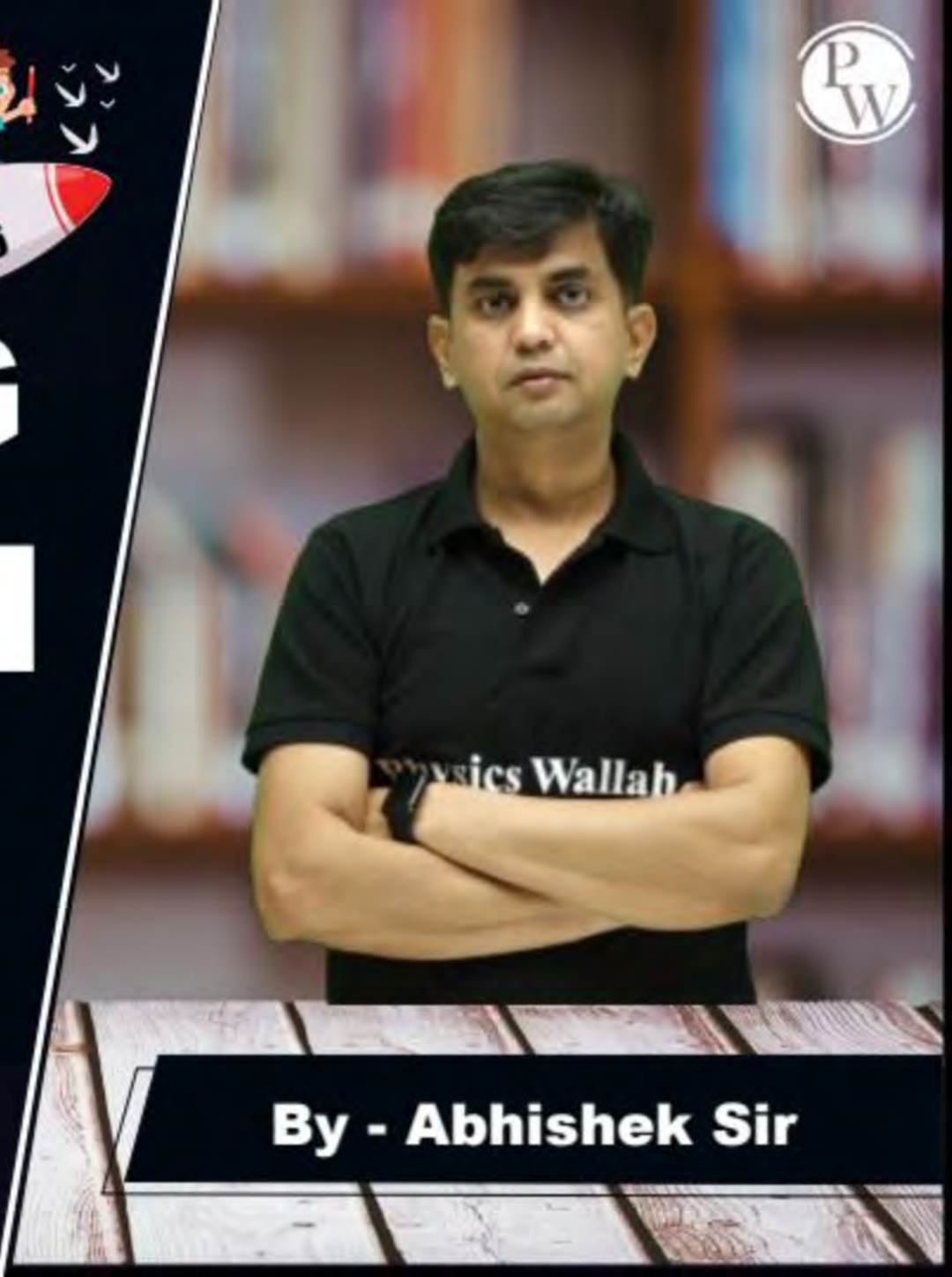
CS & IT ENGINEERING

Computer Network

IPv4 Header

Lecture No. - 02



Recap of Previous Lecture

- Topic: IPv4 Packet Header Structure
- Topic: IPv4 Packet Header Size [HLEN] *
- Topic: IPv4 Packet Size [TL] *
- Topic: MTU *
- Topic: Identification Number

Topics to be Covered

Topic Fragmentation at Source Host

↳ Based on Source n/w MTU.

