IP address is a 32 bit number that uniquely identifies a network interface on a machine. IP address typically written in decimal digits. This is four 8 bit field seperated by periods. bytes of an IP address can be further classified into two parts :-

⇒ the Network Part
⇒ the Host Part

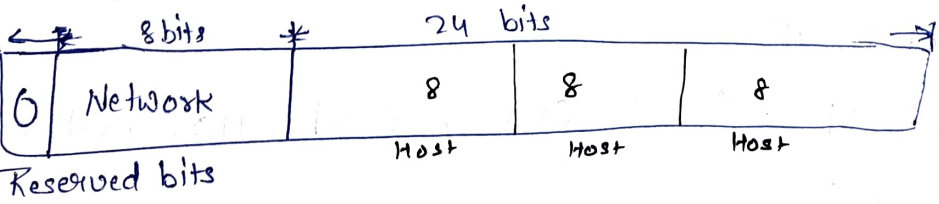
Network Part - This Part specifies the unique Number assigned to your particular Network.

Host Part = This is the Part of the IP address that you assign to each host and uniquely identifies each host on your Network.

Subnet Number - Many LAN will a large number of hosts will be divided into subnets. If you choose to divide your network into subnets, you need to assign a subnet number for the subnet.

Network classes -

Class A - uses the first 8 bits of the IP address as its Network Part. The remaining 24 bits Comprise the host Part of the IP address.



0 0000000 to 0 1111111
$2^6 2^5 2^4 2^3 2^2 2^1 2^0$

0 to 127

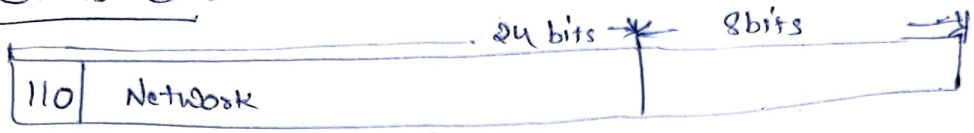
64 + 32 + 16 + 8 + 4 + 2 + 1

127

10	Network	

Reserved — 10000000 to 10111111 — 128 to 191 — $128+64+32+16+8+4+2+1$, 2^8-1

Class C =>



110	Network	

192 to 223

Class D

1110	Multicast Network

Reserved bits — 224 to 239

11110	Reserved for future Use

Class E — 240 to

11100000 — $2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0$

11101111 — $2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0$

11110111 — $2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0$

128, 64, 32 → 224 + 16 → 240

224 + 8 + 4 + 2 + 1 → 239

128, 64, 32, 16 + 7 → 247

→ Change the following from binary to dotted-decimal notation

a. 10000001 . 00001011 . 00001011 . 11101111

Ans - 129 . 11 . 11 . 239

b. 11000001 . 10000011 . 00011011 . 11111111

Ans - 193 . 131 . 27 . 255

→ Change the following from dotted deminal to binary not

a. 111 . 56 . 45 . 78

Ans - 01101111 . 00111000 . 00101101 . 0100

b. 221 . 34 . 7 . 82

Ans - 11011101 00100010 00000111 . 0101001

Machine on an IP Network. It designates the assigned to each Specific location of a device on the Network. An IP address is a S/W address, not a hardware Address. and used for finding hosts on a Local Network. IP addressing was designed to allow a host on one Network to Communicate with a host on a different Networks.

IP Terminology.

⇒ Bit = A bit is one digit 1 or 0

⇒ Byte = A byte is 7 or 8 bits

⇒ Octet = 8 bits, is just an ordinary 8 bit binary No.

⇒ Network Address - This is the destination used in routing to send packets to a remote Network.

⇒ Broadcast address - The address used by applications and hosts to send information to all nodes on the Network.

Network Addressing - N/W Address uniquely identifies each Network, Each Machine on the same Network shares that Network address as part of its IP address.

Node Address - is assigned to, and uniquely identifies, each machine on the Network. This part of the address ~~Network~~ is unique because it identifies a particular machine. This no. referred to as a host address

8bit 8bit 8bit 8bit

Class A - | N/W | Host | Host | Host |

Class B - | N/W | N/W | Host | Host |

Class C - | N/W | N/W | N/W | Host |

Class D - Multicast

Class E - Research

0xxxxxxx

If we turn the other 7 bits all off and then turn them all on, we'll find the class A range of Network Addresses:- 00000000 = 0 to 01111111 = 127

10000000 = 128
10111111 = 191 to

If we turn the other 6 bits all off and then all on, you will find the range for a Class B Network.

110 00000 = 192
110 11111 = 223 to

This range shows that this is for the Class C Network.

Class D and E are used for the Multicast and Research and Class D uses range (224-239) and Class E uses range (240-255).

