CS & IT ENGINEERING

COMPUTER NETWORKS

IPv4 Header & Fragmentation

Lecture No- 4

By- Ankit Doyla Sir

IPv4 Header

Checksum

checksum = (4bit, 8bit, 16bit, 32bit)

(TCP & IP)

Let us assume checksum = 4bit

data = 0111 | 1011 | 1100 | 0000 | 0110

7 | 11 | 12 | 0 | 6

checksum = 7+11+12+0+6 = 36

(2)

01111011111000 0000 0110	checksum = 4 bit -36

$36 - 36 = 0$ (No Error)

checksum = 4 bit $\xrightarrow{\text{max No}}$ 1111 → 15

checksum = 36 = 100100

+ 10

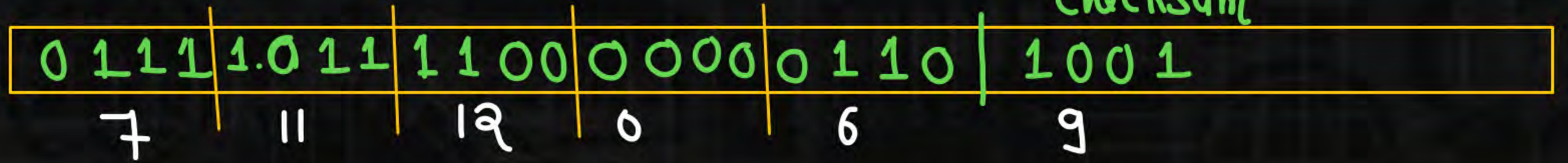
0110 → 6

1001 → 9

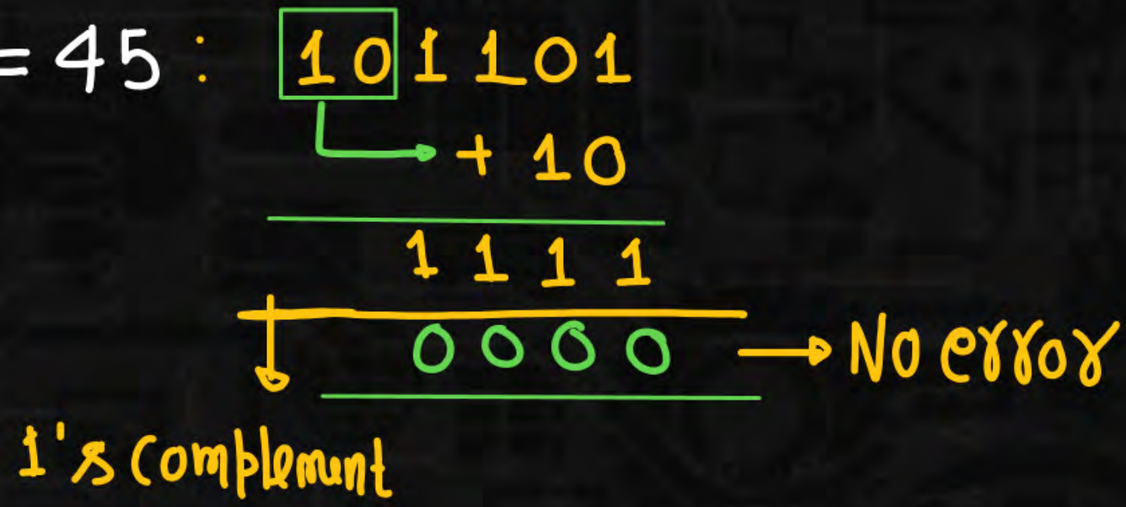
1's Complement

Transmitted data

Received data



7 + 11 + 12 + 0 + 6 + 9 = 45 :



Header checksum : (16bit)

