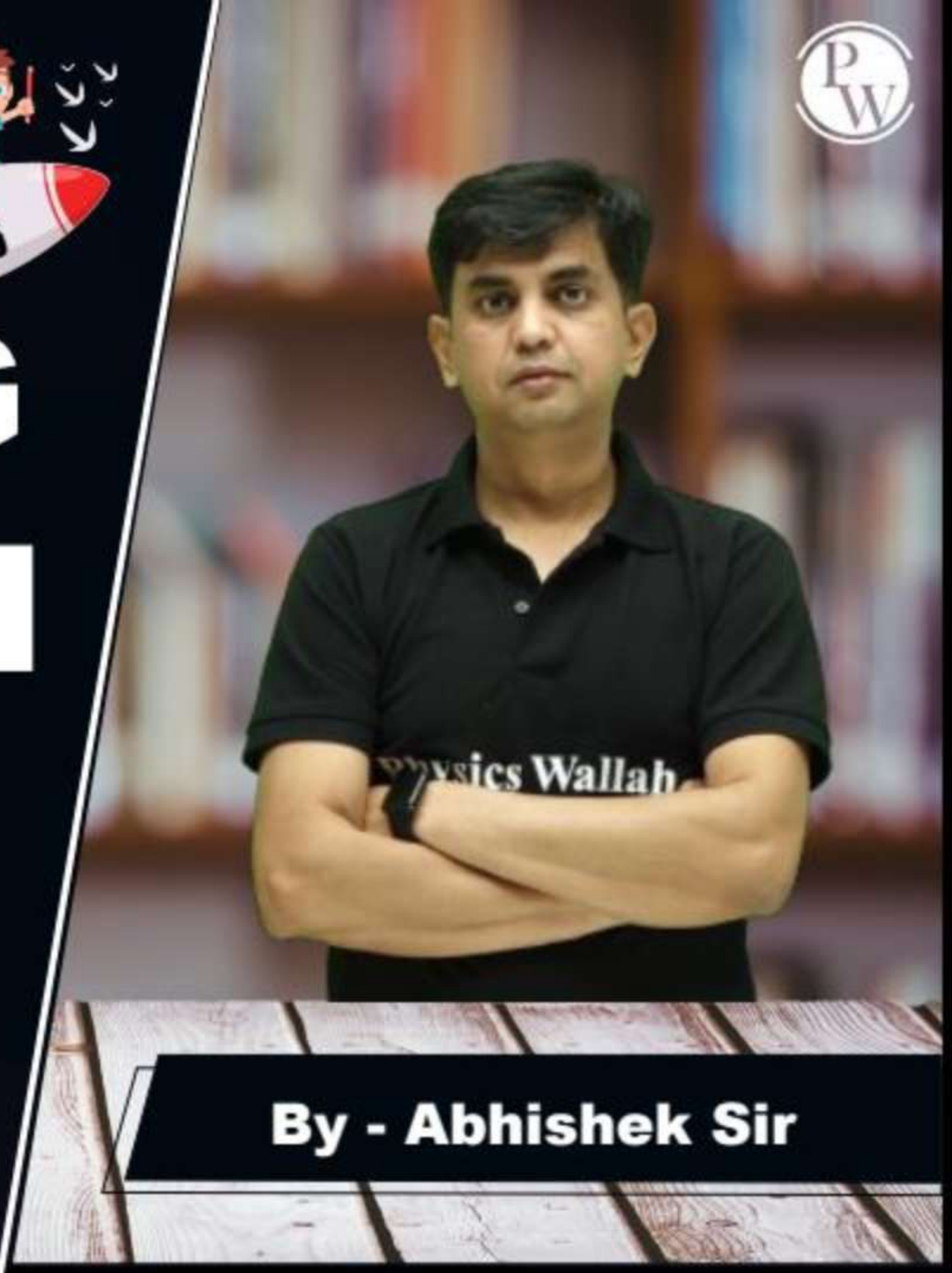
CS & IT ENGINEERING

Computer Network

IPv4 Header

Lecture No. - 04



Recap of Previous Lecture

Topic Fragmentation Offset

Topic Flag bits

Topics to be Covered

Topic Fragmentation Offset

Topic Flag bits

ABOUT ME

Hello, I'm Abhishek

- GATE CS AIR - 96
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- 12 years of GATE CS teaching experience

