IP

Computer Networks

Physical address
or
Ethernet address
or
MAC address
or
NIC address
or
LAN card

48-bit address

IANA (Internet assigned number authority)

↓

IP address (logical address)

- MAC address scope is local. Physical identification of the device is done by MAC address. It is also known as implicit address.
- Logical addresses are nothing but the IP addresses. Thes are known as explicit address.

IANA

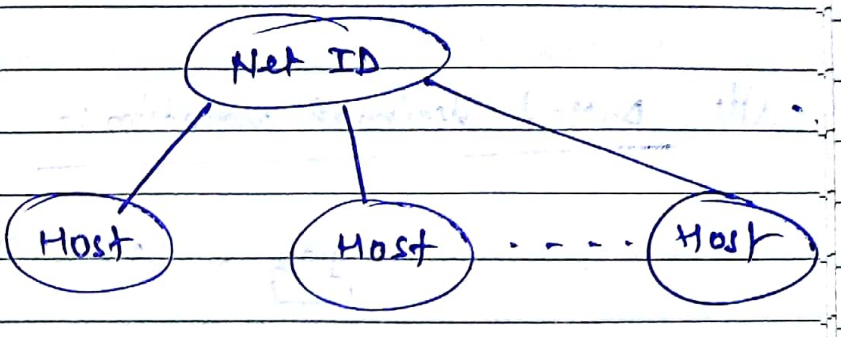
↓

(classful addressing)

A, B, C, D, E

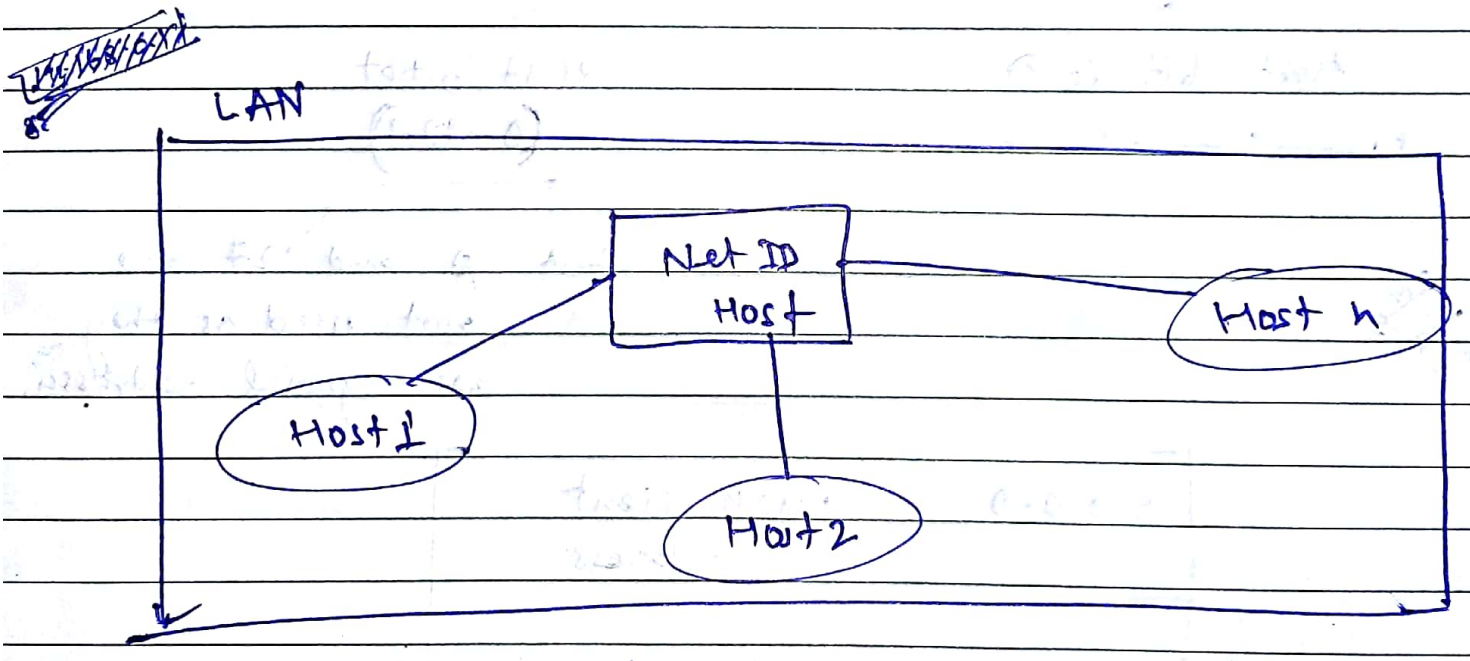
- A, B, C → unicasting
- D → multicasting
- E → Research

classful addressing ⟶ two level hierarchy



* When a computer is assigned an IP address then it called as Host.

