syllabus

Monday, July 1, 2024 12:41 AM

weightage : 9 - 12 marks

★ chapter one : IPV4 addressing

(i) introduction to IPV4 addressing
(ii) classful addressing
(iii) types of communication
★ (iv) subnetting
(v) classless addressing
(vi) subnetting in CIDR
(vii) supernetting in classful addressing
(viii) supernetting in CIDR

chapter two : error control

(i) simple parity
(ii) 2D parity
(iii) checksum
★ (iv) CRC

(v) hamming code

★ chapter three : flow control at data link layer

(i) delay in computer network
(ii) stop & wait
(iii) Go back - N (GB-N)
(iv) selective repeat (SR) (ch-51)

★ chapter four : internet protocol version 4 (IPV4)

(i) IPV4 header
(ii) fragmentation in IPV4

chapter five : transport layer protocol

(i) TCP header
(ii) wrap around time
(iii) connection establishment phase
(iv) data transfer phase
(v) connectiontermination phase
(vi) TCP state transition diagram
(vii) flags in TCP

(viii) flow control in TCP
(ix) error control in TCP
(x) TCP timer management
★ (xi) congestion control in TCP
(xii) traffic shaping

chapter six : user datagram protocol

(i) UDP header
(ii) why we need UDP
(iii) TCP vs UDP

chapter seven : media access control

★ (i) ALOHA
(ii) CSMA
★ (iii) CSMA/CD
(iv) CSMA/CA
(v) reservation
(vi) polling
(vii) token passing
(viii) FDMA
(ix) TDMA

(x) CDMA

chapter eight : routing protocol

(i) shortest path
(ii) flooding
★ (iii) distance vector routing
(iv) link state routing

★ chapter nine : switching

(i) circuit switching
★ (ii) packet switching
(iii) virtual circuit switching
(iv) datagram switching

★ chapter ten : application layer protocol

(i) DNS
(ii) SMTP
(iii) FTP
(iv) HTTP
(v) email

chapter eleven : basics of IP support protocol

(i) ARP
(ii) RARP
(iii) DHCP
(iv) ICMP

chapter twelve : OSI and TCP/IP PRotocol stack

(i) OSI model
(ii) Function of OI layer
(iii) TCP/IP model

miscellaneous

(i) network address translation (NAT)
(ii) ethernet bridging

pre-requisites

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pre-requisites

basics

2^1 =2
2^2 =4
2^3 =8
2^4 =16
2^5 =32
2^6 =64
2^7 =128
2^8 =256
2^9 =512
2^{10} =1024
2^{10} =1k (kilo)
2^{20} =1m (mega)

2^{30} =1G (giga)
2^{40} =1T (tera)
2^{50} =1P (peta)
2^{60} =1E (exa)
2^{70} =1Z (zeeta)
2^{80} =1y (yotta)

data :

1byte = 8bits
1KB = 1024bytes
1MB = 1024KB
1GB = 1024MB
1TB = 1024GB
1PB = 1024TB
1EB = 1024PB
1ZB = 1024EB
1YB = 1024ZB

Bit represents as 'b'
Byte represent as 'B'

24 because data humesha binary ki form mai hota hai means 2^{power} something

binary → decimal shortcut

128	64	32	16	8	4	2	1		
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1	2^1-1
0	0	0	0	0	0	1	1	3	2^2-1
0	0	0	0	0	1	1	1	7	2^3-1
0	0	0	0	1	1	1	1	15	2^4-1
0	0	0	1	1	1	1	1	31	2^5-1
0	0	1	1	1	1	1	1	63	2^6-1
0	1	1	1	1	1	1	1	127	2^7-1
1	1	1	1	1	1	1	1	255	2^8-1

weightage

2^n-1
n : number of 1's (continious)

8 bit range : 0 to 255 / 0 to 2^8-1

n bit range : 0 to 2^n-1

binary →								decimal	shortcut
128	64	32	16	8	4	2	1		weightage
1	0	0	0	0	0	0	0	128	255-127
1	1	0	0	0	0	0	0	192	255-63
1	1	1	0	0	0	0	0	224	255-31
1	1	1	1	0	0	0	0	240	255-15
1	1	1	1	1	0	0	0	248	255-7
1	1	1	1	1	1	0	0	252	255-3
1	1	1	1	1	1	1	0	254	255-1
1	1	1	1	1	1	1	1	255	255

255-n

n: weightage of last digits

concept of address space :

if i choose or fix one bit address space divides into two parts :

000
001
010
011 — 0

100
101
110
111 — 1

1 bit - 2parts

2^1 parts

if i choose or fix two bits address space divides into four parts :

000
001 — 00

010 — 01

001

010
011 — 01

100
101 — 10

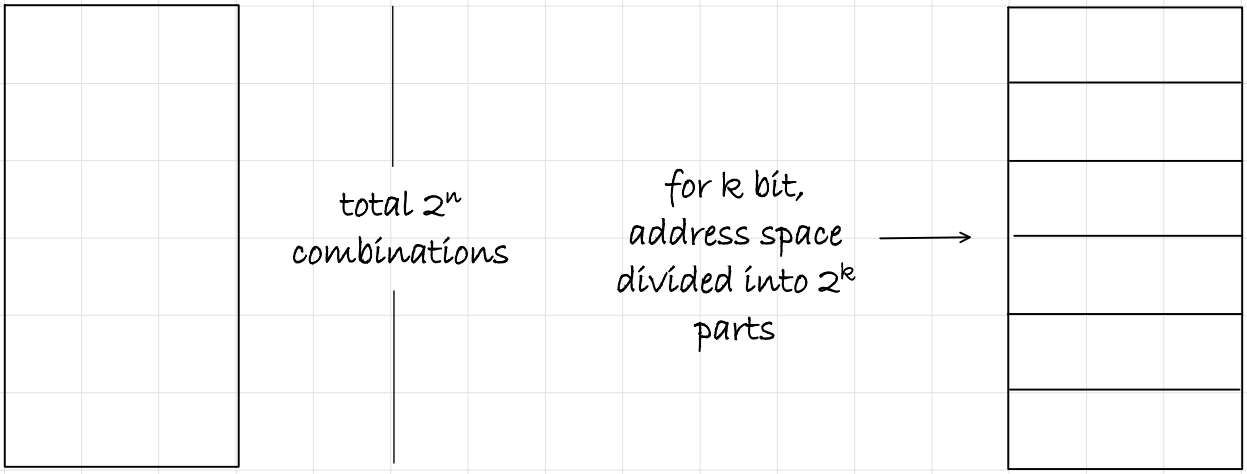
110
111 — 11

2 bit - 4parts

2^2 parts

if i choose or fix k bits address space divides into 2^k parts

combination with n bits : 2^n

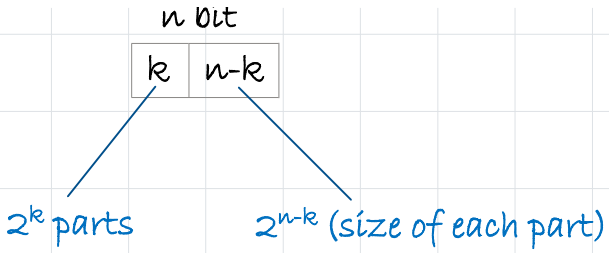


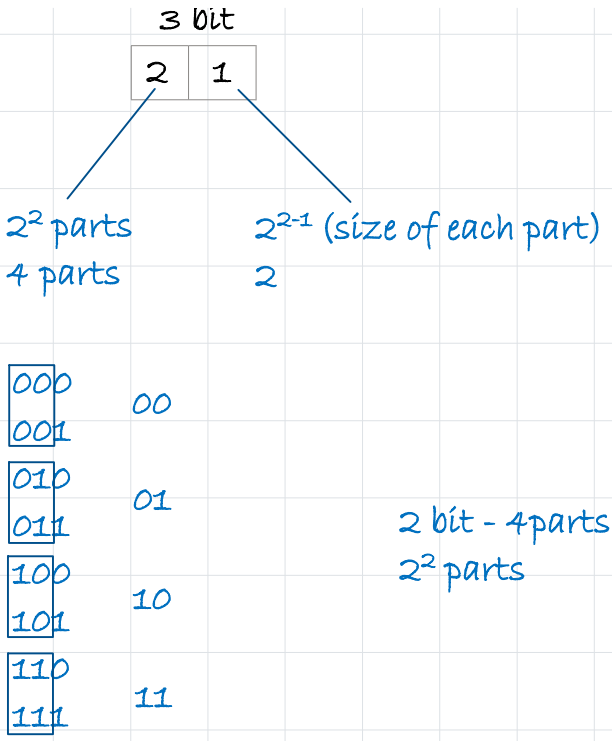
n bit

k	n-k

3 bit

2	1


n bit
k
n-k
2^k parts
2^{n-k} (size of each part)


3 bit
2
1
2^2 parts
4 parts
2^{2-1} (size of each part)
2
000
001
00
010
011
01
100
101
10
110
111
11
2 bit - 4parts
2^2 parts

IPV4 addressing

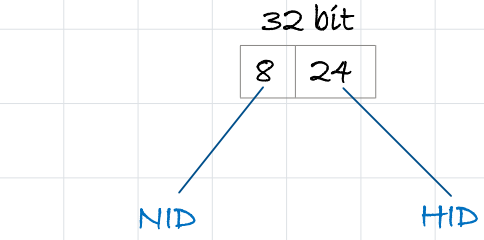
topic : introduction to IP addressing

IPV4 address : 32bit

total combinations : 2^{32} = 4,294,967,296 (4GP IP address available hai)

in 1980's IP address was divided into two fixed parts :

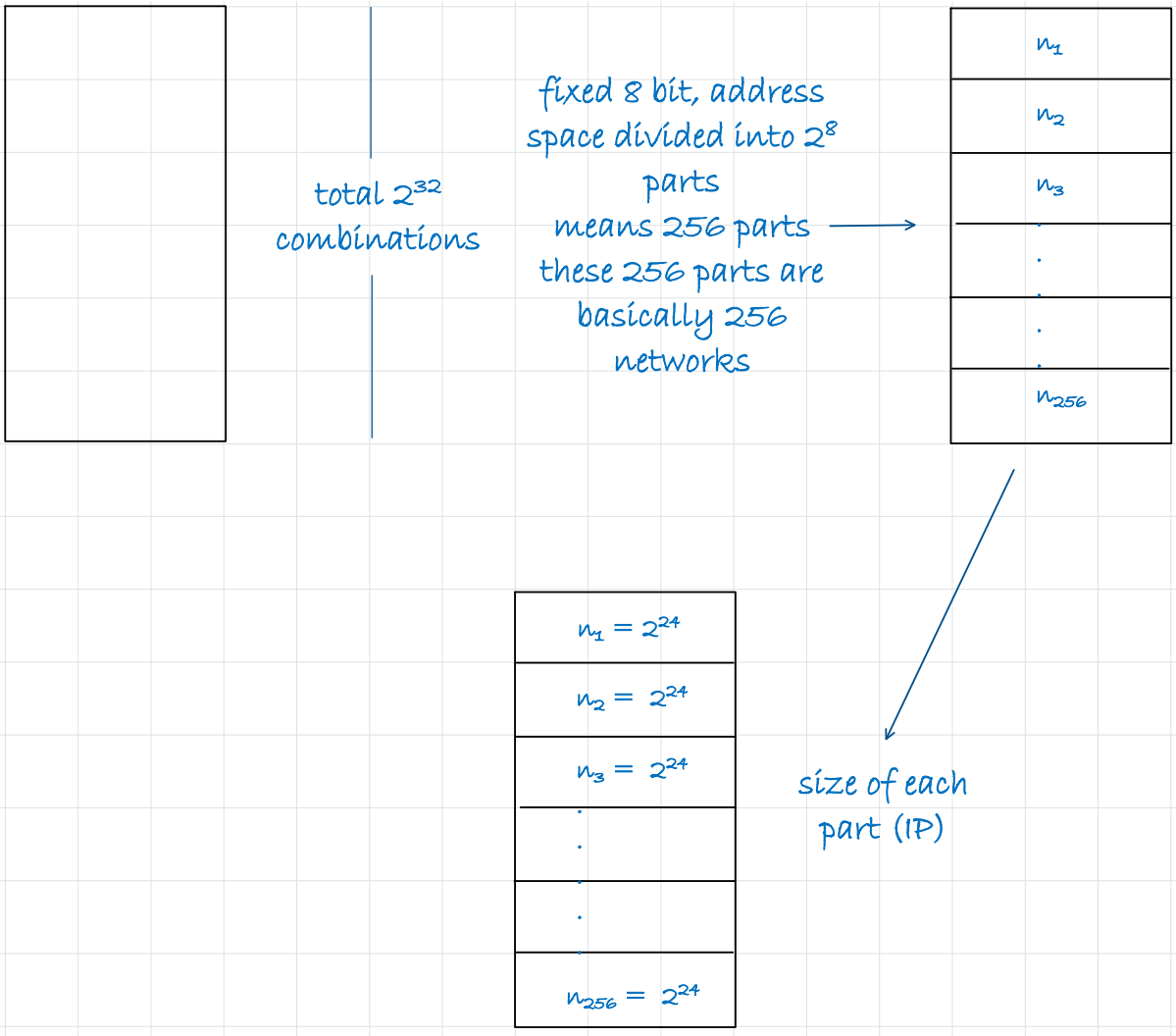
NID (network ID) : 8bit
HID (host ID) : 24bit



2^8 = 256 networks

2^{24} host per network
$2^4.2^{20}$ host per network
16M host per network
1.6 crore host per network

combination with 32 bits : 2^{32}



IP addresses 32 the jo ki 256 networks mai divide hue hai aur har network ke andar 2^{24} IP hai.

256×2^{24} IP
$2^8 \times 2^{24}$ IP
2^{32} IP

host per network : computer per network

ek computer ko ek IP address ki requirement hoti hai toh
2^{24} IP address 2^{24} computer ko assign ho sakte hai
means 2^{24} host per network.

problem : there are only 256 networks, even a small organisation must buy 16M computer (host) to purchase one network.

IANA (internet assign number authority) assign the networks.