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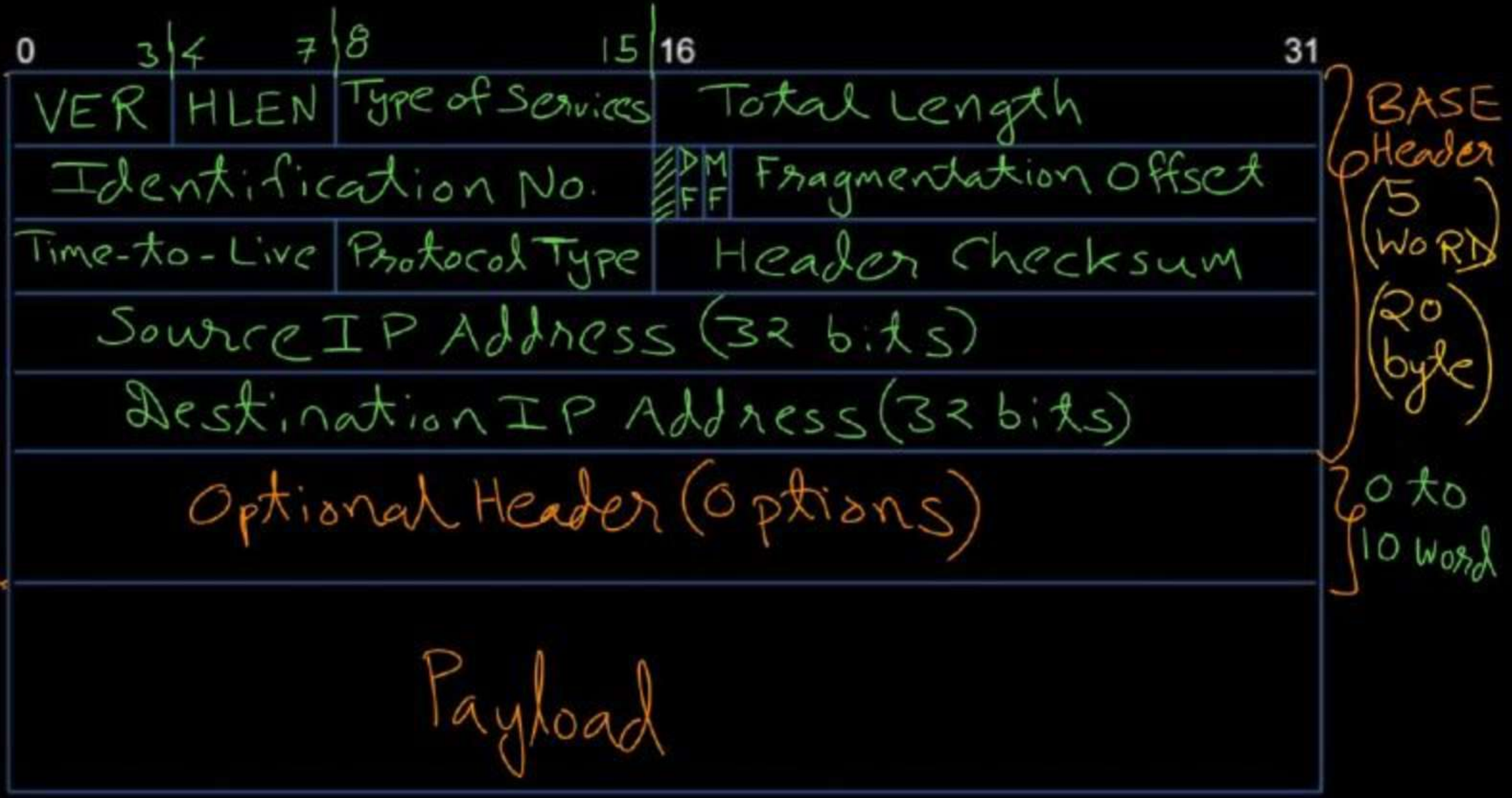