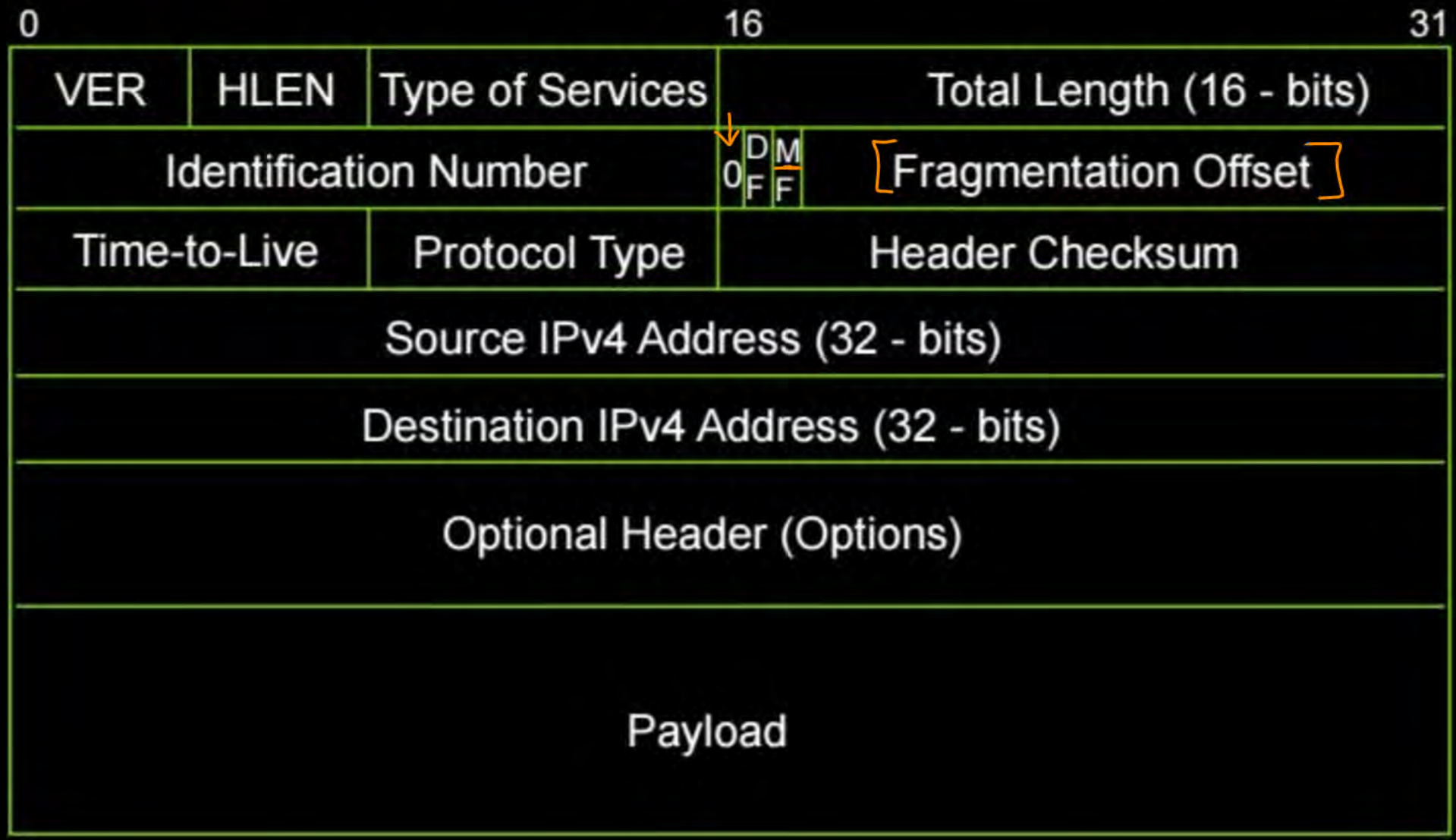
ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
- M.Tech (CS) - IIT Kharagpur
- 12 years of GATE CS teaching experience

Telegram Link : https://t.me/abhisheksirCS_PW

Topic : IPv4 Packet Header



Example 6 :-

[NAT]

#Q. Consider UDP segment of size 4000 bytes is passed to IPv4 protocol for delivery. MTU for source network is 1500 bytes and IPv4 header size is 20 bytes then calculate total number of fragments required to deliver the UDP segment ?