* Entire network will be represented by a member known as Net ID.



classful addressing notations :-

i) Binary notation : uses only binary digits

01101100 . 11100110 . 10101010 . 01101111

I octet . II octet . III octet . IV octet

In this first few bits decide the type of class.

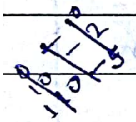
(iii) Dotted decimal notation :-

192 . 168 . 0 . 1

In this first octet decides the type of class.

- Class A -

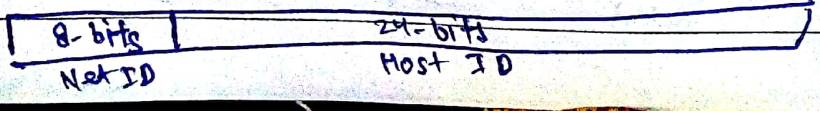
binary	Dotted decimal
first bit is 0	first octet (0-127)
0 — . — . —	but 0 and 127 are not used as they are special addresses.



0.0.0.0	DHCP client address
127.x.y.z	loop back address

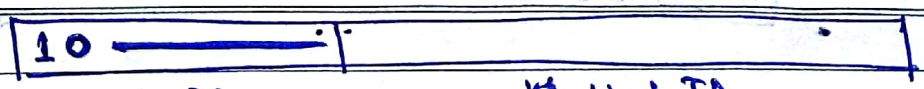
Number of networks: $2^7 - 2$ (1 - 126)

Number of host in each network : $2^{24} - 2$



(128 - 191)

- Class B :



Starting ADD 10 000000 . — . — . — 128 . — . — . —

Last ADD 10 111111 . — . — . — 191 . — . — . —

Number of Networks - 2^{14} as out of 16 bits 2 are used for identificat

Number of hosts each network - $2^{16} - 2$

- Class C :

starting ADD - 110 00000 (192 . x . y . z)

last ADD - 110 11111 (223 . x . y . z)

Number of networks - 2^{21}

Number of Host per network - $2^8 - 2$

= Class D

Net ID + Host ID

1110 - - - - - - - - - - - - - - - -

starting ADD :- 1110 0000 . — → 224 . x . y . z

last ADD :- 1110 1111 . . — → 239 . x . y . z

= Class E

1111 . . . . . .