10000000
$2^7\ 2^6\ 2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0$

$2 \times 2 \times 2 \times 2$
$2 \times 2 \times 2$

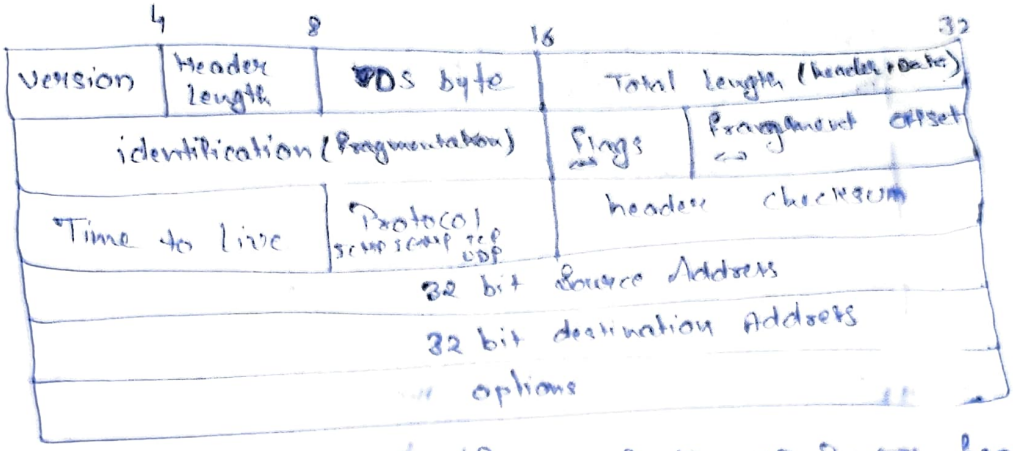
128

10111111
$2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0$

$128 + 32 + 16 + 8 + 4 + 2 + 1$

128
64
32
16
8
4
2
1
191

Header format

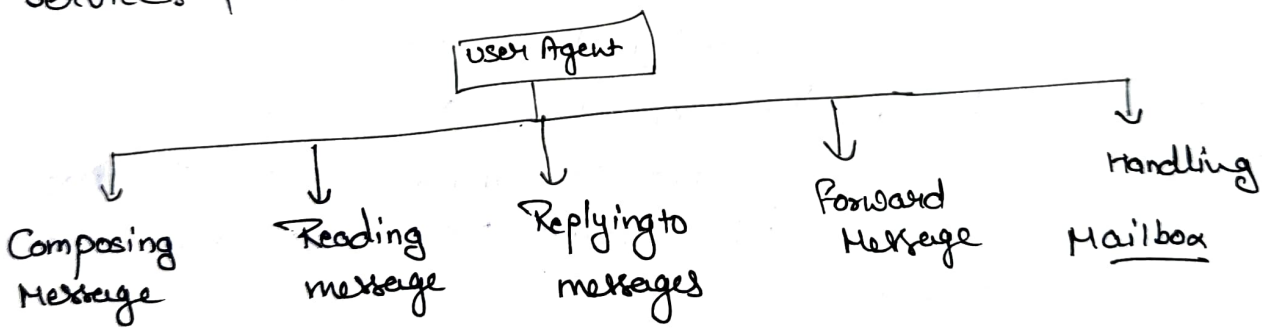


version (4 bits) - Specifies the format of the IP Packet header

IHL → Internet Header Length (4 bits) - Specifies the length of the IP Packet header in 32 bit words - Minimum value for a valid header is 5.

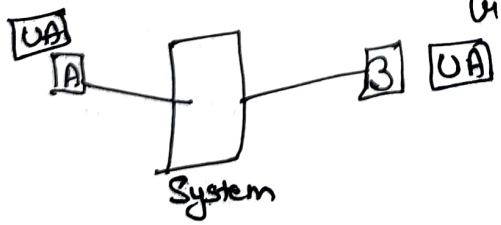
Differentiated services - 8 bits

Services provided by the user Agents.

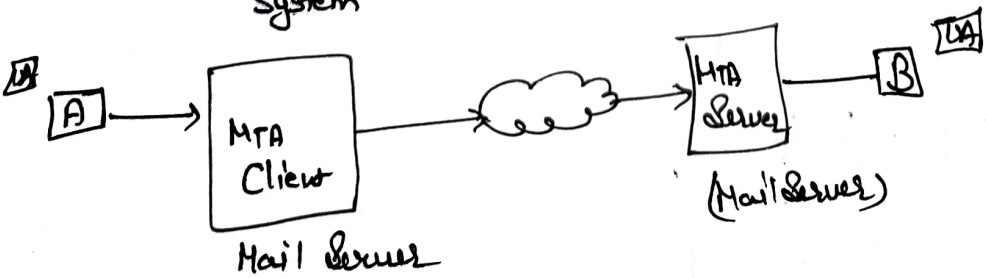


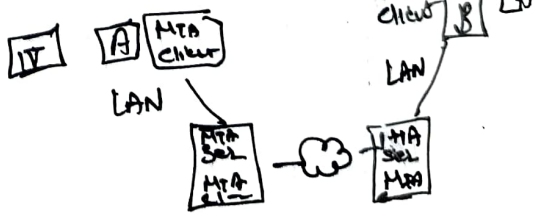
Types of user Agent - Command driven
GUI Based