Ans = 3

[TL <= MTU]

MTU = [1500 bytes]

IPv4 Header Size = [20 bytes]

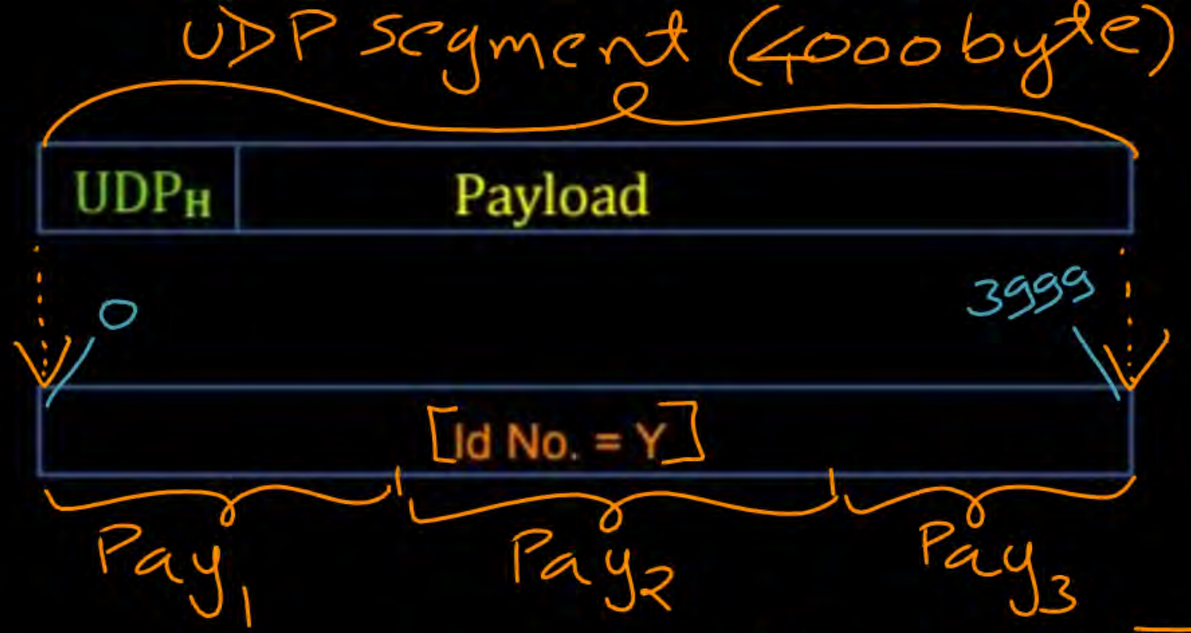
Maximum Payload Size = [MTU - Header Size] bytes

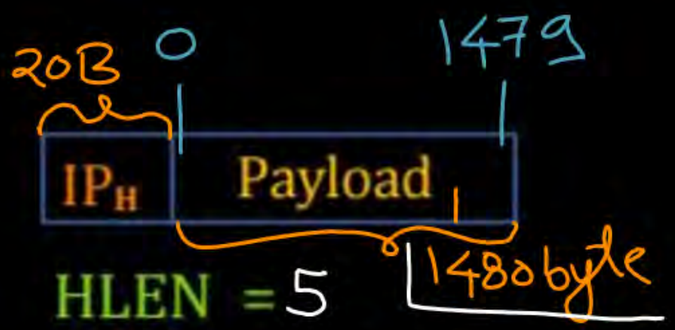
= [1500 − 20] bytes

= 1480 bytes

*Fragmentation at source host

[N/W SDU = segment]