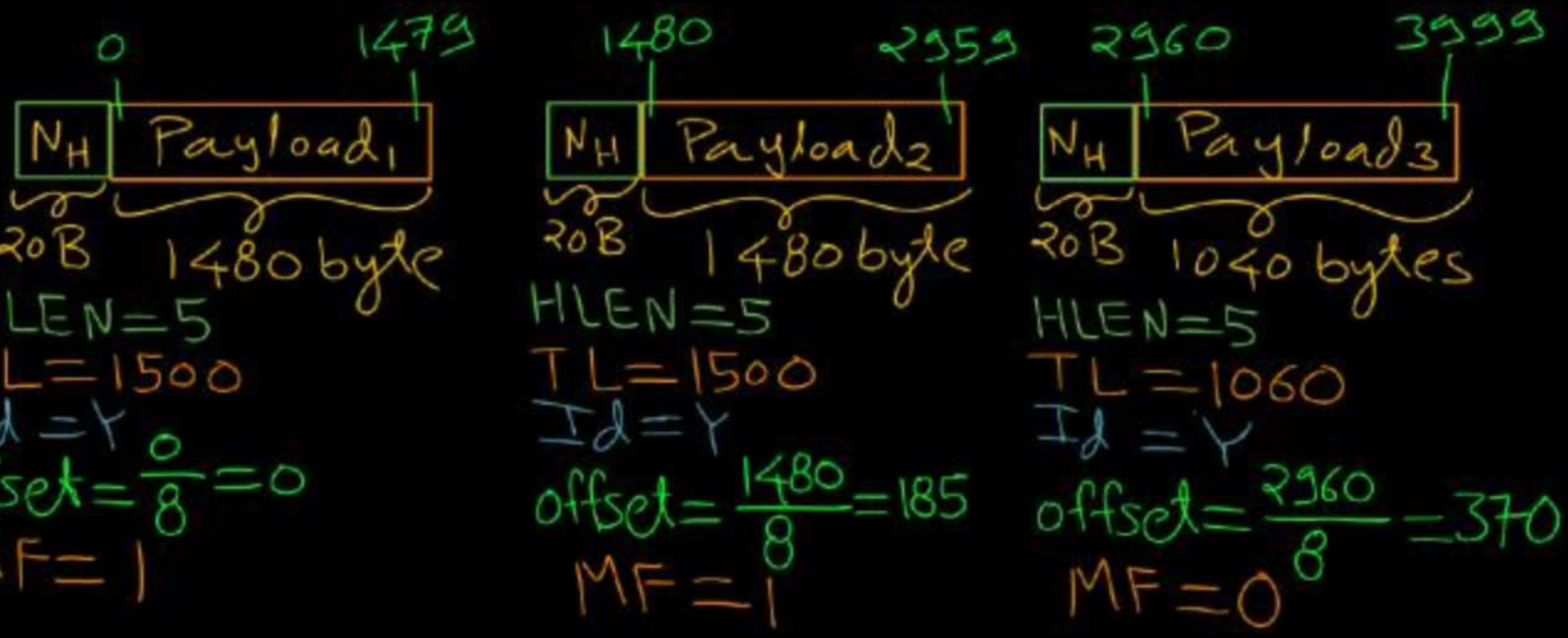
Topic : IPv4 Packet Header