(i) 256 networks sirf 256 organisations ko hi assign ho sakte the and worldwide there are much more than 256 organisations

(ii) 16M host/network means 1 network se 1.6crore computer connect ho sakte the but if a individual organisation ask for a network that wants to connect just 200 computer then remaining IP address waste ho jayege because network ki capacity 1.6crore hai so it was difficult to purchase from IANA.

it was not balanced divison.

solution : classfull addressing

classfull addressing

example : divison of telephone networks.

(i) 11 digit number

(ii) two parts
- STD
- TID

(iii) unique

telephone ID(8) and STD(3) for city

STD	TID
000	00000000
.	.
.	.
.	.
.	.
.	.
.	.
999	99999999

(3) in india there are 1000 STD available for cities because cities are limited in india means for each city there is one unique STD.

aur kisi bhi city ke andar mai 10^8 combinations means over 10 crore unique telephone number provide kar sakta hoon because population is more in cities.

less cities in india

but in each city there are lot of peoples

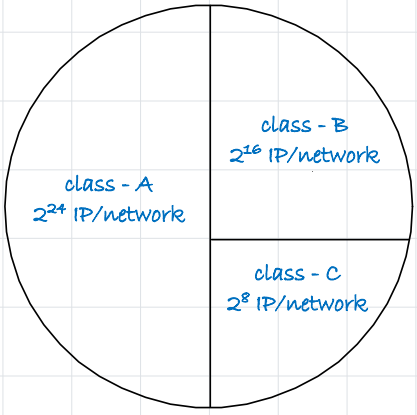
32 bit number

-----8bit---------8bit----------8bit---------8bit-----

_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _	_ _ _ _ _ _ _ _

two parts
NID
HID

unique



X organisation requirement : 200IP address
will purchase class-c network.
wastage : 2^8-200, 256-200=56 IP wastage.

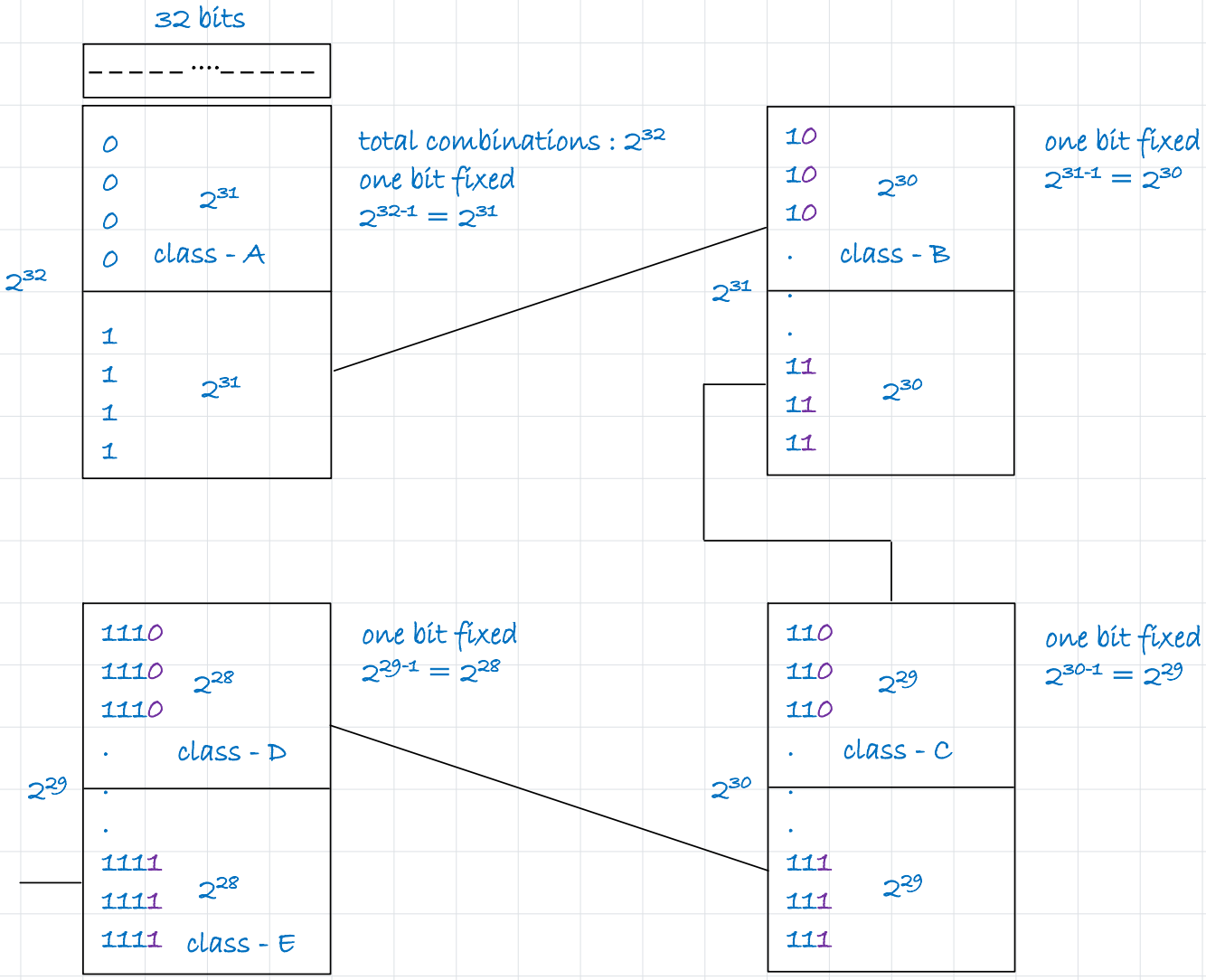
Y organisation requirement : 500IP address
will purchase class-B network.
wastage : 2^{16}-200, 65536-500=65036 IP wastage.

Z organisation requirement : 70,000IP address
will purchase class-A network.
wastage : 2^{24}-70000, 16777216-70000=16707216 IP wastage.

so, classfull addressing in not completely effective

jitne IP ki requirement hai utne mil jayenge

practical division of IP address :



IP address divided into 5 classes :

number of IP address present in Class - A : 2^{31}
bit fixed in Class - A : 0
50%

number of IP address present in Class - B : 2^{30}
bit fixed in Class - B : 10
25%

number of IP address present in Class - C : 2^{29}
bit fixed in Class - C : 110
12.5%

number of IP address present in Class - D : 2^{28}
bit fixed in Class - D : 1110

6.25%

number of IP address present in Class - E : 2^{28}
bit fixed in Class - E : 1111
6.25%

there is no ambiguity!

IP address representation

binary : 11001000.11111100.00111111.11110111

decimal : 200 . 252 . 63 . 247

hexadecimal : C8 . FC . 3F . F7

range of classes:

(i) number of IP address present in Class - A : 2^{31} [1 - 126]
bit fixed in Class - A : 0
50%

2^8 network id

8 bit	24 bit		
NID	HID		
8bit	8bit	8bit	8bit

2^8 network id
2^{24} host/network
2^{24} IP add/network

first bit fixed here (0)

0	7bit	
0	0000000	0
0	0000001	1
0	0000010	2
.		
.		
0	1111111	127

kisi bhi ip address ke network id mai agar saari ki saari bit 0 hai toh vo cancel kardenge means use kisi computer ko assign nahi kar sakte

127 bhi cancel kardenge because yeh bhi special purpose ke lie hai i.e. loop back testing

First octet - Defines the network class and part of the network ID

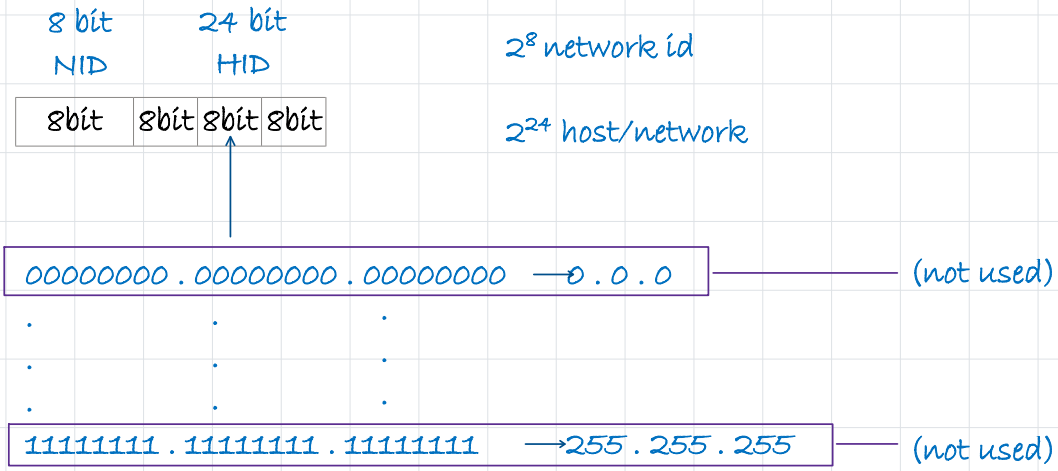
example : 16.90.30.130

first octet : 16
it is between 1 - 126 hence it is part of class-A

2^8 network id

1 bit fixed
remaining bit : 7
total combination : 2^7
all '0' and all '1' are removed means $2^7-2 = 126$
so, practically we have 126 networks in class - A

2^{24} host/network



2^{24} host/network

24 bit
total combinationd : 2^{24}
all '0' and all '1' are removed means $2^{24}-2 = 16777216 - 2 = 16777214$
so, practically we have 16777214 host/network in class - A

0.0.0.0 : DHCP client (or) default route

127.X.X.X : self connectivity (or) loop back testing (or) interprocess communication

(x means anything between 0 to 255)

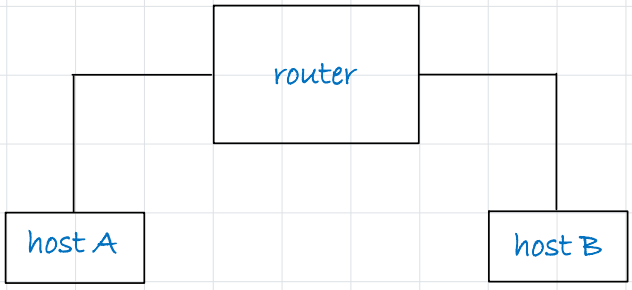
127.0.0.0
127.255.255.255

not used for loopback testing.

note :
kisi bhi ip address ki network id or host id mai saari ki saari bit '0' or '1' hai toh vo hum kisi computer ko assign nahi kar sakte. yeh IP's special purpose ke lie reserved hai, so we cannot assign these IP addresses to any host or computer.

example of loopback testing (working of 127)

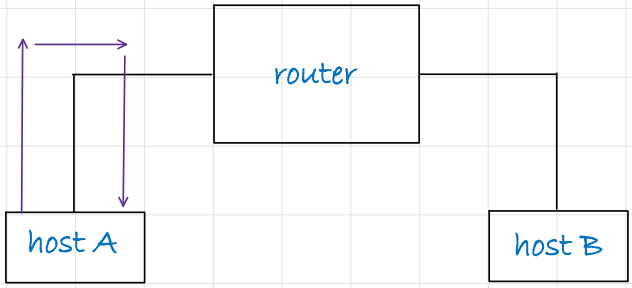
if host A sends a message to host B but host B is not replying



possible reasons :
case (i) host may be down
case (ii) NIC of host may be down.
case(iii) the link of host B may be down
case (iv) router is not working properly
case (v) the link of host A may be down
case (vi) NIC of host A may be down

case (vi) : NIC of host A may be down

to check if my computer is working or not yeh self connectivity ke through check karega



10.39.59.62

source ip destination ip

source ip	destination ip
10.39.59.62	127.X.X.X

i am messaging myself, if message aagya means NIC of host A is working

this is the working of 127.

source ip	destination ip
~~127.X.X.X~~	~~10.39.59.62~~

note :
- 127.X.X.X cannot be used as source IP address
- 127.X.X.X can only be used as destination IP address
- 127.X.X.X is reserved for special purpose some cannot assign this IP address to any host (computer)
- here X range is from 0 to 255 but not 0 and 255.

(ii) number of IP address present in Class - B : 2^{30} [128-191]
bit fixed in Class - B : 10
25%

2^{16} network id

16 bit NID | 16 bit HID

8bit	8bit	8bit	8bit

2^{16} network id
2^{16} host/network
2^{16} IP add/network

two bit fixed here (10)

10	6bit

total combinations : 2^6 (first octet)

10 000000 128
10 000001 129
.
.
10 111111 191

.
10 1111111 191

First octet - Defines the network class and part of the network ID

example : 145.90.30.130

first octet : 145
it is between 128-191 hence it is part of class-B

2^{16} network id

2 bit fixed
remaining bit : 14
total combinationd : 2^{14}
so, practically we have 16,384 networks in class - B

but how we are getting 2^{14}, total combinations are of 2^6

because 2^6 is for first octet.

first octet value : 128 to 191
but second octet is also included in network id
range will be 0 to 255

128.0	129.0	130.0 _ _ _ _ _	191.0
128.1	129.1	130.1 _ _ _ _ _	191.1
128.2	129.2	130.2 _ _ _ _ _	191.2
.	.	.	.
.	.	.	.
.	.	.	.
128.255	129.255	130.255_ _ _ _ _	191.255

256×2^6
$2^8 \times 2^6 = 2^{14}$

so that is how we have practically 2^{14} networks in class-B

2^{16} host/network

16 bit NID | 16 bit HID

8bit	8bit	8bit	8bit

2^{16} network id
2^{16} host/network
2^{16} IP add/network

00000000 . 00000000 → 0 . 0 — (not used)

.
.
.

11111111 . 11111111 → 255 . 255 — (not used)

2^{16} host/network

16 bit
total combinations : 2^{16}
all '0' and all '1' are removed means $2^{16}-2 = 65536 - 2 = 65534$
so, practically we have 65534 host/network in class - B

157.153.0.0
157.153.255.255

not used.

