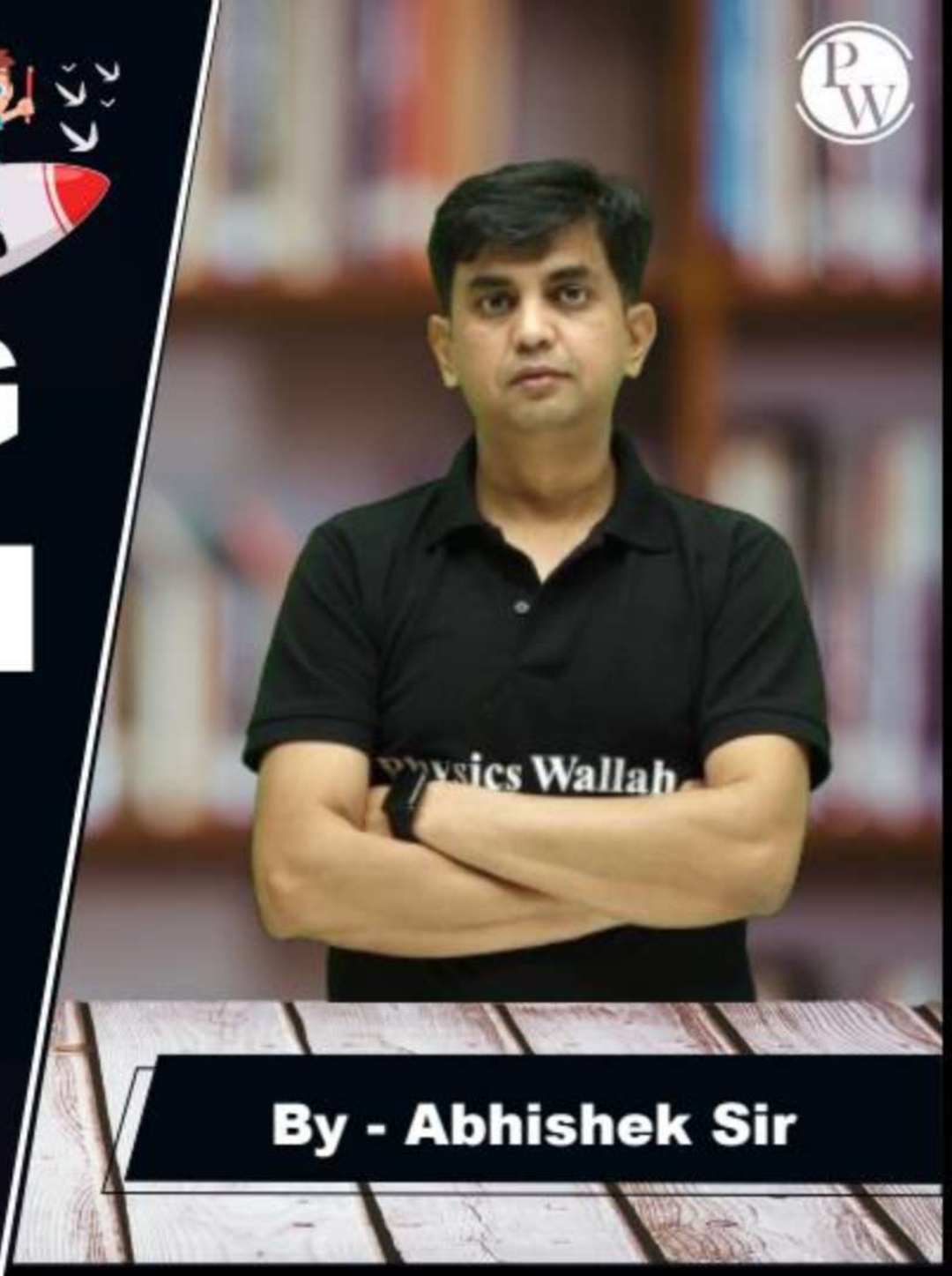
CS & IT ENGINEERING

Computer Network

IPv4 Header

Lecture No. - 02



Recap of Previous Lecture

- Topic: IPv4 Header
- Topic: Header Length
- Topic: Total Length
- Topic: MTU

Topics to be Covered

- Topic: Identification Number
- Topic: Fragmentation Offset
- Topic: 3 Flag bits