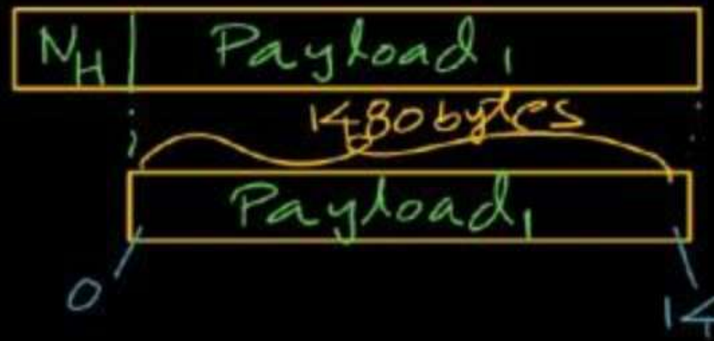


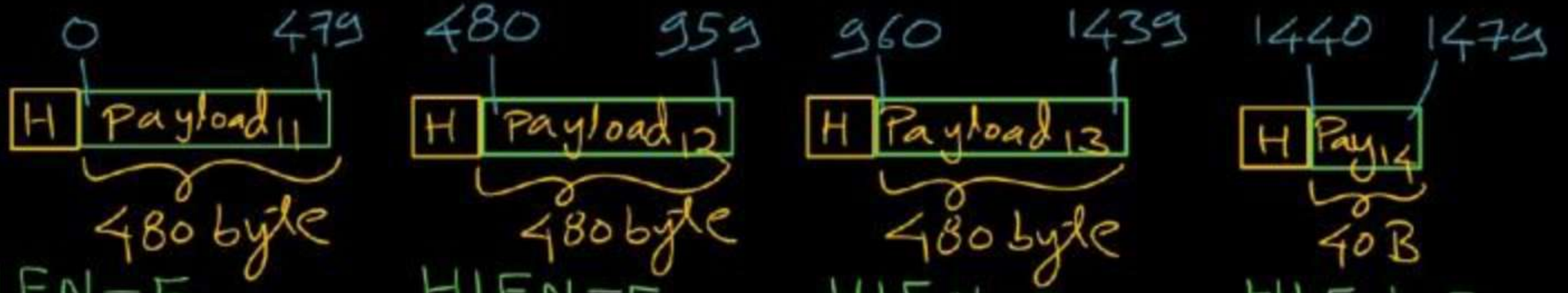
#Q. Suppose IPv4 datagrams created in previous question are arrived at intermediate IPv4 router where next network MTU is 500 bytes, then calculate total number of fragments?

Ans=11



HLEN = 5
TL = 1500
Id = Y
off = 0
M = 1
D = 0





HLEN = 5
TL = 500
Id = Y
off = $\frac{0}{8} = 0$
M = 1
D = 0

HLEN = 5
TL = 500
Id = Y
off = $\frac{480}{8} = 60$
M = 1
D = 0

HLEN = 5
TL = 500
Id = Y
off = $\frac{960}{8} = 120$
M = 1
D = 0

HLEN = 5
TL = 60
Id = Y
off = $\frac{1440}{8} = 180$
M = 1
D = 0

HLEN=5
TL=1500
Id=Y
off=185
M=1
D=0

HLEN=5
TL=500
Id=Y
off=185
M=1
D=0

HLEN=5
TL=500
Id=Y
off=185+60
=245
M=1
D=0

HLEN=5
TL=500
Id=Y
off=245+60
=305
M=1
D=0

HLEN=5
TL=60
Id=Y
off=305+60
=365
M=1
D=0

old payload size = [TL − (HLEN * 4)] bytes
= [1500 − (5 * 4)] bytes = 1480 bytes

New Payload Size = [MTU − (HLEN * 4)] bytes
= [500 − (5 * 4)] bytes = 480 bytes

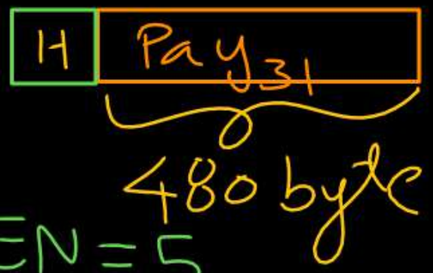
No of fragments (N) = $\left\lceil \frac{\text{old payload size}}{\text{New Payload Size}} \right\rceil$

$N = \left\lceil \frac{1480 \text{ byte}}{480 \text{ byte}} \right\rceil = 4$

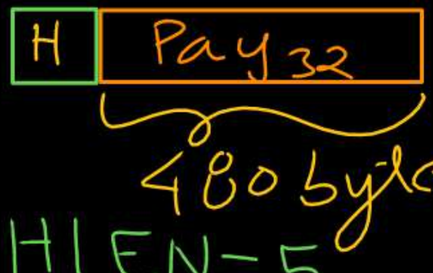
Total length of last fragment
= (HLEN * 4) + [Old payload size − (N − 1) * New Payload size]
= (5 * 4) + [1480 − (4 − 1) * 480] = (20 + 40)
= 60 bytes

offset value of last frag
= old offset + $\left(\frac{(N-1) * \text{New Payload size}}{8}\right)$
= 185 + $\left[\frac{(4-1) * 480}{8}\right]$
= 365