(iii) number of IP address present in Class - C : 2^{29} [192-223]
bit fixed in Class - C : 110
12.5%

2^{24} network id

24 bit NID | 8 bit HID

8bit	8bit	8bit	8bit

2^{24} network id
2^{8} host/network
2^{8} IP add/network

three bit fixed here (110)

110	5bit

total combinations : 2^{5} (first octet)

110	00000	192
110	00001	193
.		
.		
110	111111	223

First octet - Defines the network class and part of the network ID

example : 220.90.30.130

first octet : 220
it is between 192-223 hence it is part of class-C

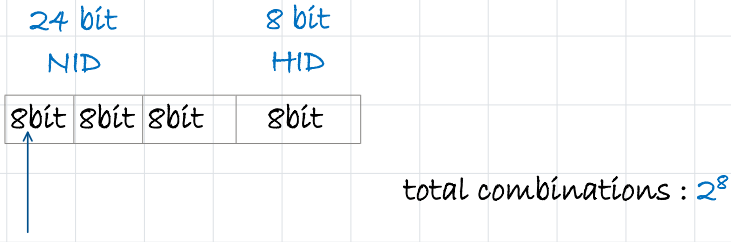
2^{24} network id

3 bit fixed
remaining bit : 21
total combinationd : 2^{21}
so, practically we have 2097152 networks in class - C

but how we are getting 2^{21}, total combinations are of 2^5

because 2^5 is for first octet.

first octet value : 128 to 191
but second and third octet is also included in network id
range will be 0 to 255 for both



total combinations : 2^8

three bits fixed
total combinations : 2^5

total combinations : 2^8

$2^5 \times 2^8 \times 2^8 = 2^{21}$
so that is how we have practically 2^{21} networks in class-B

2^8 host/network

24 bit NID | 8 bit HID

8bit	8bit	8bit	8bit

2^{24} network id
2^8 host/network
2^8 IP add/network

00000000 → 0 (not used)

.
.
.

11111111 → 255 (not used)

2^8 host/network

8 bit
total combinations : 2^8
all '0' and all '1' are removed means $2^8-2 = 256 - 2 = 254$
so, practically we have 254 host/network in class - C

(iv) number of IP address present in Class - D : 2^{28} [224-239]
bit fixed in Class - D : 1110
6.25%

8bit	8bit	8bit	8bit

four bit fixed here (1110)

1110	4bit

total combinations : 2^4 (first octet)

1110 0 0 0 0 0 224
1110 0 0 0 0 1 225
.
.
1110 1 1 1 1 1 1 239

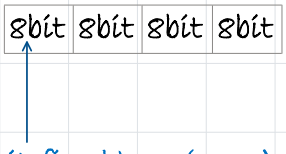
First octet - Defines the network class and part of the network ID

example : 234.90.30.130

first octet : 234
it is between 224-239 hence it is part of class-D

note :
- no network id and no host id in Class - D
- Class - D is reserved for multicasting and not for any host/computer

(v) number of IP address present in Class - E : 2^{28}
bit fixed in Class - E : 1111
6.25%



1111 00000 240
1111 00001 241
.
.
1111 111111 255

First octet - Defines the network class and part of the network ID

example : 249.90.30.130

first octet : 249
it is between 240-255 hence it is part of class-E

note :
- no network id and no host id in Class - E
- Class - E is reserved for research and future purpose not for any host/computer

CRUX

class	bit fixed	range	no of IP addresses	network id (no. of networks)	host id (number of hosts per network
A	0	(1 - 126)	2^{31}	2^{7}	2^{24}-2
B	10	(128 - 191)	2^{30}	2^{14}	2^{16}-2
C	110	(192 - 223)	2^{29}	2^{21}	2^{8} - 2
D	1110	(224 - 239)	2^{28}	no nid	no hid
E	1111	(240 - 255)	2^{28}	no hid	no hid

Q. Which of the following IP addresses have error [MSQ]

A. 150.168.045.78 0 cannot be prefix.

B. 190.100.1.100.20 5 octet IP, not possible

C. 10.75.301.100 301, but with 8bit maximum is 255, so not possible

D. 11100010.10.254.100 binary with decimal combination.

Q. To utilize a Class A network efficiently , an organization should have -------- number of host in a network

A. 20 Million

B. 64 Thousands

C. 2.1 Billion

D. 16Million

Q. In hexadecimal notation IPv4 Address has-----hex digits

A. 16

B. 8 32bits ka IPV4 address aur hex ka ek digit 4 bit ka hota

C. 4

D. 32

C. 4

D. 32

Q Find the class C address from the following.

A. 01111111.01010101.11111110.00001111

B. 11101111.01001110.11001100.01010011

C. 10001111.00000011.11111100.00111100

D. 11011111.11001111.11100010.11111010

class C starts from 110. three bits are fixed : 110

Q. The Dotted decimal notation (DDN) format for the given Hexadecimal notation (HDN) C22F1582 is

A. 194.50.21.145

B. 194.47.21.130

C. 194.45.21.120

D. 194.47.20.130

1100 0010 . 0010 1111 . 0001 0101 . 1000 0010

194 . 47 . 21 . 130

or

C2	2F	15	82
$(C2)_{16}$	$(2F)_{16}$	$(15)_{16}$	$(82)_{16}$
$12 \times 16^1 + 2 \times 16^0$	$2 \times 16^1 + 15$	$1 \times 16^1 + 5$	$8 \times 16^1 + 2$
194	47	21	130

Q. The Dotted decimal notation (DDN) format for the given Hexadecimal notation (HDN) 172A84C8

A. 24.40.132.200

B. 23.42.132.200

C. 23.42.130.200

D. 23.42.132.198

17	2A	84	C8
$(17)_{16}$	$(2A)_{16}$	$(84)_{16}$	$(C8)_{16}$
$1 \times 16^1 + 7$	$2 \times 16^1 + 10$	$8 \times 16^1 + 4$	$12 \times 16^1 + 8$
23	42	132	200

Q. Suppose, instead of using 16 bits for network part of a Class B, 20 bits had been used. Then the number of Class B networks and hosts per network are

A. $2^{10}, 2^{12}$

B. $2^{18}, 2^{12}$

C. $2^{18}, 2^{12} - 2$

D. $2^{10}, 2^{12} - 2$

class B
generally :

8	8	8	8
16bit nid		16bit hid	

2 bit fixed : 10
total combinations : 2^6
other octet : 2^8
total : 2^{14}

hosts per network :
$2^{16}-2$

class B
changes according to que:

10	10	6	6
20bit nid		12bit hid	

2 bit fixed : 10
total combinations : 2^8
other octet : 2^{10}
total : 2^{18}

hosts per network :
$2^{12}-2$

Q. Number of Networks and Number of Host in class B are 2^m,$(2^n - 2)$ respectively. Then the relation between m and n is

A. 3m = 2m

B. 7m = 8n

C. 8m = 7n

D. 2m = 3n

no of networks in class - B = $2^m = 2^{14}$, m = 14

no. of host in class-B = 2^n-2 = 2^{16}-2, n = 16

m = 14 and n = 16

$$\frac{m}{n} = \frac{14}{16}$$

8m = 7n

Q. How many networks are possible in a class B addressing system ? (Assuming Classful addressing scheme is followed.)

A. 2^{16}

B. 2^{14}

C. $2^8 - 2$

D. $2^{16} - 2$

Q. How many hosts can be present in a class C network ? (Assuming Classful addressing scheme is followed.)

A. 2^{21}

B. $2^{21} - 1$

C. 2^{16}

D. $2^8 - 2$

Q. How many bits are allocated for NID and HID in 23.192.157.234 address ? (Assuming Classful addressing scheme is followed.)

A. 16, 16

B. 8, 16

C. 8, 24

D. 24, 8

first octet : 23
class A range : 1 to 126
nid : 8bit
hid : 24bit

Q. What is the possible number of networks and addresses in each network under class B addresses in IPv4 addressing format .

A. $2^{16}, 2^{16}$

B. $2^{16}, 2^{16} - 2$

C. $2^{14}, 2^{16} - 2$

D. $2^{14}, 2^{16}$

class - A
nid : 2^{14}
addresses : 2^{16} (IP address per network)
and hid : 2^{16}-2

Q. IP Address 200.198.32.65 belong to which class ?

A. Class A

B. Class B

C. Class C

D. Class D

first octet : 200
class C range : 192 to 223

Q. Percent of Addresses occupied by Class D ?

A. 50 %

B. 25 %

C. 6.25 %

D. 12.5 %

class A : 50%
Class B : 25%
Class C : 12.5%
Class D : 6.25%

Q. In IPv4 addressing format, the number of networks all allowed under class C addresses is

Q. In IPv4 addressing format, the number of networks all allowed under class C addresses is

A. 2^{24}
B. 2^{7}
C. 2^{14}
D. 2^{21}

class A : 2^{6}
Class B : 2^{14}
Class C : 2^{21}

Q. Let 2^{p} and 2^{q} be the number of networks present in class B and class C under IPv4 addressing format, the value of p + q is 35.

- nid in class B : 2^{14}
  $2^{p} = 2^{14}$, $p = 14$

- nid in class C : 2^{21}
  $2^{q} = 2^{21}$, $q = 21$

so, p + q
14 + 21 = 35

Q. Which of the following is/are VALID IP addresses belonging to class C under IPV4 addressing format? [MSQ]

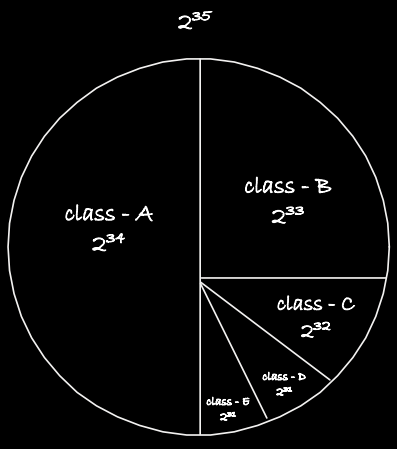
A. 191. 82. 129. 75
B. 208. 21. 97. 120
C. 224. 82. 31. 128
D. 223. 32. 64. 124

class C range : 192 to 223

Q. Consider a hypothetical IPv4 address of 35 bits where class A contain 2^{34} IP addresses. Then the number of IP address present in class D will be : (Assume classful address is used). [MCQ]

A. 2^{28}
B. 2^{32}
C. 2^{34}
D. None of these

2^{31}



Q. Which of the following is/are correct?

A. Class A IPv4 address start form 0.0.0.0. class - A (1-126)

Q. Which of the following is/are correct?

A. Class A IPv4 address start form 0.0.0.0. class - A (1-126)

B. Class B IPv4 address start from 127.0.0.0. Class - B (127 - 191)

C. Class C IPv4 address start from 191.0.0.0. Class - C (192-223)

D. None of the above.

Q. Consider the following statements- [MCQ]

I: The ratio of the number of IP addresses contained in class A to that of class E is 8:1.

II: The number of IP addresses contained in class D is 75% less than the number of IP addresses contained in class B.

Which of the above given statement(s) is/are INCORRECT?

A. I only

B. II only

C. Both I and II

D. Neither I nor II

I: The ratio of the number of IP addresses contained in class A to that of class E is 8:1.

no.of IP addresses in class - A : 2^{31}
no.of IP addresses in class - E : 2^{28}

$2^3.2^{28} : 2^{28}$
$8 : 1$

II: The number of IP addresses contained in class D is 75% less than the number of IP addresses contained in class B.

no.of IP addresses in class - B : 2^{30}
no.of IP addresses in class - D : 2^{28}

$$\frac{2^{30}-2^{28}}{2^{30}}$$

$$\frac{2^2.2^{28}.2^{28}}{2^{30}}$$

$$\frac{2^{28}[2^2-1]}{2^{30}}$$

$$\frac{3}{4}$$

$= 0.75$

$= 75\%$

Q. If the number of networks present in class B are 2^m, then number of hosts present in class C are : (classful addressing scheme is followed) [MCQ]

A. 2^{m-2}

B. $2^{m+2} - 2$

C. $\sqrt{2^{m+2} - 2}$

D. 2^m

number of networks present in class B : 2^m

generally, in class B number of networks : 2^{14}
in class B number of hosts : $2^{16}-2 = 65,536 - 2 = 65,534$

generally, in class C number of networks : 2^{21}
in class C number of hosts : $2^8-2 = 256 - 2 = 254$

$\sqrt{2^{m+2}} - 2$

$\sqrt{2^{14+2}} - 2$

$\sqrt{2^{16}} - 2$

$\sqrt{65,535} - 2$

$256 - 2 = 254$

Q. If number of network present in class B and class C are 2^p and 2^q respectively. And number of hosts present in B and class C are (2^m-2) and (2^n-2) respectively. Then which of the following is/are correct? [MSQ]

A. Relation between p and q will be 2q = 3p.

B. The number of networks present in class A $2^{n-1} - 2$ possible.

C. Relation between m and n will be m = 2n.

D. Relation between p and n will be 4p = 7n.

class : B

- number of network present in class B : 2^p
number of network present in class B : 2^{14}
p = 14

- number of hosts present in class B : (2^m-2)
number of hosts present in class B : $(2^{16}-2)$
m = 16

class : C

- number of network present in class C : 2^q
number of network present in class C : 2^{21}
q = 21

- number of hosts present in class C : (2^n-2)
number of hosts present in class C : (2^8-2)
n = 8

A. Relation between p and q will be 2q = 3p.

number of hosts present in class C : (2^8-2)

$n = 8$

A. Relation between p and q will be 2q = 3p.

$2q = 3p$

$2 \times 21 = 3 \times 14$

$42 = 42$

B. The number of networks present in class A $2^{n-1} - 2$ possible.

number of network present in class A : $2^7 = 128 - 2$ (all 0 and all 1)

