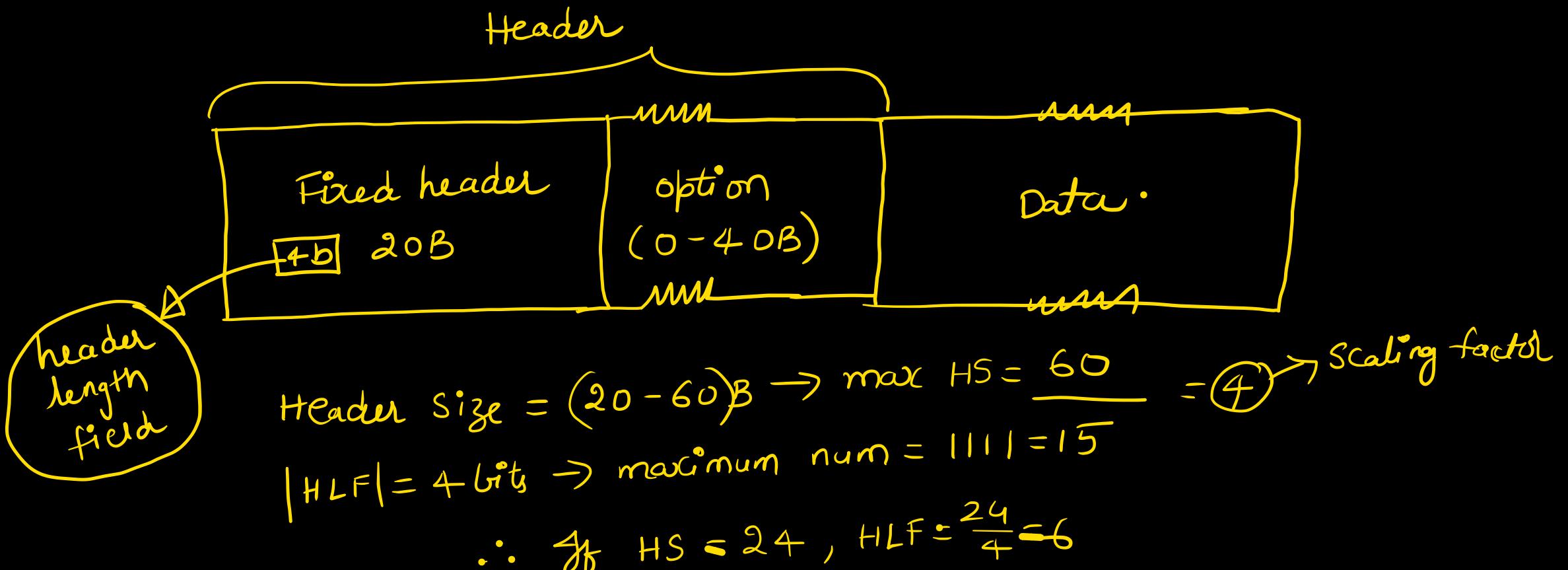


IP → works at NL → IP packet is called  
Datagram



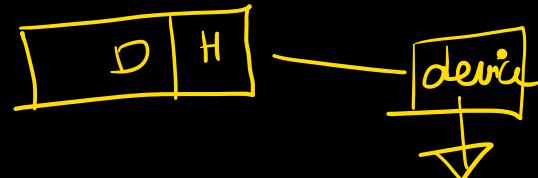
Version : 4 bit field

Version:  $V_1$   
 $V_2$   
 $V_3$

$V_4 \rightarrow$  Current

$V_5 \rightarrow$  ~~x~~ discarded  $\rightarrow$  failed

$V_6 \rightarrow$  future



which software

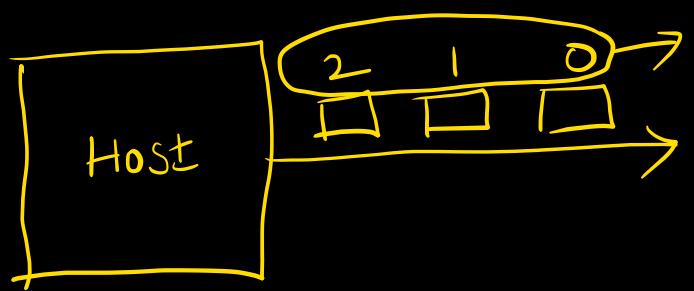
to use



both version  
are in use

$[0100] \rightarrow V_4$   
 $[0110] \rightarrow V_6$ .

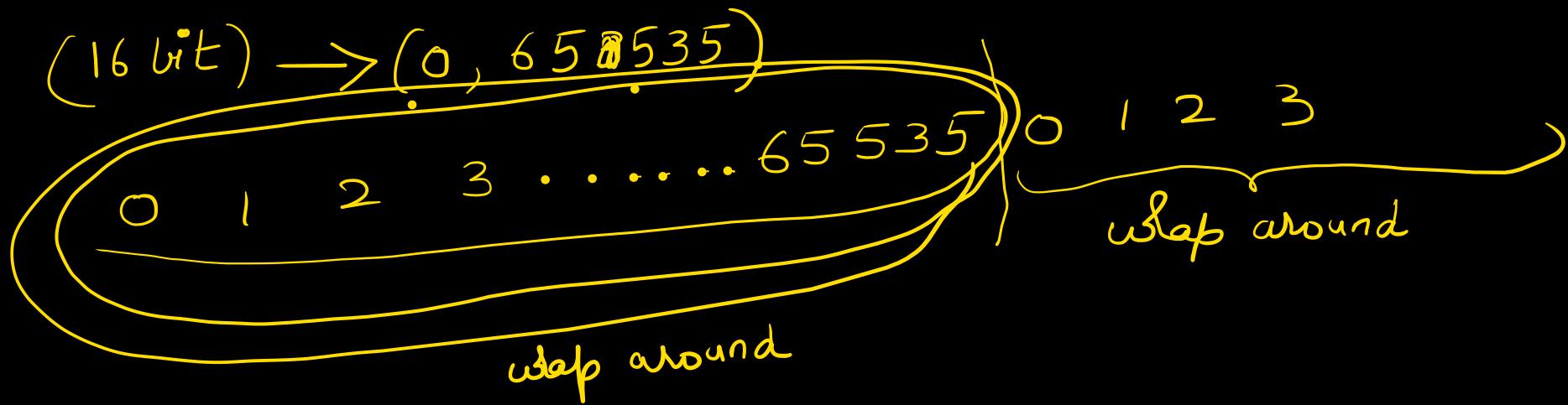
both are in  
use.



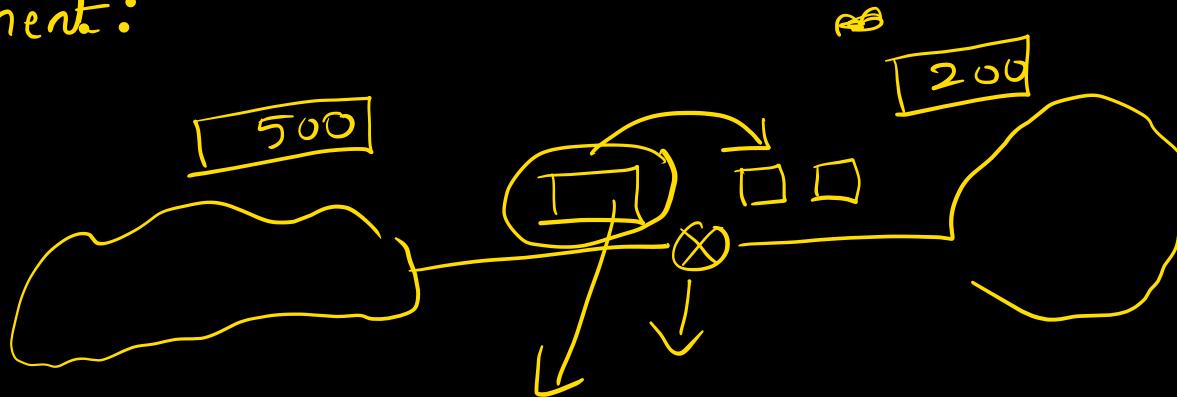
identification numbers



every datagram will have unique numbers.



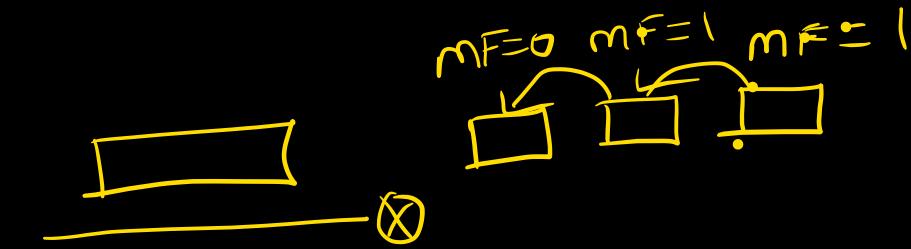
DF: Do not fragment:



if  $DF = 1$

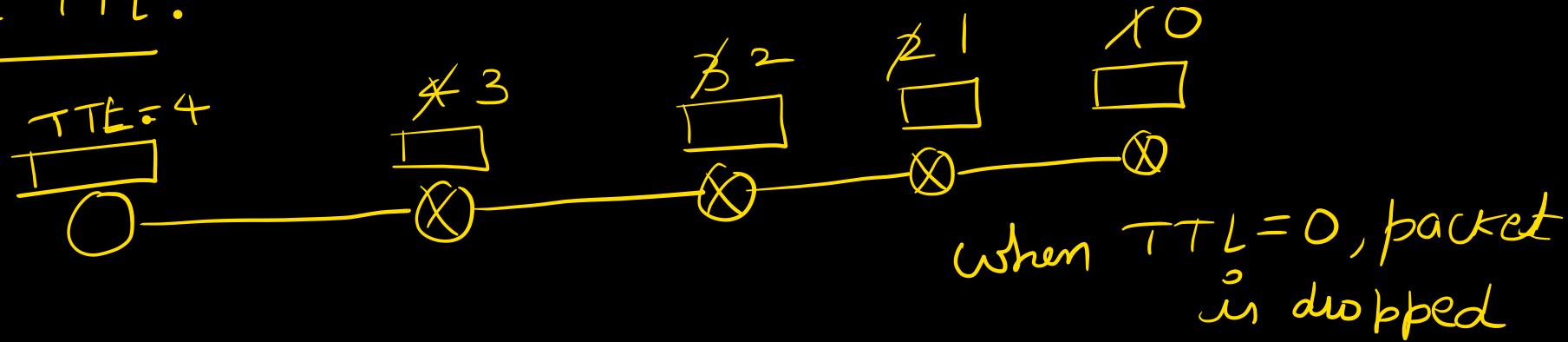
means do not fragment  
we will see later

