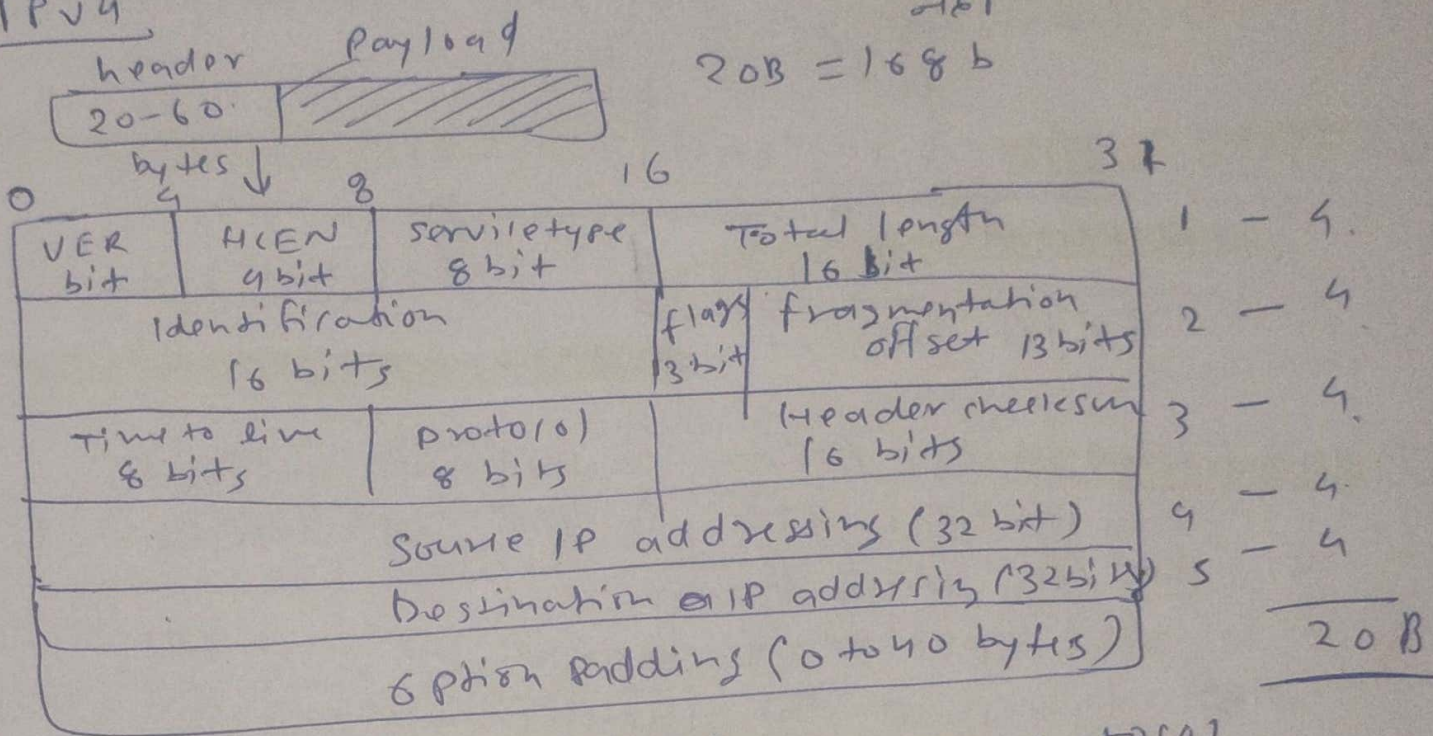


UNIT-4

Network Layer (Data2ram)

- ① Source to destination delivery → packet को S to D तक पहुँचाने का काम करता है
- ② Logical Addressing → IP address कोट करता है
- ③ Routing → Routing path select करता है (best)
- ④ Packetizing → बड़े फ़ाइल को packet में resize करता है
- ⑤ Error and flow control → basic level का error control करता है
- ⑥ Congestion control → error हुआ तो inform करता है, solve करता है नहीं

