

# CS & IT ENGINEERING



## Computer Network

### IPv4 Header

**Lecture No. - 01**



**By - Abhishek Sir**





# Recap of Previous Lecture



Topic

Ethernet Bridging







# Topics to be Covered



Topic

IPv4 Header



# ABOUT ME



Hello, I'm **Abhishek**

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

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# Topic : Computer Networks



## Syllabus :

→ Concept of layering : OSI and TCP/IP Protocol Stacks;

→ Data link layer : Framing, Error detection, Medium Access Control, Ethernet bridging; *Flow Control*

*CRC, CSMA/CD*



## Topic : Network Layer



→ Internet Protocol (IP)

→ Two versions :

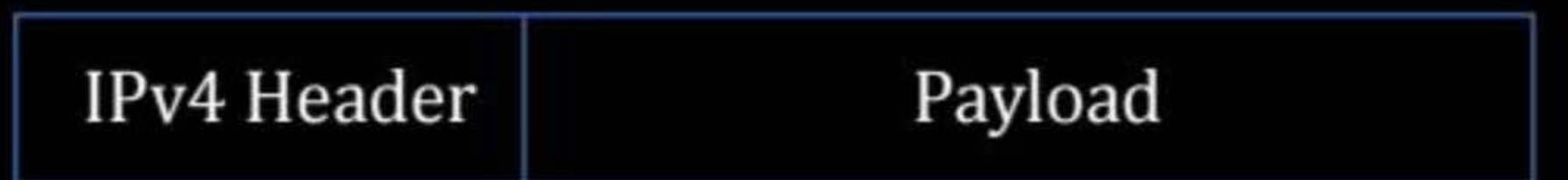
1. IPv4 ✓

2. IPv6





## Topic : IPv4 Packet Header



← IPv4 Datagram (packet) →



# Topic : IPv4 Packet Header



IPv4  
Header  
5 to  
15 word

0	3 4	7 8	15 16	31
VER	HLEN	Type of Services	Total Length	
Identification No.			DMFF	Fragmentation Offset
Time-to-Live		Protocol Type	Header Checksum	
Source IP Address (32 bits)				
Destination IP Address (32 bits)				
Optional Header (options)				
Payload				

BASE  
Header  
(5  
word)  
(20  
byte)  
0 to  
10 word





## Topic : IPv4 Packet Header



- Header represented in words  
[Word of 32 bits (4 bytes)]
- Minimum (Base) Header Size = 5 Words (20 Bytes)  
[Word size = 4 bytes]
- Variable Size IPv4 Header  
[due to options (optional header)]



## Topic : Version



→ First four bits of IP datagram

→ "0100" : for IPv4 ✓

→ "0110" : for IPv6



## Topic : Header Length



→ Header Length [HLEN]

→ HLEN field is 4 bits long

→ Size of header in words ✓  
[Word of 4 bytes]

→ Header Length = (HLEN) Words  
= (HLEN \* 4) Bytes





## Topic : Header Length

→ Minimum Header Size = 5 Words (20 Bytes)

$$[5 \leq \text{HLEN} \leq 15]$$

→ Maximum Header Size = 15 Words (60 Bytes)



4 bit  
Range

$$0 \text{ to } (2^4 - 1)$$

#Q. Identify which can be a valid IPv4 packet header size (in bytes).

~~A. 4~~

~~B. 5~~

~~C. 25~~

✓ D. None of the above

Ans: D



## Topic : Header Length



Header Size = 5 Words (20 Bytes)

Header Size = 6 Words (24 Bytes)

Header Size = 7 Words (28 Bytes)

Header Size = 8 Words (32 Bytes)

Header Size = 9 Words (36 Bytes)

Header Size = 10 Words (40 Bytes)

Header Size = 11 Words (44 Bytes)

Header Size = 12 Words (48 Bytes)

Header Size = 13 Words (52 Bytes)

Header Size = 14 Words (56 Bytes)

Header Size = 15 Words (60 Bytes)



#Q. Identify which is/are can be a valid IPv4 packet starting bits.