$m_F$ : more fragments

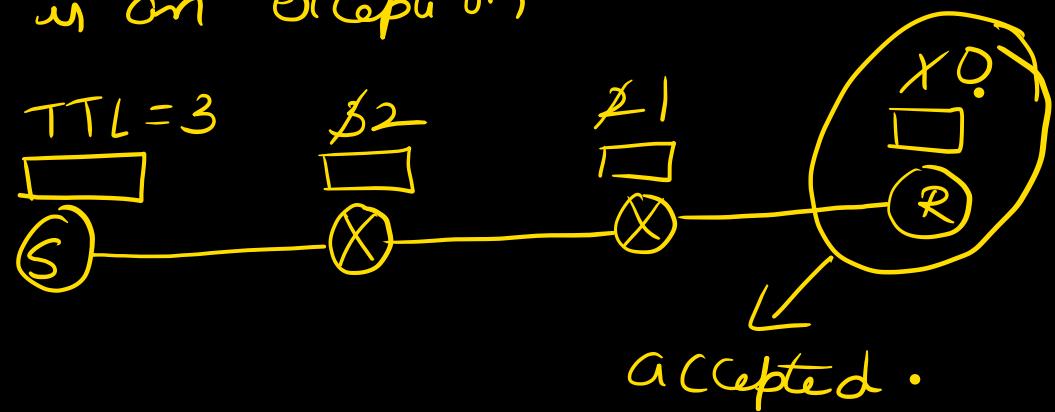


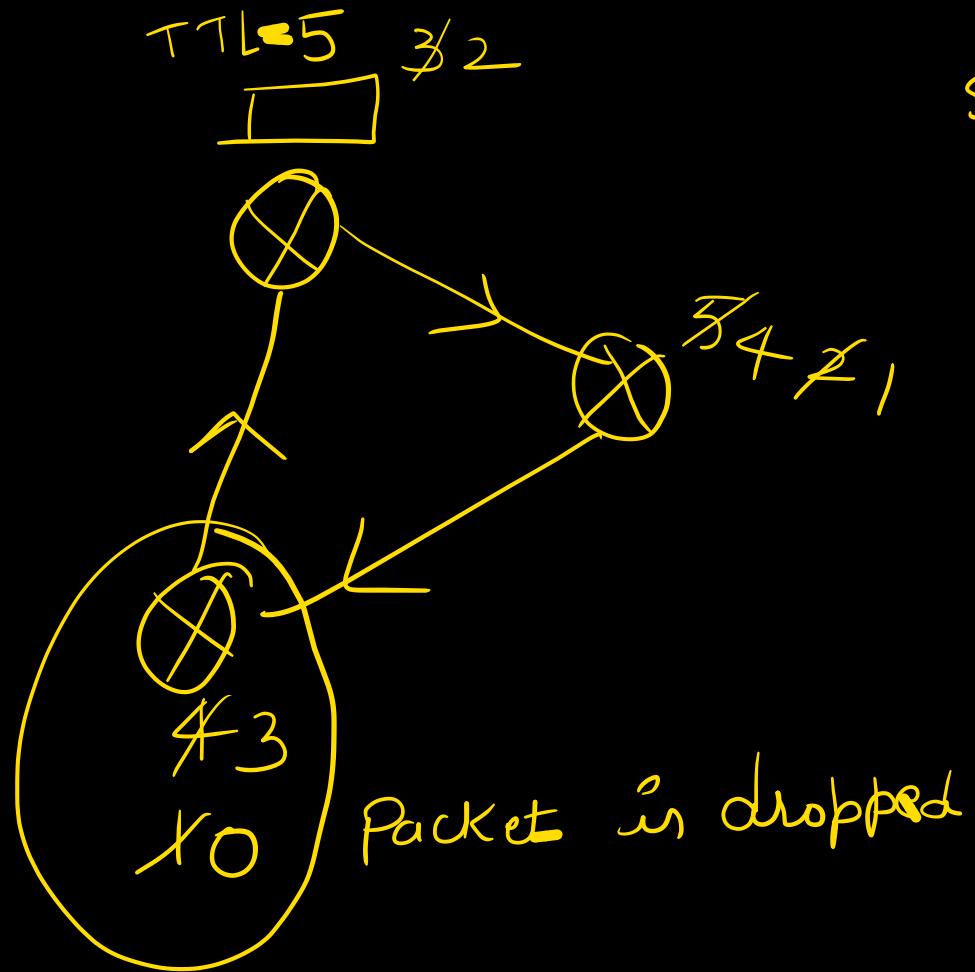
Fragment offset: we will see later

Time to live TTL:



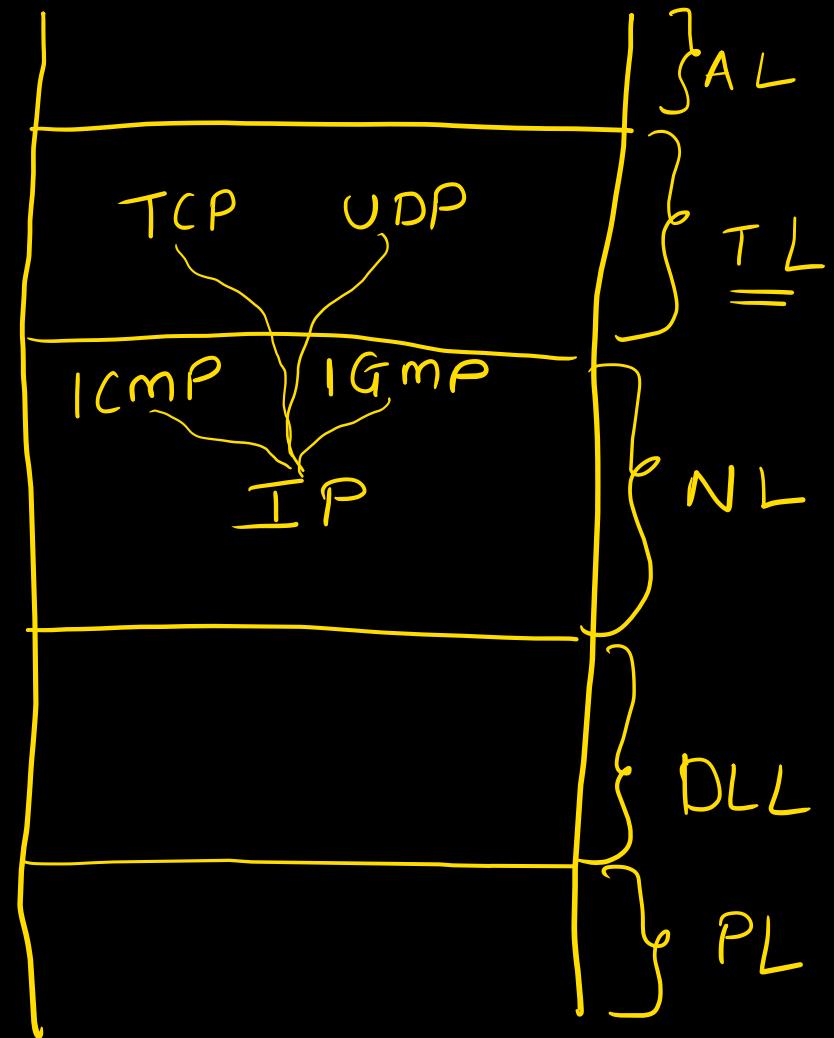
But there is an exception



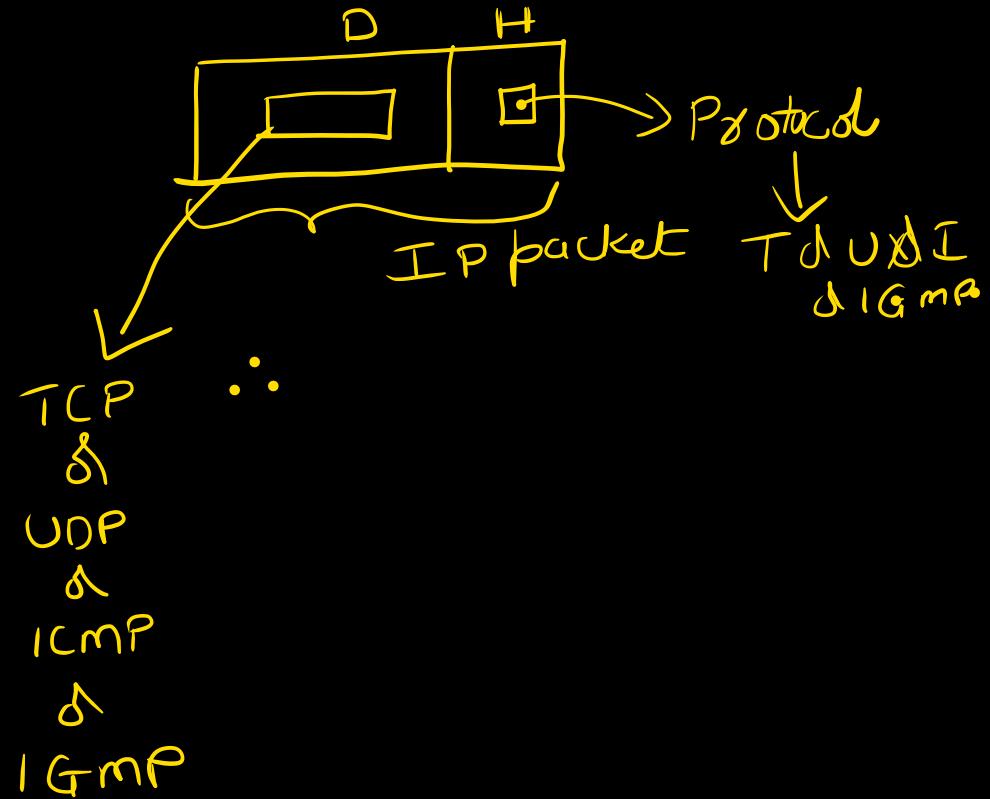


so TTL helps in  
avoiding infinite loops

Protocol:(8 b)