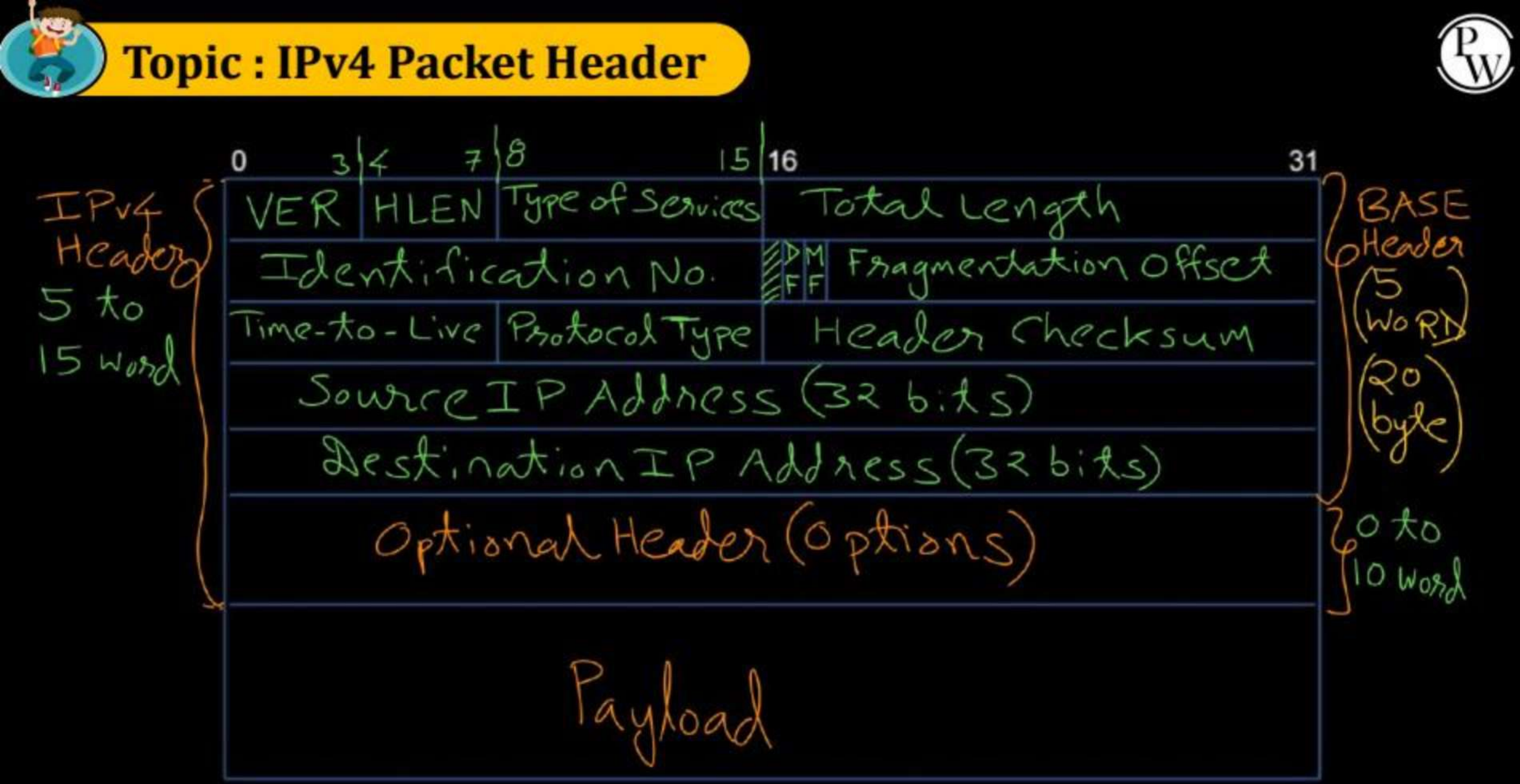
ABOUT ME

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



Topic : Identification Number

→ 16 bits long

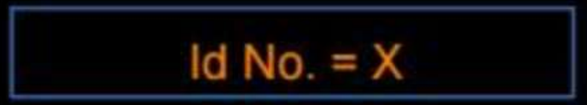
→ Assigned by source host only
[Assigned unique identification number to each transport layer Segment]

→ Fragments of same segment, must have same identification number
[does not change during routing]

Topic : Identification Number

Transport Layer PDU (Segment)

SDU for Network Layer

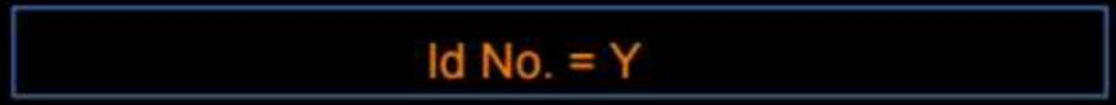


Id No. = X

Topic : Identification Number

Transport Layer PDU (Segment)