Ist -



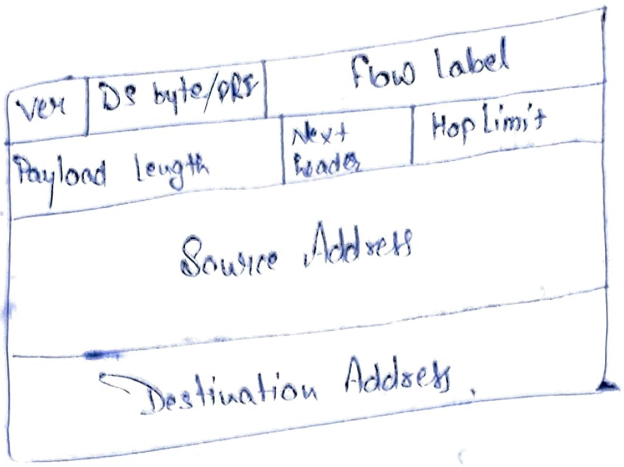
IInd -





MTA -
MAA -
POP3
ICMP

IPV6



Version 4 bit → Protocol version and contain the number 6

DS byte/PRS 8 bit → This field is used by the source and routers to identify the packets belonging to the same traffic class and thus distinguish b/w packets with different priorities.

Flow label - (20 bit) → label for a data flow.

Payload Length (16 bit) - Indicates the length of the packet data field.

Next header (8 bit) - Identifies the type of header immediately following the IPV6 header.

Hop Limit (8 bit) ;- Decremented by one by each node that forward the packet, When the hop limit field reaches zero, the packet is discarded

Source Address - 128 bit

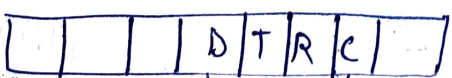
Destination Address - 128 bit

Header length ⇒ Minimum - 20
Maximum = 60

Total length datagram = 4 bytes
Field value
4 x (5) = 20 — When no option
(15) x 4 = 60 → When highest value

Differentiated Service. = 8 bits

Tos bits | Precedence bits



defines Priority of Congestion

000 0
to
111 7

Tos
0000 - Normal
1000 - D
0100 - T
0010 - R
0001 - C

No.

Header Length - 32 bits that shows length of header.

Type of Service - How the datagram should be handled. The first 3 bits are the priority bits.

Total Length - Length of the packet including header and data.

Identifier - Unique IP-Packet value.

Flag - Specifies whether fragmentation should occur.

Frag offset - Provides fragmentation and reassembly if the packet is too large to put in a frame.

TTL - The time to live is set into a packet when it is originally generated. This stops IP packets from continuously circling the network looking for a home.

Protocol - TCP is Port 6 and UDP is Port 17.

Header Checksum - Cyclic Redundancy check (CRC) on header only.

Source IP address - 32 bit IP address

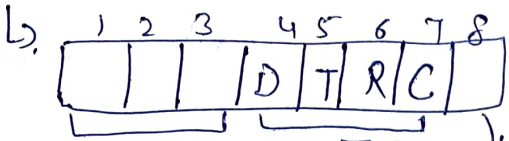
Destination IP address - 32 bit

IP option - used for Network testing, debugging, Security

Data - Data.

Formal Post Conduct

Type of Services ⇒ Differentiated Services (DS)