$2^{n-1} - 2$

$n = 8$

$= 2^{8-1}-2$

$= 2^7 - 2$

$= 128 - 2$

$= 126$

C. Relation between m and n will be m = 2n.

$m = 2n$

$16 = 2 \times 8$

$16 = 16$

D. Relation between p and n will be 4p = 7n.

$4p = 7n$

$4 \times 14 = 7 \times 8$

$56 = 56$

Q. In classful addressing, a large part of the available addresses are _____.

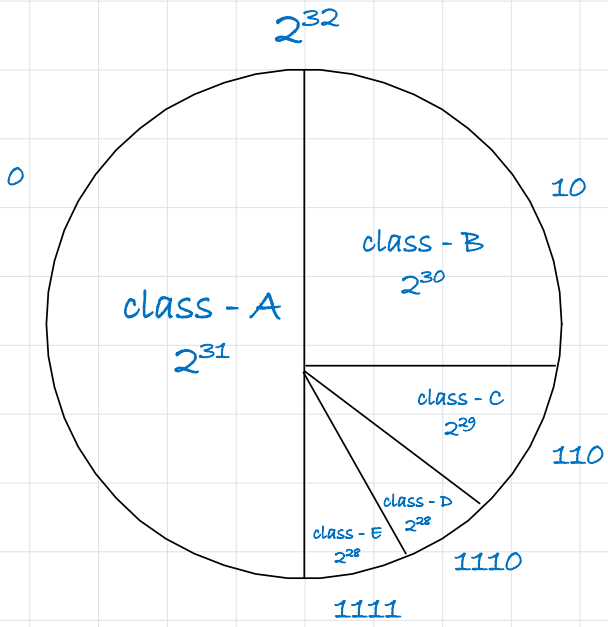
A. Dispersed

B. Blocked

C. Wasted

D. Reserved

IP address per network

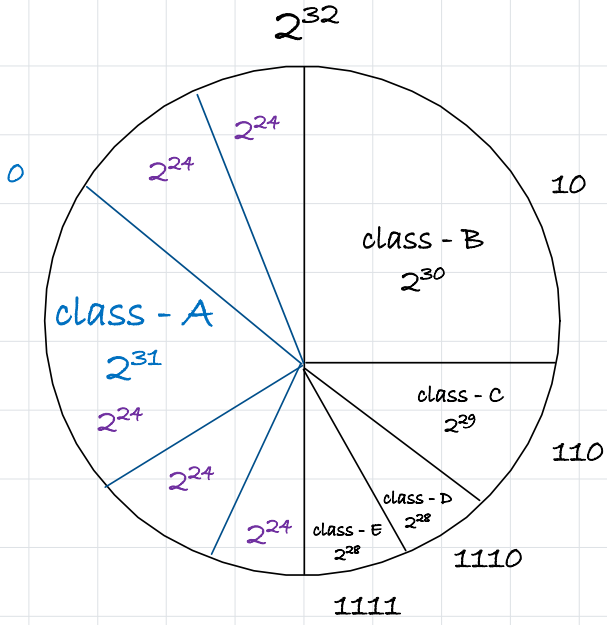


(i) class - A divided in networks

2^{24} IP add/network

2^{24}-2 host/network

har network ke pass 2^{24} IP address

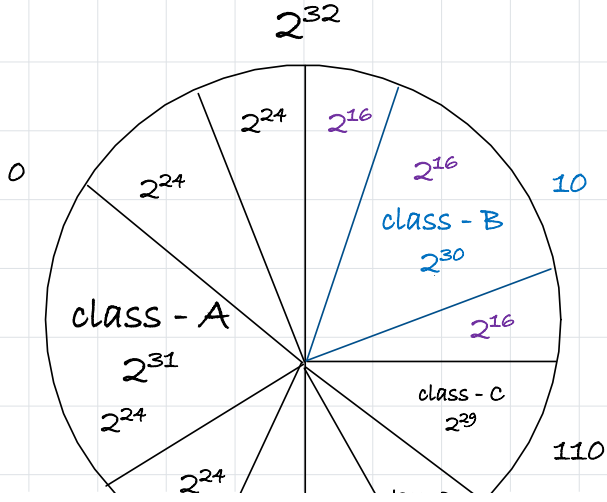


(ii) class - B divided in networks

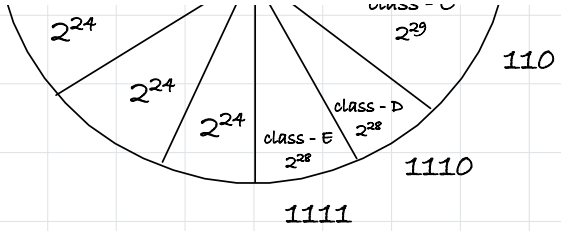
2^{16} IP add/network

2^{16}-2 host/network

har network ke pass



har network ke pass
2^{16} IP address

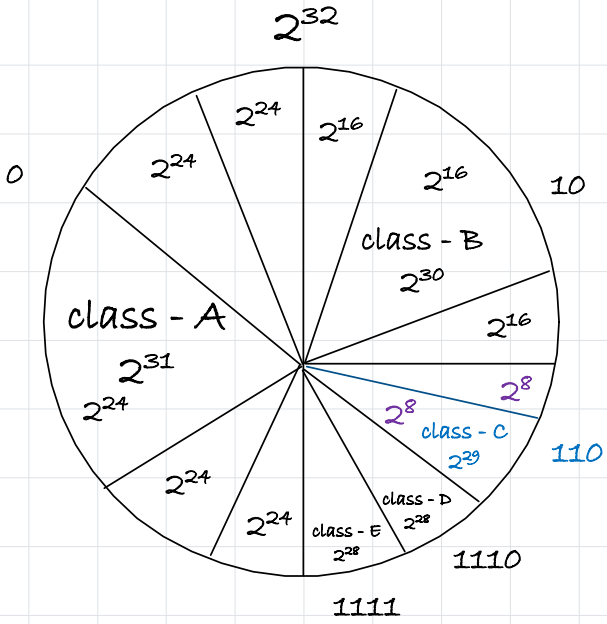


(iii) class - C divided in networks

2^8IP add/network

2^8-2 host/network

har network ke pass
2^8 IP address



no network in class D and class E

q.assume a organization X requires : 2^{20} ip address, which class network will be assigned?

class 'A' will be assigned.

number of IP address wasted : $2^{24} - 2^{20}$

$= 2^4.2^{20} - 2^{20}$

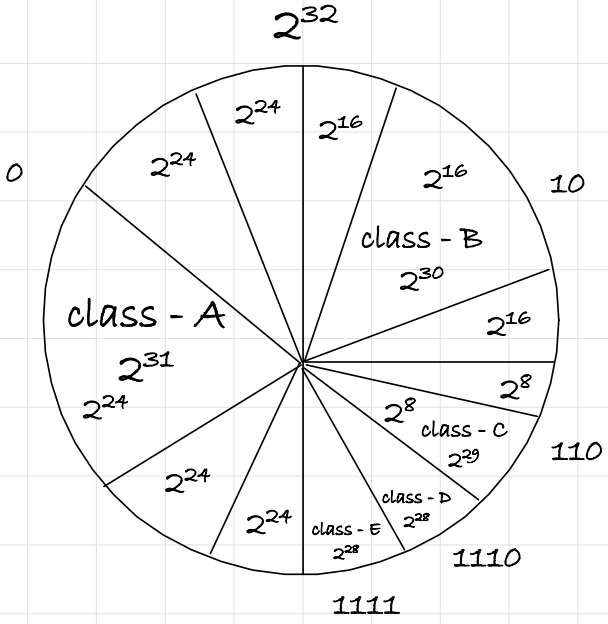
$= 16.2^{20} - 2^{20}$

$= 15.2^{20}$

$= 15M$

$= 15728640$

more than 1.5 crore IP address wasted.



q.assume a organization Y requires : 2^{10} ip address, which class network will be assigned?

class 'B' will be assigned.

number of IP address wasted : $2^{16} - 2^{10}$

$= 2^6.2^{10} - 2^{10}$

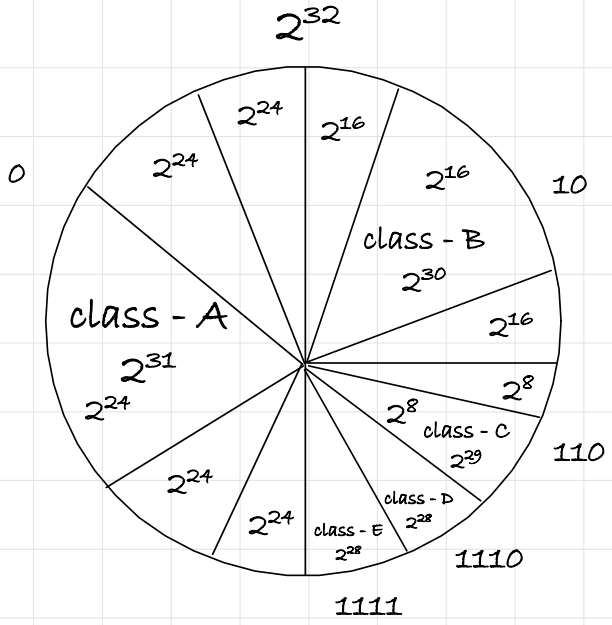
$= 64.2^{10} - 2^{20}$

$= 63.2^{10}$

$= 63K$

$= 64,512$

more than 64 thousand IP address wasted.



q.assume a organization Z requires : 2^7 ip address, which class network will be assigned?

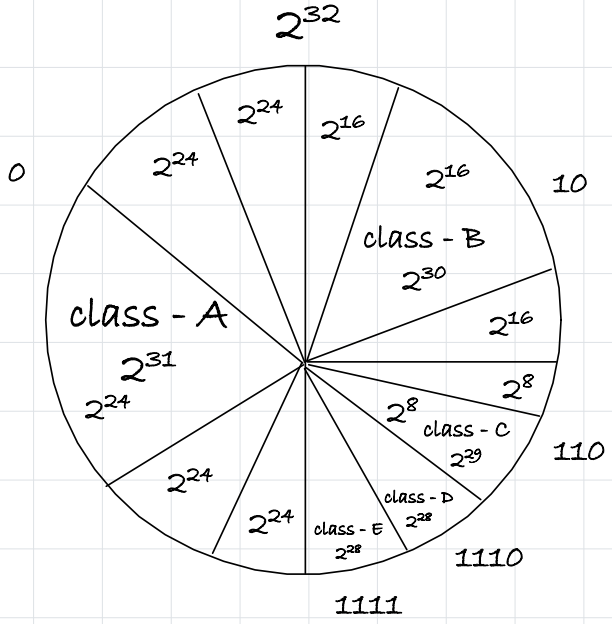
class 'C' will be assigned.

number of IP address wasted : $2^8 - 2^7$

$= 256 - 128$

$= 128$

128 IP address wasted.



Problems in computer network :

(i) communication problem.

(ii) idenitification problem.

(iii) connection problem.

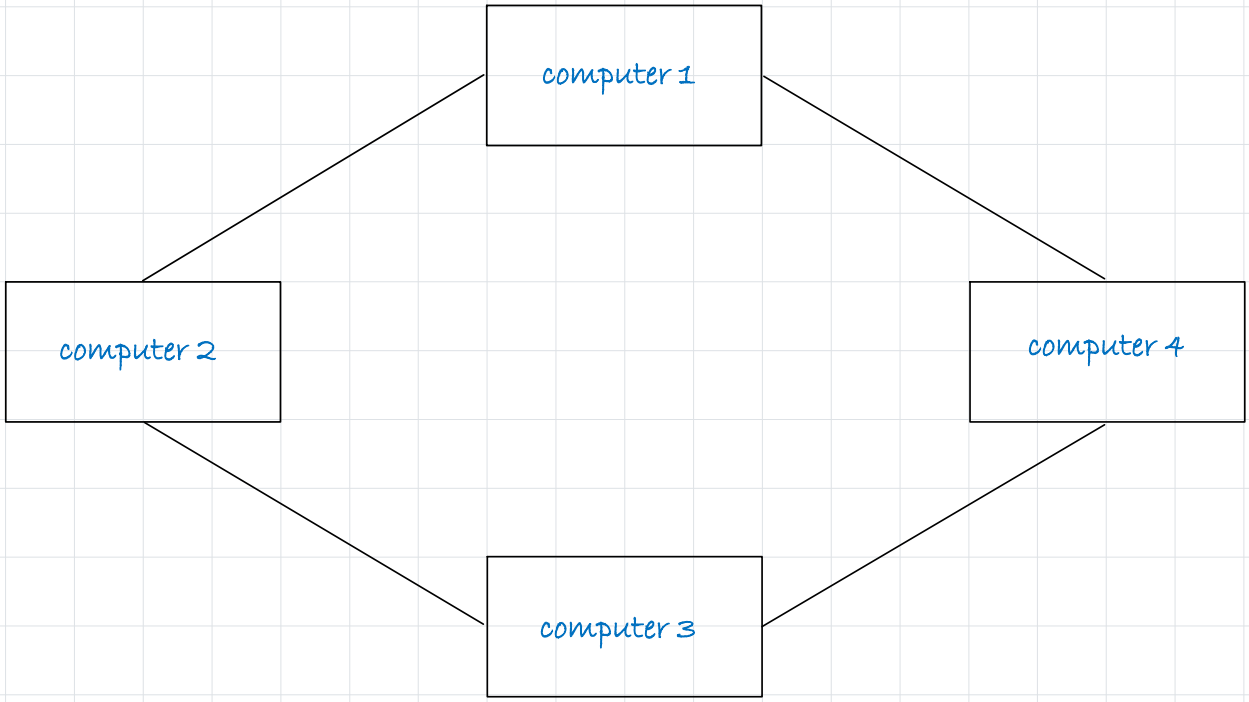
(i) communication problem.

in laymen terms we have to follow three rule in order to communicate properly -

- language : language must be same

- meaning : both understand meaning of the sentence

- response : proper response



if these computer want to communicate, they to follow some protocols.

communication problem can be solved by using protocols

protocol : a protocol is a set of rules that govern data communication.

protocol defines :
(i)what is communicated?

(ii) how it is communicated?

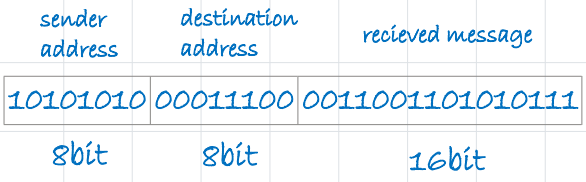
(iii) when it is communicated?

key elements of protocols :

(a) syntax : the term syntax refers to the structure or format of data, meaning the order in which they are presented.

jab data send karoge toh uska format kya hai.

example : some protocol might accept the first 8 bit of data to be the address of sender, the second 8 bit of data to be the address of the reciever and rest of the stream to be the message itself.



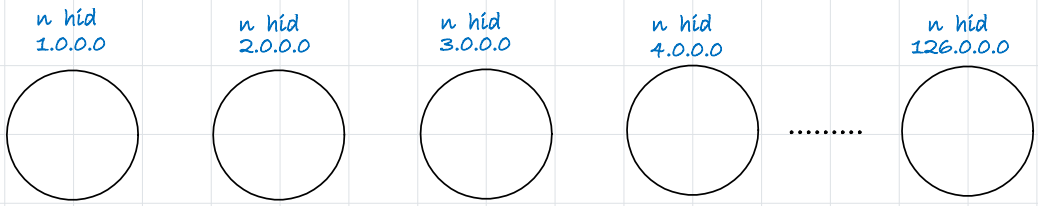
(b) semantics : the word semantics refers to the meaning of each section of bits. (source address, destination address, message etc valid hai ya nahin?)