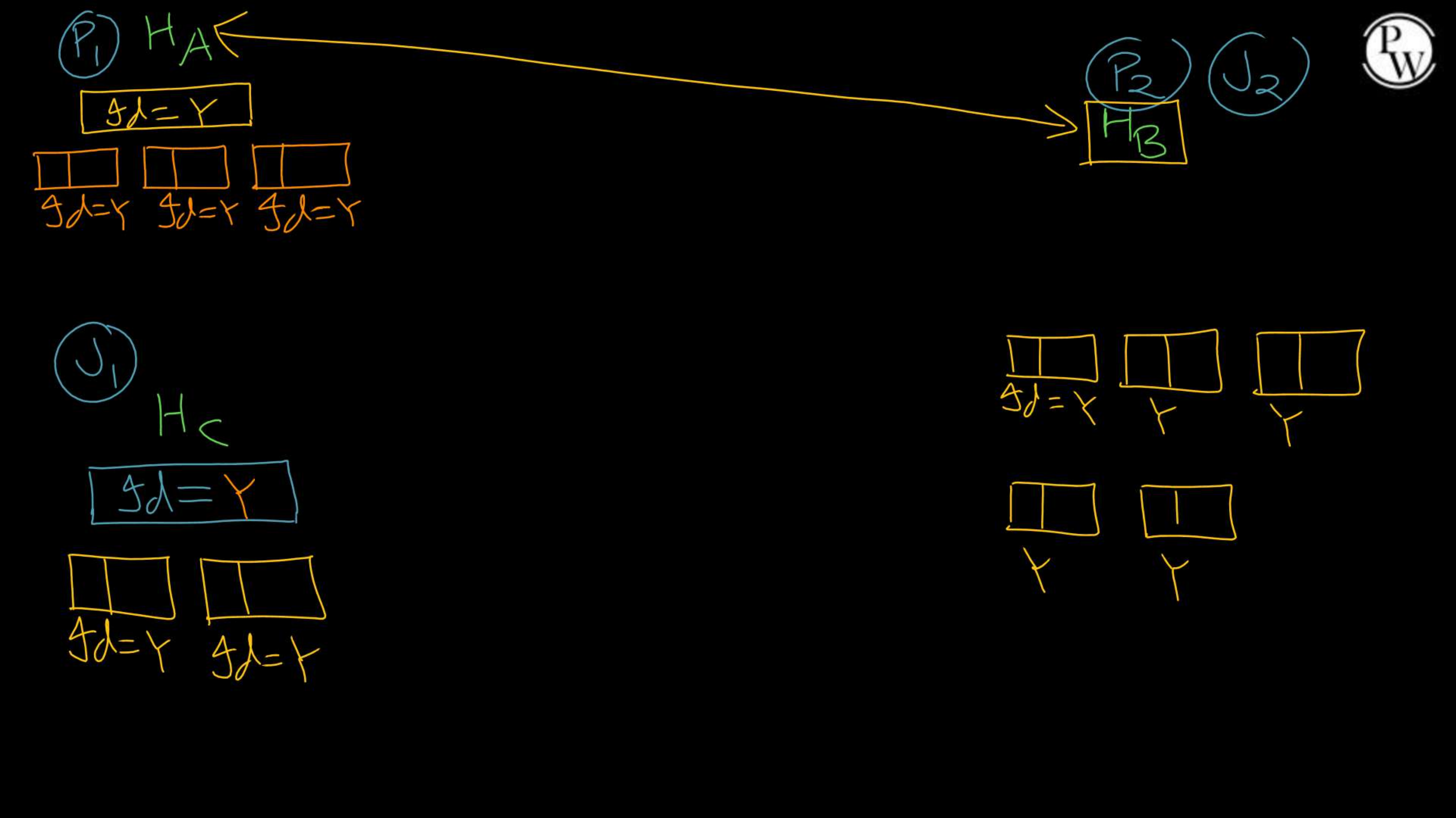
SDU for Network Layer



Id No. = Y

Id No. = Y

Id No. = Y


P1
HA
gd=Y
gd=Y
gd=Y
gd=Y
P2
J2
HB
J1
HC
gd=Y
gd=Y
gd=Y
gd=Y
gd=Y
Y
Y
Y
Y

Topic : Identification Number

→ Receiver host do clustering of fragments, before assembly

→ based on Source IP Address and Identification number

IPv4 = (32 bits) (16 bit)

Identification Number (16 bits) : Locally unique

Source IP Address & Identification Number (48 bits) : Globally unique

Example 1 :-

Every host in an IPv4 network needs to generate up to 1024 unique identifiers per second. After what period (in seconds) will the identifiers generated by a host wrap around?