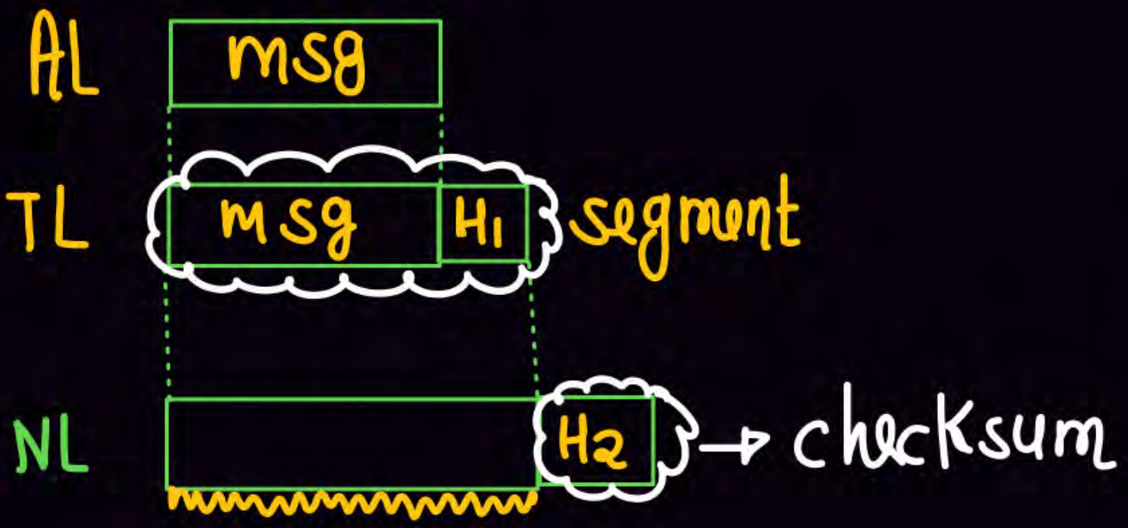
It is calculated only for header part not the data because rest of the component in packet already covered by TCP checksum.

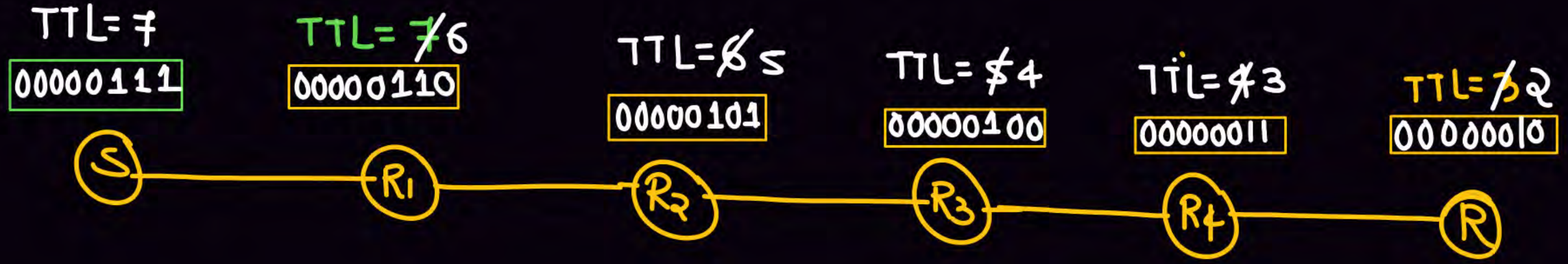
Header checksum is calculated at each and every Router because related to IP Header might be change when packet is moving from one router to another.

Every router makes one modification

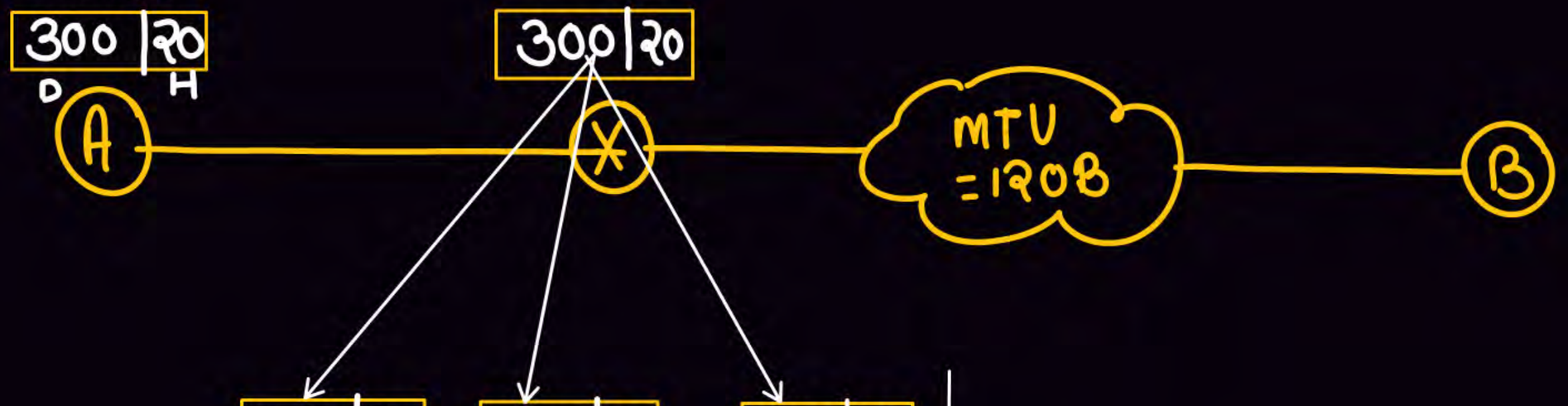
i.e. TTL so Header checksum is calculated at every Router.