(c) timing : the term timing refers of two characteristics when data should be sent and how fast they can be sent (data kab aur kitni speed par bejhna hai).

example : if a sender produces data at 100Mbps but reciever can process data at any 1Mbps, the transmission will overload the reciever and some data will be lost.

class A range : 1 to 126

q. how i can identify 126 class - A network?
har network ko uniquely identify krne ke lie har network ki ek id hogi.



n : network id
hid : host id

note : if in any IP address all the bits of host id are 0 then these IP addresses represents the network id of entire network that is why we don't assign them to any computer/host.

(ii) identification problem :

to send a packet from source to destination we need 3 identification steps :

(a) idenitfy the network
with the help of IP address (or) logical address.
DNS : domain name system.
domain name ko ip address mai convert karta hai jisse humein destination IP mil jata hai.

source IP	destination IP
_____	13.92.52.75

- yeh IP address kis network mai hoga?
  first octet : 13
  belongs to class - A (1 to 126)

- class - A mai 126 network hai, un 126 network mai se kis particular network ke ander yeh IP hai?
  nid : 13.0.0.0 (nid : 8bit)
  host id mai saari bit 0 kardi.

source IP	destination IP
_____	153.157.92.184

- yeh IP address kis network mai hoga?
  first octet : 153
  belongs to class - B (127 to 191)

- class - B mai 191 network hai, un 191 network mai se kis particular network ke ander yeh IP hai?
  nid : 153.157.0.0 (nid : 16bit)
  host id mai saari bit 0 kardi.

source IP	destination IP
_____	200.32.95.189

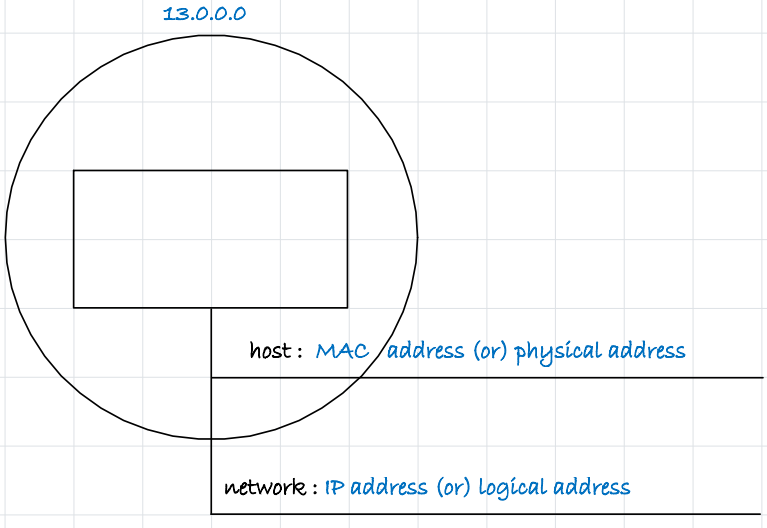
- yeh IP address kis network mai hoga?
  first octet : 200
  belongs to class - C (192 to 223)

- class - C mai 223 network hai, un 223 network mai se kis particular network ke ander yeh IP hai?
  nid : 200.32.95.0 (nid : 24bit)
  host id mai saari bit 0 kardi.

(b) idenitfy the host with in the network i.e. among all computer one computer is identified.
identification of host within the network uses physical address or MAC address. given an IP address we get MAC address using ARP (address resolution protocol)

source IP	destination IP
_____	13.92.52.75

nid : 13.0.0.0



ARP request :

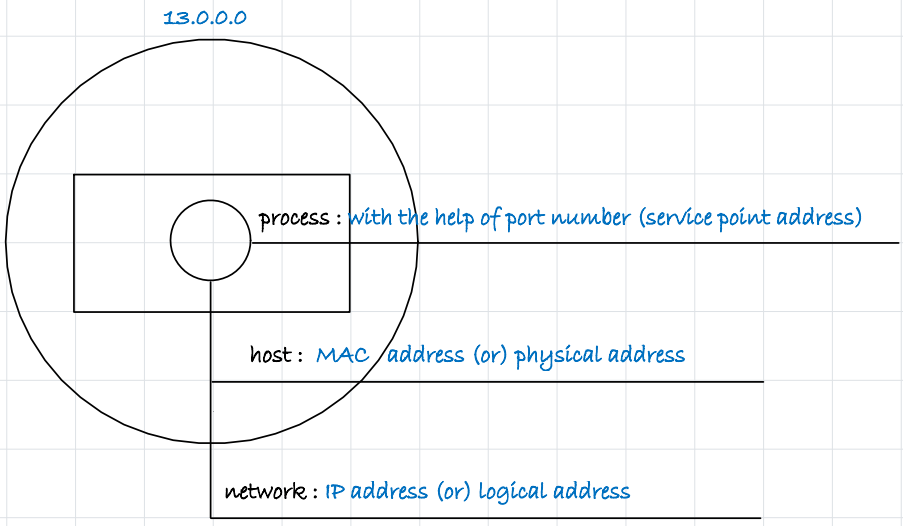
IP address	MAC address
13.92.52.75	_____

i will send this ARP request (message) to all computer (2^{24}-2), aur jis bhi computer ka IP address hoga vo return mai MAC address likh kar reply bejh dega.

- ARP request is broadcasting.
- ARP reply is unicasting.

(c) identify the process with in the host.
identification of process within the host is port number.

process : ek computer ke andar ek se jada running program ho sakte hai.

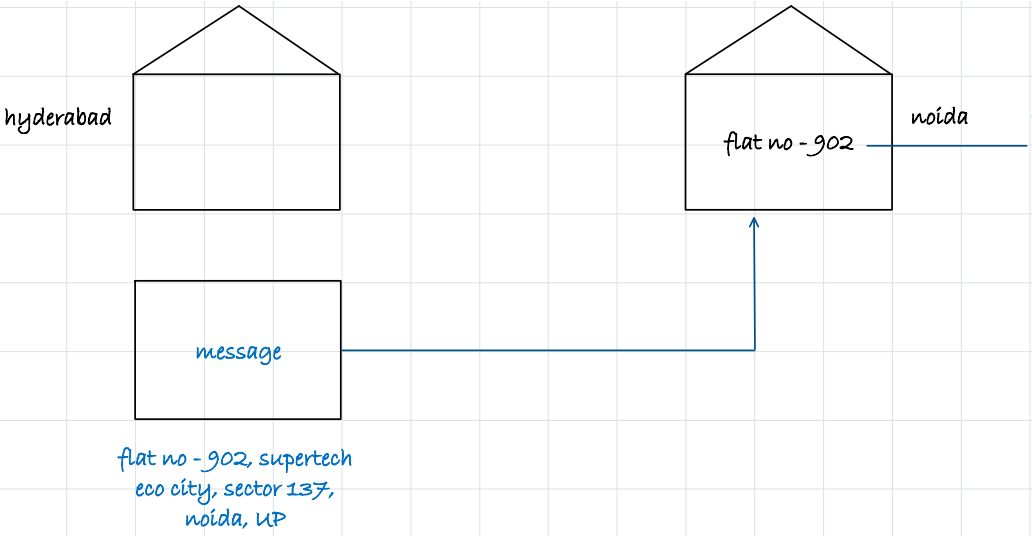


port no. : 16bit
range : 0 to 2^{16}-1
0 to 65,535

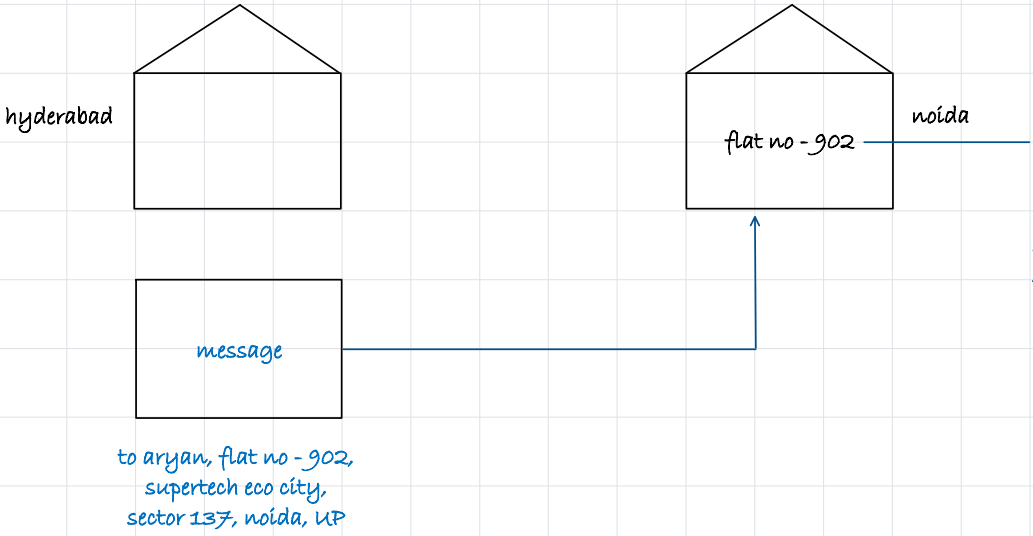
well known port number : assigned by IANA
0 to 1023 (1024 well known services)
(i) 25 - SMTP (simple mail transfer protocol) (used for mail)
(ii) 80 - HTTP (used to retrieve web page)
(iii) 110 - POP (post office protocol) (used to download the mail)
(iv) 143 - IMAP (internet mail access protocol) (used to download the mail)
(v) 20 - FTP (file transfer protocol) (used to transfer files)
(vi) 21 - FTP (file transfer protocol) (used to transfer files)

example : vipul wants to send message to aryan

(i) anyone can recieve the letter here (no name / no port number)



(ii) only aryan can recieve the letter here (name mentioned / port number mentioned)



note :
IP address (state) can be changed but MAC address (engine no./chasis no.) cannot be changed

(iii) connection problem

there are various ways to connect the system :
(i) bus topology
(ii) ring topology
(iii) mesh topology
(iv) tree topology
(v) star topology

these topology are not for GATE.

types of communication :

(i) unicast communication (1 : 1)

(ii) broadcast communication (1 : all)

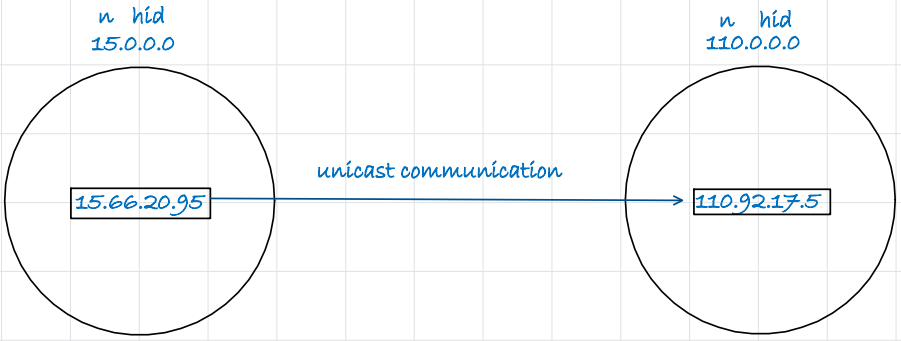
(iii) multicast communication (1 : many)

(i) unicast communication (1 : 1) : transmitting the data from one computer to another computer is called as unicast communication.

- it is one to one transmission.

example :

(i) same class network



source IP	destination IP
15.66.20.95	110.92.17.5

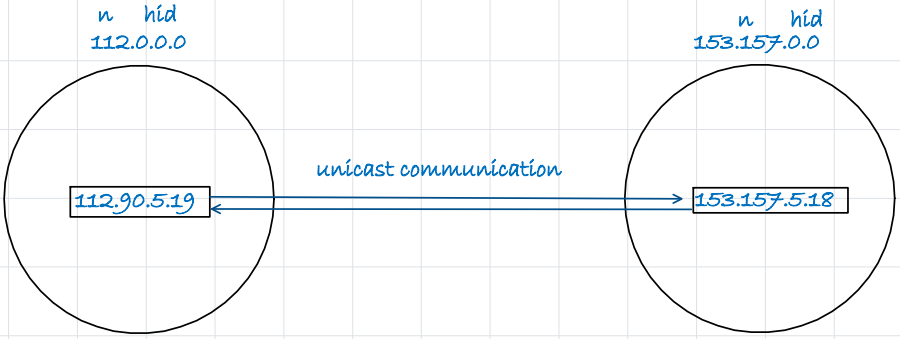
class : A (1bit fixed)
2^{24}-2 host/computer

15.0.0.0 (cannot be used)
15.255.255.255 (cannot be used)

class : A (1bit fixed)
2^{24}-2 host/computer

110.0.0.0 (cannot be used)
110.255.255.255 (cannot be used)

(ii) different class network



source IP	destination IP	
112.90.5.19	153.157.5.18	valid

source IP	destination IP	
153.157.5.18	112.90.5.19	valid

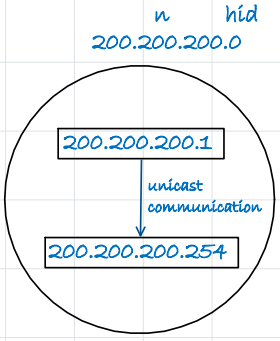
class : A (1bit fixed)
2^{24}-2 host/computer

15.0.0.0 (cannot be used)
15.255.255.255 (cannot be used)

class : B (2bit fixed)
2^{16}-2 host/computer

153.157.0.0 (cannot be used)
153.157.255.255 (cannot be used)

(iii) both source and destination in same network.



	source IP	destination IP
data	200.200.200.1	200.200.200.254

class : C (3bit fixed)
2^{8}-2 host/computer

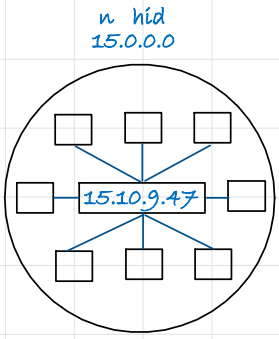
200.200.200.0 (cannot be used)
200.200.200.255 (cannot be used)

note :
in unicast communication both source and destination can be present in the same network (or) different network.

