiplexing.

→ Multiplexing combines multiple data streams into a single signal for transmission and in the context of the transport layer, it allows a host to send data from different applications over the same network connection This is achieved by adding transport layer headers, including port numbers to identify the destination application.

Key Concept of multiplexing in Transport layer :-
○ Combining Data streams :-

The transport layer gathers data from different sockets on the sending host.
- Adding headers :- Each data segment is encapsulated with a transport layer header including source and destination port numbers.
- Passing to network layer :- The resulting segments are then passed to the nlw. layer for transmission
- Demultiplexing at Receiver :- on the receiving side the transport layer uses port number in the headers to deliver the data to the correct application (Socket)

Benefits of multiplexing
- Efficient Resource utilization
- Simplified network Infrastructure
- Scalability
- Flexibility

Q-6 List out the TCP/IP Suite of protocols and explain :- 1. HTTP, 2. SMTP, 3. FTP, 4. IMAP & POP3, 5. DNS, 6. TCP, 7 UDP

--> The TCP/IP Suite of protocols include protocols like :-
HTTP :- for web Communication
SMTP :- for email sending
FTP :- for file transfer.

- IMP and POP3 :- for email retival
- DNS :- for Domain name resolution
TCP and UDP :- for reliable and unreliab
data transmission

Core protocols :-

- TCP :- Provides reliable ordered and error checked data transmission over IP network
- IP (Internet protocol) :- Handles addressing and routing of data packets across networks enabling communication between different devices.

protocols :-
a) HTTP :- Hyper Text transfer protocol used for transmitting web pages and content over world wide web.

b) SMTP :- Simple mail transfer protocol used for sending emails from a client to a server (mail)

c) FTP (file Transfer protocol) :- used for transferring files between a client and a server.

d) IMAP :- Internet Message Access protocol Allows user to access and manage email messages on a mail server, enabling synchronization across devices

e) POP3 (Post office protocol 3) :-
A protocol for receiving email from a
mail server and downloading it to a
client

8) DNS :- Domain Name system :-
Translates human - readable domain
names (like abc.com) into numerical
IP addresses that computers use to
communicate

9) UDP (user datagram protocol) :-
provides a connectionless, lightweight and
fast data transfer method often used
and fast applications where speed is
more important than reliability