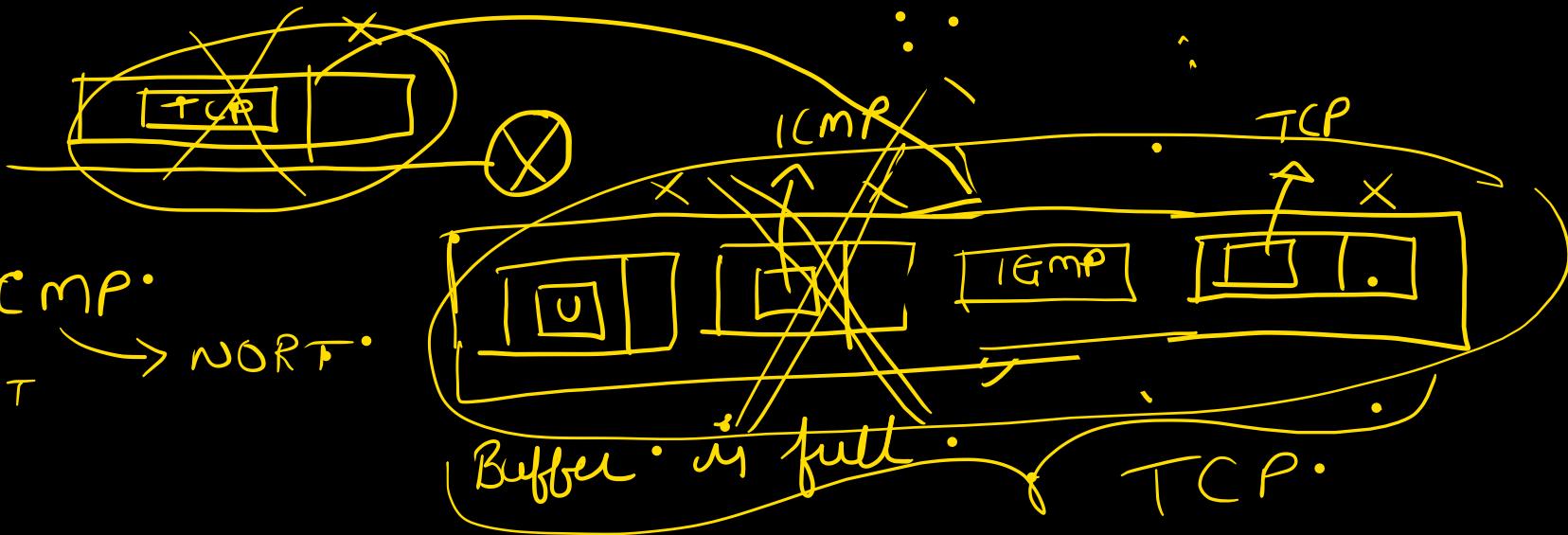
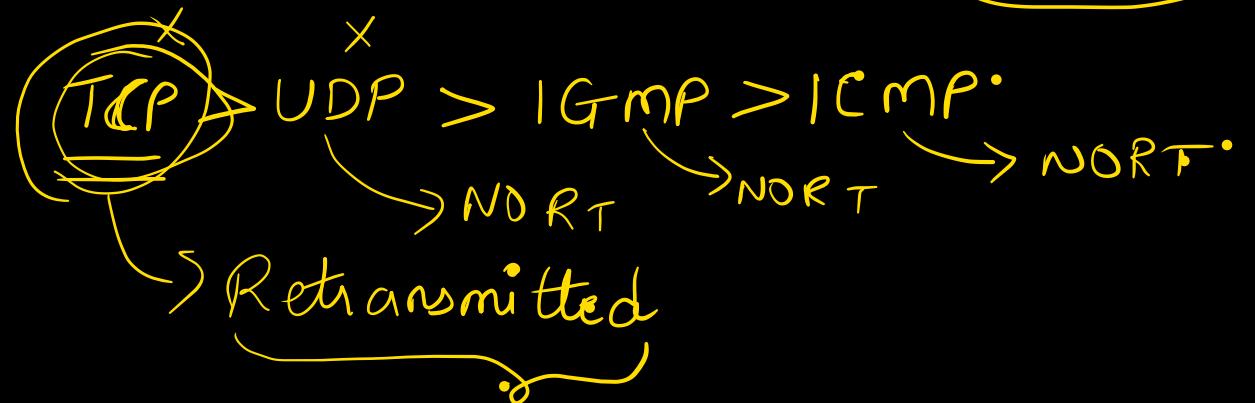


ICMP, IGMP → later  
TCP, UDP → After two days

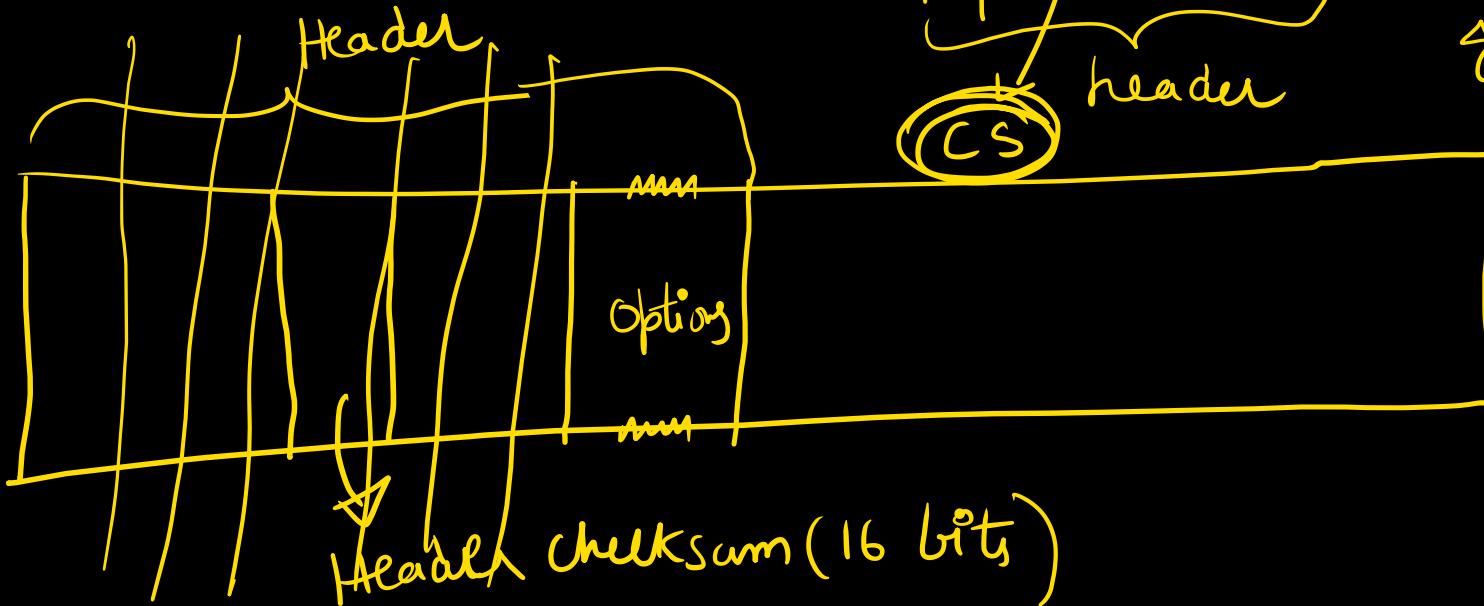


At a router a packet may be discarded if there is congestion (no enough resources)

Priority:



## Header checksum

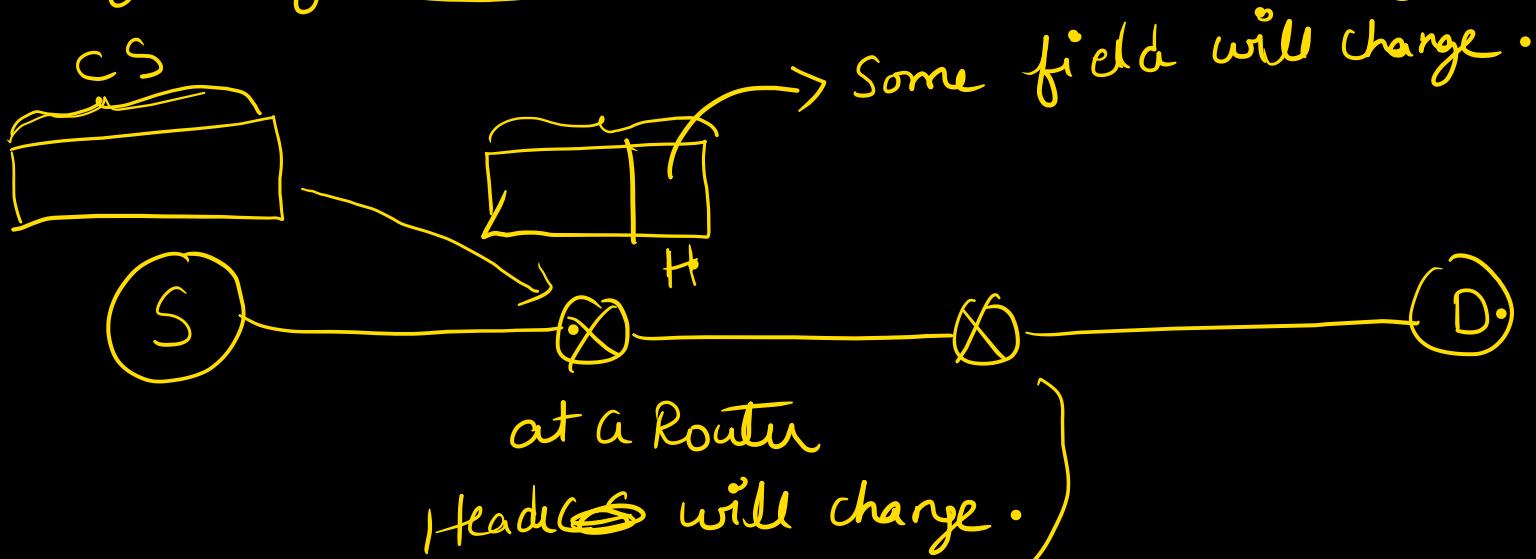


→ CS is calculated  
Initially we put all 0's  
in CS.

header will be divided into 16 bit numbers  
CS is calculated

why only Header CS, not on the body

↓ Reduce the load  
on Router, only  
Header CS is calculated.