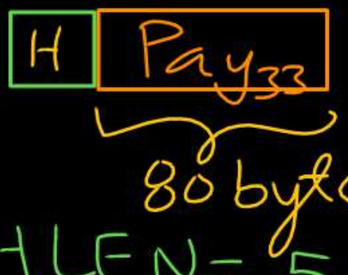
HLEN=5
TL=1060
Id=Y
off=370
M=0
D=0



HLEN=5
TL=500
Id=Y
off=370
M=1
D=0



HLEN=5
TL=500
Id=Y
off=370+60
=430
M=1
D=0



HLEN=5
TL=100
Id=Y
off=430+60
=490
M=0
D=0

Old payload size = [1060 − (5*4)] bytes = 1040 bytes

New Payload size = [500 − (5*4)] bytes = 480 bytes

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

$N = \left\lceil \frac{1040 \text{ bytes}}{480 \text{ bytes}} \right\rceil = 3$

Total Length for last fragment

= (HLEN * 4) + [Old payload size − (N − 1) * New Payload size]

= (5*4) + [1040 − (3 − 1) * 480] = (20 + 80) = 100 byte

Topic : Fragmentation at Intermediate Router

IPv4 Datagram Size ≤ Intermediate Network MTU

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

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

Number of fragments at intermediate router (N)
= ⌈ [Old Payload Size / New Payload Size] ⌉

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

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

#Q. An IP datagram of size 1000 bytes arrives at a router. The router has to forward this packet on a link whose MTU (maximum transmission unit) is 100 bytes. Assume that the size of the IP header is 20 bytes. The number of fragments that the IP datagram will be divided into for transmission is _____ .

[GATE 2016]

TL = 1000 byte

Old payload size
= [TL − Header size]
= [1000 byte − 20 byte]
= 980 byte

MTU = 100 byte

New Payload Size
= [MTU − Header Size]
= [100 byte − 20 byte]
= 80 byte

Header size
= 20 byte

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

$N = \left\lceil \frac{980 \text{ byte}}{80 \text{ byte}} \right\rceil = 13$

Ans = 13

#Q. An IP router with a Maximum Transmission Unit (MTU) of 1500 bytes has received an IP packet of size 4404 bytes with an IP header of length 20 bytes. The values of the relevant fields in the header of the third IP fragment generated by the router for this packet are

[GATE 2014]

(A) MF bit: 0, Datagram Length: 1444; Offset: 370

(B) MF bit: 1, Datagram Length: 1424; Offset: 185

(C) MF bit: 1, Datagram Length: 1500; Offset: 37

(D) MF bit: 0, Datagram Length: 1424; Offset: 2960

Ans: A

MTU = 1500 bytes

New Payload Size
= [MTU − Header size]
= (1500 − 20) = 1480 byte

TL = 4404 byte

Header size = 20 byte

old payload size
= [TL − Header size]
= [4404 − 20] byte
= 4384 bytes

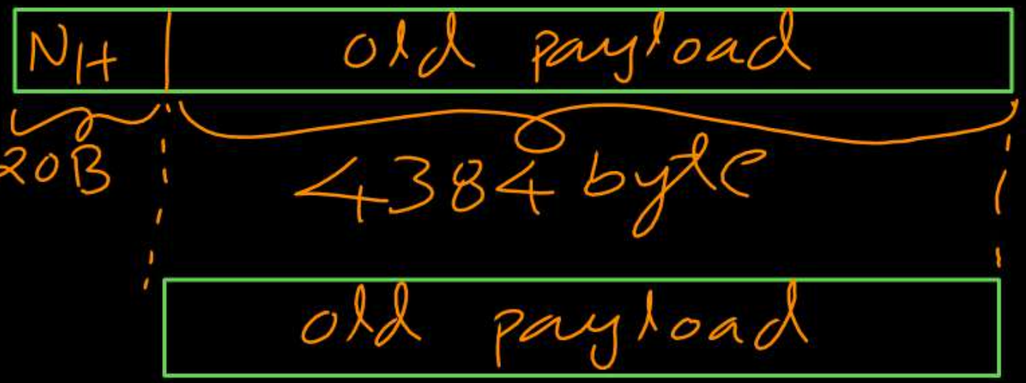
No. of fragments (N) =
$\left\lceil \frac{\text{Old payload size}}{\text{New Payload Size}} \right\rceil$

$N = \left\lceil \frac{4384 \text{ byte}}{1480 \text{ byte}} \right\rceil = 3$

Total length of last fragment
= Header size + [old payload size
− (N − 1) * New Payload size]