0 1 1 1 1 1 1 1
2^6 2^5 2^4 2^3 2^2 2^1 2^0

64 32 16 8 4 2 1

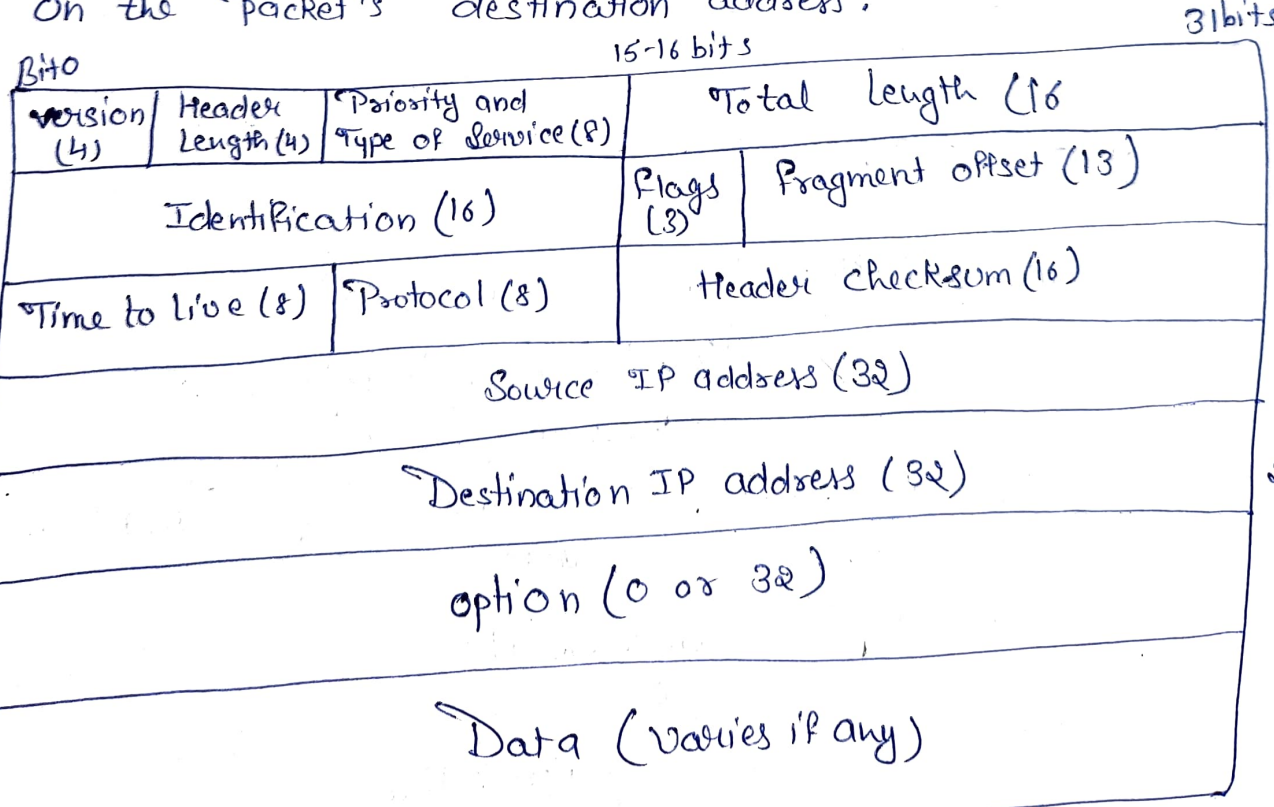
32
96
16
112
8
120
1

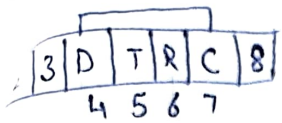
000 to 111
0 to 7

Congestion is Live and Router needs to discard datagram [having less]

UDP / Transport

Internet Protocol (IP) essentially is the Internet layer. The other protocols found here merely exist to support IP. Looks at each packet's address. Then using a routing table, it decides where a packet is to be sent next, choosing the best path. Identifying devices on networks requires answering these two questions. Which n/w is it on.? and what is its ID on that Network? The first answer is Software address, or Logical Address. The second address is the Hardware address. All hosts on a Network have a Logical ID called an IP address. IP receives Segments from Host to Host Layer and fragments them into datagrams. IP then reassembles datagram back into Segments on the receiving side. Each datagram is assigned the IP address of the Sender and of the recipient. Each router that receives a datagram makes routing decision based on the packet's destination address.





D - Minimum Delay - 1000

T - Maximum Throughput - 0100

R - Maximum Reliability - 0010

C - Minimum Cost ⇒ 0001

Normal or By default ⇒ 0000

Protocol Field ⇒

Value	Protocol
1	ICMP
2	IGMP
6	TCP
17	UDP
89	OSPF

Identification ⇒ Source IP of Datagram.

Flags ⇒ 3 bits ⇒ First bit reserved

2nd bit ⇒ Do not fragment

0 ⇒ Fragment ⇒ if necessary

1 ⇒ No fragment

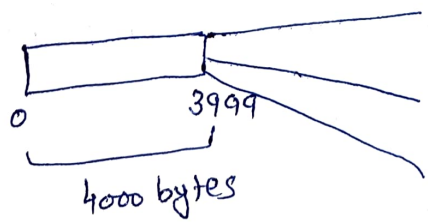
3rd bits ⇒ More fragment

1 ⇒ means more fragments there

0 ⇒ means its last

Fragmentation / Reassembly ⇒ Datagram measured unit is 8 byte

Data Size = 4000 bytes



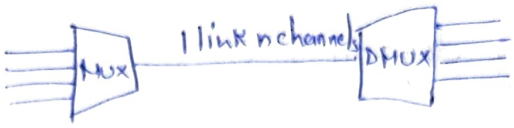
0000 to 1399 ⇒ 0/8 = 0

1400 to 2799 ⇒ 1400/8 = 175

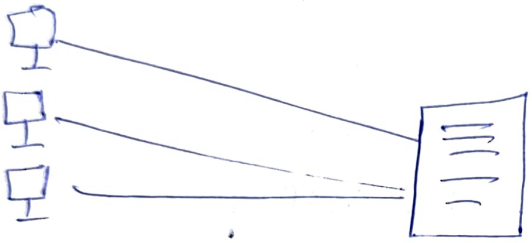
2800 to 3999 ⇒ 2800/8 = 350

→ Transmission Service is very expensive - Leased lines.
→ Multiplexing and Compression techniques save business.
→ Data capacity of lines increases.