~~A. 01000100~~

~~B. 01010101~~

✓ C. 01000101

✓ D. 01000110

VER HLEN

Ans: C & D

#Q. In IPv4 packet starting bits are "01001010", calculate header size (in bytes)?  
VER HLEN

$$HLEN = (1010)_2 = 10 \text{ words}$$

$$\text{Header Size} = (HLEN * 4) \text{ bytes}$$

$$= (10 * 4) \text{ bytes}$$

$$= 40 \text{ bytes}$$

$$\boxed{\text{Ans} = 40}$$



## Topic : Header Length



Size of options (in IPv4 packet header)

$$= [\text{HLEN} - 5] \text{ words}$$

$$= [\text{HLEN} - 5] * 4 \text{ bytes}$$

Maximum Size of options (in IPv4 packet header)

$$= [15 - 5] \text{ words}$$

$$= 10 \text{ words} = 10 * 4 \text{ bytes}$$

$$= 40 \text{ bytes}$$



#Q. In IPv4 packet starting bits are "01001100", calculate options field size (in bytes) in packet header?

VER HLEN

$$HLEN = (1100)_2 = 12 \text{ words}$$

$$\text{Options size} = (HLEN - 5) \text{ words}$$

$$= (12 - 5) \text{ words}$$

$$= 7 \text{ words}$$

$$= 7 * 4 \text{ bytes}$$

$$= 28 \text{ bytes}$$

$$\boxed{\text{Ans} = 28}$$



## Topic : Type of Services



- Type of Services [ToS]
- ToS field is 8 bits long  
[Second byte of IPv4 packet header]
- For QoS  
[Quality of Services]



## Topic : Total Length



- Total Length field is 16 bits long
- Define size of IPv4 packet (datagram) in bytes  
[including header]
- Maximum IPv4 datagram size =  $[2^{16} - 1]$  bytes

16 bits  
Range

$$0 \text{ to } (2^{16} - 1)$$

$$20 \leq \text{Total length}$$





## Topic : Total Length



Size of Payload = [Total Length - (HLEN \* 4) ] bytes

#Q. In IPv4 packet values in total length field and header length (HLEN) fields are 250 and 10 respectively, calculate size of data (payload size) carrying by this packet (in bytes)?

Total Length = 250 bytes

HLEN = 10 words

$$\begin{aligned}\text{payload size} &= [\text{Total Length} - (\text{HLEN} \times 4)] \text{ bytes} \\ &= [250 - (10 \times 4)] \text{ bytes} \\ &= 210 \text{ bytes}\end{aligned}$$