= 20 byte + [4384 byte − (3 − 1) * 1480 byte]
= (20 + 1424) = 1444 byte

Id = K
off = F
M = x
D = 0
HLEN = 5
TL = 4404



HLEN = 5

1480 byte

TL = 1500, Id = K
off = F
M = 1
D = 0

HLEN = 5

1480 byte

TL = 1500, Id = K
off = F + 185
M = 1
D = 0

HLEN = 5

1424 byte

TL = 1444, Id = K
off = F + 370
M = x
D = 0

#Q. A TCP message consisting of 2100 bytes is passed to IP for delivery across two networks. The first network can carry a maximum payload of 1200 bytes per datagram and the second network can carry a maximum payload of 400 bytes per datagram, excluding network overhead. Assume that IP overhead per packet is 20 bytes. What is the total IP overhead in the second network for this transmission?

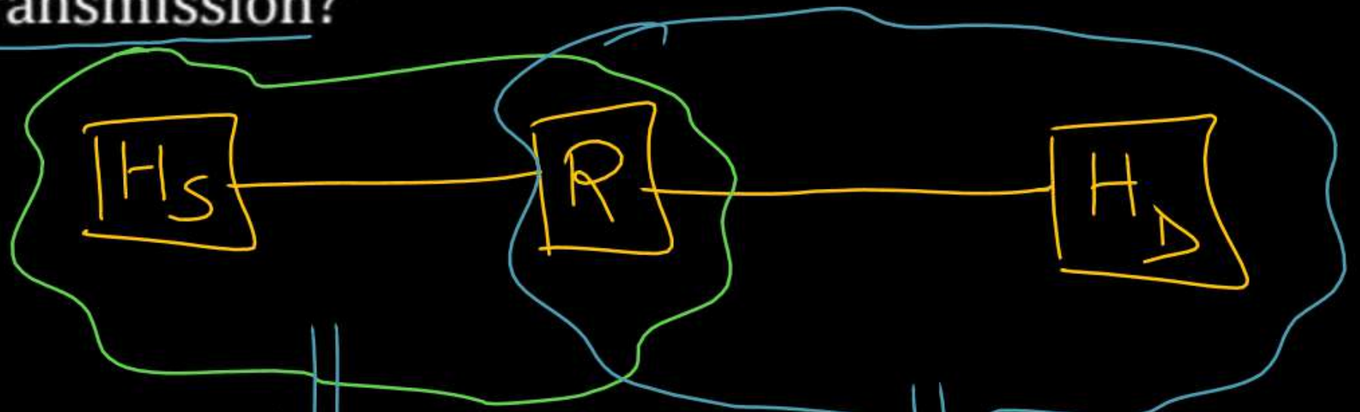
[GATE 2004]