(ii) broadcast communication :
- it is one to all transmission.

(a) limited broadcasting : transmitting data from one computer to all computer in the same network.

(i) class - A
$2^{24}-2$



	source IP	destination IP	
data	15.10.9.47	255.255.255.255	valid

	source IP	destination IP	
data	255.255.255.255	15.10.9.47	not valid

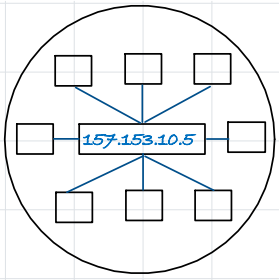
If all 32 bits are set to '1', then to send a message to all computers within your network, the appropriate destination IP address would be 255.255.255.255 irrespective of the classes.

all 32 its are '1' then, agar aap kisi bhi class ke network mai if aap apne network mai saare computer ko message bejhna chate ho toh the destination IP will be 255.255.255.255

n hid
157.153.0.0

(ii) class - B

$2^{16}-2$

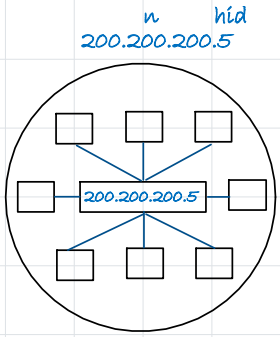


	source IP	destination IP	
data	157.153.10.5	255.255.255.255	valid

	source IP	destination IP	
data	255.255.255.255	157.153.10.5	not valid

(ii) class - C

$2^{8}-2$



	source IP	destination IP	
data	200.200.200.5	255.255.255.255	valid

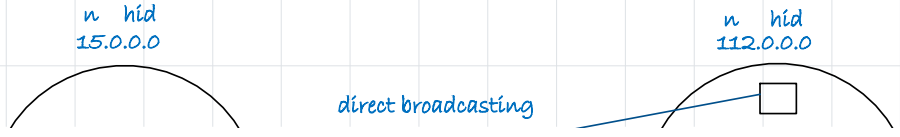
	source IP	destination IP	
data	255.255.255.255	200.200.200.5	not valid

note :
- 255 (all 32 bits '1') is fixed (or) reserved for limited broadcasting irrespective of the classes.
- limited broadcast address will always be used as a destination IP address.
- limited broadcast address cannot be used as a source IP address.

(b) direct broadcasting : transmitting data from one computer to all computer in the other network.

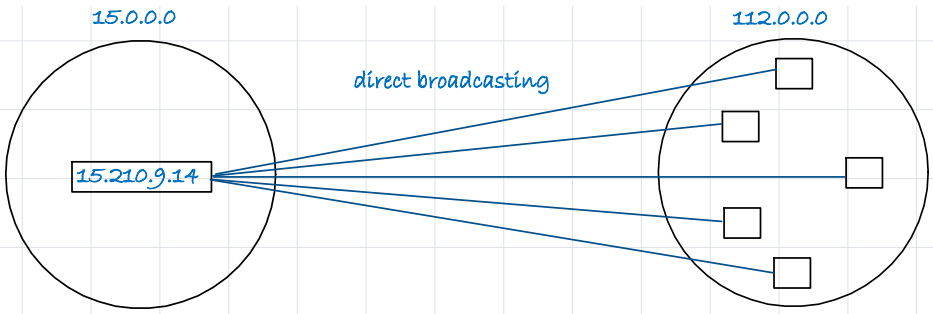
(i) class - A

$2^{24}-2$



(i) class - A

$2^{24}-2$



	source IP	destination IP	
data	15.210.9.14	112.255.255.255	valid

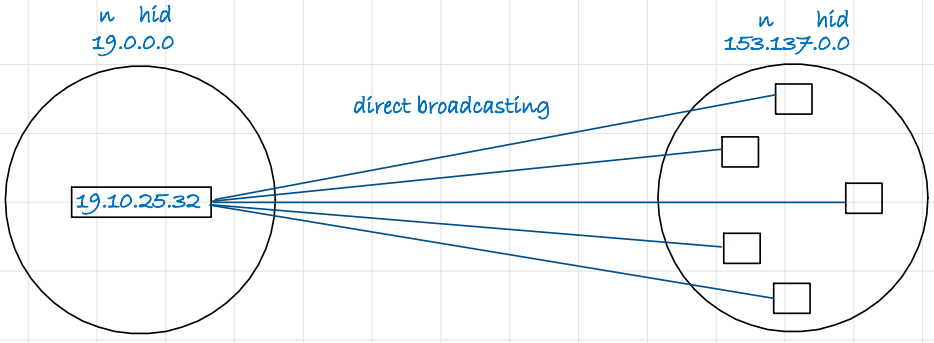
	source IP	destination IP	
data	112.255.255.255	15.210.9.14	not valid

note :
- 255 (all bits are '1' in host id) that IP address represents direct broadcast address so this is the reason we cannot assign this IP address to any host.
- Direct broadcast address cannot be used as a source IP address
- Direct broadcast address will always be used as a destination IP address.

- limited broadcasting address : 255.255.255.255
- direct broadcasting address :
  class A : nid.255.255.255
  class B : nid. nid.255.255
  class C : nid. nid. nid.255

(ii) class - A

$2^{24}-2$



(ii) class - B

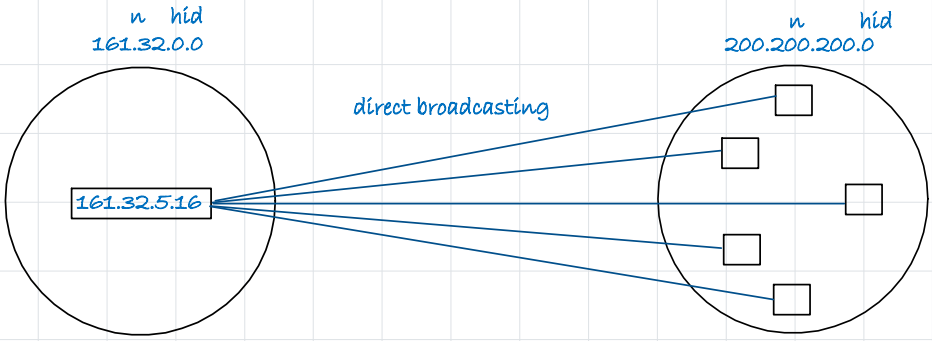
$2^{16}-2$

	source IP	destination IP	
data	19.10.25.32	153.137.255.255	valid

	source IP	destination IP	
data	153.137.255.255	19.10.25.32	not valid

(ii) class - B

$2^{16}-2$



(ii) class - C

$2^{8}-2$

	source IP	destination IP	
data	161.32.5.16	200.200.200.255	valid

	source IP	destination IP	
data	200.200.200.255	161.32.5.16	not valid

network id	host id	what it represents?
valid	all bit 0's	NID of entire network
valid	all bit 1's	direct broadcast address
all bit 1's	all bit 1's	limited broadcast address

IP Address	Network-Id	Direct Broadcast Address	Limited Broadcast Address
19.35.21.31	19 (A)	19.255.255.255	255.255.255.255
119.31.34.2	119 (A)	119.255.255.255	255.255.255.255
150.0.94.31	150.0 (B)	150.0.255.255	255.255.255.255
190.34.17.31	190.34 (B)	190.34.255.255	255.255.255.255
200.200.34.92	200.200.34 (C)	200.200.34.255	255.255.255.255
217.39.47.9	217.39.47 (C)	217.39.47.255	255.255.255.255
226.9.7.97	no nid	x	x
243.2.3.5	no nid	x	x

topic : network masks

a network mask helps you to know which portion of the address identifies the network-id and which portion of the address identifies the host-id.

class A,B and C networks have default masks, also knowns as natural masks, as shows here

Class A : 255.0.0.0 (8bit)
Class B : 255.255.0.0 (16bit)
Class C : 255.255.255.0 (24bit)

network id	host id	what it represents?
all bit 1's	all bit 0's	network masks

note :
- in the network masks number of 1's indicate the NID part and number of 0's indicate HID part

(i) class - A : network id - 8bit

1111 1111 . 0000 0000 . 0000 0000 . 0000 0000
255.0.0.0

(ii) class - B : network id - 16bit

1111 1111 . 1111 1111 . 0000 0000 . 0000 0000
255.255.0.0

(iii) class - C : network id - 24bit

1111 1111 . 1111 1111 . 1111 1111 . 0000 0000
255.255.255.0

example :

- IP address : 200.200.200.96
IP address : 1100 1000 . 1100 1000 . 1100 1000 . 0110 0000

- network mask : 255.255.255.0
network mask : 1111 1111 . 1111 1111 . 1111 1111 . 0000 0000

nid : 200.200.200
hid : 96

concept : bitwise AND (digital)

IP address : 1100 1000 . 1100 1000 . 1100 1000 . 0110 0000
AND
network mask : 1111 1111 . 1111 1111 . 1111 1111 . 0000 0000

NID : 1100 1000 . 1100 1000 . 1100 1000 . 0000 0000
NID : 200.200.200.0

if we perform bitwise AND of any 8 bit number with 255 then we will get the same 8 bit number in the result.

Q. Identify the type of the IP address 192.192.192.255 (Assuming Classful addressing scheme is followed.)

A. Directed broadcast address
B. Limited broadcast address
C. Host IP address
D. Network address

nid	hid
192.192.192	255

class - C
192 to 223
nid : 24bit
hid : 8bit
hid all '1'
hence, direct broadcasting address

Q. Match the following:

	List-I		List-II
(a)	200.10.192.100	(i)	Class A
(b)	7.10.230.1	(ii)	Limited Broadcast Address
(c)	128.1.1.254	(iii)	Directed Broadcast Address
(d)	255.255.255.255	(iv)	Class C
(e)	100.255.255.255	(v)	Class B

Codes:

A. a-ii, b-iii, c-iv, d-v, e-i
B. a-iv, b-i, c-v, d-ii, e-iii
C. a-iii, b-i, c-v, d-ii, e-iv
D. a-iv, b-ii, c-v, d-i, e-iii

Q. What is the network ID (NID) of the IP address 230.100.123.70? (Assuming Classful addressing scheme is followed).

A. 230.100.123.0
B. 230.100.0.0
C. 230.0.0.0
D. None of these

class - D
224 to 239
no nid and hid in class D

Q. Which can be valid class-c network ID?

A. 200.200.200.200
B. 200.200.200.0
C. 200.0.0.0
D. 194.194.194.0

class - C
192 to 223
nid : 2^{24}

nid : 2^{24}

D. 194.194.194.0

Q. 100.86.95.75, 157.192.190.253 ,200.1.56.97, 10.34.87.95. Which of the following is common for all these IP Addresses.

A. Class of IP address

B. Limited broadcast address 255.255.255.255

C. Network address

D. Direct broadcast address

Q. For the IP Addresses 132.54.78.98 identify the Class ,and Limited broadcast Address

A. IP address belong to class A, Limited broadcast address = 255.255.255.255

B. IP address belong to class B, Limited broadcast address = 130.255.255.255

C. IP address belong to class B, Limited broadcast address = 255.255.255.255

D. IP address belong to class A, Limited broadcast address = 130.54.255.255

Q. One host having IP address 200.187.96.0, sends a message to a host with IP address 205.54.83.97, what will be the destination address attached to message by source?

A. 205.54.83.97

B. 205.54.83.255

C. 205.54.83.0

D. Not possible

200.187.96.0 — class : C
nid : 2^{24}
hid : 2^{8}
all bits 0
assigned hid cannot be 0

invalid IP

Q. Which of the following can be used as a source IP as well as destination IP ?

A. 23.0.0.97 unicast communication

B. 255.255.255.255

C. 157.54.255.255

D. 15.255.255.255

Q. Which of the following IP address can be given to a computer as a host?

Q. Which of the following IP address can be given to a computer as a host?

A. 32.0.0.0 class - A (0 hid)

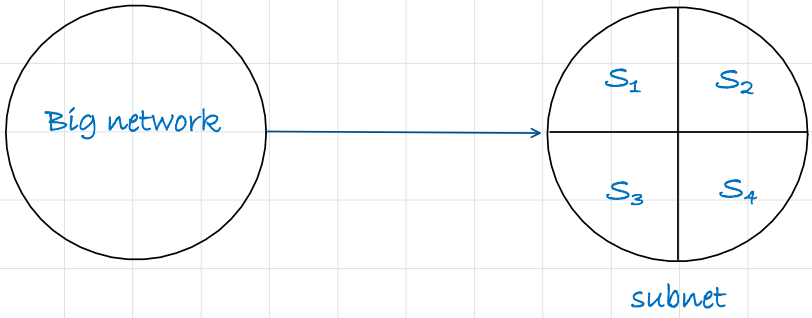
B. 255.255.255.255 all 1 hence limited broadcasting address