starting ADD: 1111 0000 240 . x . y . z

Last ADD : 1111 1111 255 . x . y . z

Q. IP = 201 . 55 . 89 . 123
find Net ID, direct broadcast address ?

Default Mask
or
Network Mask

Class A - 11111111 00000000 00000000 00000000

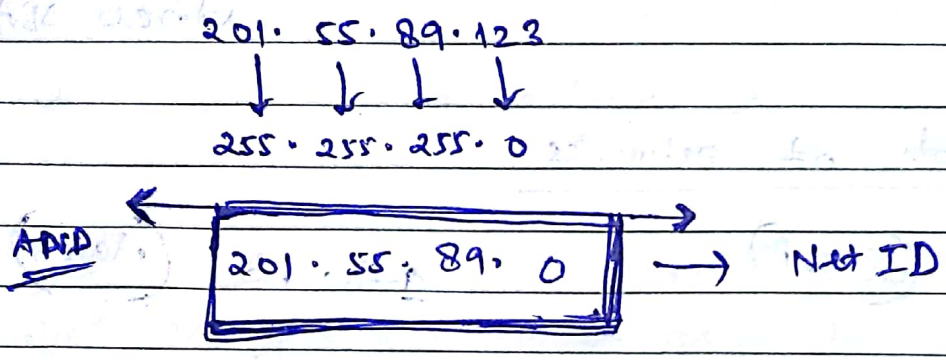
255 . 0 . 0 . 0

Class B - 255 . 255 . 0 . 0

Class C - 255 . 255 . 255 . 0

Since 201.55.89.123 → class C

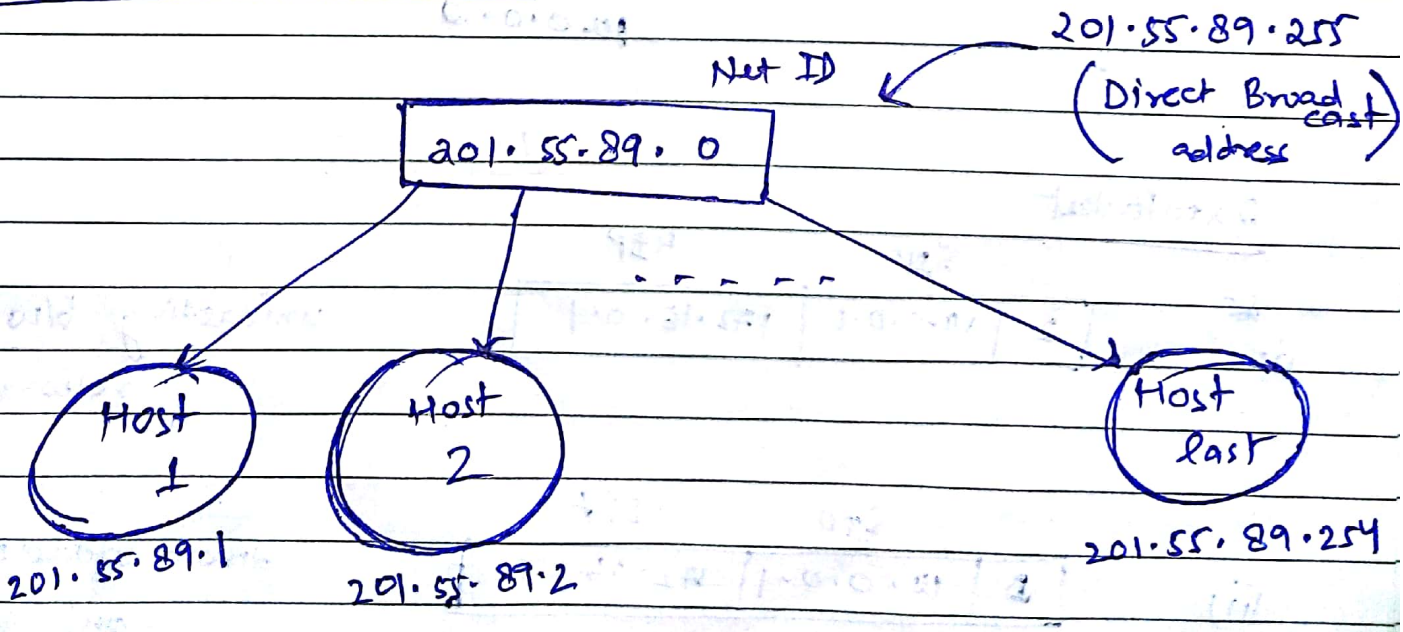
So, perform Bit-wise AND operation with class C network Mask.



* By performing bitwise AND between IP address & network mask will get Net ID.

* Network mask is a mathematical tool which is used to solve networking problems.