Wrap around $\Rightarrow$ $0 \ldots\ldots (2^{16}-1), 0 \ldots\ldots (2^{16}-1)$

Id no. = 16 bits

2^{16}

1 sec $\longrightarrow$ 1024 identifiers

2^{10} identifiers $\longrightarrow$ 1 sec

2^{16} identifiers $\longrightarrow \left(\frac{2^{16}}{2^{10}}\right)$ sec

Ans = 2^6 sec

= 64 sec

#Q. Every host in an IPv4 network has a 1-second resolution real-time clock with battery backup. Each host needs to generate up to 1000 unique identifiers per second. Assume that each host has a globally unique IPv4 address. Design a 50-bit globally unique ID for this purpose. After what period (in seconds) will the identifiers generated by a host wrap around?

[GATE 2014, Set-3, 2-Mark]

H. W.

#Q. Suppose UDP packet 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?

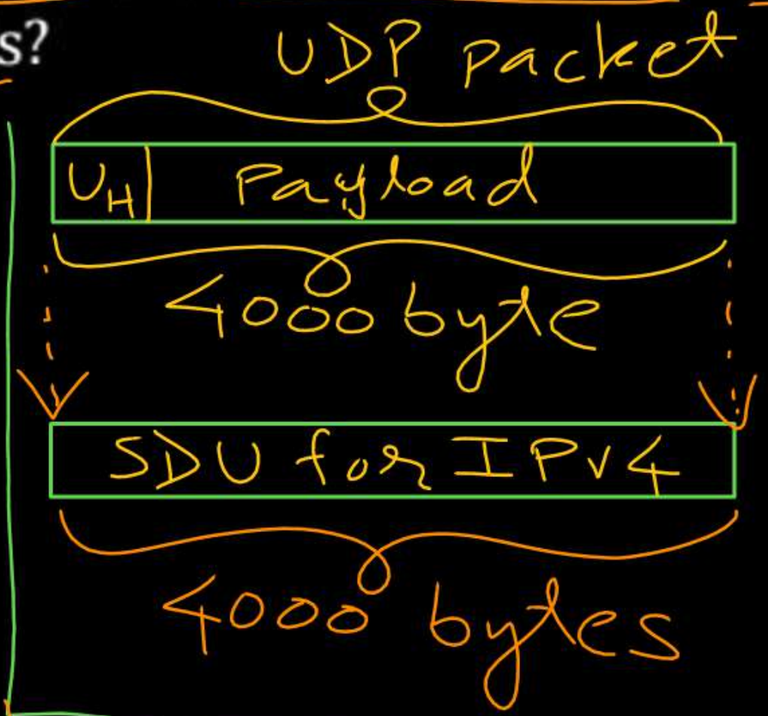
SDU Size = 4000 bytes

MTU Size = 1500 bytes

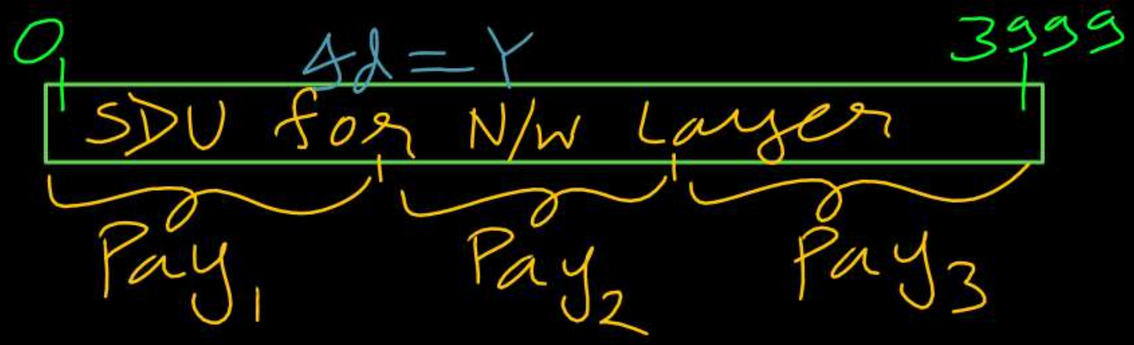
Header Size = 20 bytes

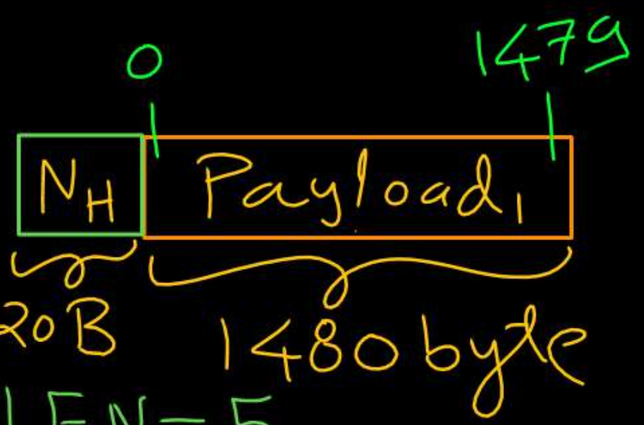
Payload Size = [MTU Size − Header Size]

Payload Size = (1500 − 20) bytes
= 1480 byte

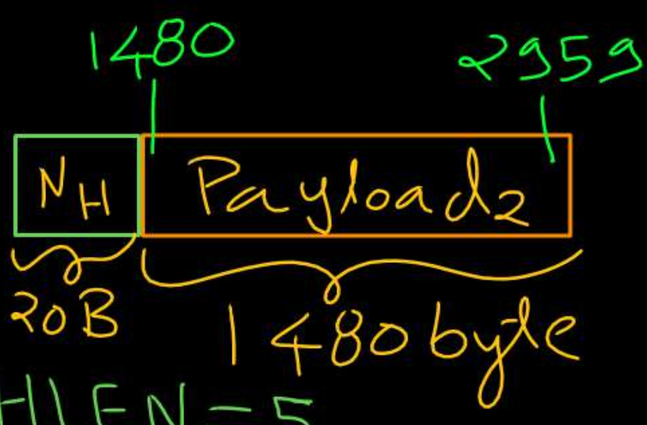


IPv4 Datagram Size ≤ MTU

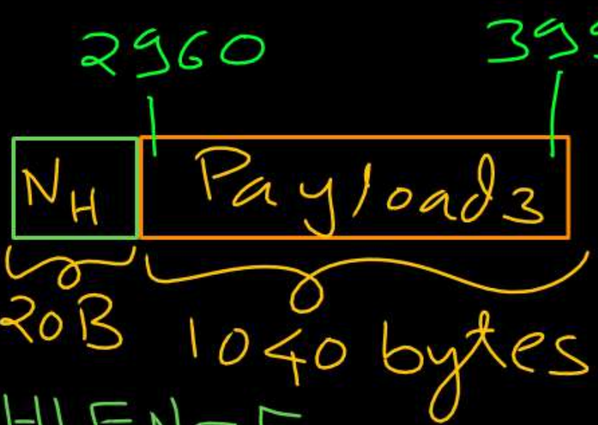




HLEN = 5
TL = 1500
Id = Y
offset = $\frac{0}{8}$ = 0
MF = 1



HLEN = 5
TL = 1500
Id = Y
offset = $\frac{1480}{8}$ = 185
MF = 1



HLEN = 5
TL = 1060
Id = Y
offset = $\frac{2960}{8}$ = 370
MF = 0

No. of fragments (N) $= \left\lceil \frac{\text{SDU Size}}{\text{Payload size}} \right\rceil$

$N = \left\lceil \frac{4000 \text{ bytes}}{1480 \text{ bytes}} \right\rceil = \lceil 2.70 \rceil = 3$