IPv4



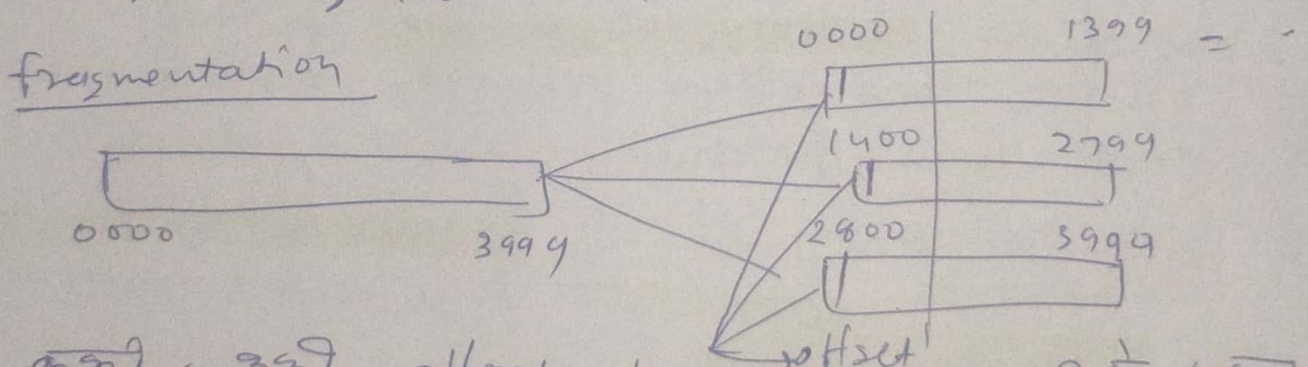
- ① unreliable connectionless datagram protocol offering a best-effort delivery service which doesn't guarantee packet safety or order.
- ② IPv4 each datagram is independently treated & allow different routes to their destination.
- ③ To enhance reliability, IPv4 should be coupled with a reliable protocol like TCP, forming the TCP/IP protocol stack for secured data delivery.

- ① version (4 bit) → IPv4 / IPv6
0100 0110
- ② header length (4 bit) 5x4 to 15x4
20 to 60

- ③ Service type (8 bit) Low high
3 bit → priority control 3 bits 000-111
5 bit → D T R C □
minimize delay | Throughput | minimize cost
maximum reliability
- एक characteristic के base पर प्रो service की demand से मिलता है.

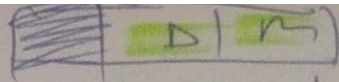
- ④ Total length → header + payload का size बताता है
header length 16 bytes
Total length = $16 + \text{payload}$
65535 bytes max.
 $8 \times 16 =$ datagram का size बताता है

- ⑤ Identification → किसी packet को uniquely identify करने के लिए identification bit का use किया जाता है →
→ अगर packet fragment हो तो बताता है कि एक ही fragment का identification bit same रहेगा



किसी . किसी offset $2^{16}-1$ के अतिरिक्त कोई भी नहीं
कर सकते हैं तो fragment offset 13 bit का है तो
 $\frac{2^{16}}{2^{13}} = 2^3 = 8$ मतलब हर offset पर
6 से devide करेंगे यही fragment offset bit
होगा

① flags (3)



Do not fragment

1 → not fragment

0 → can be fragmented if necessary

1 → not last fragment
0 → not last or only fragment.

⑦ Time to live (8)

① maximum number of hops can take if any datagram take more than TTL then it ~~route~~ discard. and have a error message

② infinite loop → can occur

Protocol values

⑧ Protocol (8 bit)

TCP - 06

UDP - 17

ICMP 01, 11, 02

OSPF 89

⑨ checksum

verified the header not payload indicating that IP is not entirely reliable as it doesn't affirm the payload remains unaltered during transmission.

⑩ Source to destination 16 bit

⑪ option 40 byte (9 router)