Fragment offset, mF, Total length, option all may be changed at a Router.

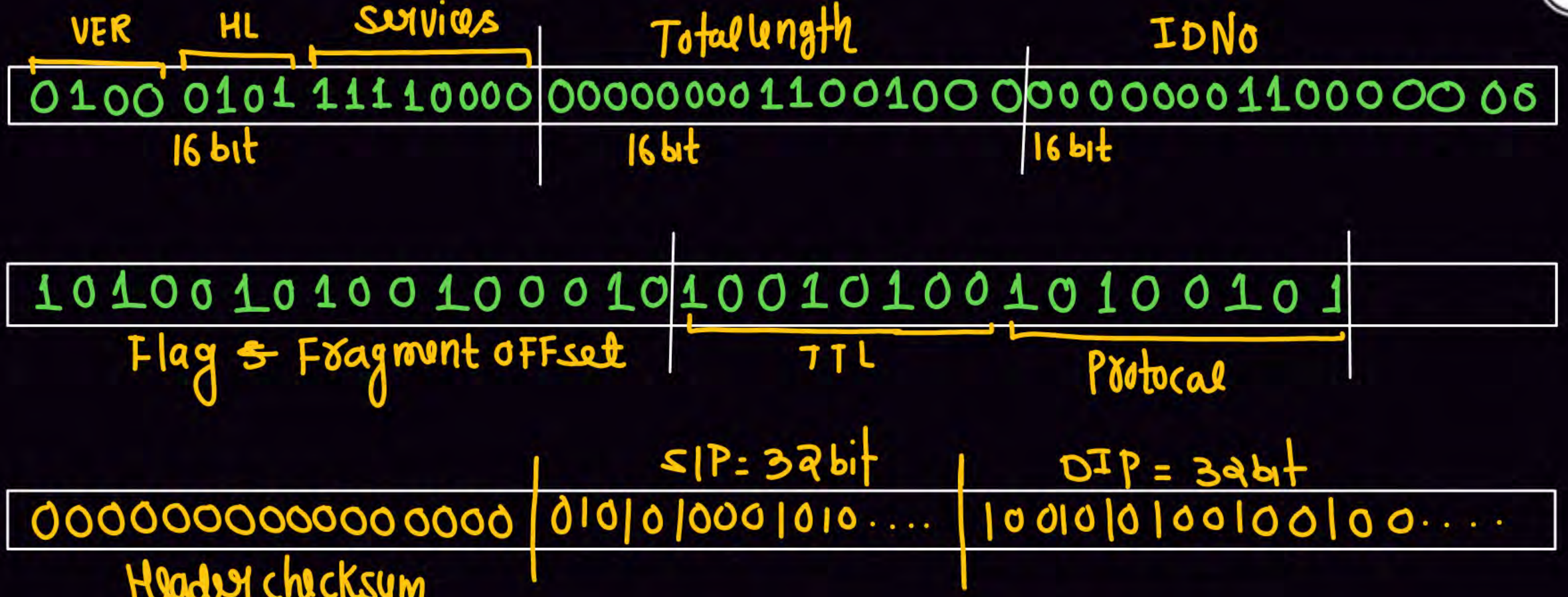

AL
msg
TL
msg
H1
segment
NL
H2
checksum


TTL= 7
00000111
TTL= 7/6
00000110
TTL=6/5
00000101
TTL=5/4
00000100
TTL=4/3
00000011
TTL=3/2
00000010
S
R1
R2
R3
R4
R

TL= 320
OFFset=0
MF=0
ID=100



100 | 20	100 | 20	100 | 20	
100	100	100	IDNo
0	1	1	MF
200	100	0	OFFset
120	120	120	TL



All 16 bit will be zero initially

Source Address :

This 32 bit defines the IPV4 address of source. This field remain unchanged during the time the IPV4 data gram travel from the source Host to destination Host.