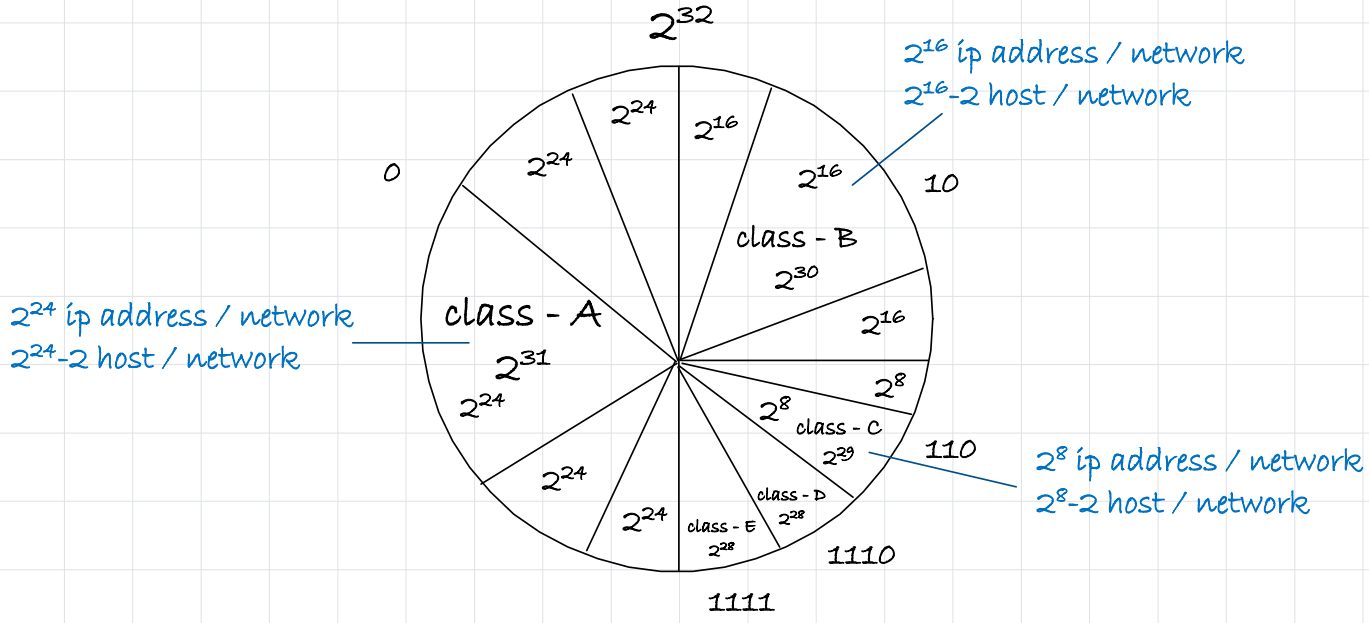
C. 157.54.255.254 class - B (hid is not 1 and 0)

D. 172.15.0.0 class - B (0 hid)

subnetting

the process of dividing a big network into many smaller subnet is called subnetting





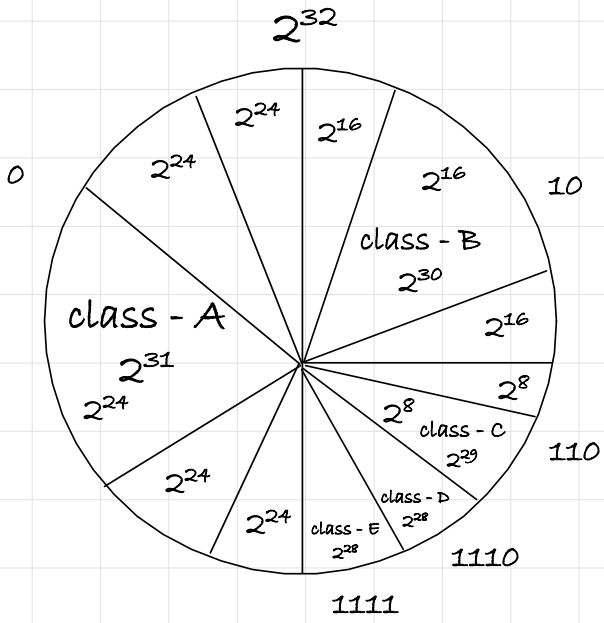
(i) Class A : 2^{24} IP addresses in one network.
2^{24}-2 host per network

(ii) Class B : 2^{16} IP addresses in one network.
2^{16}-2 host per network

(iii) Class C : 2^8 IP addresses in one network.

2^8-2 host per network

q.assume a organization X requires : 2^{22} ip address, which class network will be assigned?



class 'A' will be assigned.

number of IP address wasted : $2^{24} - 2^{22}$

$= 2^2.2^{22}-2^{22}$

$= 4.2^{22}-2^{22}$

$= 3.2^{22}$

$= 3.2^2.2^{20}$

$= 3.4.2^{20}$

$= 12.2^{20}$

$= 12M$

$= 12,582,912$

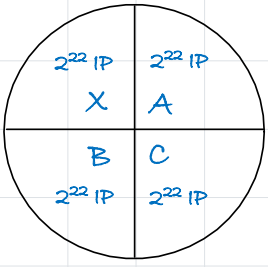
more than 1.2 crore IP address wasted.

that is why we need subnetting!

so, x organisation purchased the class-A network and searched for 3 other organisations that requires of same amount IP addresses.

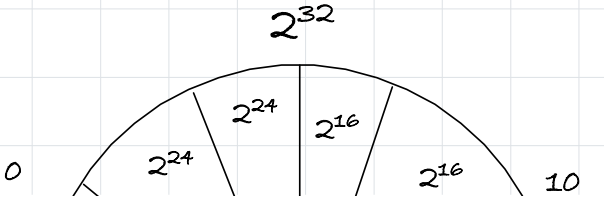
$\frac{2^{24}}{4} = \frac{2^{24}}{2^2} = 2^{24-2} = 2^{22}$

X : 2^{22}
A : 2^{22}
B : 2^{22}
C : 2^{22}



so, dividing and sharing the larger IP address into many smaller networks

q.assume a organization Y requires : 2^{13} ip address, which class network will be assigned?



class 'B' will be assigned.

number of IP address wasted : $2^{16} - 2^{13}$

class 'B' will be assigned.

number of IP address wasted : $2^{16} - 2^{13}$

$= 2^3.2^{13} - 2^{13}$

$= 8.2^{13} - 2^{13}$

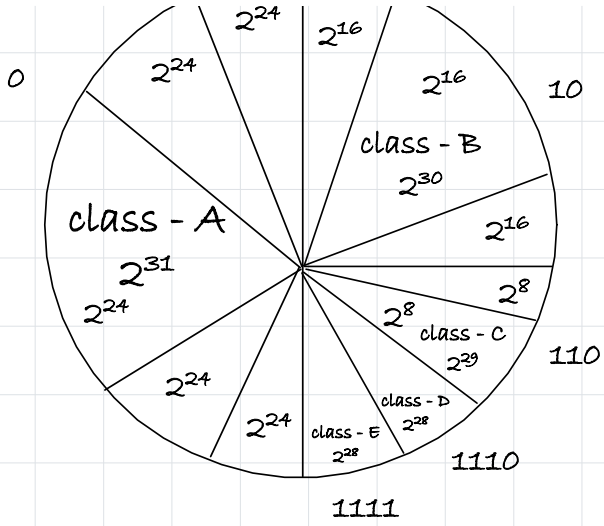
$= 7.2^{13}$

$= 7.2^{10}.2^3$

$= 7.8.2^{10}$

$= 56K$

$= 57,344$



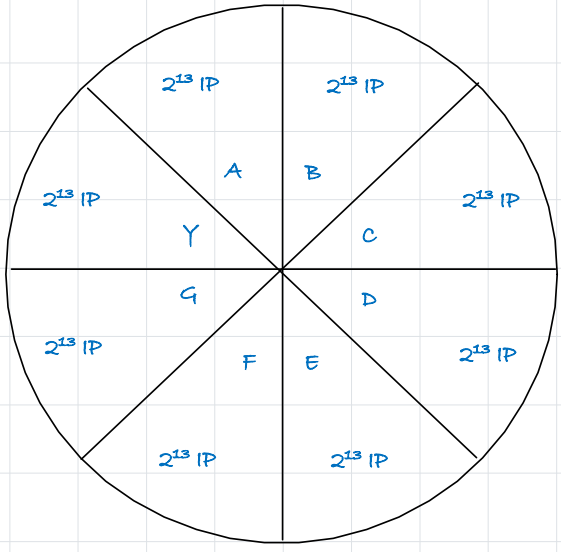
more than 57 thousand IP address wasted.

that is why we need subnetting!

so, Y organisation purchased the class-B network and searched for 7 other organisations that requires of same amount IP addresses.

$\frac{2^{16}}{8} = \frac{2^{16}}{2^3} = 2^{16-3} = 2^{13}$

Y : 2^{13}
A : 2^{13}
B : 2^{13}
C : 2^{13}
D : 2^{13}
E : 2^{13}
F : 2^{13}
G : 2^{13}



so, dividing and sharing the larger IP address into many smaller networks

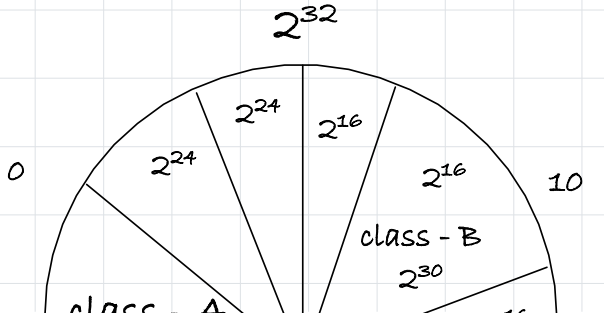
q.assume a organization Z requires : 2^7 ip address, which class network will be assigned?

class 'C' will be assigned.

number of IP address wasted : $2^8 - 2^7$

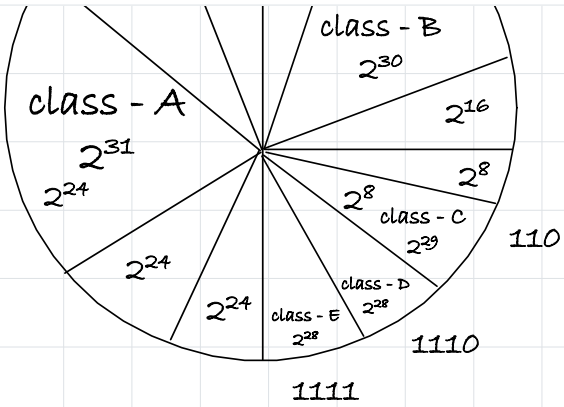
$= 256 - 128$

$= 128$



$= 256 - 128$

$= 128$



128 IP address wasted.

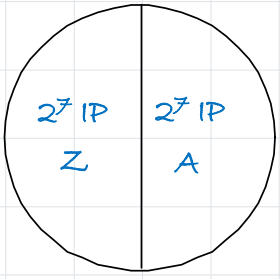
that is why we need subnetting!

so, Z organisation purchased the class C network and searched for 1 other organisation that requires of same amount IP addresses.

$$\frac{2^8}{2} = \frac{2^8}{2^1} = 2^{8-1} = 2^7$$

Z : 2^7

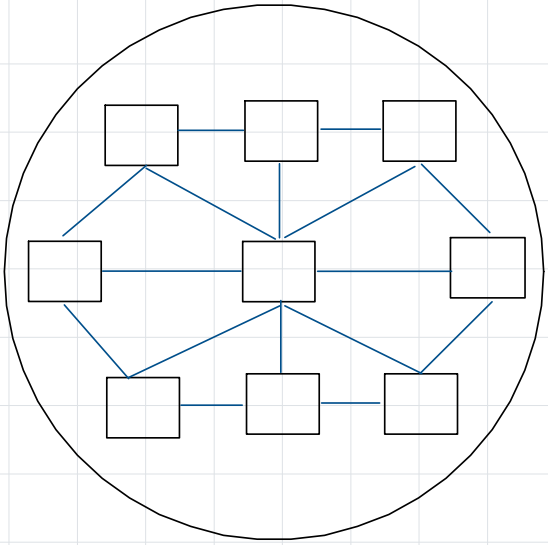
A : 2^7



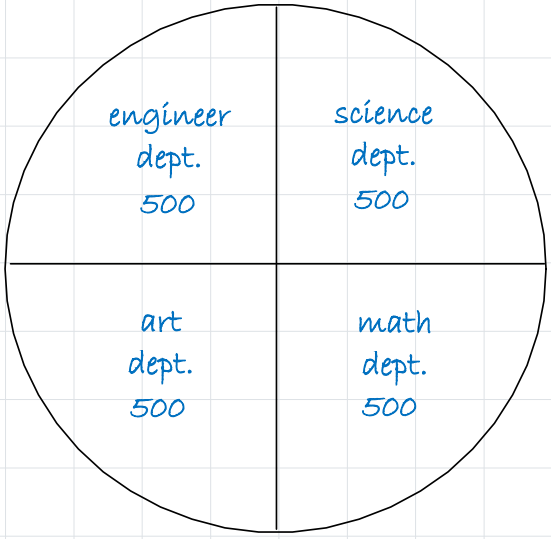
so, dividing and sharing the larger IP address into many smaller networks

advantages :

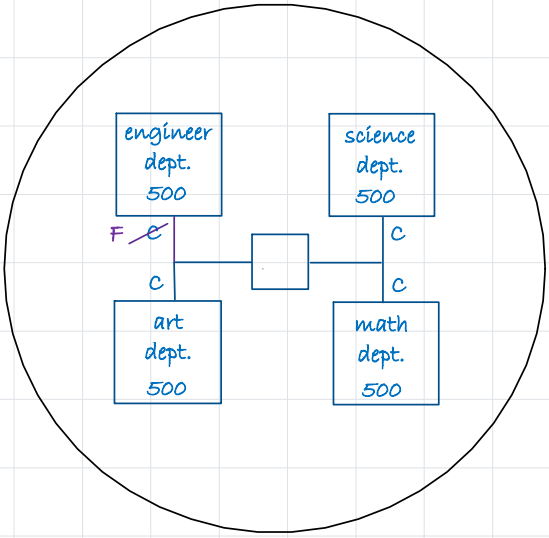
(i) maintainence and administration is simple and easy



JNU - 2000

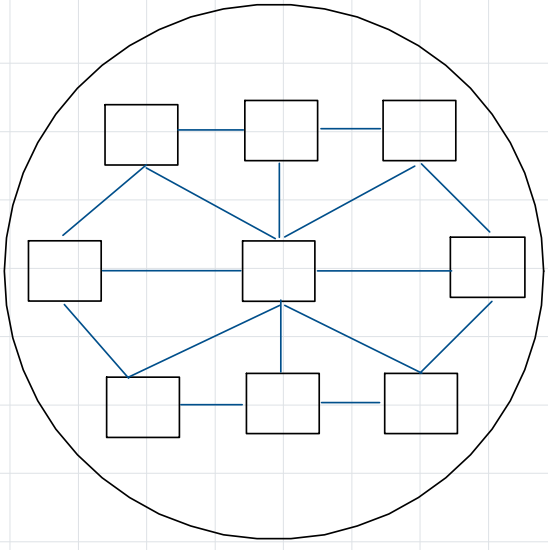


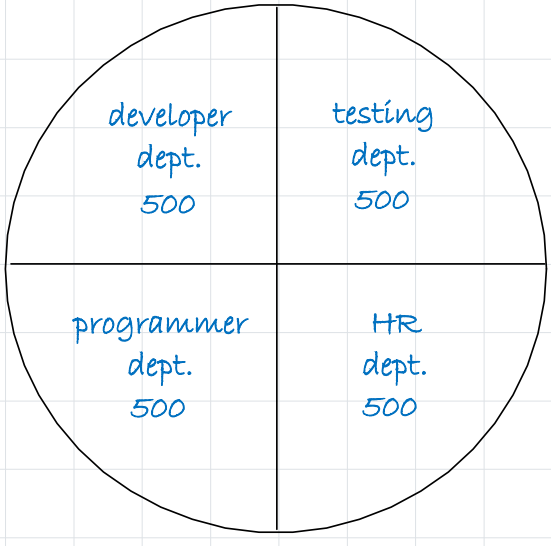
in the JNU lab all 2000 computers are connected with a copper cable. engineer students are demanding to change the copper cable to fibre cable, but in the lab all 2000 computer are connected with copper cable. so, in order to change copper cable to fibre cable we have to change it for all the computers exists in lab. hence, maintainence cost will be high.



in the JNU lab all 2000 computers are connected with a copper cable but to fulfil demand we divided all four department into different sub networks and then we specifically changed the copper cable to fibre cable for engineering department lab.