Total Length for last fragment

$= \text{Header Size} + [\text{SDU Size} - (N-1) * \text{Payload Size}]$

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

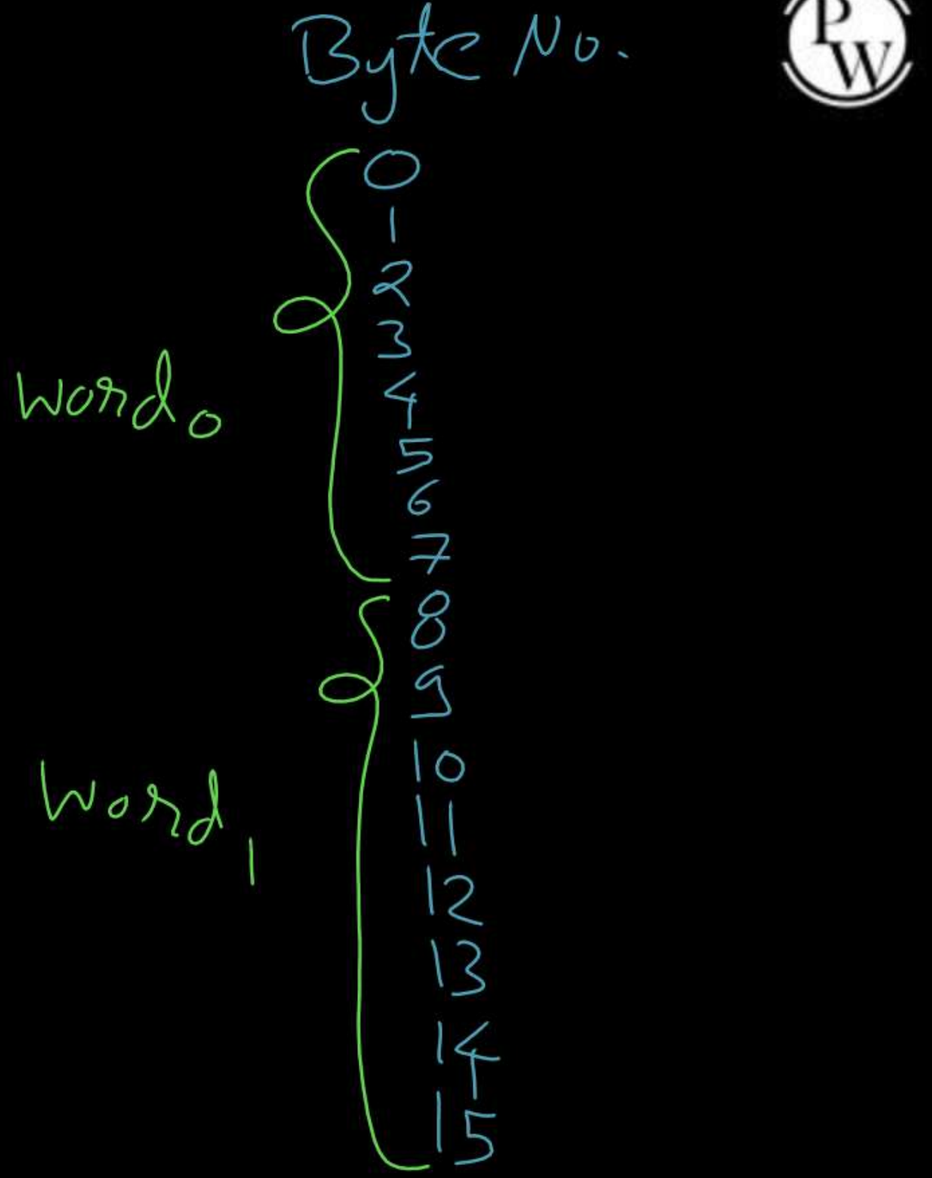
$= (20 + 1040) \text{ bytes} = 1060 \text{ bytes}$

Offset value of last fragment

$= \frac{(N-1) * \text{Payload Size}}{8} = \frac{(3-1) * 1480 \text{ bytes}}{8} = 370$

If word size is 8 byte

$$\text{Word no.} = \left\lfloor \frac{\text{Byte no.}}{8} \right\rfloor$$



Topic : Fragmentation Offset

→ Fragmentation offset is 13 bits long

→ Used to identify the sequence of fragments

→ 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"

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 intermediate fragments (except last), MF bit should be "One".

Topic : Fragmentation at Source Host

IPv4 Datagram Size ≤ Source Network MTU

Payload Size = [MTU – (HLEN * 4)] bytes

Number of fragments at source host (N) = [SDU Size / Payload Size]

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

Total length of last fragment = (HLEN * 4) + [SDU Size – (N – 1) * Payload Size]

#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

[GATE 2013]

IIT-B

H.W.

(A) Last fragment, 2400 and 2789

(B) First fragment, 2400 and 2759

(C) Last fragment, 2400 and 2759

(D) Middle fragment, 300 and 689

#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?

[GATE 2015]

IIT-K

H.W.

(A) 6 and 925

(B) 6 and 7400

(C) 7 and 1110

(D) 7 and 8880

2 mins Summary

Topic Identification Number

Topic Fragmentation Offset

Topic 3 Flag bits

THANK - YOU