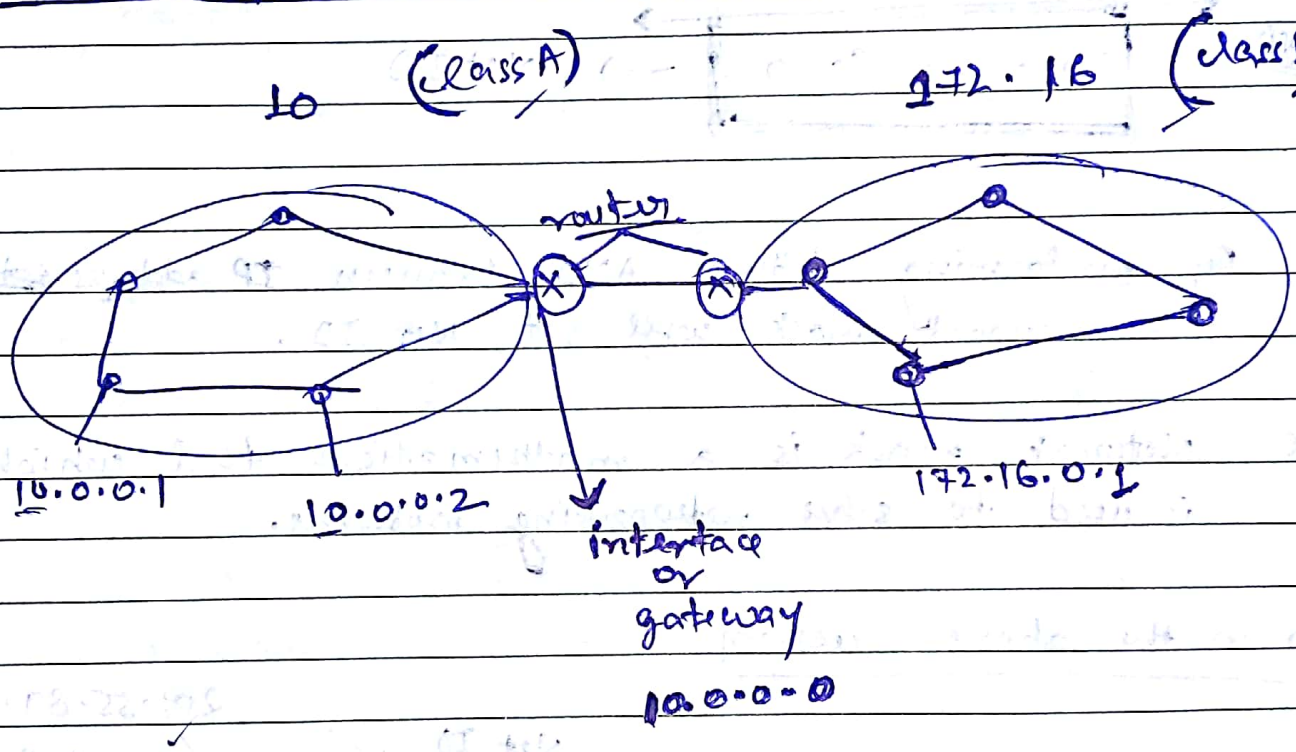
So in the above question



we are substracting two addresses in the number of host in each address.

- one is Net ID
- last one for direct broadcast address DBA

Pseudo approach of networks



Datapacket

(i)

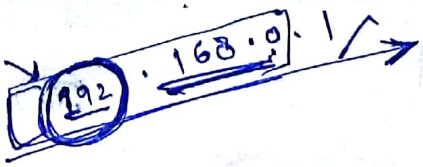
D	SIP	DIP
	10.0.0.1	172.16.0.1

unicasting b/w networks

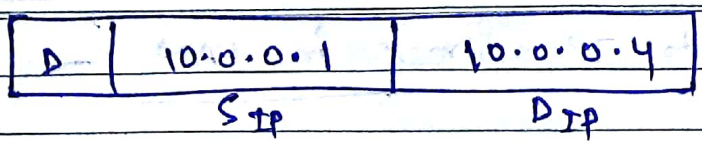
(ii)

D	SIP	DBA
	10.0.0.1	172.16.255.255

direct broadcasting on other network.

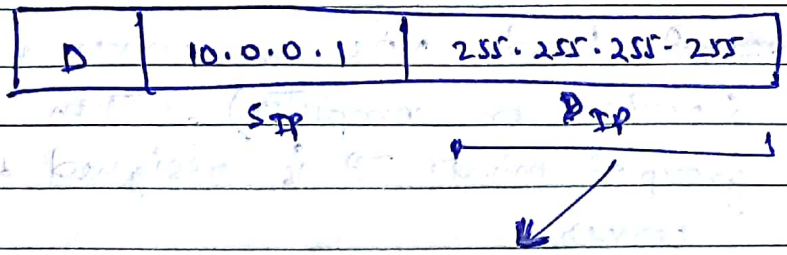


(iii)



unicasting packet within network.