Destination Address :

This 32 bit Field defines the IPV4 address of the destination. This field remain unchanged during the time the IPV4 data gram travel from source host to destination host.

Not changed	may be changed	Def. Changed
① VER ② HL ③ Services ④ Identification No ⑤ DF ⑥ Protocal ⑦ S.I.P ⑧ D.I.P	Total length MF Fragment offset	TTL Header checksum

Option :

The Header of IPV4 data gram is made of two parts a fixed part and a variable part. The fixed part is 20 Byte long and variable part that can be maximum of 40 Bytes.

There are 5 options

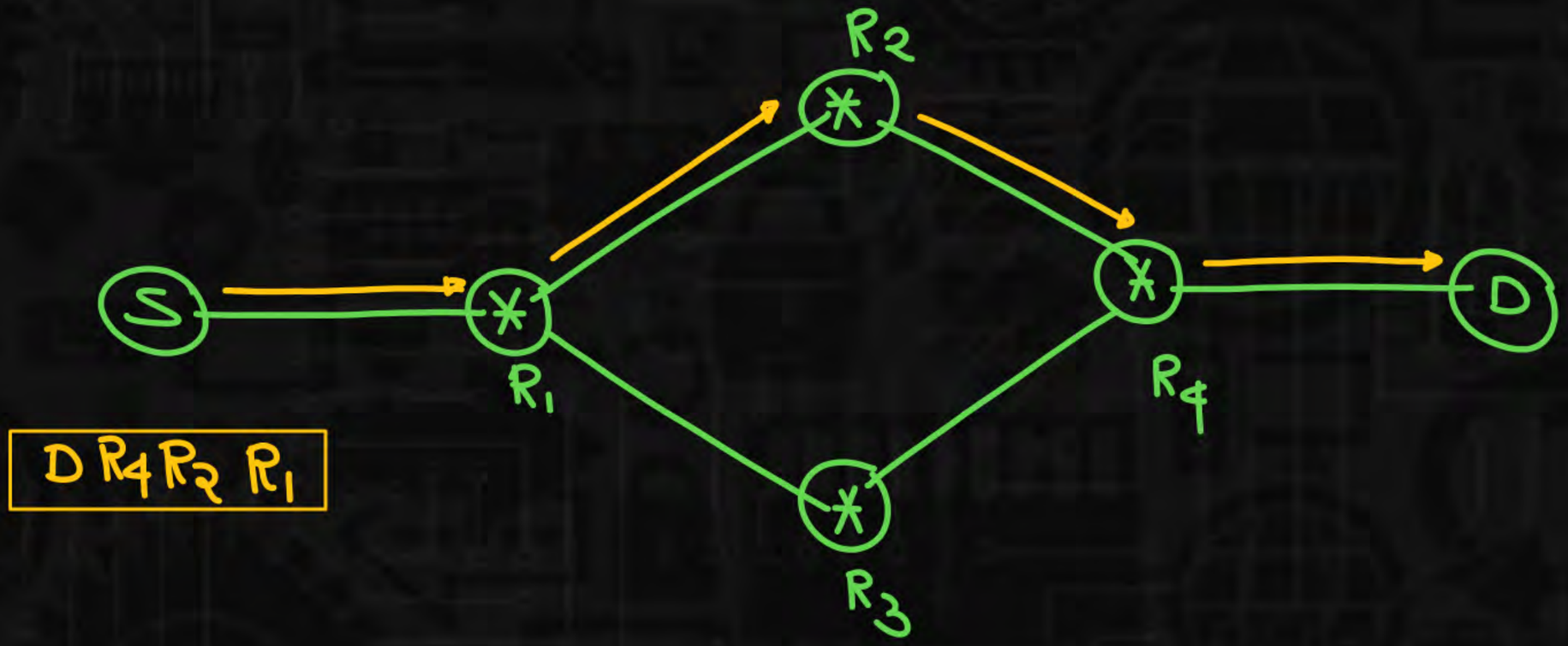
1. Strict source Routing
2. Loose source Routing