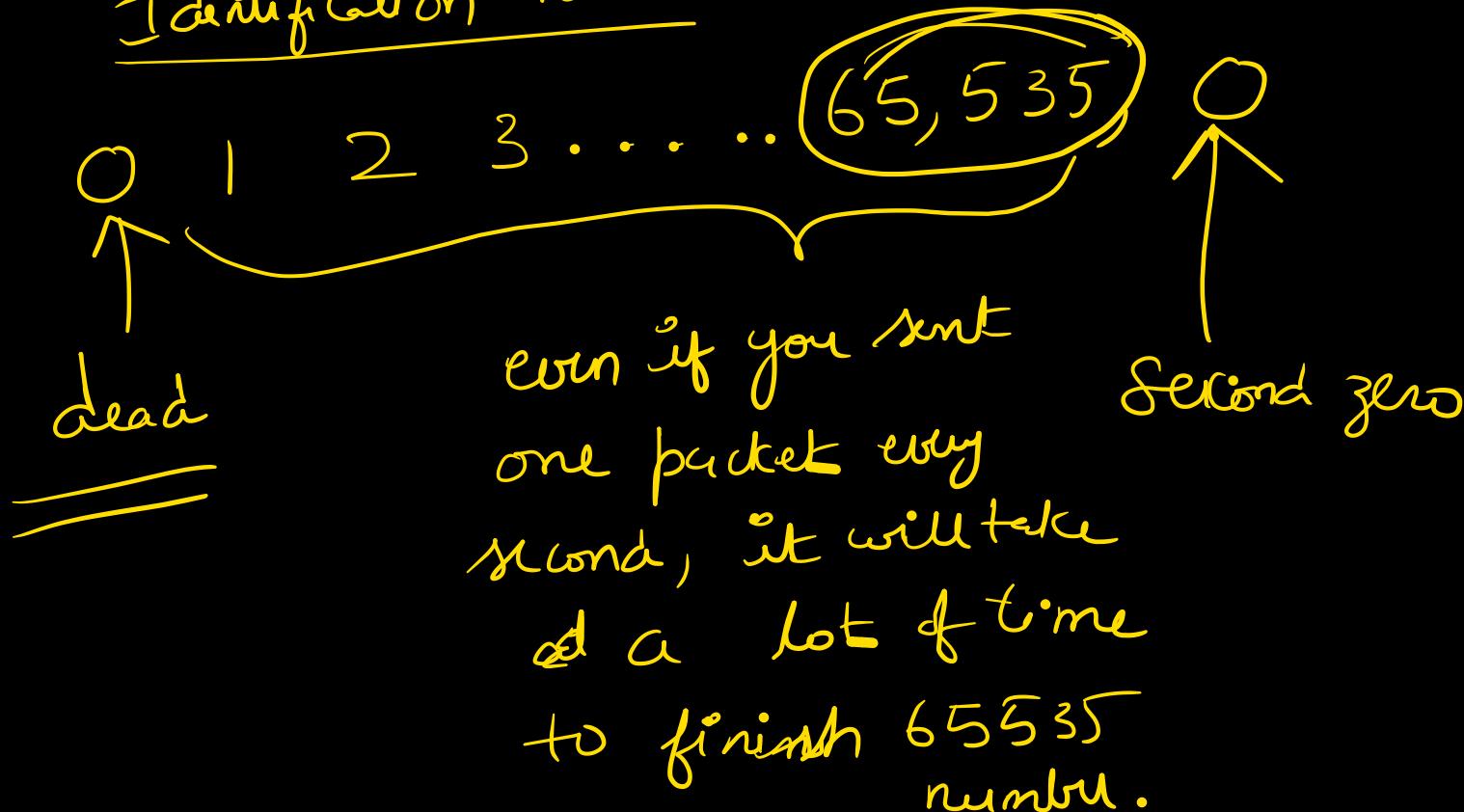




Some fields may change. what are the fields that may change?

- 1) TTL will change
- 2) Fragment off, MF, Total length → may change → Later
- 3) Options → may change ← You will understand
- 4) Header CS → changes. ← Later

Identification number:



## IP address: (32 bit):

<u>NID</u>	<u>HID</u>	
✓	✓	→ <u>Valid IP</u> → SIP, DIP
✓	0's	→ <u>NID</u> → SIP, DIP
✓	1's	→ <u>DBA</u> → SIP, DIP
1's	1's	→ <u>LBA</u> → SIP, DIP
1's	0's	→ <u>Subnet mask</u> → later SIP, DIP
0's	✓	→ <u>Host within a n/w</u> → later SIP, DIP
0's	0's	→ "I don't have IP." → later SIP, DIP
127	✓	→ <u>loop back address</u> → later SIP, DIP

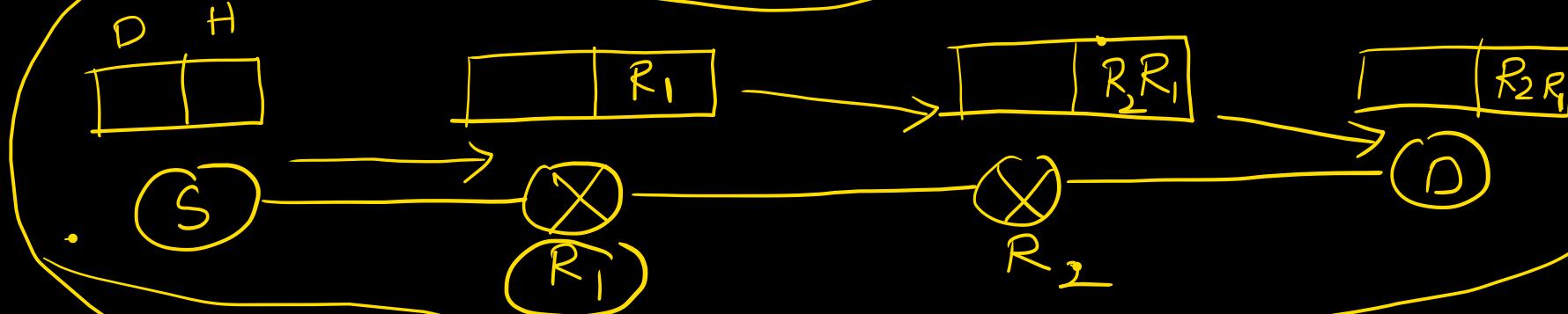
FAQ:

DO we have to remember?

Yes, you have to remember  
everything that I teach.

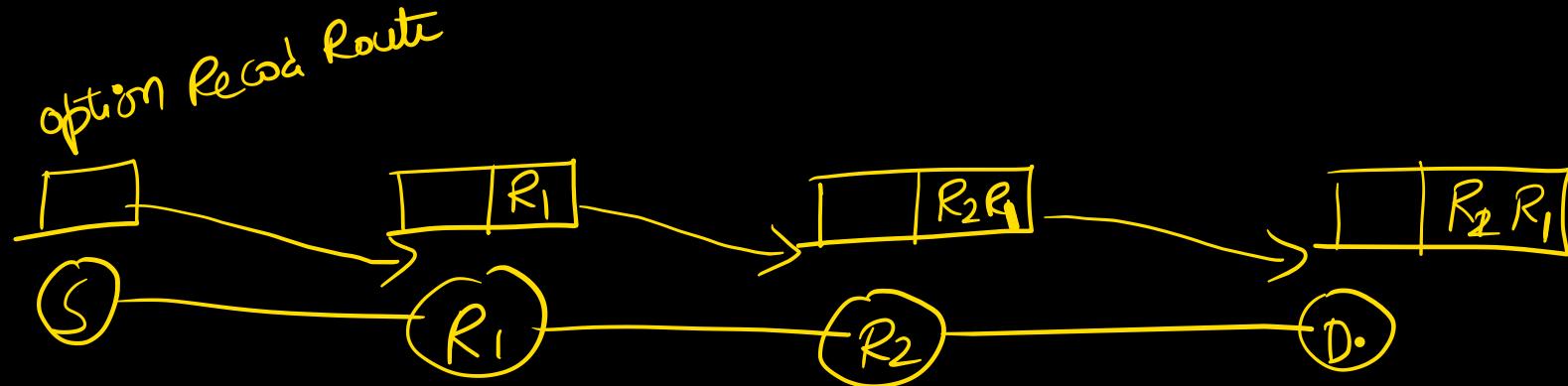
Break - 5 min:

options: (i) Record Route



∴ Destination will see the route, not source.

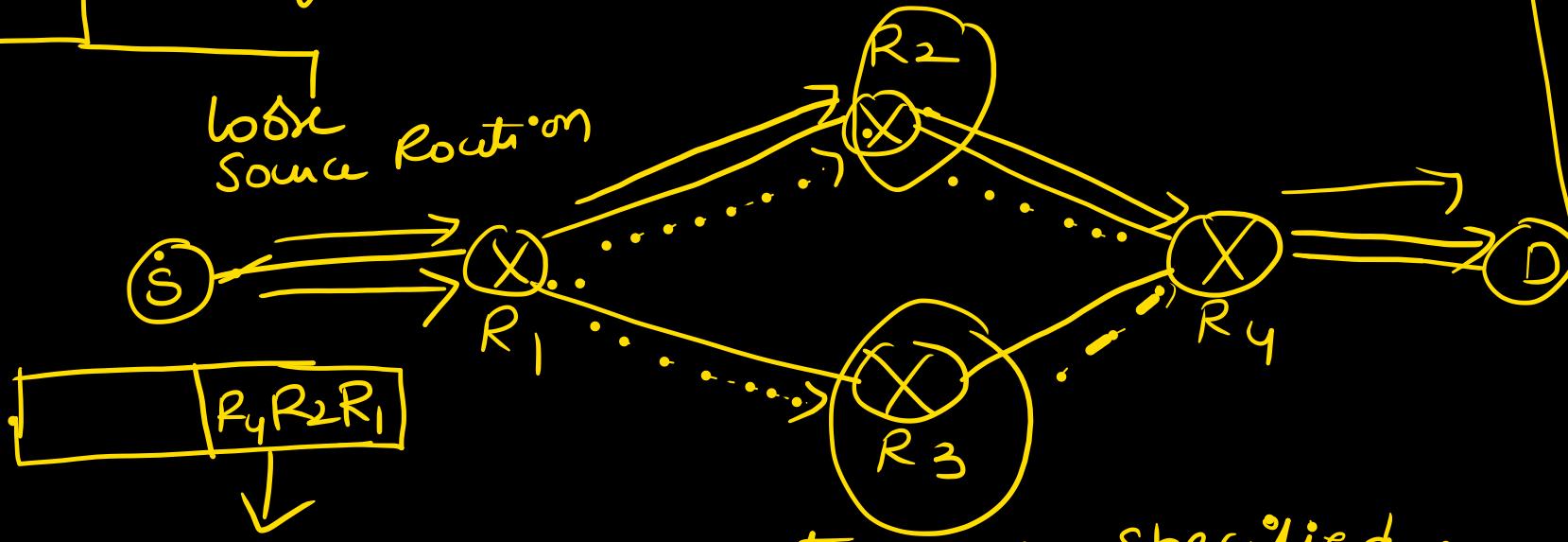
For source to see the route  $\rightarrow$  we use Pass. Route Trace



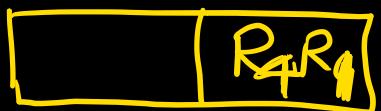
option: Source Routing: Source can specify entire route

strict  
source  
Routing

look  
Source Routing



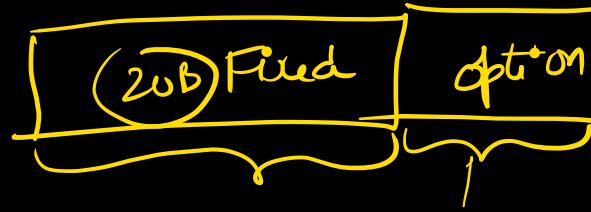
strict  $\rightarrow$  all routes are specified.