(iv)



broadcasting packet within network.

limited broadcasting address

* "255.255.255.255" is used for broadcasting packet withing local network. This packet will not move out of scope.

* "10.255.255.255" is a DBA which can't used by for broadcasting within network.

* Limited and direct broadcasting address can only be used as destination IP address.

IP address

Private IP address

- used in LAN only (scope is local)
- free of cost
- loading NOS (network operating sys)

(10.0.0.0 — 10.255.255.255)
(172.16.0.0 — 172.31.255.255)
(192.168.0.0 — 192.168.255.255)

Public IP address

- Internet service
- Not free of cost
- control by ISP
- globally unique

Assigning private IP address in LAN :-

Step-1 → Load NOS on server machine (router or computer). Then a particular group of private IP is assigned to the server.

Step-2 →

D	10.0.0.1	255.255.255.255

The data packet is broadcasted locally with the help of LBA. to all the client.

Step-3 - Now each client or host send a data packet to the server using DHCP client Add

D	0.0.0.0	10.0.0.1
	+ MAC	

* 0.0.0.0 (DHCP client) address is used by host for sending data packet when no IP is assigned to it.

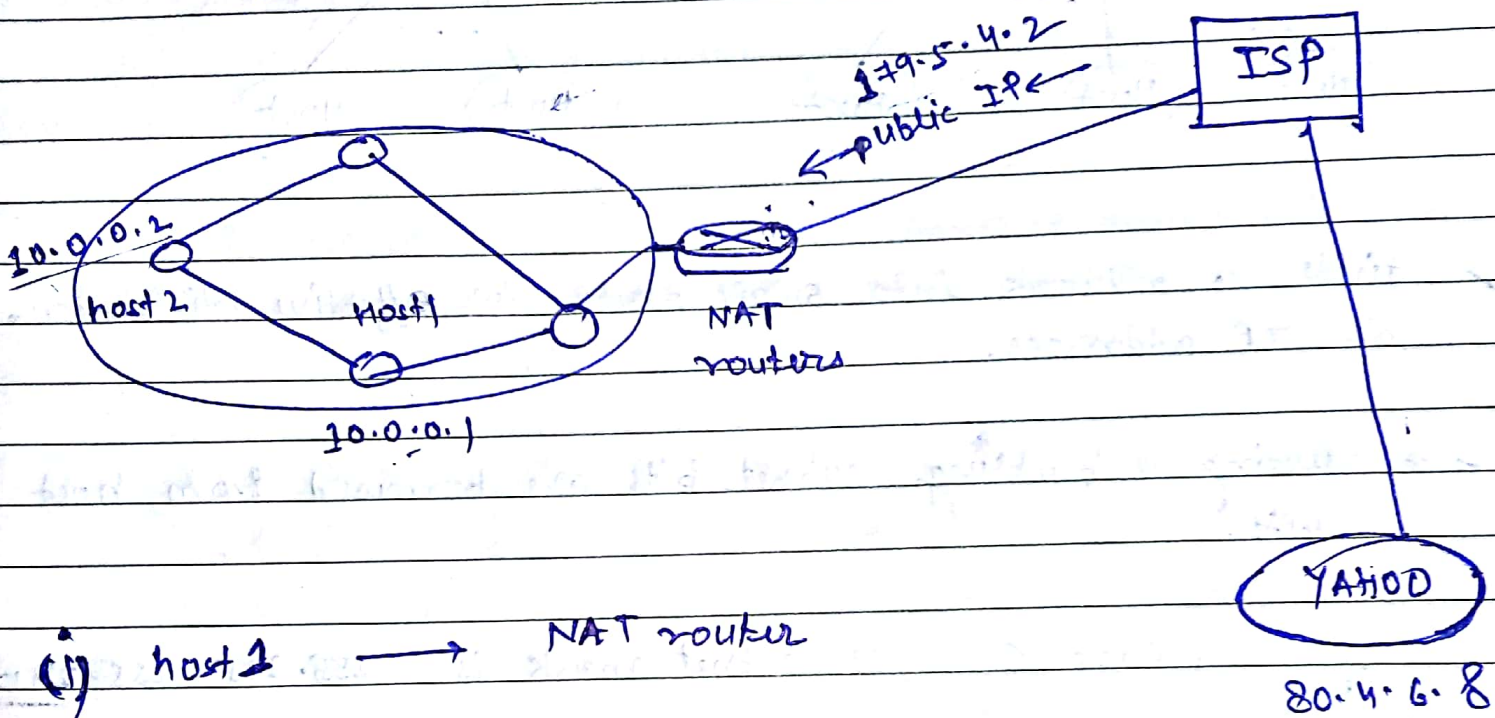
Step-4 - Server maintain a mapping table