} Source will decide the Route

3. Record Routing } Routers will decide Route
4. Time stamp
5. Padding

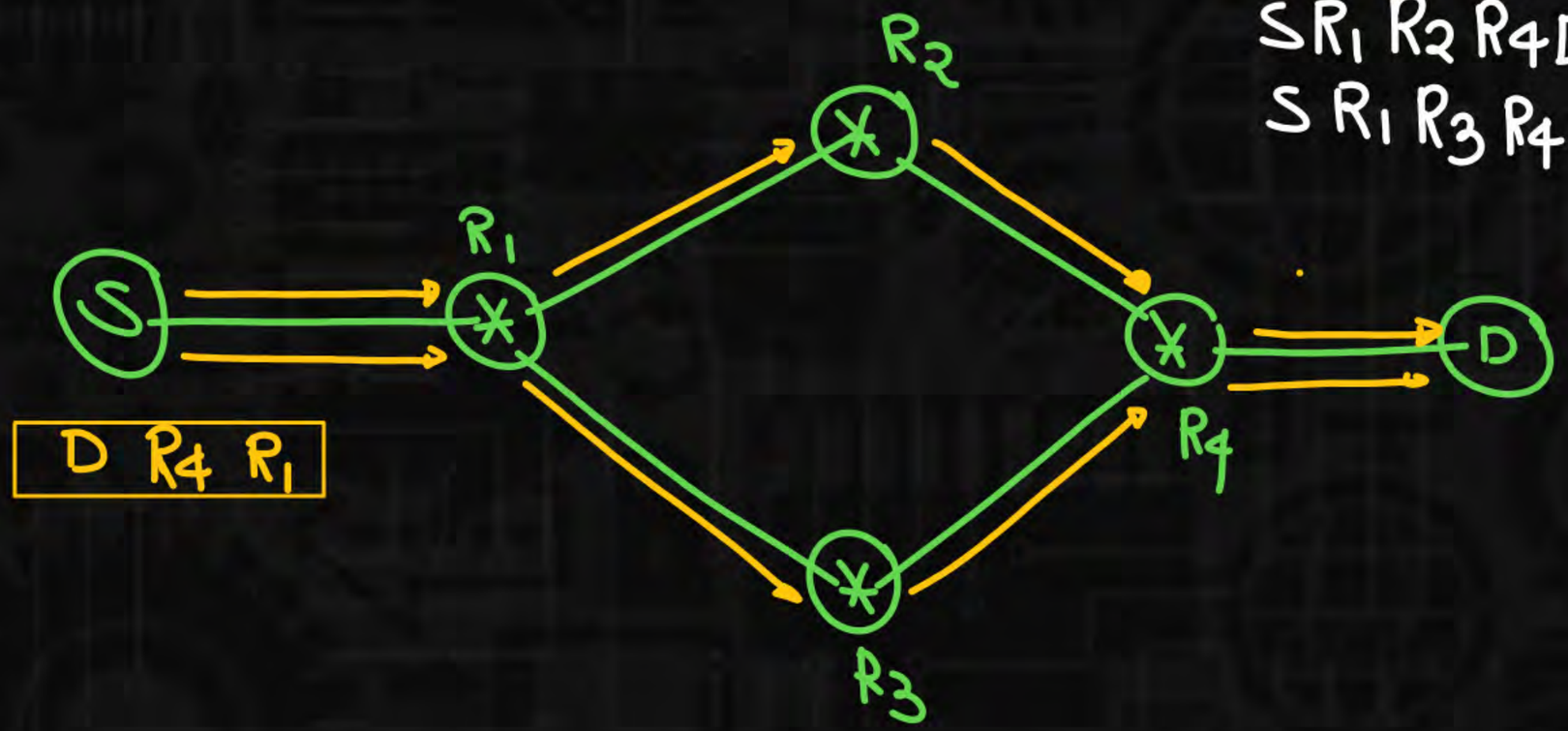
Strict Source Routing :

A strict source routing is used by the source to predetermine a route for data gram as it travel through the internet.



