CS & IT ENGINEERING

COMPUTER NETWORKS

IPv4 Header & Fragmentation

Lecture No 06

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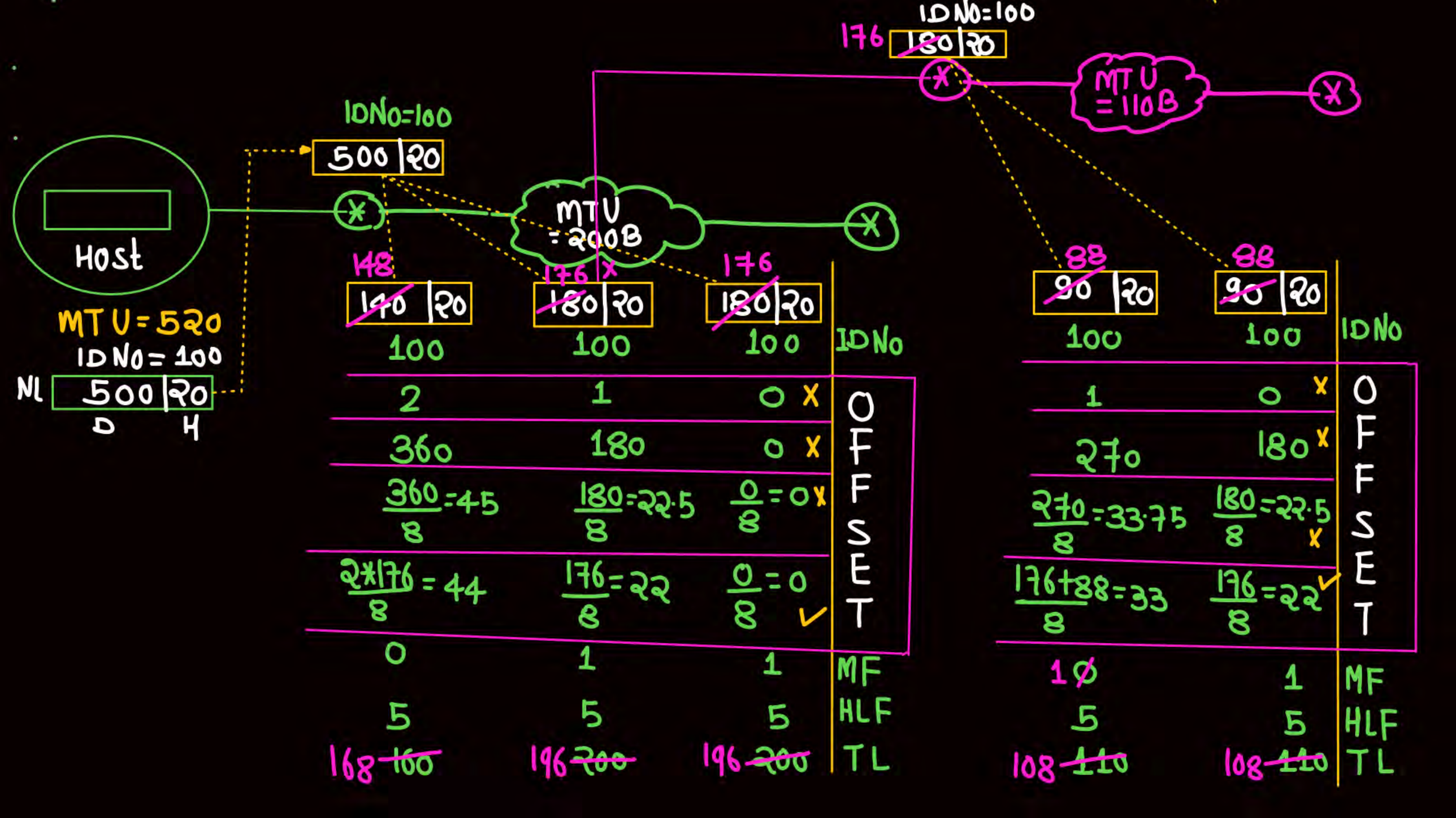
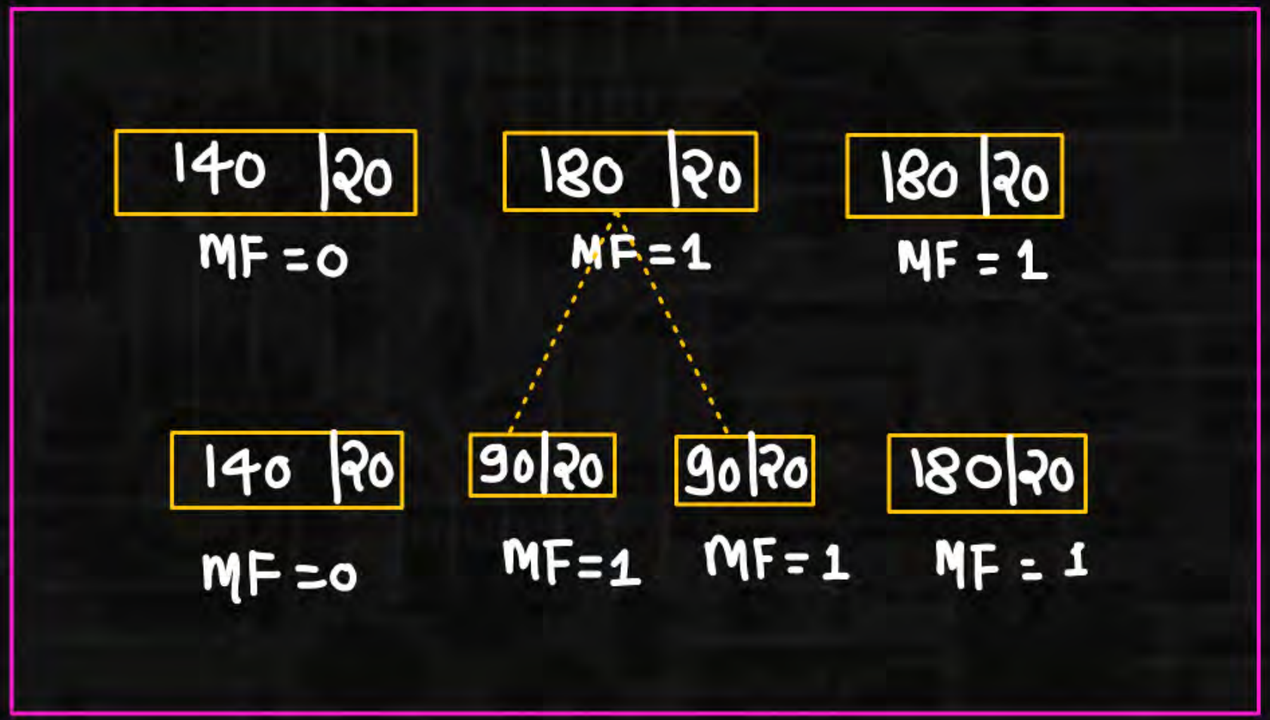
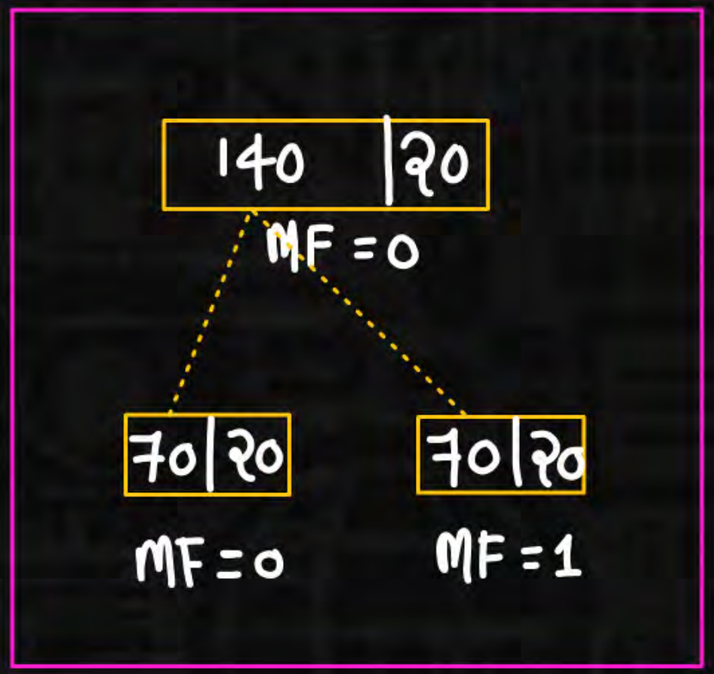
Fragmentation in IPv4