→ FDM
→ TDM
→ WDM
→ CDM



Alternative Approach is ① point to point

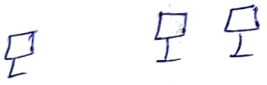


I/O Ports. for each device

② Multidrop line

Host Polls machines to see who wants to send

Saves I/O Ports.



Hybrid Multiplexing Scheme - FDM + TDM Ex:- Cellphone

Available channel is broken up into frequency bands

In each band, multiple channels are accomodated through TDM

→ IETE ⇒ Internet Engineering Task force, 1998 (Transport)

IPv4 head...

Eight groups + 4 Hexadecimal digits (16 Bits)

IPv4 = 32 bit ⇒ 4.3 billion devices.
= 2^{32} = 4 billion add.

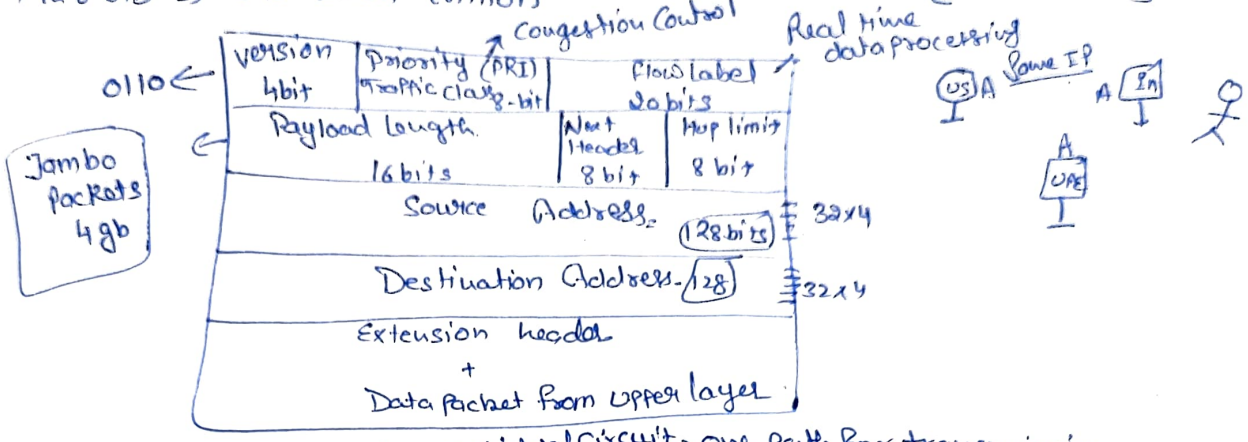
Ex:- 3001 : 0d08 : 7593 : 0000 : 0000 : 8a2e : 0370 : 7334

IPv5 ⇒ Internet Stream Protocol (Not for addressing)

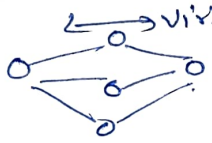
Types of IPv6 address.

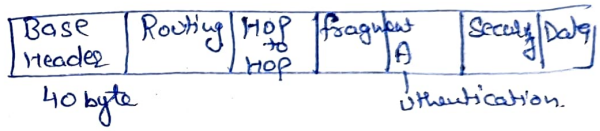
- → Unicast Address → [one to one] ⇒ [Sender to Receiver]
- → Multicast Address → group of IP device
- → Anycast Address → Content Delivery Network (CDN) → upload and download [Audio/video]