~~loose~~ loose: only few routes are specified

more  
clear,  
after  
ICMP  
is  
discussed

Size of options max is 40B



Size of IP add is 4 B

∴ In both Record Route & Source routing  
max IP's we can put in options

$$\therefore \frac{40}{4} = 10$$

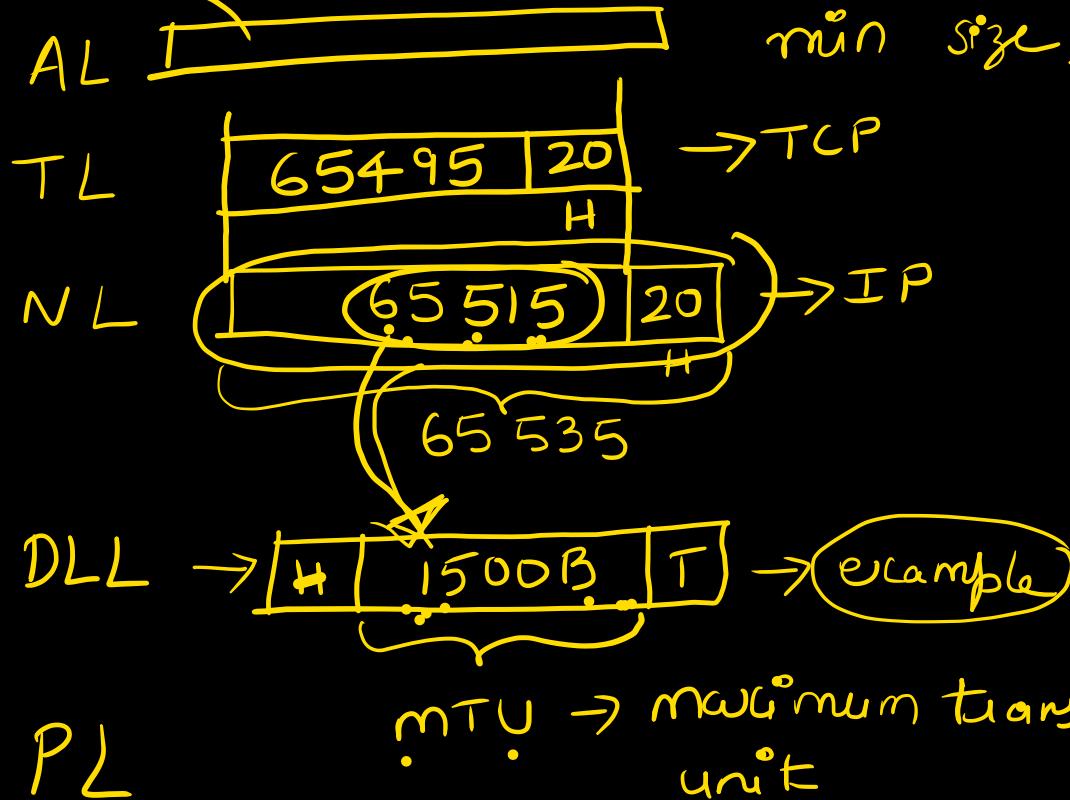
But we cant put 10,  
because there has to be  
space to specify type of option.



⑨ → max

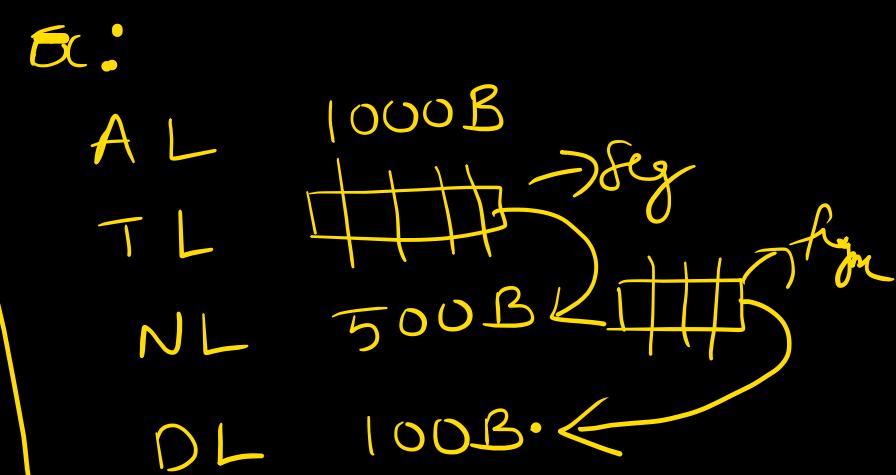
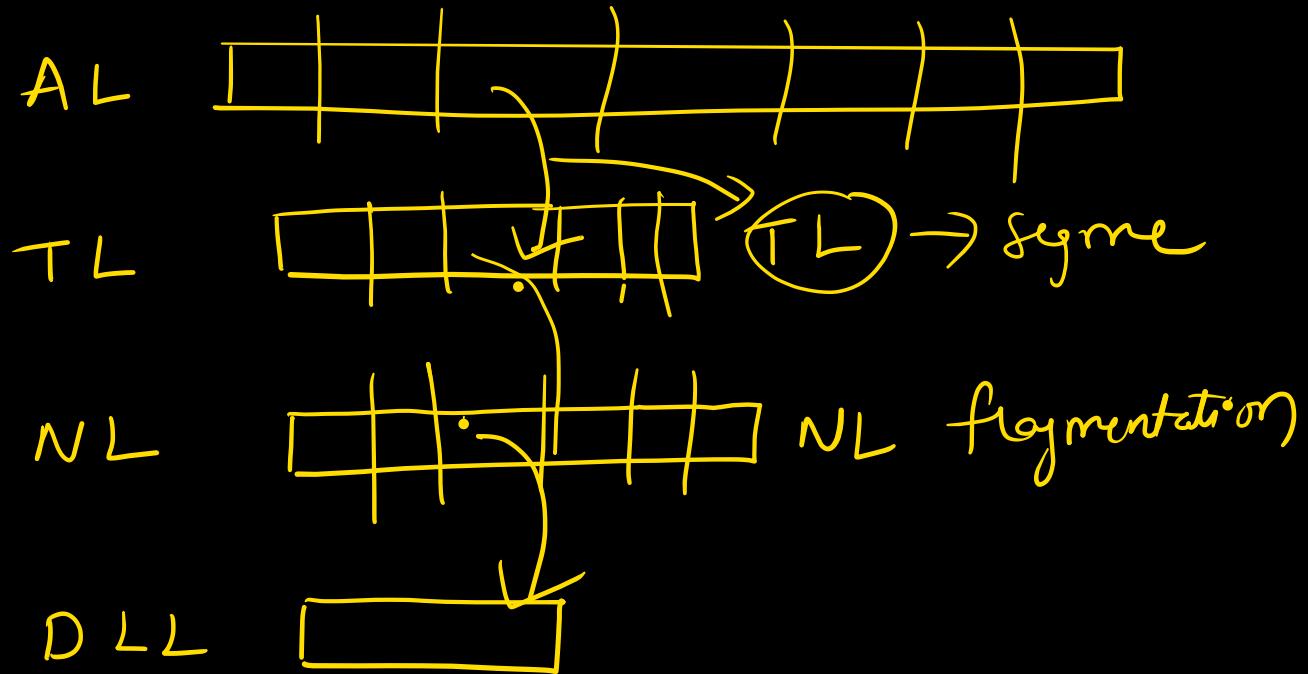
Total length field: (16 bit number)  $\rightarrow$  max val  $\rightarrow 2^{16}-1 = 65,535$

message  $\rightarrow$  any size  $\therefore$  maximum size of IP datagram = 65,535 Byte  $\rightarrow$  VImp

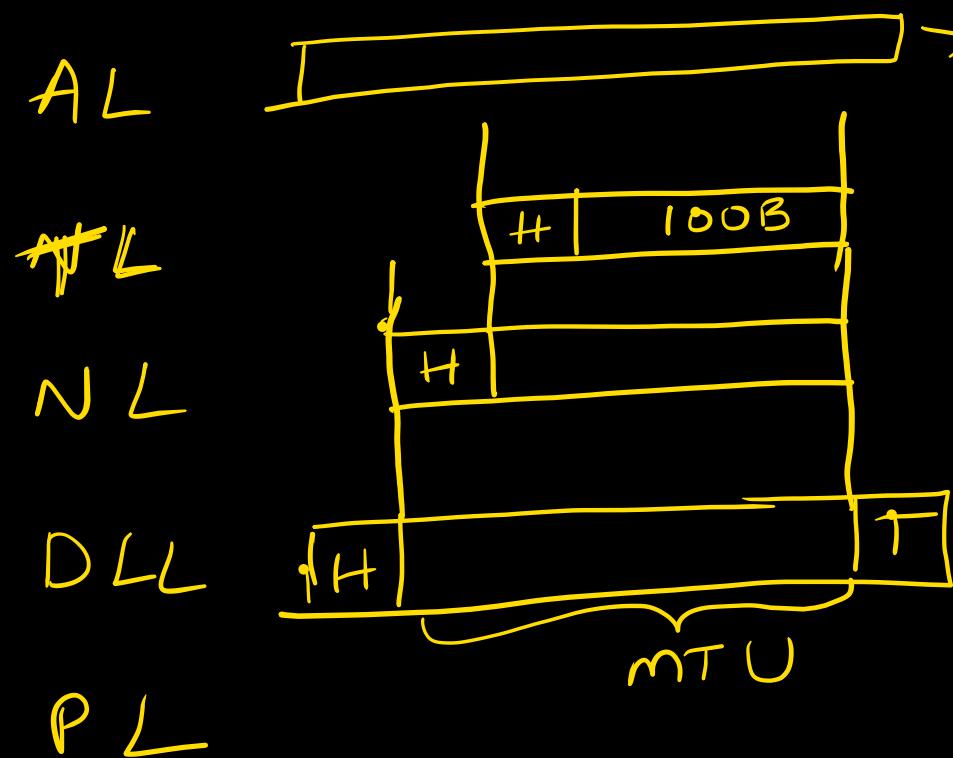


$\therefore$  TL has to break the AL message into 65495 size data  $\rightarrow$  Segmentation  
NL has to break datagram to fit in DLL frame.  $\rightarrow$  Fragmentation

TL - seg  
NL - frag.



But TL can do some thing clever.