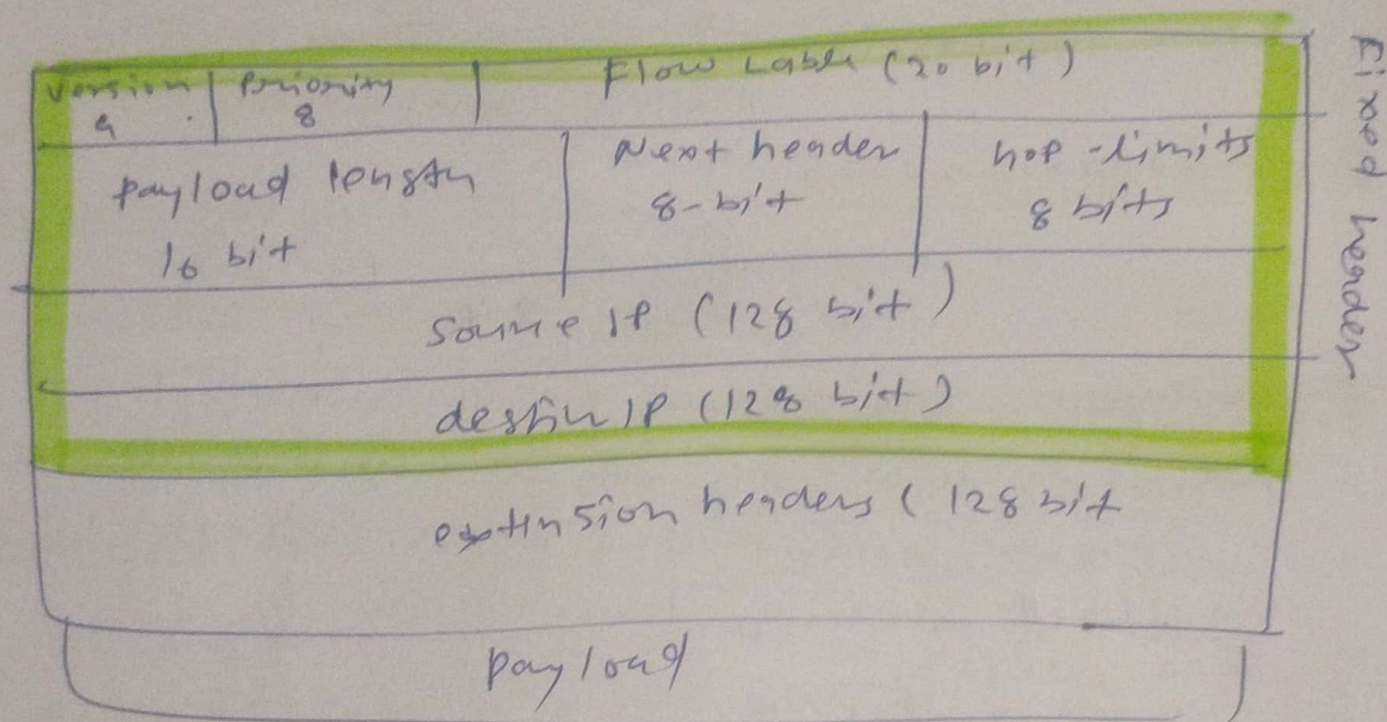
① Strict source route → with router as IP address set in the packet & 3rd bit follow set other bits in the packet

② loosely source route → route not set route that route not at start

③ Timestamp → ~~timestamp~~ timing store which.

IPv6

- ① each packet can be divided into two parts
 - base header
 - payload
- ② payload is made up of two parts
 - An optional header
 - the upper layer data
- ③ base header has eight fields.



difference between IPv4 - IPv6 is YouTube

Advantages

- ① larger address space
- ② simplified header
- ③ improved header
- ④ No NAT Required
- ⑤ mobility and security