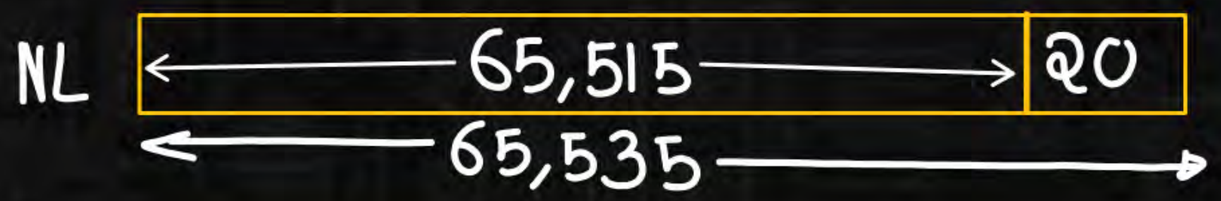

Host
MTU = 520
IDNo = 100
NL
500 | 20
D H
IDNo=100
500 | 20
MTU = 200B
MTU = 110B
IDNo=100
176
180 | 20
148
140 | 20
176
180 | 20
176
180 | 20
88
80 | 20
88
80 | 20
100 100 100 IDNo
2 1 0 X
360 180 0 X
360/8 = 45 180/8 = 22.5 0/8 = 0 X
2*176/8 = 44 176/8 = 22 0/8 = 0 ✓
OFFSET
0 1 1 MF
5 5 5 HLF
168 ~~160~~ 196 ~~200~~ 196 ~~200~~ TL
100 100 IDNo
1 0 X
270 180 X
270/8 = 33.75 180/8 = 22.5 X
176+88/8 = 33 176/8 = 22 ✓
OFFSET
1Ø 1 MF
5 5 HLF
108 ~~110~~ 108 ~~110~~ TL