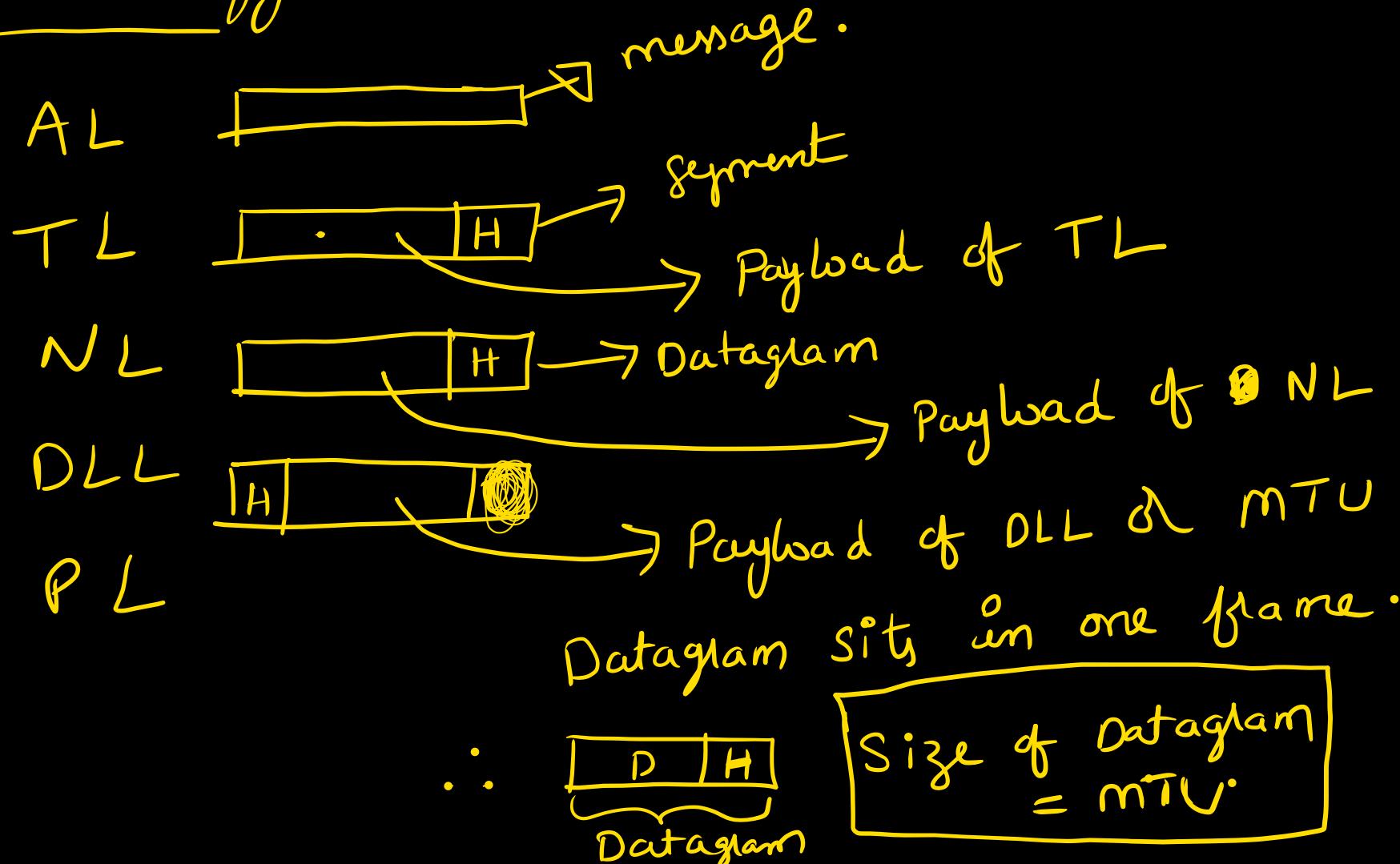
if TL breaks AL message into  
100B parts, then data will  
directly fit in DLL frame  
without Fragmentation.

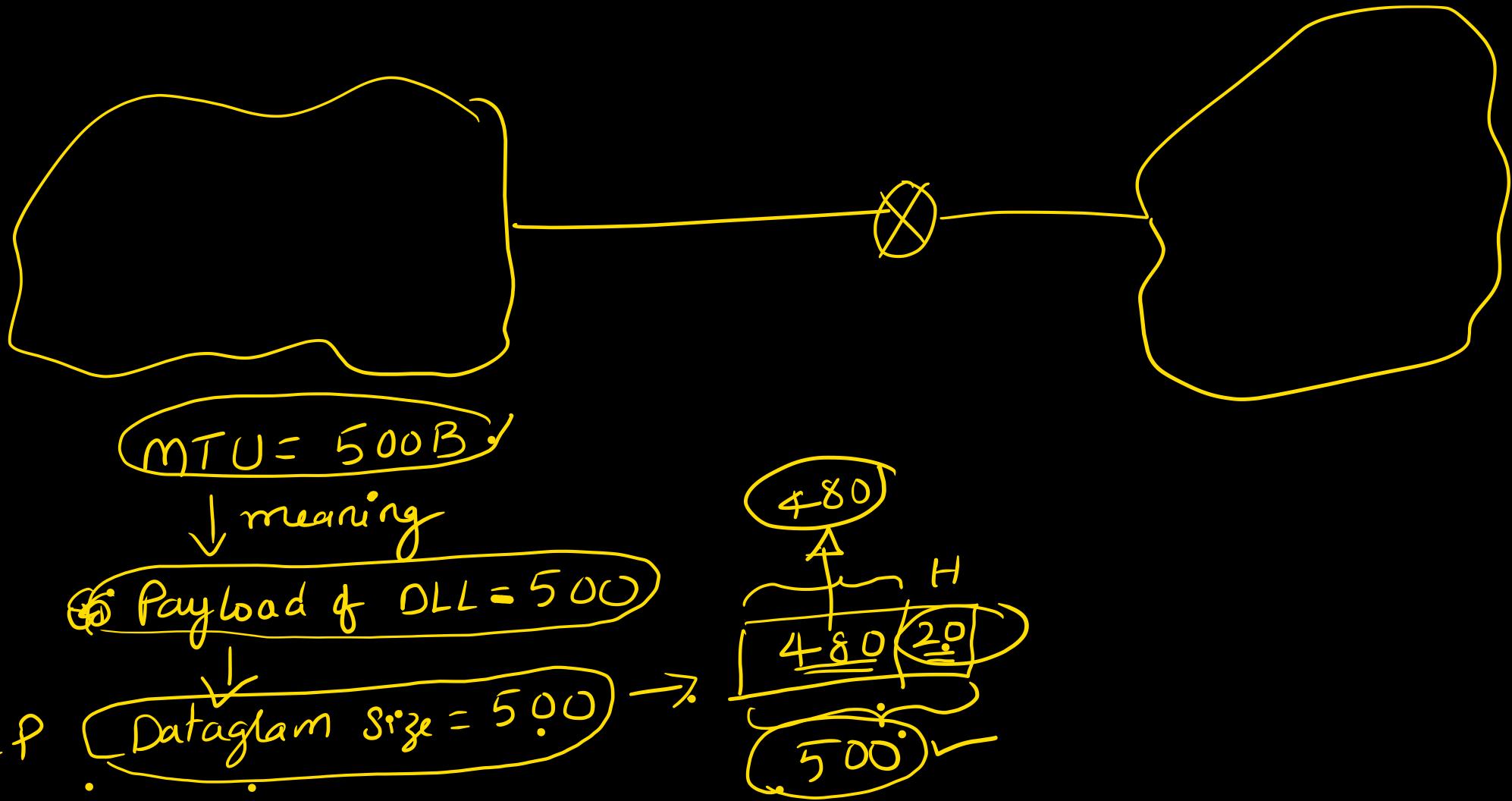
∴ At some only segmentation  
is needed, not fragmentation.

So if we do segmentation wisely, there is no need of fragmentation at source.

But fragmentation will happen at the Routers

## Terminology:





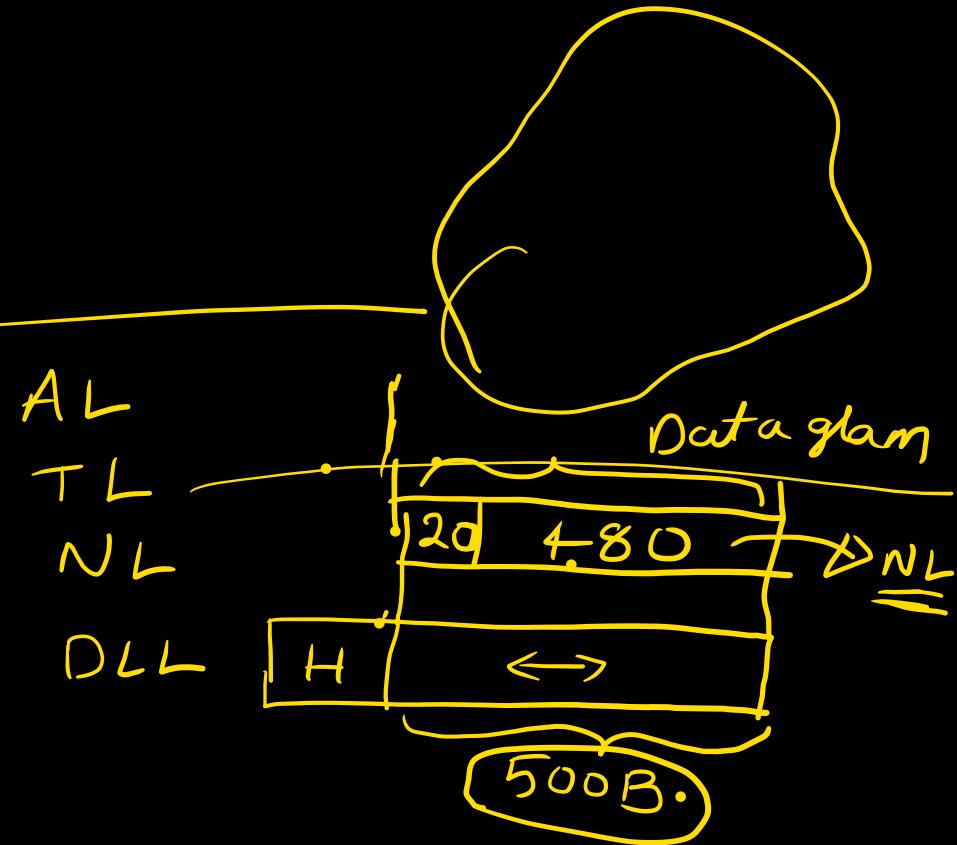
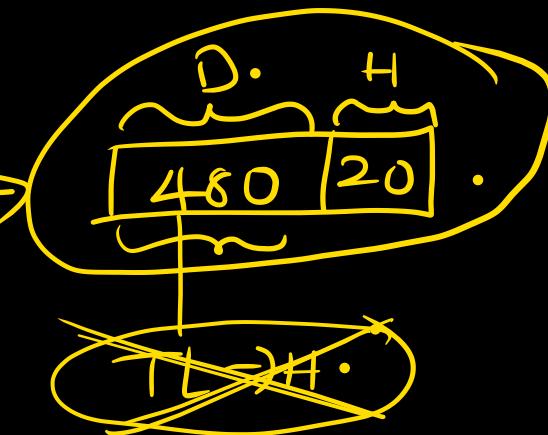
$MTU = \underline{500\text{ B.}}$

at  $NL \rightarrow NL$

$MTU \rightarrow$  Payload &  
DLL

$\rightarrow$  Size of IP Datagram

$20 \leftarrow +1+D$



5 min break .