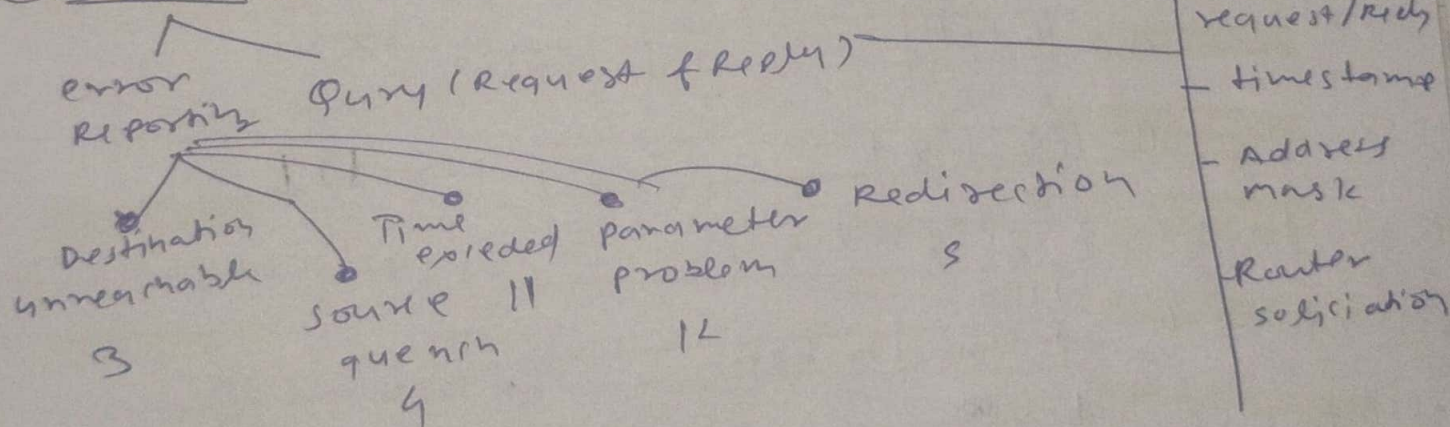
① ARP → address resolution protocol

जब कोई device suppose A इस network में है
दूसरी device से communicate करना चाहता है।
A के पास उसका IP address है पर उसे उसका
address नहीं है तो A के request broadcast
होगा इस network में जिसका भी IP match
होगा वो A को reply होगा. mac address के साथ

② RARP → Reverse Address Resolution Protocol

जब आपके पास mac address है पर आपको उसका
IP address नहीं है तो RARP इसके जरूर होता है
आप अपने network में mac address के साथ
broadcast करते हैं network में इस system होगा
जो ये mac to IP बता देगा. जो आपको
reply होगा, वो आपको IP दे देगा

③ ICMP → Internet Control Message Protocol



④ IGMP → Internet Group Message Protocol

आज इस में

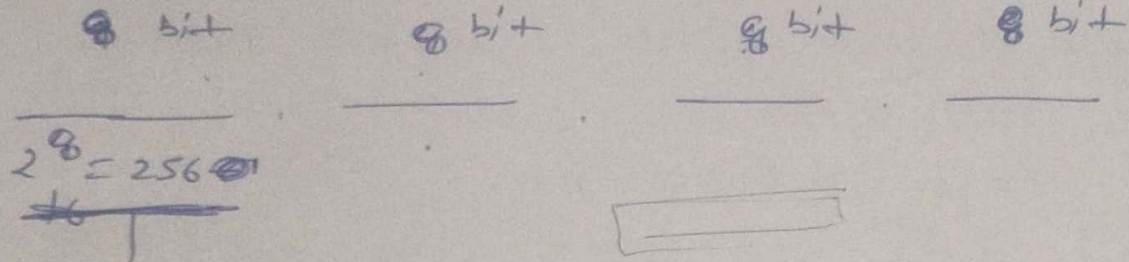
IPv4 address

① The internet protocol address are 32 bit in length
 2^{32} - addresses

② 4 billion address 4,294,967,296

③ unique & universal flat

④ Notation



① binary format में लिखा जाता है

② dot decimal number में लिखा जाता है

⑤ Classful addressing

50% Class A 8 bit | _____ $\Rightarrow 0 - 127$

25% Class B 16 bit | _____ | _____ $128 - 191$

12.5% Class C 24 bit | _____ | _____ | _____ $192 - 223$

6.25% Class D 32 bit | _____ | _____ | _____ | _____ $224 - 239$

1.25% Class E 32 bit | _____ | _____ | _____ | _____ $240 - 255$

reserved for future / multi-casting

① Class A \rightarrow 8 bit - 24 bit

0

0 - 7

Reserved $2^7 \rightarrow$ network can contain $2^7 - 2$

0.0.0.0 broadcast /

127 \rightarrow loop back address / self connectivity

126 network can create
145 network

class
host
range

$2^{24} - 2$ host ID से करते हैं
00.0.0 → network id
1.1.1.1 → broadcasting purpose.