Loose source Routing :

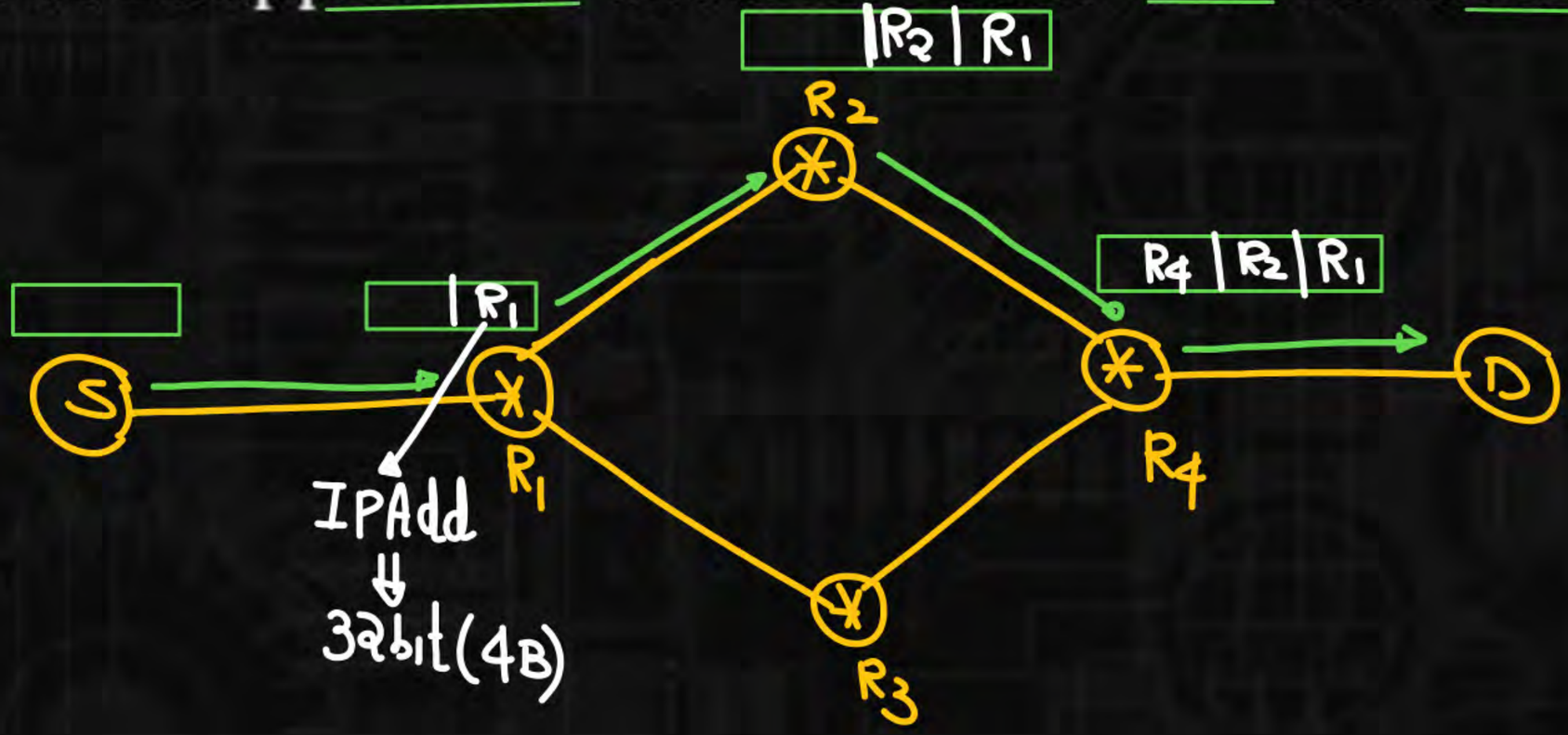
A loose source route option is similar to strict source route but it is less rigid. Each router in the list must visited, but the data gram can visit other outer as well.



Record Routing :

A record route option is used to record the internet routers that handle the data gram. It can list up to 9 router Address.

All the Router are supposed to record their IP Add on their IP packets.



option = 40Byte, IP Add = 4B

$\frac{40B}{4B} = 10$ Router IP Add can be Recorded

38B

9 Router IP Add

Note :

First 16 bits (2 byte) are reserved for option type(8 bit) and length (8 bit). Out of 40 byte only 38 bytes are remaining for storing ipv4 addresses. In 38 byte we can store 9 ipv4 addresses as each ipv4 address is of 4 byte

Time stamp :

It is used to find out delays at each router. Every router should record incoming time and outgoing time

Delay = 5 min

Problem Solving
On
IPv4 Header

Q.1

In an IPv4 packet the value of HLEN is $(1100)_2$. How many Byte of options are being carried by this packet ?