---

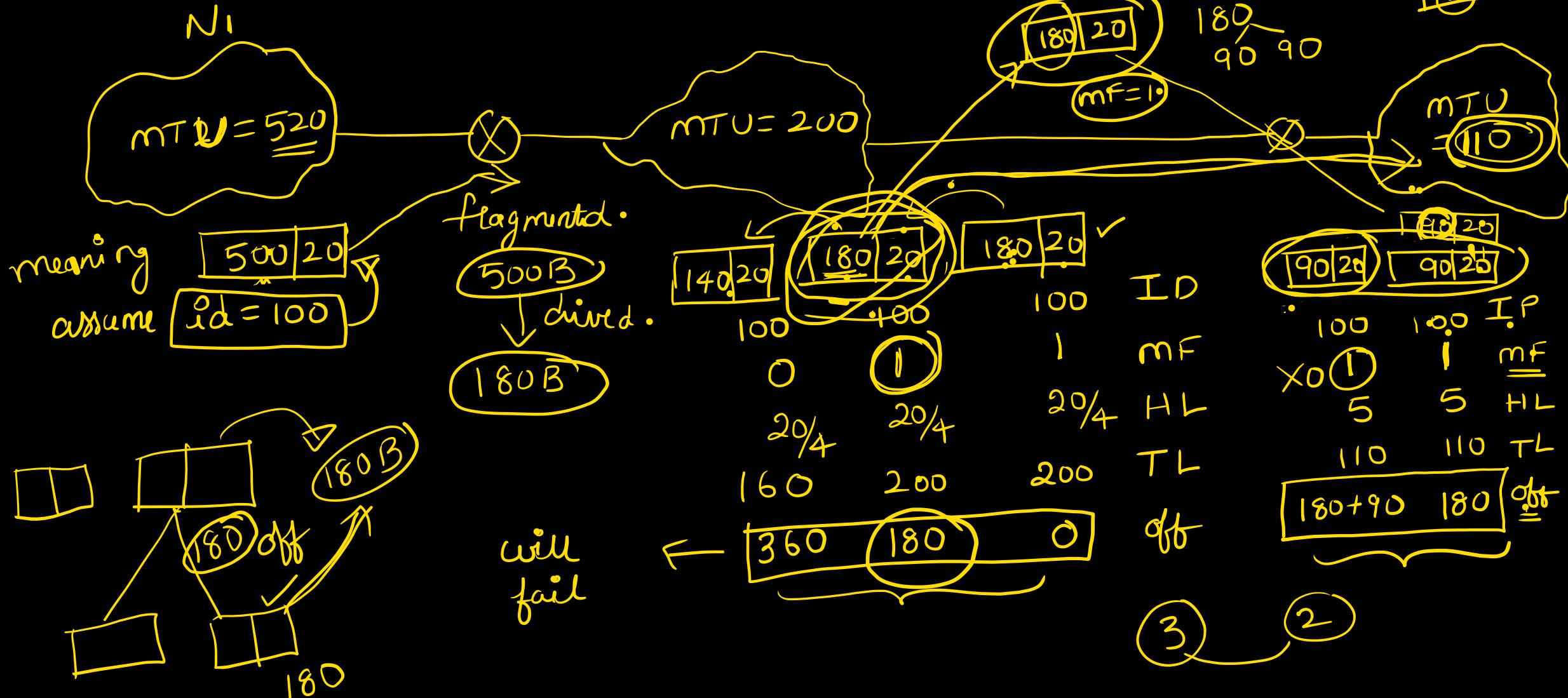
most important topic

I will repeat 100 times

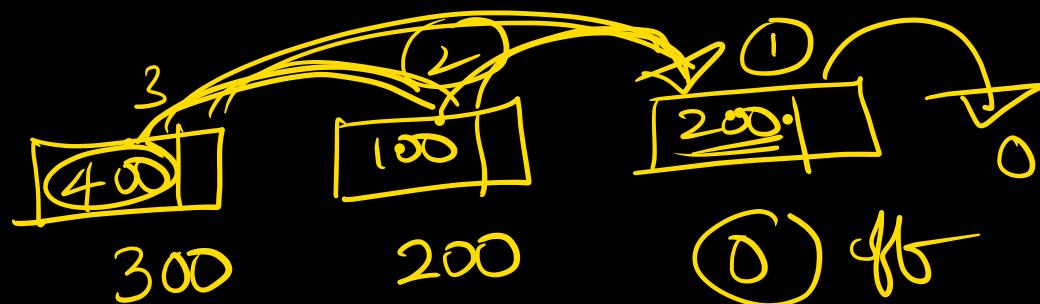
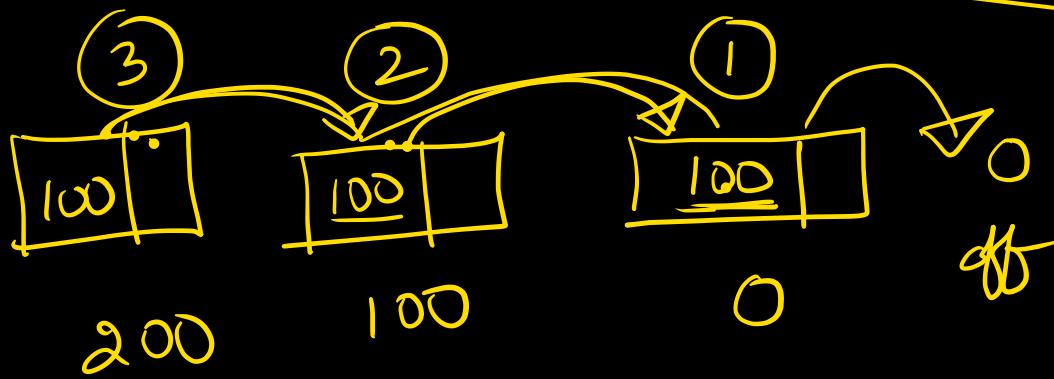
Take the notes with me.

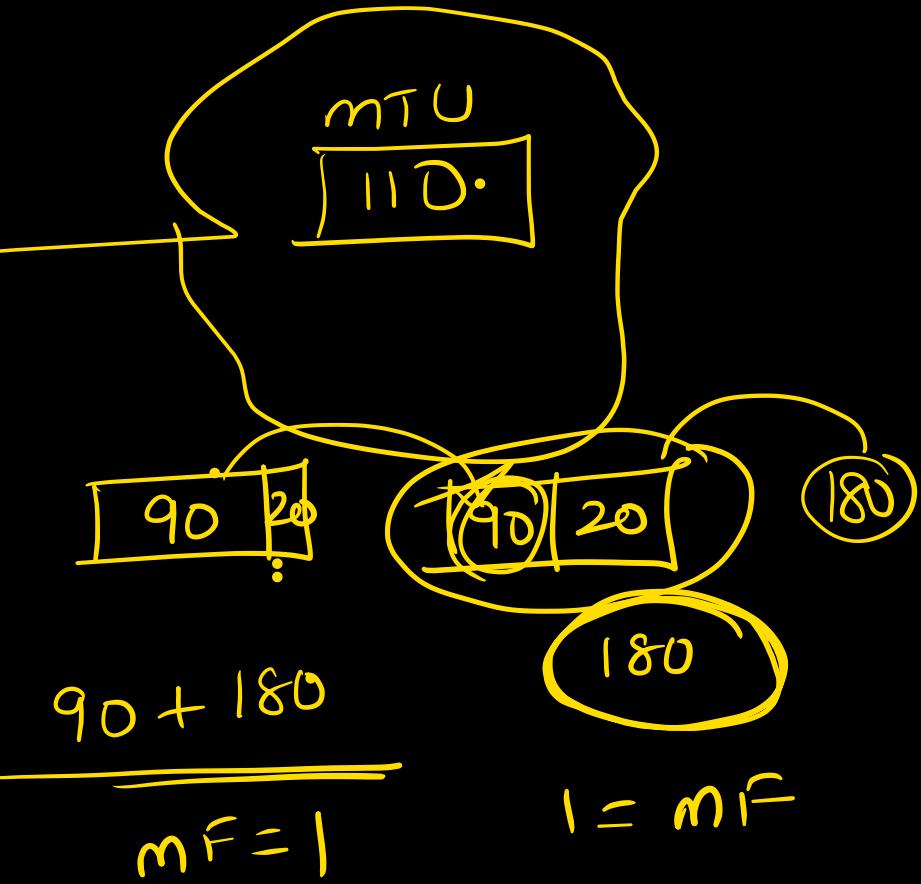
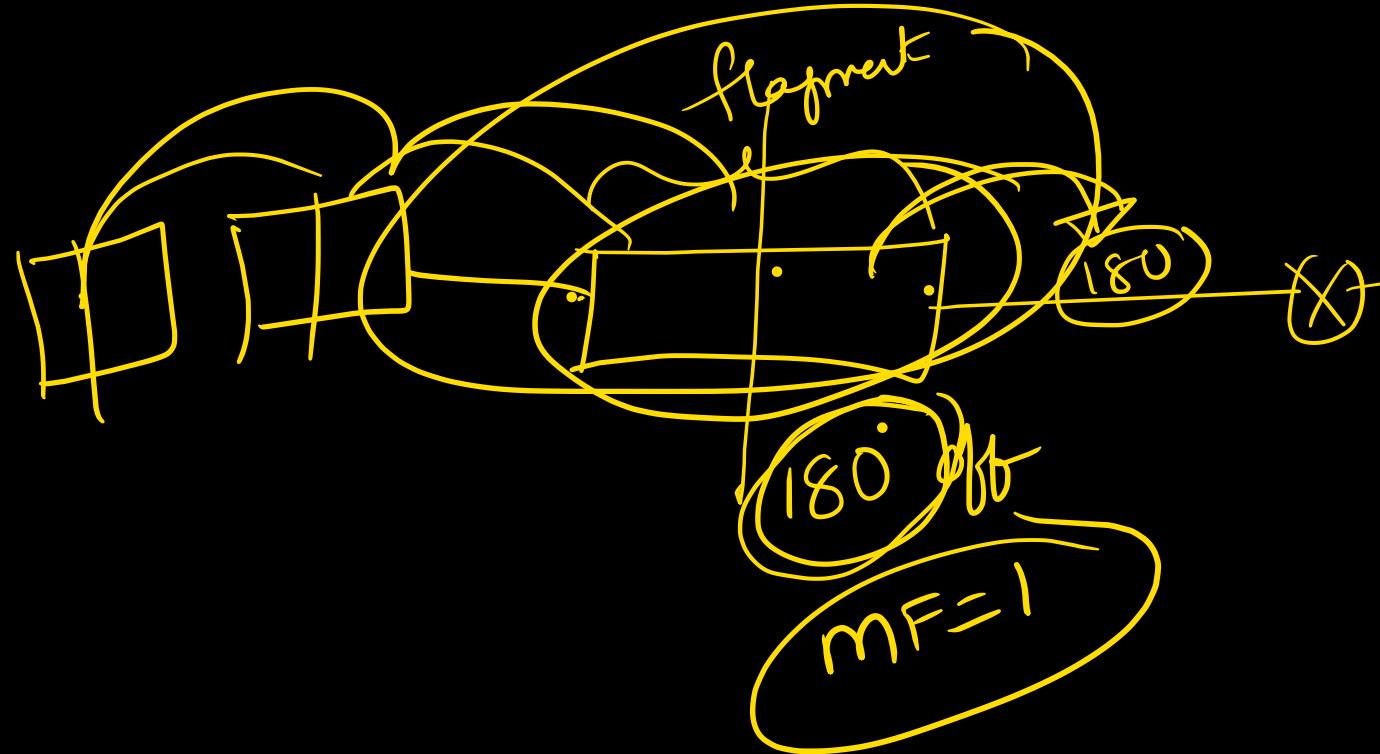
I will keep erasing the diagram.