IP address	MAC address

IP are then assigned to the client

* The purpose of mapping table is to understand which IP is assigned to which computer.

Assigning public IP address (Internet Service) :-



(i) host 1 ⟶ NAT router

D	10.0.0.1	80.4.6.8

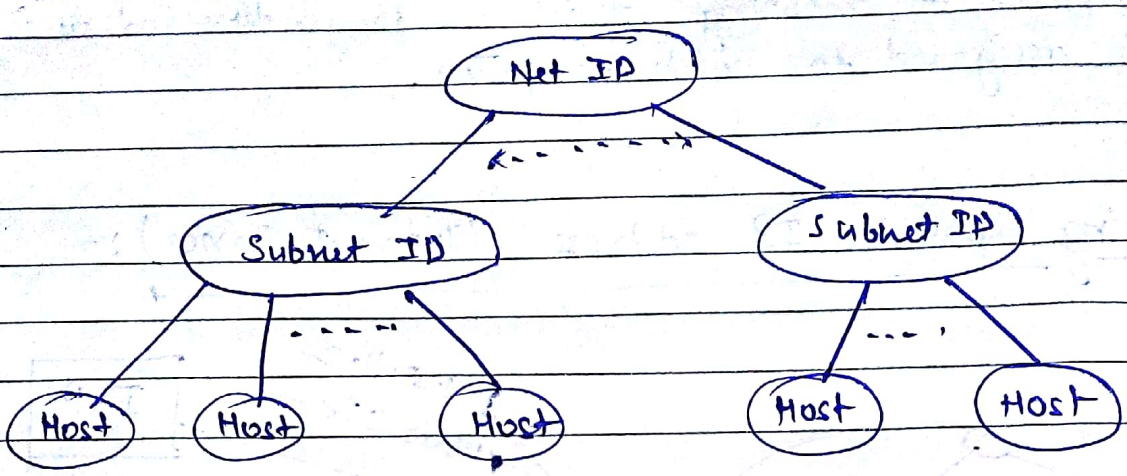
then NAT router converted private IP into public IP

(ii) NAT router ⟶ ISP ⟶ YAHOO

D	179.5.4.2	80.4.6.8

Dt.:
Pg.:

Subnetting & Supernetting :-



- divide a network into small parts. for effective utilization of IP addresses.

- during subnetting subnet bits are borrowed from host bits.

eg- Class C if subnet mask is 255.255.255.240

network mask of C :- 255.255.255.0

11111111 11111111 11111111 00000000

subnet mask : 255.255.255.240

11111111 11111111 11111111 11110000

So, no. of subnets $= 2^n - 2$

where n is the number of bits borrowed

$= 2^4 - 2 = 14$

Dt.:
Pg.:

Total no. of host in each subnets $= 2^4 = 16$

Q. IP - 201.55.66.88 and subnet mask is 255.255.255.240.

Find number of subnets and number of host in each subnets. Also find subnet ID, and subnet number.

To calculate subnet ID we have to perform bitwise AND operation of IP with subnet mask.

(Subnet ID = IP (AND) Subnet Mask)

Since 201.55.66.88 belongs to class C;

so, ~~subnet~~ 201.55.66.0

Subnet ID = 201.55.66.64

Subnet number = decimal equivalent of Subnet bits.

Q. IP = 205.66.77.121
Subnet mask = 255.255.255.240

Calculate
(i) Subnet ID
(ii) Subnet number

205. 66. 77. 12 belongs to class C

Network mask : 255. 255. 255. 0

Subnet mask : 255. 255. 255. 240

So, 11111111 11111111 11111111 1111.0000

Subnet ID = 205. 66. 77. 12

Number of host in each subnet = $2^K - 2$ where K is the number of host bits.