N H

<u>Class B</u> 10	16 bit $2^{16} - 2$ 214 Network	16 bit $2^{16} - 2$ 65535 → host connect के करते हैं	128-191
----------------------	---------------------------------------	--	---------

<u>Class C</u> 110	24 $2^{24} - 3 =$ 2^{21} Network	8 $2^8 - 2 = 254$	192-223
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Class D 224, 239, broadcast

Class E → milit, research, future 240-255

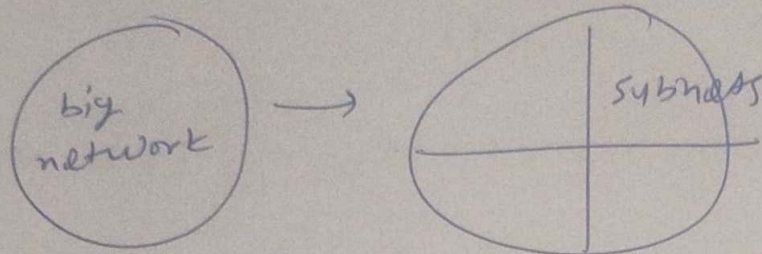
unicast → one to one

broadcast → limited → अपने network में broadcast
direct → अपने से बिना इन्ते
ह/व में broadcast करने है कि.

multicast → group में but लक्ष्यो नहीं
दिनाते permission है

Reason for Subnetting

Maintenance of very big network like class A and class B is very big for network administrator
 at network $\frac{1}{2^8} - \frac{1}{2^8}$ sub network is divided
 subnet $\frac{1}{2^8} - \frac{1}{2^8}$



- Advantages
- ① It improves the security
 - ② The maintenance and administration of subnets is easy.

- Disadvantages
- ① Identification of a station is difficult
 - ② Not possible to direct broadcast from outside network.

Types of Subnetting

$$1 - \frac{1.1.1.1}{2^8} = .$$

$$2^8 = 128$$

$$2^{10} = 256$$

$$\frac{256}{2} = 128$$

- ① fixed length subnet \rightarrow सब सब same size
- ② Variable length subnetting \rightarrow सब सब size,

1st Subnet

$$\textcircled{1} \frac{200.1.2.0}{-128} \quad \frac{128}{-2}$$

$$2^7 = 128 \text{ IP addresses}$$

$$\textcircled{3} 128 - 2 = 126$$

$$\textcircled{4} 200.1.2.1 \text{ to } 200.1.2.126$$

2nd Subnet

$$\text{subnet id} = 200.1.2.128$$

$$2^7 = 128 \text{ IP addresses}$$

$$128 - 2 = 126 \text{ allocatable IP}$$

$$200.1.2.129 \text{ to } 200.1.2.254$$

same is for class B

$$\text{Subnet mask} \leftarrow 255.255.255.128$$

1 bit network

address \times 255.255.255.128

divide the class B

$$225.225.225.128$$

Subnet mask

In case of subnetting the problem is how to identify to which subnet the incoming packet from outside the network must be delivered. To solve this problem, we use the idea of subnet mask.

→ 32 bit number which is sequence of 1's followed by a sequence of 0's.
1's → Network ID
0's → host ID part.

→ Default mask for different classes of IP address are:-

Class A → 255.0.0.0

Class B → 255.255.0.0

Class C → 255.255.255.0

Classless addressing

Routing algorithm

अपने अपने IP addresses को uniquely identified कर दिया लेकिन आज उसको ढूँढें, जिस path को हम को ले चलें routing में जाते हैं। ये सब है routing table में उस का क्या काम करते हैं। हमें routing table में IP collection करना है।

Flooding → Packet को पूरे Internet में broadcast कर दो → Brute force type.

Advantages → ① No routing algorithm is required
② Shortest path is guaranteed
③ Highly reliable &

Dis → ① Duplicate packets will arrive at destination, and intermediate routers
② Traffic high.

Routing idea

① Static table → पकड़ ले Router में static table configuration other network IP address etc store रहता है और कोई changes करना होता है तो हम manually उसको change करें।

② Dynamic table → Runtime में data configuration होता है और update होता है तो automatic

different domain

same domain link

Routing protocols

Intradomain

interdomain

Distance, vector

link state

path vector

RIP

OSPF

BGP

routing information protocol

open source shortest path first

Border gateway protocol

① हर n/w में single cost count होता है। यदि n/w बिना की जाय तो

distance, time में अंतर है बाकि में cost count होता है
discovery algorithm

S — 0 — 0 — 0 — D
cost = 3

Distance vector

हर Router अपना routing table अपने neighbor को share करता है और सभी अपना-अपना table update करते हैं।