Ans = 210



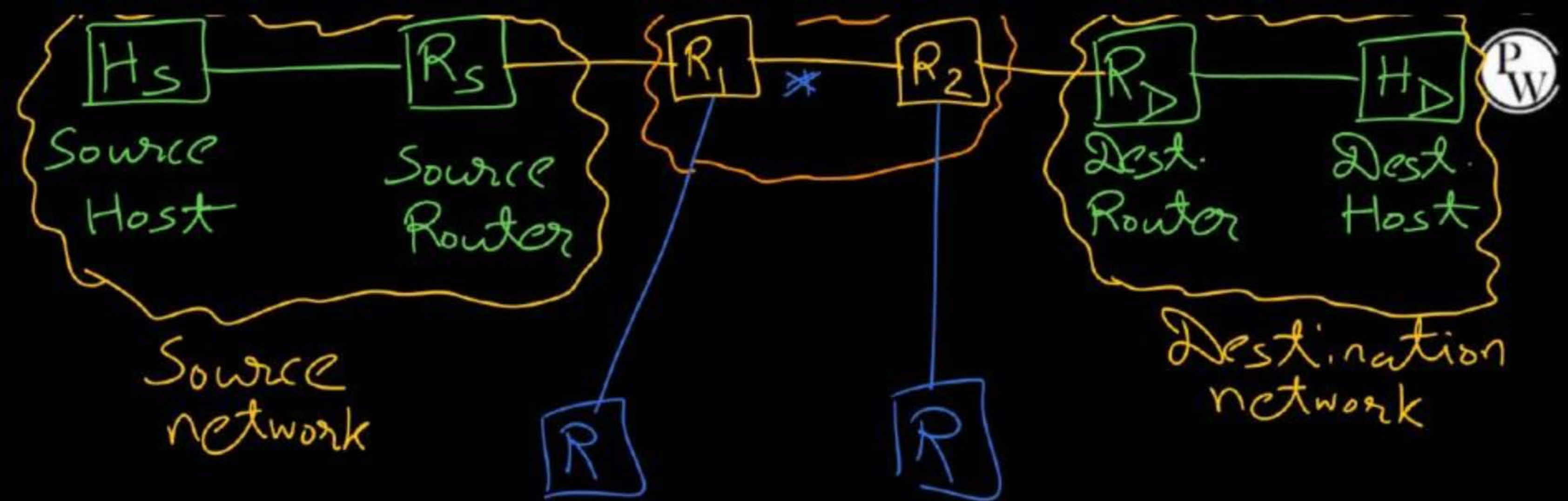
## Topic : MTU



- Maximum Transmission Unit [MTU]
- Measurement in bytes
- Size of largest PDU (datagram) that can be communicated over a network

$$\text{IP Datagram Size} \leq \text{MTU Size}$$







## Topic : MTU



- Source host creates IPv4 datagram as per source network MTU
- At intermediate IPv4 router, for an received IPv4 datagram  
if datagram length is greater than next network (link) MTU size  
then need to do fragmentation according to MTU



## Topic : Identification Number



→ 16 bits long ✓

Range →  
0 to  $(2^{16} - 1)$

→ 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]