A. 40 Byte

B. 60 Byte

C. 12 Byte

D. 28 Byte ✓

HLEN = $(1100)_2$

HLEN = 12

Header size = 12*4 = 48 Byte

option = 48B - 20B (Fixed length Header)

option = 28Byte

Q.2

In an IPv4 packet, the value of HLEN is 5, and the value of total length field is $(0048)_{16}$. How many Bytes of the data are being carried by this packet

52 .

HLEN = 5

Header size = 5*4 = 20 Byte

Total length = Data + Header

Data = TL - H

= 72 - 20 = 52

Total length = $(0048)_{16}$

$16^1 16^0$

Total length = $4*16^1 + 8*16^0$

= 64 + 8 = 72

Q.3 An IPv4 packet has arrived with the first few Hexa decimal digits as shown below

$(45\,00\,00\,5C\,000\,30000\,59\,06\,\ldots\ldots)_{16}$

1st row | 2nd row | 3rd row (TTL)

VER | HL | Services | TL | IDNo | Flag | Fragment offset

How many Hops can this packet take before being dropped ?

A) 30

B) 59

C) 89 ✓

D) 90

$TTL = (59)_{16}$

$16^1\ 16^0$

$= 5*16^1 + 9*16^0$

$= 80 + 9$

$= 89$

VER(4)	HL(4)	Services (8)	TL(16bit)
IDNo(16bit)	Flag (3)	Fragment offset (13)	
TTL(8)	Protocal(8)	Header checksum (16)	
S.I.P(32bit)			
D.I.P(32bit)			

32bit

32bit

Q.4

In an IPv4 packet the value of HLEN is $(1000)_2$. How many Byte of options are being carried by this packet ?

(H.W)

Q.5

An IPv4 packet has the first few Hexa decimal digit as shown below

450000 5C | 000 3 0000 | 59 06

1st row | 2nd row | TTL | Protocal

The above packet is belong to which protocol

(A) TCP

(B) UDP

(C) ICMP

(D) IGMP

$Protocal = (06)_{16}$

$= 6 * 16^0 = 6$

ICMP → 01
IGMP → 02
UDP → 17
TCP → 06

Q.6

In an IPv4 packet the value of HLEN is 10 and value of total length field is '0084' Hexadecimal how many byte of data are being carried by this packet ?