A) 40 bytes

B) 80 bytes

C) 120 bytes

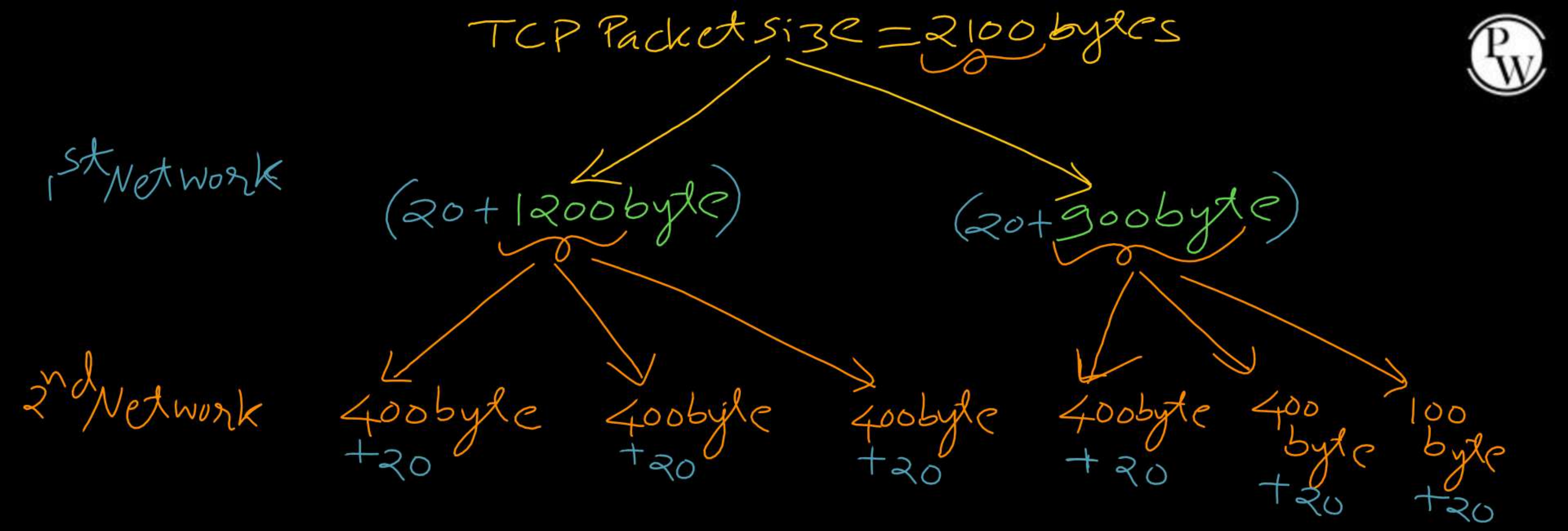
D) 160 bytes



Max^m payload = 1200 byte

max^m payload = 400 byte

Ans: C



Ans = Total IP overhead in 2nd network

= 6 * 20 byte = 120 byte

#Q. Consider three IP networks A, B and C. Host H_A in network A sends messages each containing 180 bytes of application data to a host H_C in network C. The TCP layer prefixes a 20 byte header to the message. This passes through an intermediate network B. The maximum packet size, including 20 byte IP header, in each network is :

A : 1000 bytes B : 100 bytes C : 1000 bytes

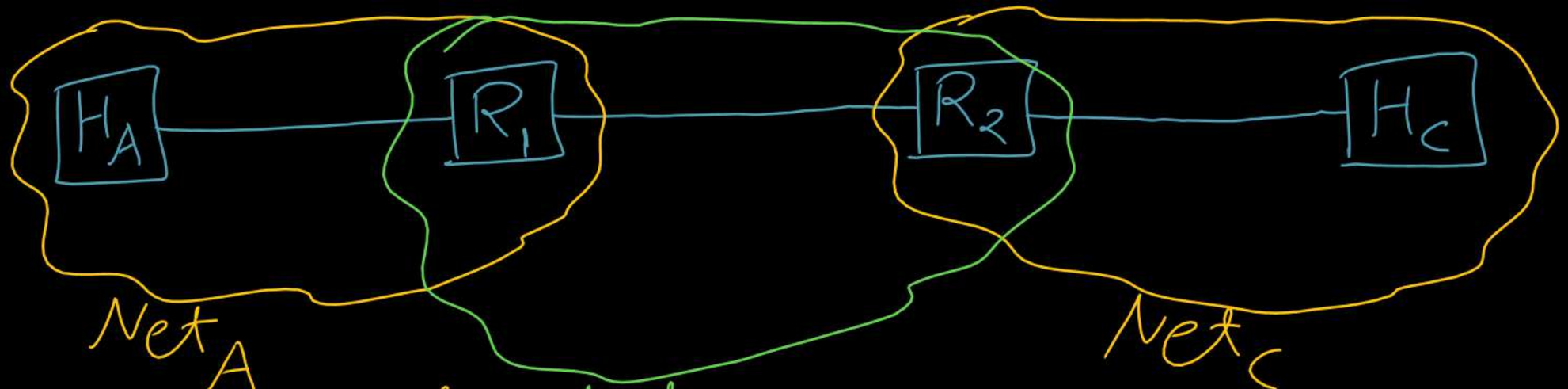
Assuming that the packets are correctly delivered, how many bytes, including headers, are delivered to the IP layer at the destination for one application message, in the best case ?

Consider only data packets.