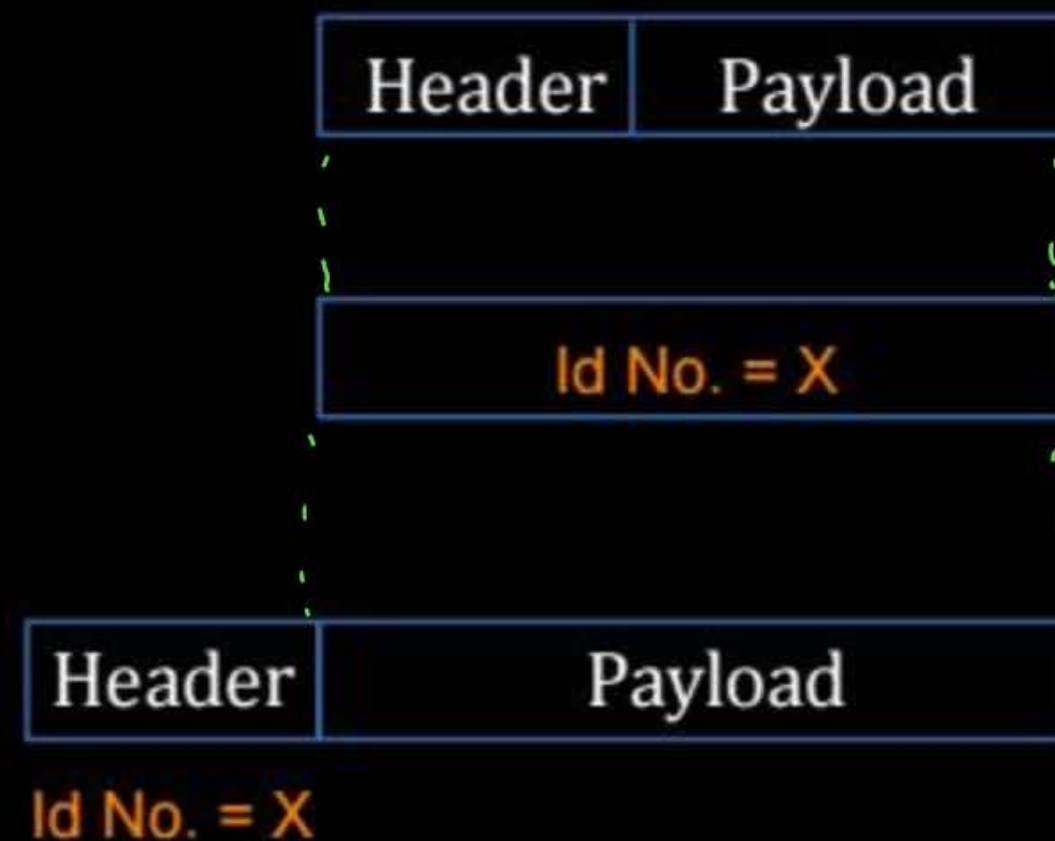


## Topic : Identification Number



Transport Layer PDU (Segment)

SDU for Network Layer



Id No. = X

$IP\ Datagram \leq MTU$

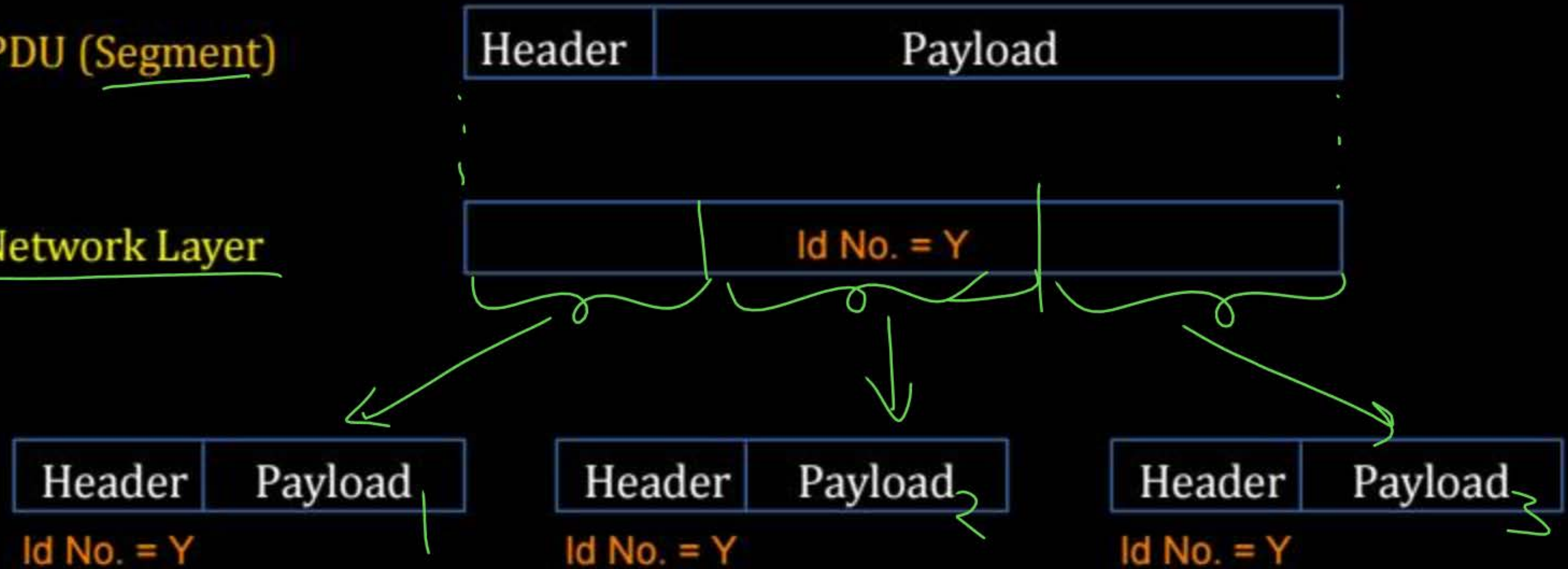


# Topic : Identification Number



Transport Layer PDU (Segment)

SDU for Network Layer





## 2 mins Summary



Topic

IPv4 Header

- ① Header Size
- ② Total Length
- ③ MTU
- ④ Id no.





**THANK - YOU**