Routing table में जो next hop का column होता है तो वह share करने में efficiency improve करने के लिए।

periodic update → PS time limit में share होता है

trigger update → अगर कोई भी कोई changes होता है तो तुरंत-3 सेकंड में भेजा जाता है।

problem two - node connectivity भी प 1000 को
 net / temporality भी प / paramet भी होता है

Link state

अपने autonomous system अपने neighbour
 table को share करता है जो अपने neighbour
 के को share करता है और ये-ये पूरा neighbour
 है उसे. जिससे पता चलता है कि link list table
 बन जाता है जिसकी copy हर पड के पास होती है
 हर station को अपने neighbour के को पता चलता है
 उसके पास पड table बन जाता है जो हम table
 को अपने autonomous system में broadcast कर देता है
 जिससे सबको पता चलने लगता है

p. 10 - discovery algorithm को describe करना
 उसी की example लगा देना. / उस को योन्करना
 देना है

DVR	LSR
इस फॉर्म	

Transport layer

① host to host communication
 process to process

② connection less
 UDP
 unreliable
 fast

connection oriented,
 TCP
 reliable
 slow

③ Port number system के अंदर इसी process को
 identify करने के लिए port number का use किया
 जाता है

IANA

② 16 bit का होता है $2^{16} = 65535$

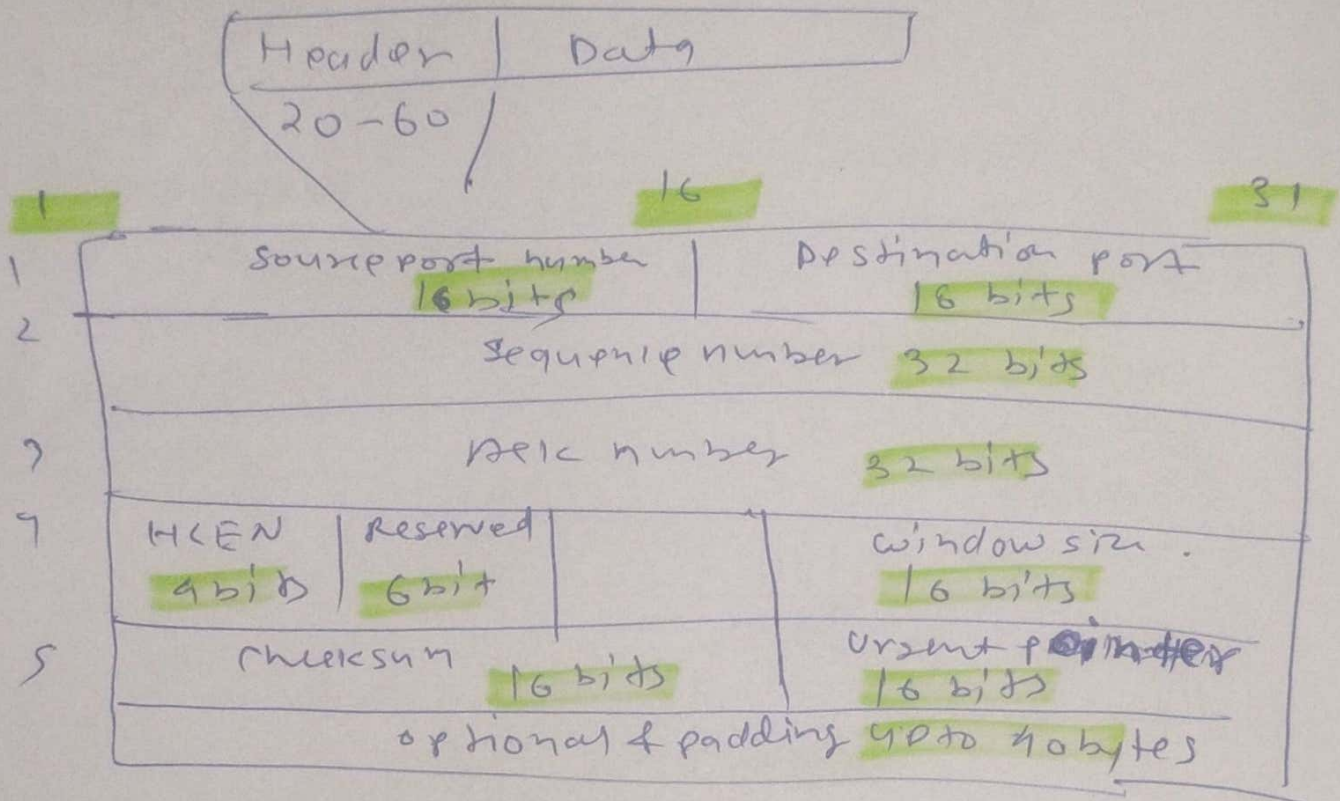
③ 1023 → well known → imp protocols होते हैं
 1024 → 49151 → register port → होते हैं जो
 control के लिए होते हैं
 49152 → dynamic port number
 → short time etc के लिए.
 49152 → 65535