2 is substracted because one is subnet ID and one is used as DBA.

Similarly in calculating number of subnets we also substracted 2 which also used for NetID and DBA of whole Net.

Q. IP - 201. 99. 88. 12 , subnet mask = 255. 255. 255. 224

(i) 1st host of 1st subnet

(ii) 2nd host of 3rd subnet

Pg.: Delta

subnet mask = 255 . 255 . 255 . 224

↓

111 00000

1st subnet = (001 00000) octet

↓

1st subnet ID = 201.99.88.32

so, 1st host ID = 201.99.88.33

Q. IP_1 = 201.99.88.141

IP_2 = 201.99.88.161

IP_3 = 201.99.88.151

Subnet mask = 255.255.255.240

Identify the IP's belong to same subnet?

IP_1

1111 0000
1000 1101
1000 0000

IP_2

1111 0000
1010 0001
1010 0000

IP_3

1111 0000
1001 0111
1001 0000

since every subnet ID is different so no one belongs to same subnet.

Dt.:
Pg.:

Q. IP = 202.44.55.89

subnet mask = 255.255.255.240

(i) First host of first subnet.

subnet mask = ___ ___ ___ 11110000

first subnet = 00010000

= 202.44.55.32

so, first host address = 202.44.55.33

(ii) last host of last subnet.

Q. IP = 201.99.88.78

subnet mask = 255.255.255.224

net ID = 201.99.88.000 ___

1 Subnet - 201.99.88.32 001 ___

2 Subnet - 201.99.88.64 010 ___

3 subnet - 201.99.88.96 011 ___

Q. IP = 200 . 89 . 99 . 119

Subnet mask = 255 . 255 . 255 . 41

101001 (This mask is known as discontinous mask)

(i) First subnet ID – 000001

200 . 89 . 99 . 1

(ii) Second subnet ID – 001000

200 . 89 . 99 . 8

(iii) Third subnet ID – 001001

200 . 89 . 99 . 9

(iv) Fourth subnet ID – 100000

200 . 89 . 99 . 32

(v) Fifth subnet ID – 100001

200 . 89 . 99 . 33

Discontinous mask work in network security. The IP of next hop can't be calculated using deterministic standard equation.

Q. DBA of subnet is given as 201.55.77.3/ which of the following will be suitable subnet mask?

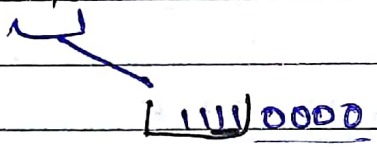
(i) 255.255.255.192

(ii) 255.255.255.128

✓ (iii) 255.255.255.240

Q. DBA of subnet 202.88.99.63

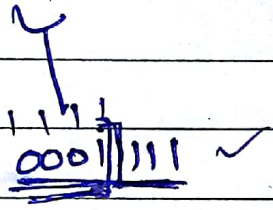
(i) 255.255.255.240



(ii) .248

11111000

Q. DBA of a subnet — 200.99.88.31



✓ .224 — 11100000 ✗

✓ .240 — 11110000

✓ .248 — 11111000

Pg.: extra

Q. Company requires 30 hosts, how to find mask.

Subnet mask = 255.255.255.224

$2^k + 2 \geq 30$

$2^k \geq 32$

$k \geq \log_2 32$

$\lceil k \rceil$

$2^k + 2 = 30$

$2^k = 32$

$k = \lceil \log_2 32 \rceil$

if k is an integer then 0

Q. Company requires 500 host, find subnet mask?

class B - 255.255.0.0

subnet mask = 255.255.254.0

$k = \lceil \log_2 (500+2) \rceil$

$k = 9$ (host bits)

Supernetting -

joining two or more network to form a larger network.

Eg in class C, if supernet mask : 255.255.252.0

(11111100)

During supernetting, supernet bits are borrowed from network id bits.

No. of networks joined $= 2^n$

where n is the no. of bits borrowed

Q. In class C of supernet mask: 255.255.248.0

Network mask of class C: 255.255.255.0

11111111

supernet mask: 255.255.248.0

11111000

$2^3 = 8$ networks.