→ 128 bits ⇒ 340 trillion trillion



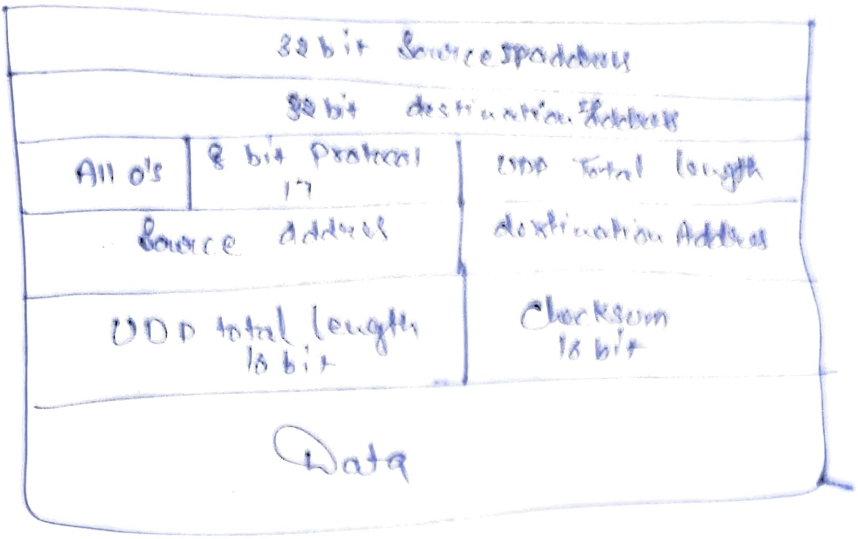
Virtual Circuit ⇒ Virtual Circuit → one path for transmission.