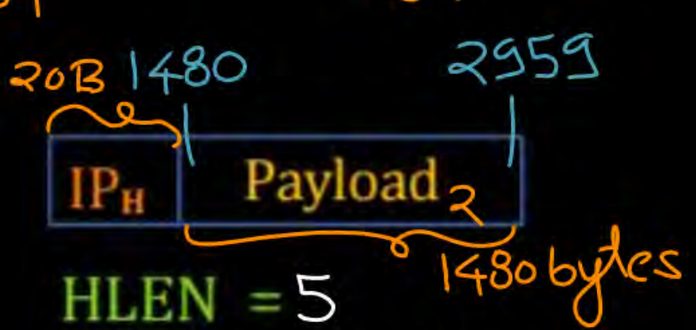
HLEN = 5

TL = 1500

Id No. = Y

Offset = $\frac{0}{8} = 0$

MF bit = 1



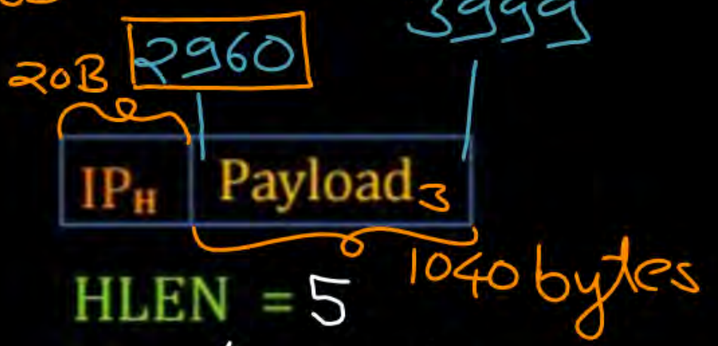
HLEN = 5

TL = (20 + 1480) = 1500

Id No. = Y

Offset = $\frac{1480}{8} = 185$

MF bit = 1



HLEN = 5

TL = (20 + 1040) = 1060

Id No. = Y

Offset = $\frac{2960}{8} = 370$

MF bit = 0

UDP Segment Size = [4000 bytes]

Total Number of IP fragments [N] = $\left\lceil \frac{[\text{UDP Segment Size}]}{[\text{Max}^{m}\ \text{Payload Size}]} \right\rceil$

$N = \left\lceil \frac{4000\ \text{bytes}}{1480\ \text{bytes}} \right\rceil$

$N = \lceil 2.70 \rceil$

$N = 3$

Total length of the last IP fragment =

Header Size + [UDP Segment Size − (N−1) * Max^m Payload Size] bytes

$= 20 \text{ byte} + [4000 \text{ byte} - (3-1) * 1480 \text{ byte}]$

$= [20 + 1040] \text{ byte}$

$= 1060 \text{ bytes}$

$$\text{Offset value of the last IP fragment} = \left[\frac{(N-1) * \overset{\text{Max}^m}{\text{Payload Size}}}{8} \right]$$

$$= \left[\frac{(3-1) * 1480 \text{ bytes}}{8} \right]$$

$$= 370 \text{ word}$$

Topic : Fragmentation Offset

→ Fragmentation offset is 13 bits long

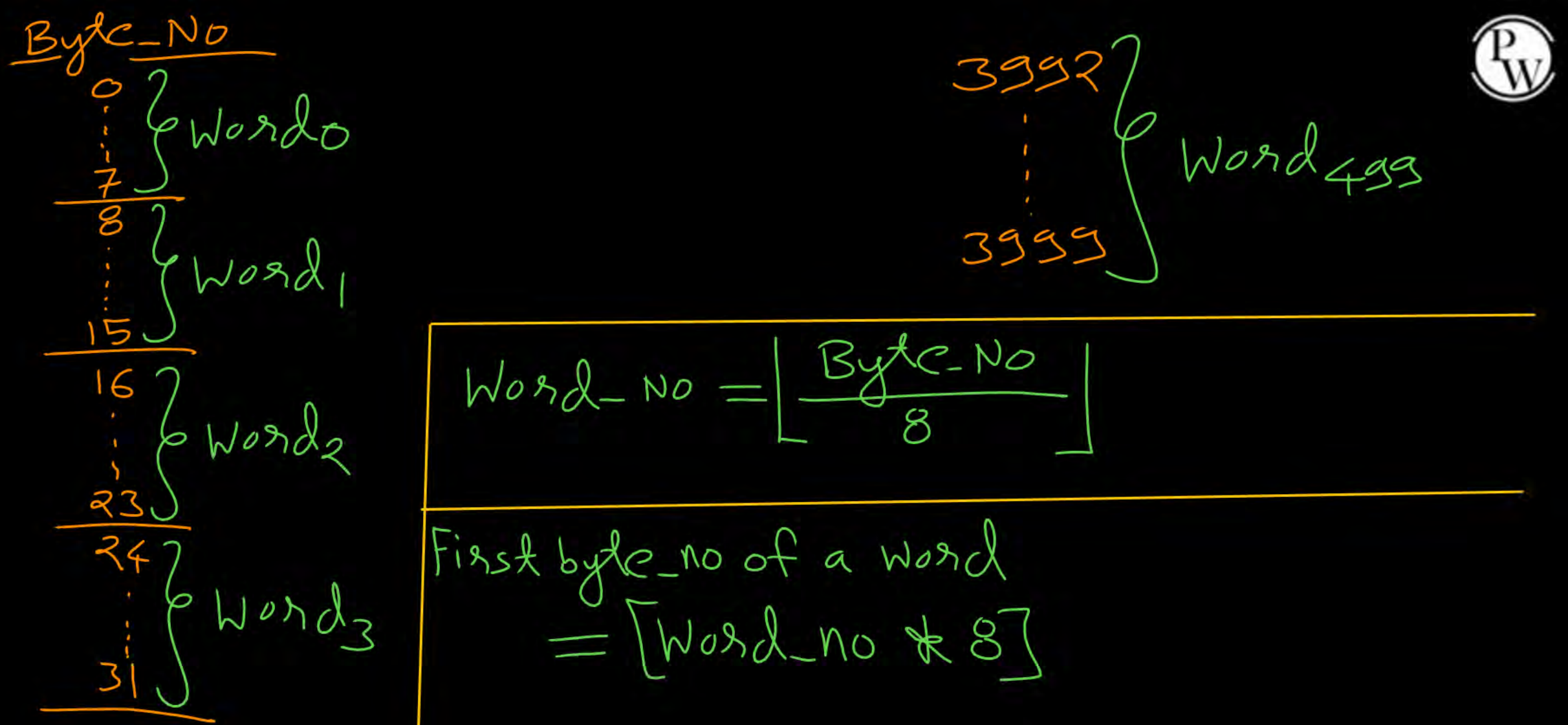
→ Used to identify the sequence of fragments