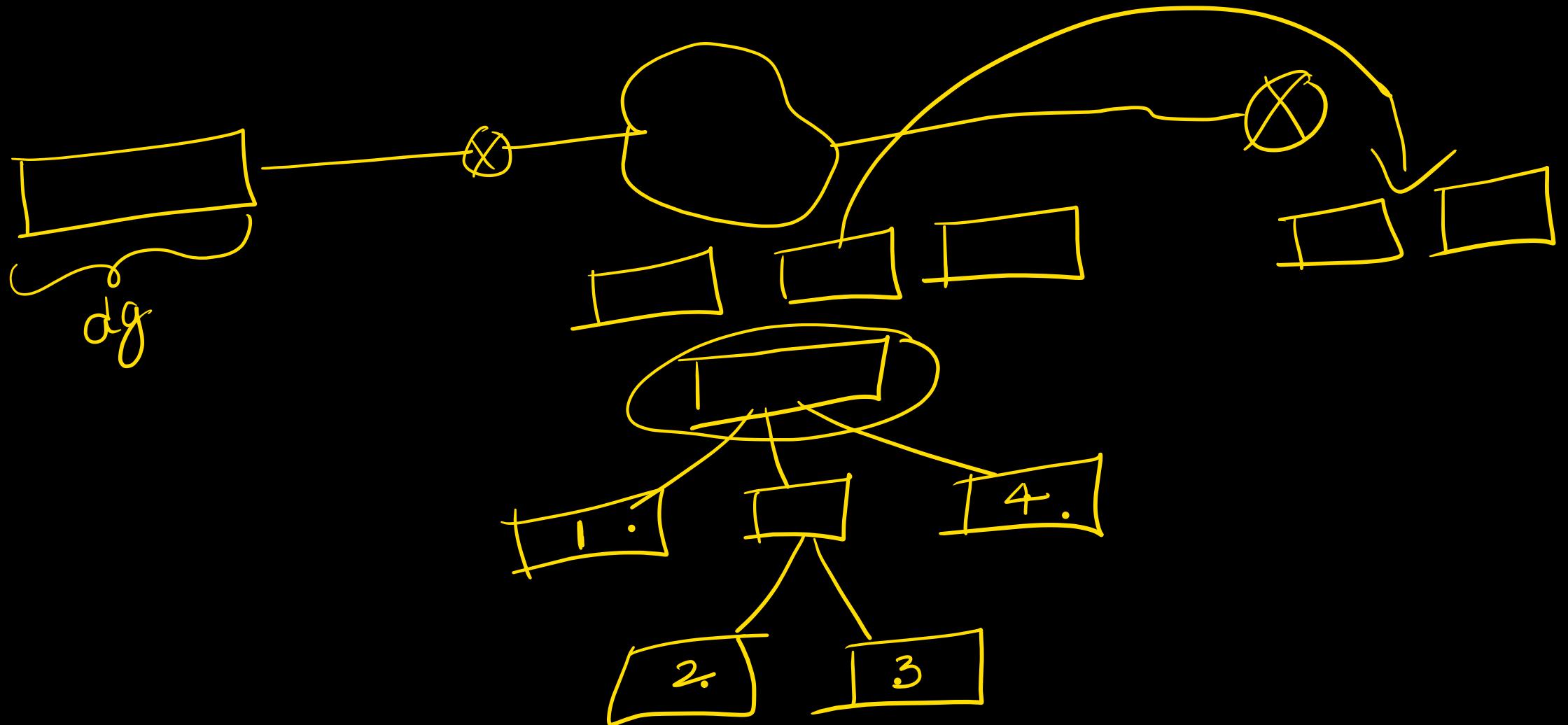
## Fragmentation at Routers

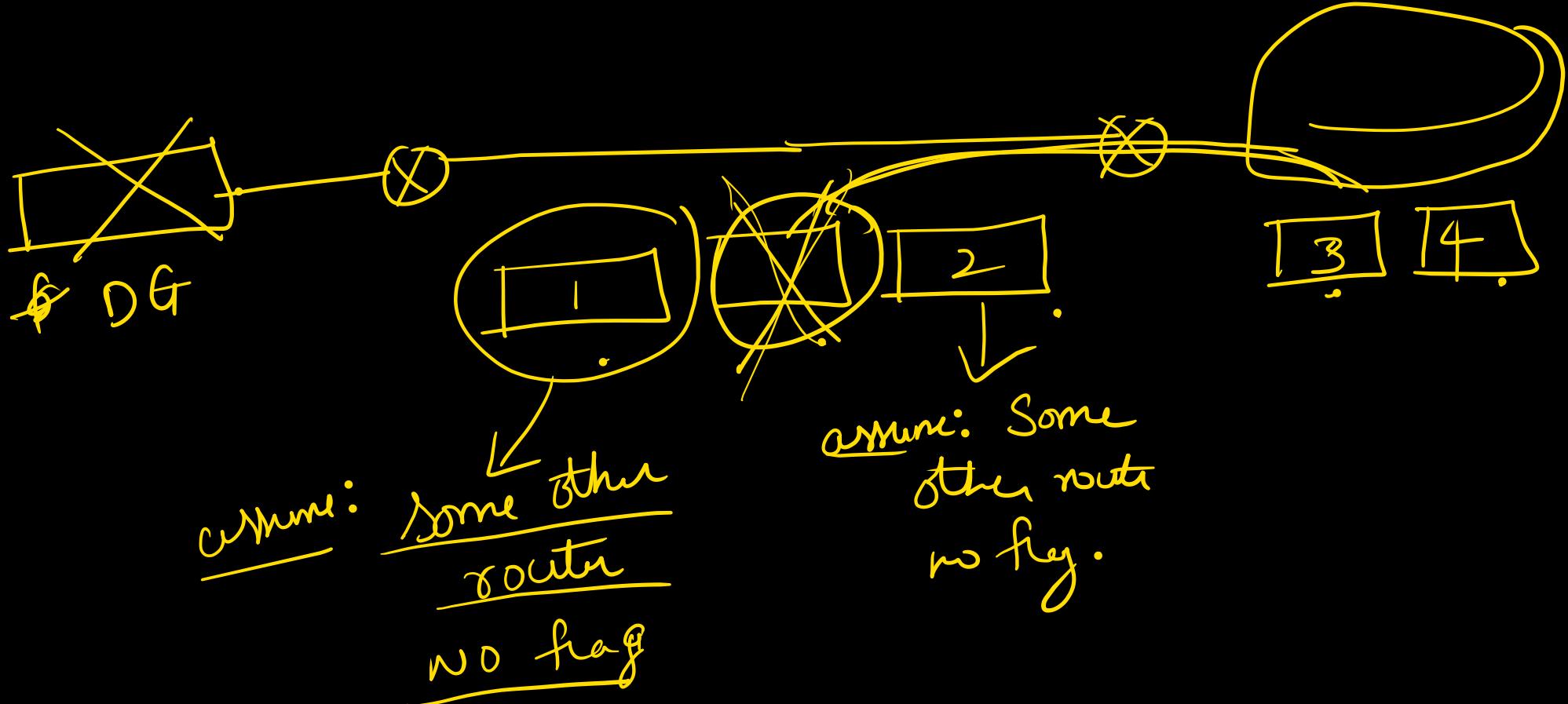


offset: no of data byte ahead of this fragment.









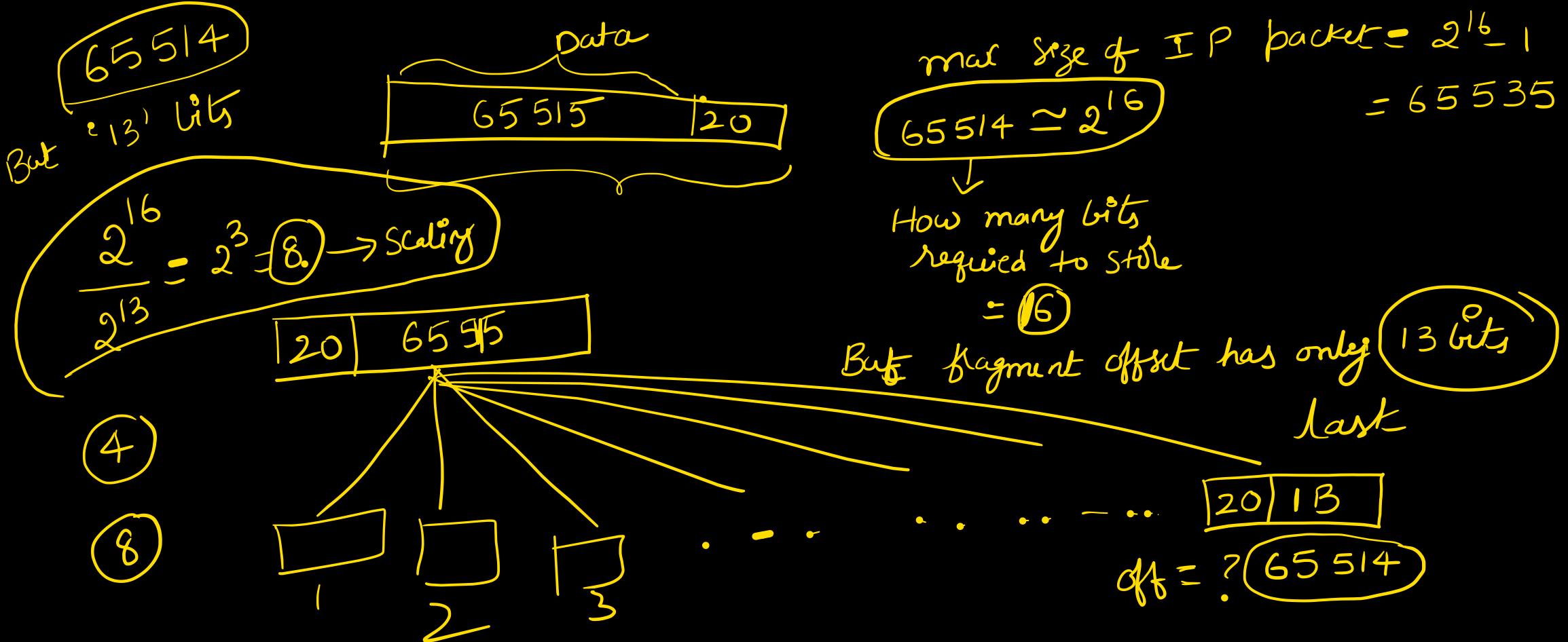
we got 4 fragments:

	<table border="1"><tr><td>20</td><td>180</td></tr></table>	20	180	<table border="1"><tr><td>20</td><td>90</td></tr></table>	20	90	<table border="1"><tr><td>20</td><td>90</td></tr></table>	20	90	<table border="1"><tr><td>20</td><td>140</td></tr></table>	20	140	.
20	180												
20	90												
20	90												
20	140												
ID:	100	100	100	100									
off:	0	180	270	360	0								
MF:	1	1	1	5	5								
HL:	5	5	110		160								
TL:	200	110											

Problem:

we will do it again

every thing.



$2^{16}$  → save in field

$\frac{2^{13}}{2^3} = ⑧$  scaling  
↳ divisible by 8

∴ offset  $\frac{8}{8}$  → store result  
in the packet

Break for 5 min:































































































































