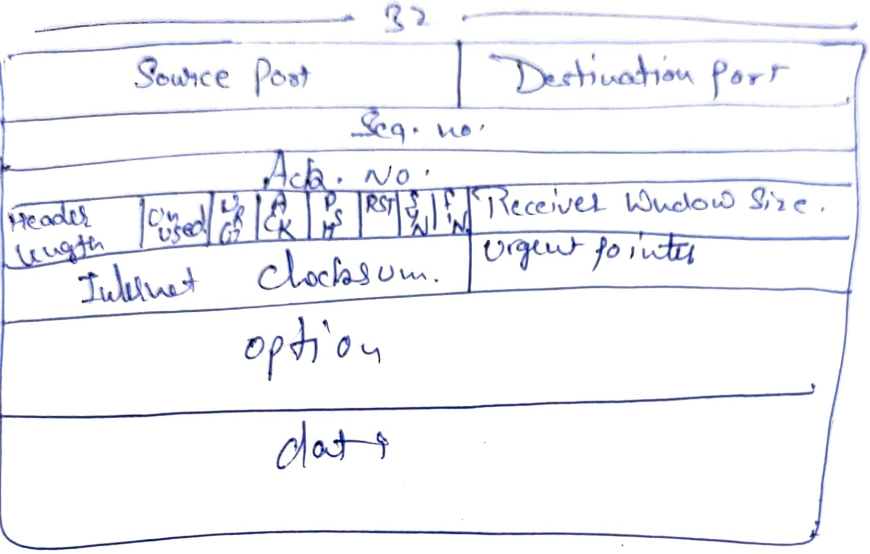




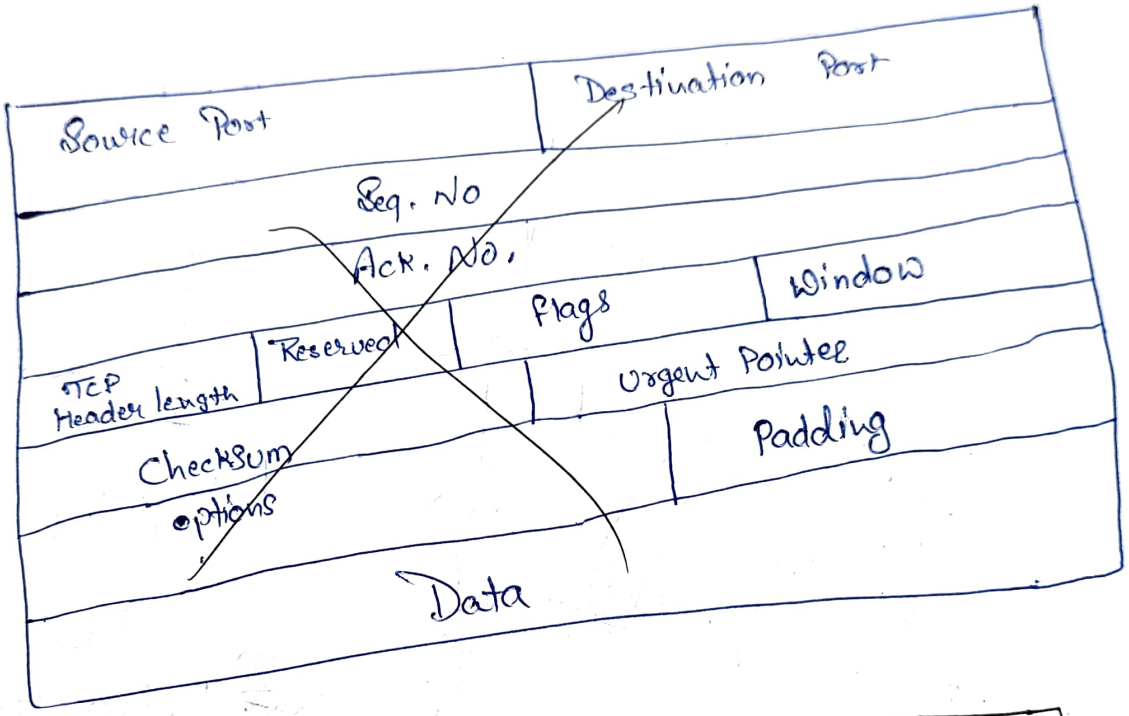
tures of IPv6 →

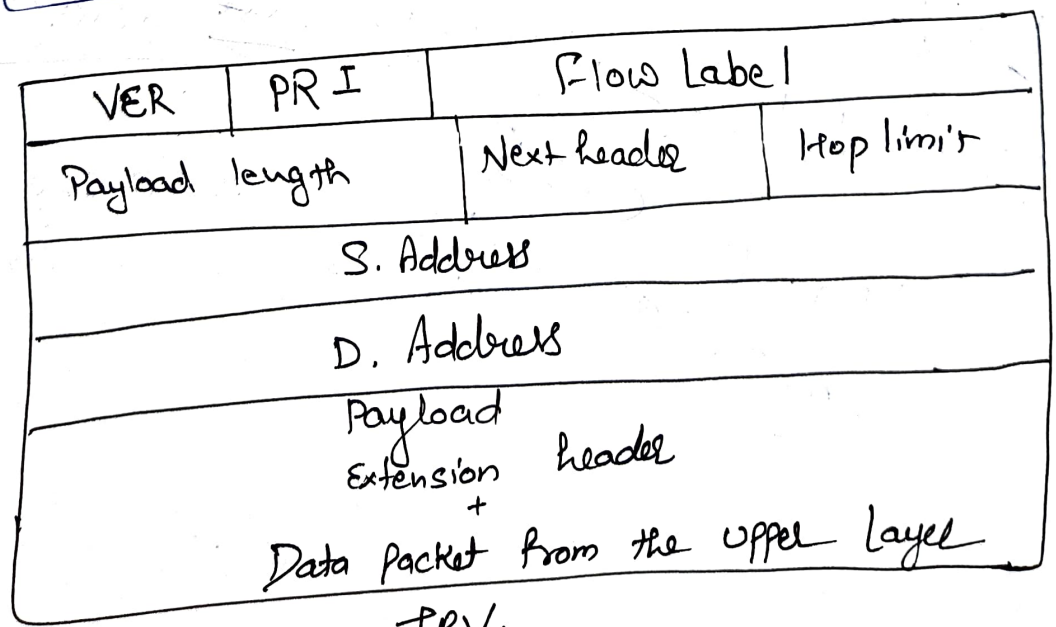
- → Larger Address Space = [34×10^{38}] approx [Asia, Africa]
- → Simplified Header ⇒ 40 bytes [8 fields only]
- → End to End Connectivity → No need NAT → [Network Address Translation. IP Conversion not required]
- → Auto Configuration ⇒ [DHCP-6 (Stateful) / Self Configuration (Stateless)]
- → IP Security [IPsec]
  - ↳ Tunneling
- → No Broadcast
- → Mobility → IP Stable → No change
- → IPv6 ⇒ datagram Service


32 bit Source IP address
32 bit destination IP address
All 0's
8 bit Protocol
17
UDP Total length
Source Address
destination Address
UDP total length
16 bit
Checksum
16 bit
Data