[GATE 2004]

A) 200 B) 220 C) 240 D) 260

Ans : D



Net_A

MTU = 1000 byte

Payload size
= (1000 − 20) byte
= 980 byte

Net_B

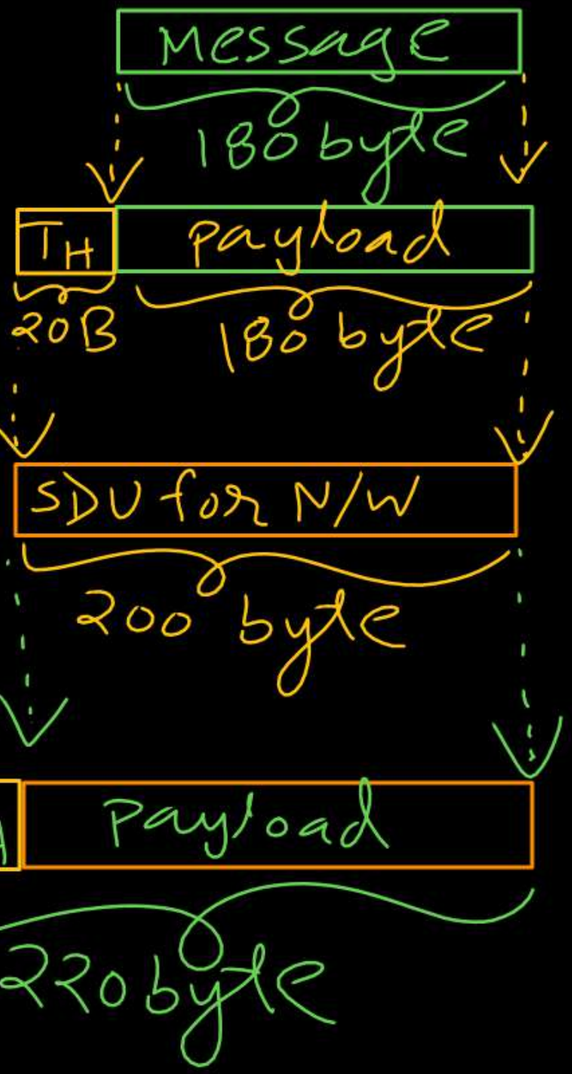
MTU = 100 byte

Payload size
= (100 − 20) byte
= 80 byte

Net_C

MTU = 1000 byte

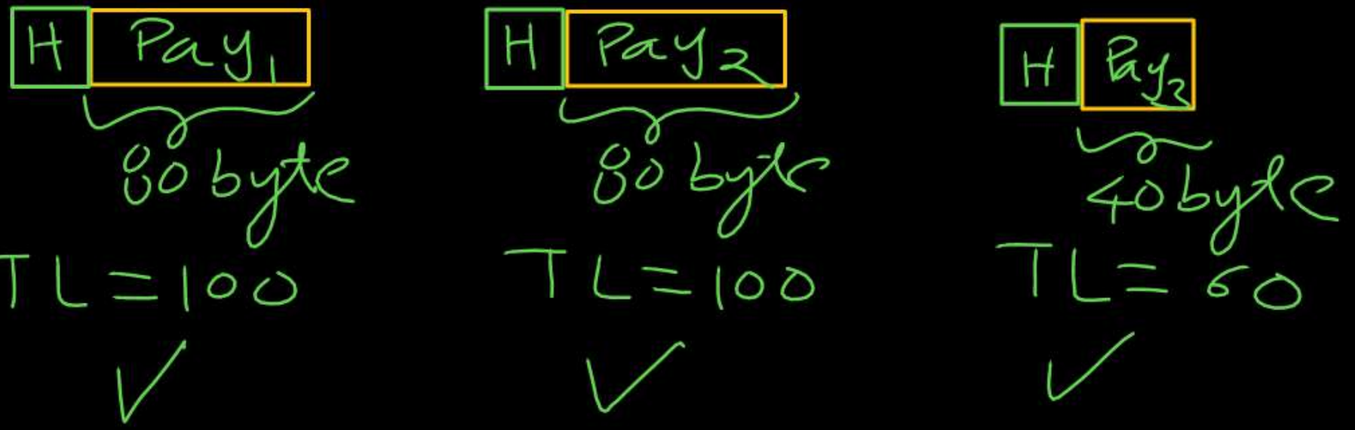
Payload size
= 980 byte


Message
180 byte
T_H
Payload
20B
180 byte
SDU for N/W
200 byte
N_H
Payload
220 byte

H_A :

H_A :

R_1 :



R_2 :

H_C :

Ans = (100 + 100 + 60) byte
= 260 bytes

2 mins Summary

Topic Fragmentation Offset

Topic Flag bits

THANK - YOU