A. 44 Byte

B. 74 Byte

C. 92 Byte ✓

D. 84 Byte

HLEN = 10

Header size = 10*4 = 40Byte

$TL = (0084)_{16}$

$16^1\ 16^0$

$8*16^1 + 4*16^0 = 132$

TL = D + H

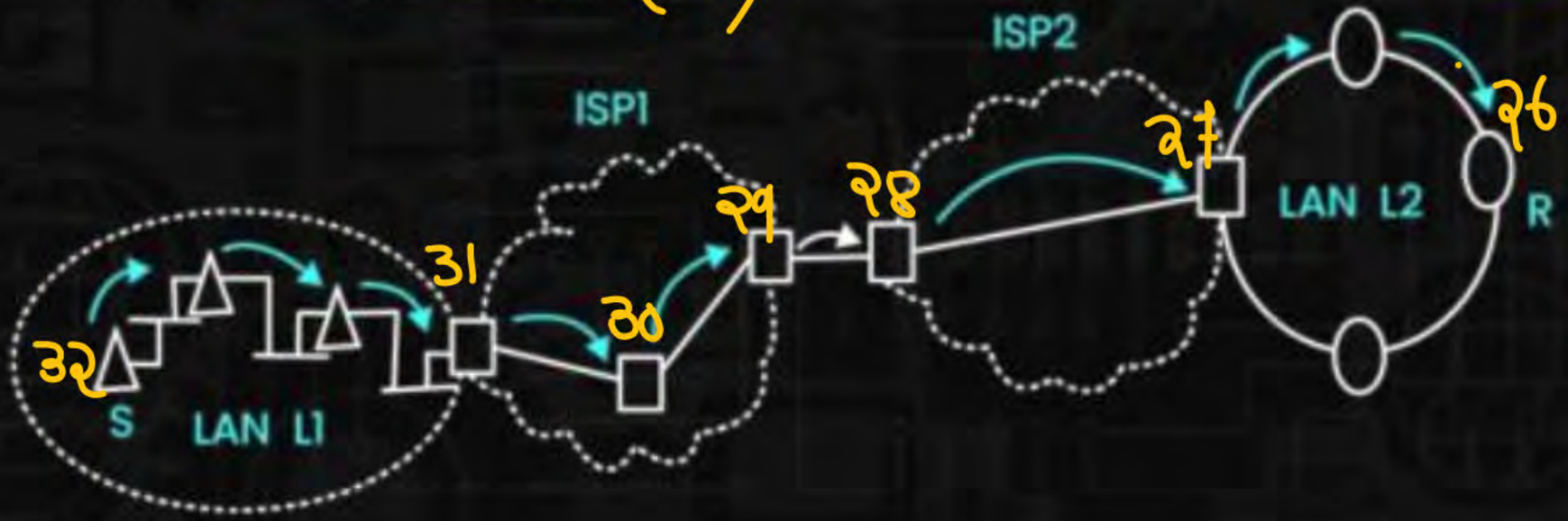
D = TL - H

D = 132 - 40 = 92

Q.7

In the diagram shown below, L1 is an Ethernet LAN and L2 is a Token-Ring LAN. An IP packet originates from sender S and traverses to R, as shown. The links within each ISP and across the two ISPs, are all point-to point optical links. The initial value of TTL field is 32. The maximum possible value of the TTL field when R receives the datagram is ____(26)____.

GATE 2014



Q.8

For which one of the following reasons does Internet Protocol (IP) use the time-to-live (TTL) field in the IP datagram header ?

GATE 2006

A Ensure packets reach destination within that time.

B Discard packets that reach later than that time

C Prevent packets from looping indefinitely.

D Limit the time for which a packet gets queued in intermediate routers.

Q.9

One of the header fields in an IP datagram is the Time-to-Live (TTL) field. Which of the following statements best explains the need for this field?

GATE 2010

A. It can be used to prioritize packets

B. It can be used to reduce delays

C. It can be used to optimize throughput

D. It can be used to prevent packet looping

Q.10

In the TCP/IP protocol suite, which one of the following is NOT part of the IP header? **GATE 2004**

A. Fragment Offset

B. Source IP address

C. Destination IP address

D. Destination port number ✓

Part of IP Header

Q.11

Which one of the following fields of an IP header is NOT modified by a typical IP router? **GATE 2015**

A. Checksum

B. Source address

C. Time to Live (TTL)

D. Length

Q.12

Host A (on TCP/IP v4 network A) sends an IP datagram D to host B (also on TCP/IP v4 network B). Assume that no error occurred during the transmission of D. When D reaches B, which of the following IP header field(s) may be different from that of the original datagram D? **GATE 2014**

(i) TTL

(ii) Checksum

(iii) Fragment offset

A (i) only

B (i) and (ii)

C (ii) and (iii)

D (i), (ii) and (iii)

Q.13 Which of the following statement is TRUE?

GATE 2009

A. Both Ethernet frame and IP packet include checksum fields

B. Ethernet frame includes a checksum field and IP packet includes a CRC field

C. Ethernet frame includes a CRC field and IP packet includes a checksum field

D. Both Ethernet frame and IP packet include CRC fields

Q.14

Which can be possible header size (in bytes) in IPv_4 datagram ?

H.W

I. 20

II. 30

III. 50

IV. 60

A I only

B I and IV

C IV only

D I, II, III and IV

Q.15

An IPv4 packet has the first few Hexa decimal digit as shown below

450000 5C 000 3 0000 59 06

What is data size of IPv4 packet _____ .

HW

Q.16

In a IP datagram a TCP segments is present header length field of IP datagram is 10 total length of IP datagram is 1000 byte. Header length field in TCP header is 15, then what is the size of TCP data present in the datagram.

40

A 988

B 952

C 964

D 900

Q.17

An ipv4 packet has arrived with the first 16 bit as (0100001011110000) the receiver discard this packet why ?

HW

A. Invalid VER

B. Invalid HLEN

C. Both A &B

D. NONE

Q.18

An IPv4 packet has the first few Hexa decimal digit as shown below

450000 5C 000 3 0000 59 0600000A0C0E05

What is Source IP Address(in decimal) of IPv4 packet _____.

HW

Q.19

Which of the following value is/are not possible of the TTL in a datagram ?

PW

A 23

B 0

C 1

D 301


THANK YOU
GW
SOLDIERS !