* During supernetting we can join only power of 2 (2^n) networks i.e 2, 4, 8, 16, 32, etc.

Q. One of the IP address of supernet is 201.55.89.99 supernet mask is 255.255.252.0.

Find range of supernet.

Supernet Id ⇒ IP add (AND) supernetmask

⇒ 201.55.89.99 (AND) 255.255.252.0

11111100

01011001

⇒ 201.55.88.0 ←

01011000

In supernet mask

11111111 11111111 11111100 00000000

supernet bits

Supernet ID:

201.55.88.0

01011000 . 00000000

11111111

(201.55.88.0 — 201.55.88.255)

(201.55.89.0 — 201.55.89.255)

(201.55.90.0 — 201.55.90.255)

(201.55.91.0 — 201.55.91.255)

Range of supernet = $\frac{2^8 \times 4}{}$

as, super net bits are two

00 — 2^8 hosts
01 — "
10 — "
11 — "

201.55.88.0 — 201.55.91.255

This will be the final supernet network.

Q: which of the following IP can be used as Source IP as well as dest IP:

(a) 10.255.255.255 — direct broadcasting address

(b) 172.16.255.255 — direct broadcasting address

(c) ···255.255.255.255 — limited broadcasting address

✓ (d) 10.5.6.7

Classless addressing :-

Block → group of IP address

Notation : IP add / n → mask

This notation is also known as CIDR (classless Inter domain Routing)

eg.. 201.55.89.99 / 24

here 24 mask value denotes 24-bits are used for network ID and left 8-bits are used for host ID.

Thus in the above IP address 201.55.89.0 will be gateway address or Network ID.

range is (201.55.89.0 — 201.55.89.255)

Q. One of the address of a block is given as

200.89.99.93 / 26

Range of blocks.

$= 2^{32-26}$

$= 2^6 = 64$

200.89.99.93

01011100

6-bits are used by Host

So, 01000000 — 01111111

(200.89.99.64 — 200.89.99.127)

200.89.99.64 ↑ Network ID

200.89.99.127 ↑ DBA

First Host address — 200.89.99.65

Last Host address — 200.89.99.126

Q. One of address of block is 39.49.26.119 /27

Range = $2^{32-27} = 2^5 = 32$

39.49.26.119

01110111

01100000 — 01111111

96 — 127

(39.49.26.96 — 39.49.26.127)

96 ↑ Net ID

127 ↑ DBA

First Host add — 39.49.26.97

Last Host add — 39.49.26.126

Dt.: Pg.: Delta

* Addresses in a block are continous.

First address of a block should be exactly divisible by number address a block.

The last address of a block should be exactly divisible by number of addresses + (n-1) where n is a divisor.

Q. One of the address as -

101. 55. 89. 112 / 20

Range = $2^{12} = 2^4 \cdot 2^8 =$

101 . 55 . 89 . 112

0101 1001

01010000 — 01011111

.80.0 — .95.0

255

(101. 55. 80. 0 — 101. 55. 95. 255)

Dt.:
Pg.:

Delta

Q: One of address of block is given as 91.81.112.29/27

91.81.112.29

00011101

$2^5 = 32$ addresses

(91.81.112.0 — 91.81.112.31)

91.81.112.79

01001111

(91.81.112.64/27 — 91.81.112.95/27)

Q: Block contains 32 IP addresses which of following can be best address of space:

(a) 201.55.16.1
(b) 201.55.16.33
(c) 201.55.16.160 ✓
(d) 201.55.16.163

Pg.: Delta

Q. One of the address of the block is given as - 94.25.79.95/26. If this block is divided into four equal sub-blocks then calculate the range of the blocks, and sub-blocks.

$2^{32-26} = 2^6 = 64$

94.25.79.95

01011111

01000000 — 01111111

Range of block (94.25.79.64/26 — 94.25.79.127/26)

sub-block 1 (94.25.79.64/28 — 94.25.79.79)

sub-block 2 (94.25.79.80 — 94.25.79.95)

sub-block 3 (94.25.79.96 — 94.25.79.111)

sub-block 4 (94.25.79.112 — 94.25.79.127)

Q.

32768
8192
1024

41984

16384

23552

$a * 2^{15}$