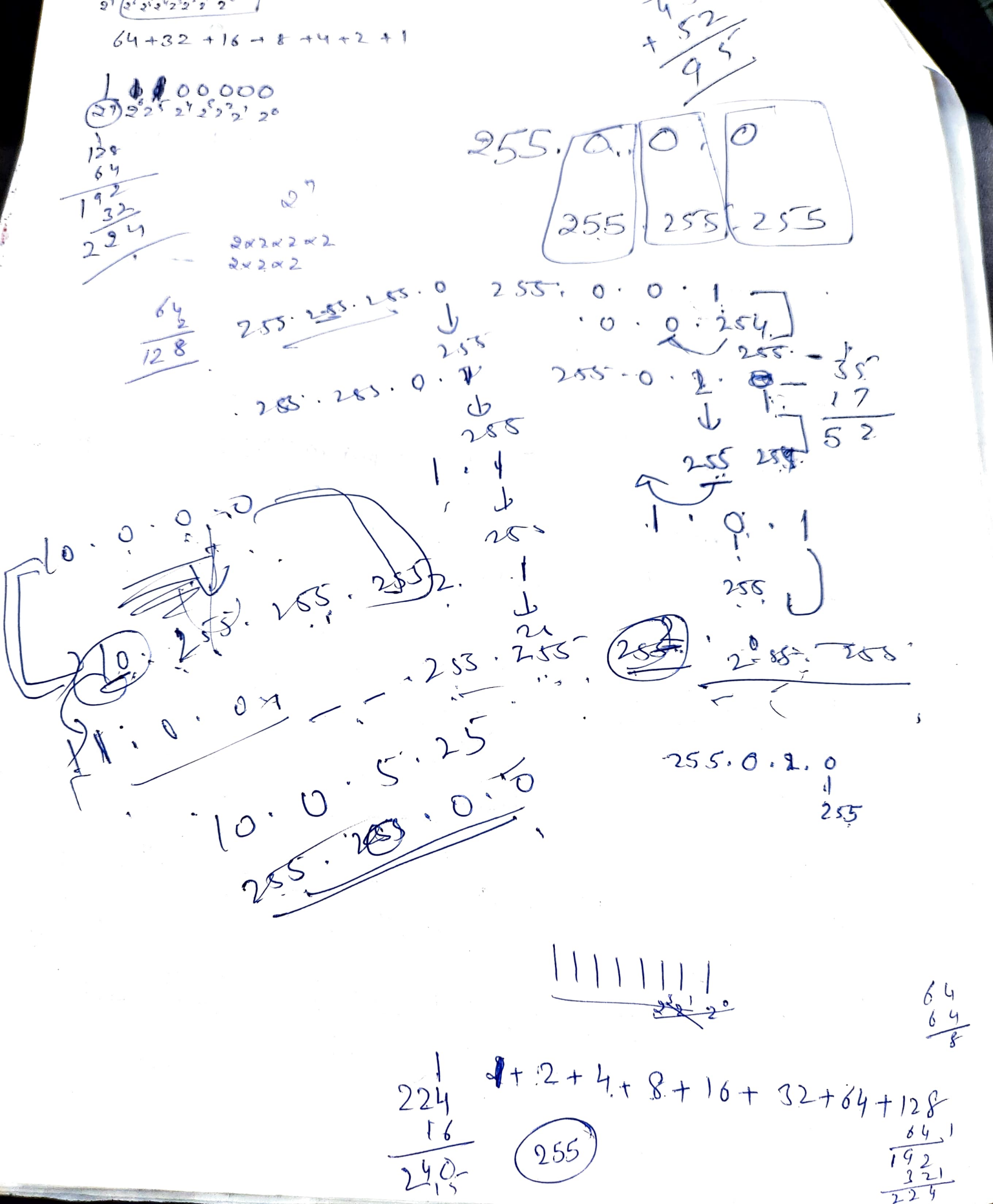

32
Source Port
Destination Port
Seq. no.
Ack. no.
Header length
Un used
URG
ACK
PSH
RST
SYN
FIN
Receiver Window Size.
Internet checksum.
Urgent pointer
option
data

1. What is the difference b/w Connection oriented & Connectionless Service?
2. Explain different type of Network?
3. Write down Silent features of Network?
4. What do you mean by wireless Network?





IPV6.


64+32+16+8+4+2+1
255.0.0.0
255 255 255
2×2×2×2
2×2×2
255.255.255.0
255.0.0.1
0.0.0.254
255.255.0.1
255.0.2.0
10.0.5.25
255.255.0.0
64
64
8
224
16
240
255
64
64
128
64
192
32
224

Classless inter domain Routing - it is basically the method that ISPs use to allocate an amount of addresses to a company, a home, a customer, they provide addresses in a certain block size.

Address blocks - In classless addressing, when an entity, small or large needs to be connected to the internet, it is granted a block of addresses. The size of the block (no. of addresses) varies based on the nature and size of the entity. An ISP as the Internet service provider, may be given thousands or hundreds of thousands based on the no. of customers it may serve. When you receive a block of addresses from an ISP, what you get will look something like this 192.168.10.32/28. This is telling what your subnet mask is. The slash notation (/) means how many bits are turned on (1s). The maximum could only be /32 because a byte is 8 bits and there are four bytes in an IP addresses (4x8 = 32) But keep in mind that the largest subnet mask available can only be /30 because you have got to keep at least 2 bits for host bits.

	CIDR value
255.0.0.0	/8
255.128.0.0	/9
255.192.0.0	/10

11111111.11000000.
00000000.00000000

Example :- 205.16.37.39/28

a. First address

b. Last address

c. Number of addreses

a. The first address can be found by ANDing the given address with the mask. ANDing here is done d bit by bit.

	Address :-	11001101	00010000	00100101 00100111
⋮	Mask :-	11111111	11111111	11111111 11110000
AND (x)	First address :-	11001101	00010000	00100101 00100000

b. Last address can be found by ORing the given addreses with the Complement of the Mask. ORing here is done bit by bit.

	Address :-	11001101	00010000	00100101 00100111
⋮	Mask Complement :-	00000000	00000000	00000000 00001111
OR (+)	Last Address :-	11001101	00010000	00100101 00101111

c. The Number of addresses can be found by complementing the mask, interpreting it as a decimal number and adding 1 to it.

Mask Complement :- 00000000 00000000 0000000 00001111

15+1 = 16