Topic : Fragmentation Offset

→ Contains payload's starting word number
[Words of 8 bytes]

→ Word number according to "Service Data Unit" (SDU)

→ Offset value for the first fragment in the sequences always "Zero"



$$Word\_No = \left\lfloor \frac{Byte\_No}{8} \right\rfloor$$

First byte_no of a word

$$= [Word\_no * 8]$$

Topic : 3 Flag Bits

→ First bit unused, must be zero

→ DF : Do not fragment *

→ MF : More fragment *

Topic : MF Flag

MF : More fragment

→ Used to identify last fragment in the sequence of fragments

→ For last fragment, MF bit should be "Zero"

→ For first and intermediate fragments (except last), MF bit should be "One".

Topic : Fragmentation at Source Host

IPv4 Datagram Size ≤ Source Network MTU

Maximum Payload Size = [MTU – Header Size] bytes

Total Number of IP fragments [N] = ⌈[UDP Segment Size / Payload Size]⌉

Total length of the last IP fragment
= Header Size + [UDP Segment Size – (N–1) * Payload Size] bytes

Offset value of the last IP fragment = [(N–1) * Payload Size / 8]

[MCQ] IIT-B, H.W. [GATE-2013] [2 Mark]

#Q. In an IPv4 datagram, the M bit is 0, the value of HLEN is 10, the value of total length is 400 and the fragment offset value is 300. The position of the datagram, the sequence numbers of the first and the last bytes of the payload, respectively are

(A) Last fragment, 2400 and 2789

(B) First fragment, 2400 and 2759

(C) Last fragment, 2400 and 2759

(D) Middle fragment, 300 and 689

[MCQ] IIT-K, H.W. [GATE-2015] [2 Mark]

#Q. Host A sends a UDP datagram containing 8880 bytes of user data to host B over an Ethernet LAN. Ethernet frames may carry data up to 1500 bytes (i.e. MTU = 1500 bytes). Size of UDP header is 8 bytes and size of IP header is 20 bytes. There is no option field in IP header. How may total number of IP fragments will be transmitted and what will be the contents of offset field in the last fragment?

(A) 6 and 925

(B) 6 and 7400

(C) 7 and 1110

(D) 7 and 8880

[MCQ] IIT-R, H.W. [GATE-2025] [1 Mark]

#Q. Consider a network that uses Ethernet and IPv4. Assume that IPv4 headers do not use any options field. Each Ethernet frame can carry a maximum of 1500 bytes in its data field. A UDP segment is transmitted. The payload (data) in the UDP segment is 7488 bytes. Which ONE of the following choices has the CORRECT total number of fragments transmitted and the size of the last fragment including IPv4 header?

(A) 5 fragments, 1488 bytes

(B) 6 fragments, 88 bytes

(C) 6 fragments, 108 bytes

(D) 6 fragments, 116 bytes

2 mins Summary

Topic Fragmentation at Source Host

segments ⟹ Fragments

TCP/UDP IP

THANK - YOU