socket address → IP + port

TCP Transmission Control Protocol

① Reliable, flow control, error control, congestion control → एका से मिला है

TCP header segment



Sequence Number → एक से एक byte का number होता है।
एक ही byte, sequence number से denote करता है।

Header length → आता है data को carry करे लाता है।

checksum → error control करने के लिए

Window-size → पर एक ही आता है data

Control Flag → URG - 1 bit → ये होता है set फिर

push the data

ACK -

PSH

urgent point पर मग

data करती है 31-32

consider करता है

reset the connection

RST

SYN

Synchronization

FIN - finish

TCP connection

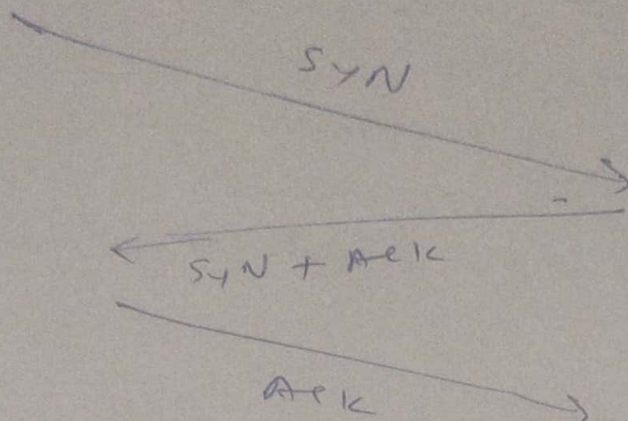
TCP connection is called three-way handshaking.

Client

Active open

Server

passive open



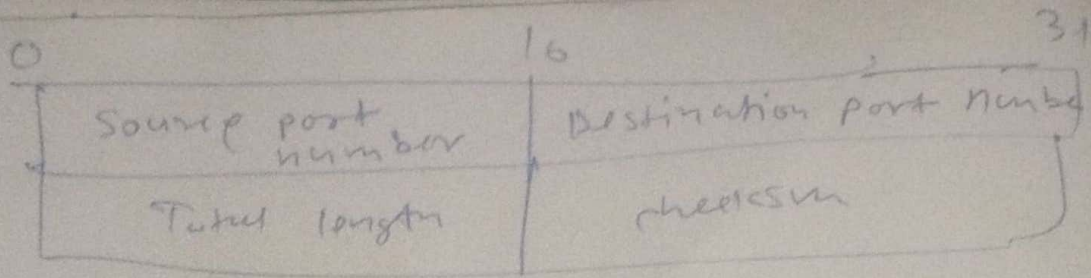
TCP three way connection

UDP

- ① User Datagram Protocol (UDP) is a connectionless, unreliable transport protocol.
- ② It does not add anything to the services of IP except for providing process-to-process communication instead of host-to-host communication.

why to use UDP

- ① Very simple protocol using a minimum of overhead.
- ② If a process wants to send a small message and does not care about reliability.
- ③ Sending a small message using UDP takes much less interaction between the sender and receiver than using TCP.



Header format.

Application

- ① multicasting
- ② Routing protocols in use
- ③ real-time application that cannot afford delay between reception of a receiver message.

Data Compression

data ko data ke compress krke chhota size me krke data compression ke karte hai.

Types of compression

① Lossless compression

data compress krte h loss nhi krta hai

② Lossy compression

krke kch data permanently loss krke compress krke retrieve krte h