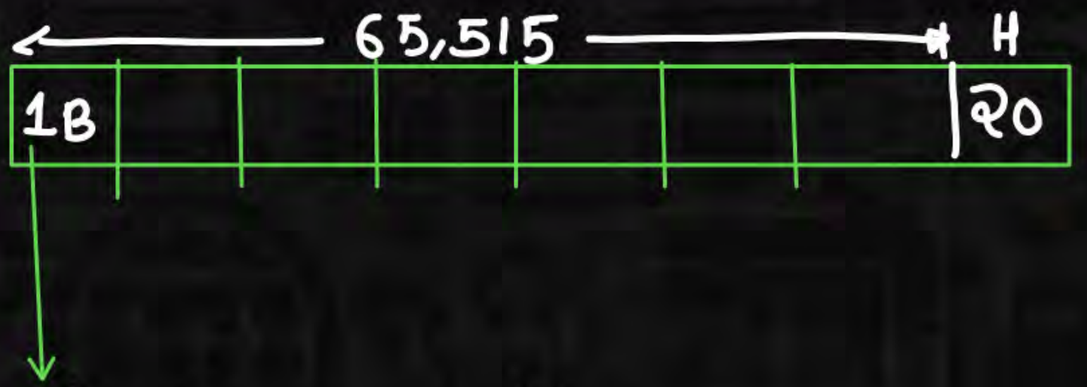

140 | 20
MF = 0
180 | 20
MF = 1
180 | 20
MF = 1
140 | 20
MF = 0
90 | 20
MF = 1
90 | 20
MF = 1
180 | 20
MF = 1


140 | 20
MF = 0
70 | 20
MF = 0
70 | 20
MF = 1

Total length = 16 bit

Maximum No = $2^{16} - 1 = 65,535$





Fragment offset = 65,514 $\cong 2^{16}$

Fragment offset = 13 bit

Maximum No = $2^{13} - 1 = 8191 \cong 2^{13}$

$\frac{2^{16}}{(S.F) \rightarrow x} = 2^{13}$

$\frac{2^{16}}{(S.F) \rightarrow 8}$

$\frac{2^{16}}{2^3}$

$= 2^{16-3} = 2^{13}$

Final Result

148 | 20	88 | 20	88 | 20	176 | 20	
100	100	100	100	IDNo
44	33	22	0	OFFset
0	1	1	1	MF
5	5	5	5	HLF
168	108	108	196	TL

OFFset = {22, 33, 0, 44)

⇓ Inc. order

{0, 22, 33, 44)

Lost

OFFset = {~~22~~, 33, 0, 44)

⇓ Inc.

{0, 33, 44)

(i) | 176 | 20 |

$\frac{176}{8} = 22 \Rightarrow 2^{nd}$ Fragment offset value

(ii) | 80 | 20 | | 96 | 20 |

$\frac{176+88}{8} = 33 \rightarrow 3^{rd}$ Fragment offset value

(iii) | 88 | 20 | | 88 | 20 | | 176 | 20 |

$\frac{176+88+88}{8} = 44 \rightarrow 4^{th}$ Fragment offset value

Reassemble Algorithm

If each fragment follow a different path and arrives out of order, the final destination host can reassemble the original datagram from the fragment received by using the following strategy:

1. Identify the fragment with offset = 0 and it is the first fragment.
2. Identify the fragment with MF = 0 and it is the last fragment.
3. Divide the data length of the first fragment by 8. The second fragment has an offset value equal to that result $\frac{176}{8} = 22 \Rightarrow$ 2nd Fragment Offset Value
4. Divide the data length of the first and second fragment by 8. The third fragment has an offset value equal that result. $\frac{176+88}{8} = 33 \Rightarrow$ 3rd Fragment Offset Value
5. Repeat this process as many times as possible to cover all the fragment.

Note:-

1. Fragmentation is done by Intermediary devices such as Router.
2. The reassembly of fragmented datagrams is done only after reaching the destination

Q. Why Reassembly is not done at the router?

1. All the fragment may not meet at a router
2. Fragmented datagram may each the destination through Independent path.
3. Fragmented packet may be fragmented further.

Fragmentation Overhead

1. Fragmentation of datagram Increase the overhead
2. This is because after fragmentation, IP header hast to be attached with each Fragment.

Total overhead = (Total No. Fragment datagram–1) * size of IP Header


THANK YOU
GW
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