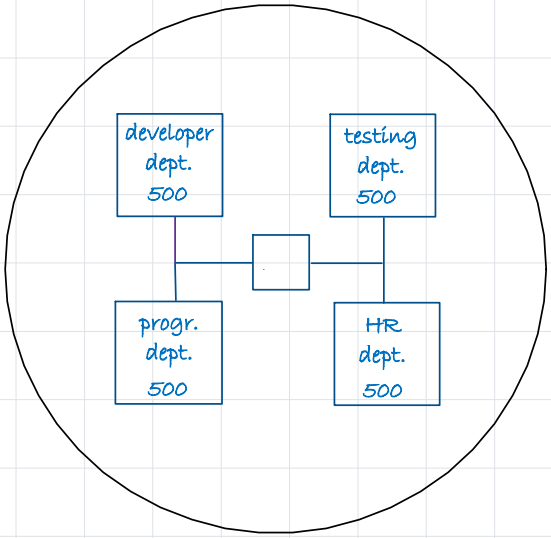
(ii) it provides security to one network from another network





IBM - 2000

in the IBM all 2000 computers are connected with a network. i dont want other departments to know about the code developer has developed or HR manages the salary so, i dont want other departments to know the salary data that HR maintains. i want internal security.



now, there is internal security as there are individual departments where only developers can enter development department and so on.

disadvantages :

(i) subnetting complicates the communication process. instead of 3 step procedure now it becomes 4 step procedure.

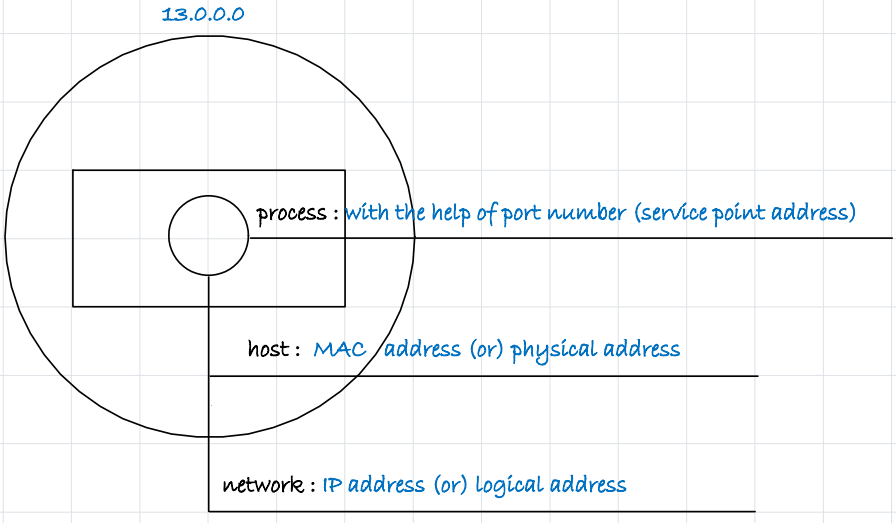
step (i) identify the network

step (ii) identify the subnet with in the network

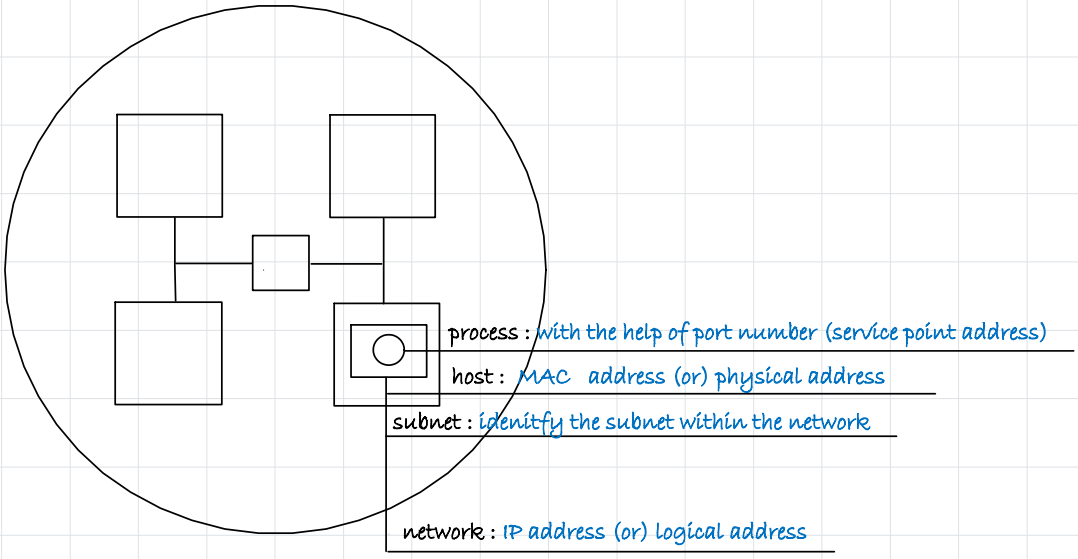
step (iii) identify the host with in the subnet

step (iv) identify the process with in the host

before :



now :



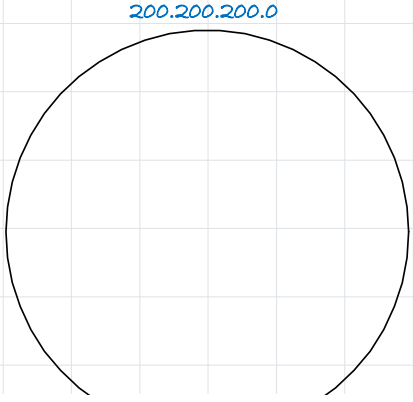
(ii) in case of single network only two IP addresses are wasted to represent the network id and direct broadcast address but in case of subnetting two IP addresses are wasted for each subnet.

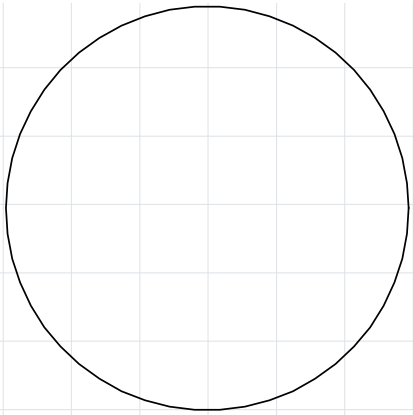
(iii) cost of overall network also increase. subnetting requires internal routers, switches, hub, bridges, etc. which are very costly.

(iv) subnetting and network management require an experienced network administrator. this adds to the overall cost as well.

note :
- the process of borrowing bits from HID to generate the subnet ID is also called as subnetting.
- number of bit borrowed depends on our requirement.

example : the process of borrowing bits from HID to generate the subnet ID is also called as subnetting.





class : C

nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

hid : 6 bit
2^6-2 host / subnet
62 host / subnet

2bit borrowed : 2^2 = 4 subnet

possible combinations :
S_1 : 00
S_2 : 10
S_3 : 01
S_4 : 11

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

confusion :
nid : 24 bit
hid : 8 bit
nid mai all bits 0 wala 1 IP address is not used
hid mai all bits 1 wala 1 IP address is not used

total 2 IP address wasted.

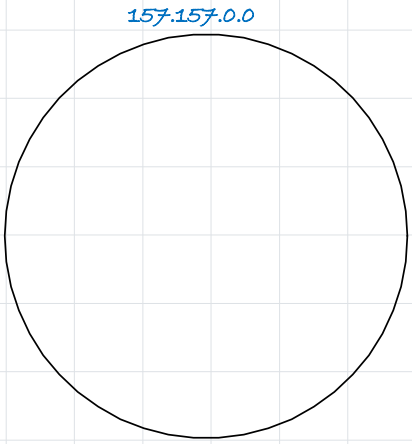
ab unke subnets bane 4 jisme har subnet mai bhi 2 IP address same way mai waste hoga toh
total 8 aur 2 IP address network ke waste

total : 10

but according to answer only 8 IP address are wasted, why?
because, humare pass jo IP (200.200.200.0) pure network ki network id ko represent karega wahi IP first subnet ki subnet ID ko represent karega.

so, first subnet ki subnet id = pure network ki network id.

(ii)



class : B

nid : 16 bit
hid : 16 bit
2^{16} = 256 IP addresses
i have to borrow 9 bits in order to make 512 subnets

hid : 7 bit
2^7-2 host / subnet
126 host / subnet

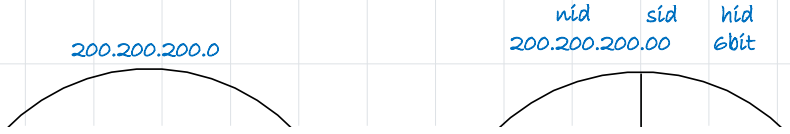
9 bit borrowed : 2^9 = 512 subnet

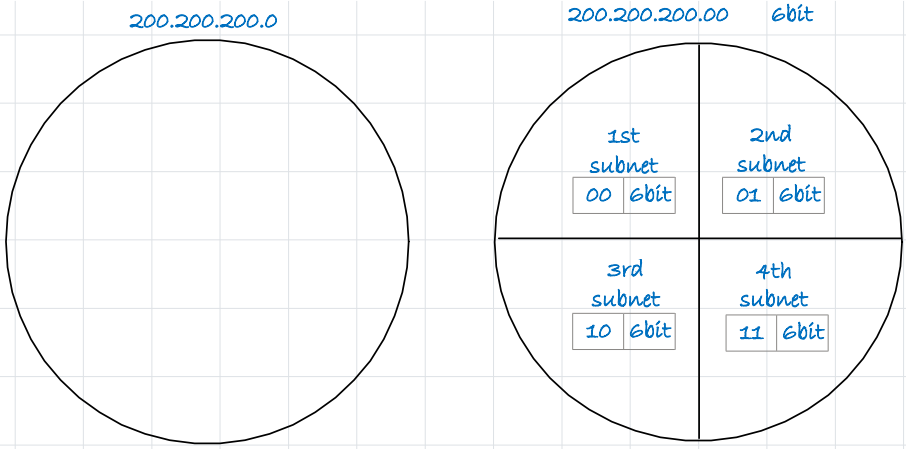
512 subnet x 126 host = 64,512 host
65,536 IP addresses - 64,512 host = 1024 IP addresses wasted

subnetting categories : 1 to 10

subnetting category - 1

example 1 :





class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

- hid : 6 bit
2^6-2 host / subnet
62 host / subnet

2bit borrowed : 2^2 = 4 subnet

- possible combinations :
S_1 : 00 - 1st subnet
S_2 : 01 - 2nd subnet
S_3 : 10 - 3rd subnet
S_4 : 11 - 4th subnet

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

first subnet

nid	sid	hid
200.200.200.00		6bit

possible combination:

200.200.200.00 000000 200.200.200.0 ——— subnet id
200.200.200.00 000001 200.200.200.1

200.200.200.00	000000	200.200.200.0 — subnet id
200.200.200.00	000001	200.200.200.1
200.200.200.00	000010	200.200.200.2
.		.
.		.
200.200.200.00	111110	200.200.200.62
200.200.200.00	111111	200.200.200.63 — direct broadcasting address

valid hosts : 62.
2^6-2 host / subnet

second subnet

nid	sid	hid
200.200.200.01	6bit	

possible combination:

200.200.200.01	000000	200.200.200.64 — subnet id
200.200.200.01	000001	200.200.200.65
200.200.200.01	000010	200.200.200.66
.		.
.		.
200.200.200.01	111110	200.200.200.126
200.200.200.01	111111	200.200.200.127 — direct broadcasting address

valid hosts : 62.
2^6-2 host / subnet

third subnet

nid	sid	hid
200.200.200.10	6bit	

possible combination:

200.200.200.10	000000	200.200.200.128 — subnet id
200.200.200.10	000001	200.200.200.129
200.200.200.10	000010	200.200.200.130
.		.
.		.
200.200.200.10	111110	200.200.200.190
200.200.200.10	111111	200.200.200.191 — direct broadcasting address

valid hosts : 62.
2^6-2 host / subnet

fourth subnet

nid	sid	hid
200.200.200.11	6bit	

200.200.200.11 6bit

possible combination:

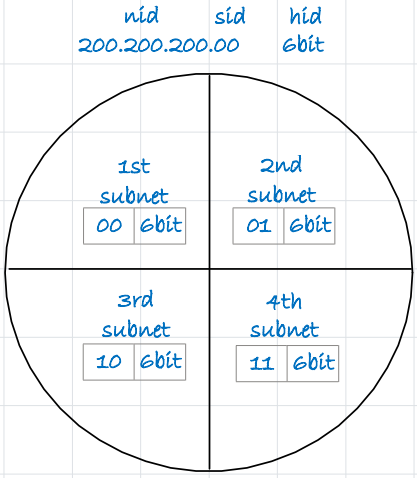
200.200.200.11 000000	200.200.200.192 — subnet id
200.200.200.11 000001	200.200.200.193
200.200.200.11 000010	200.200.200.194
.	.
.	.
200.200.200.11 111110	200.200.200.254
200.200.200.11 111111	200.200.200.255 — direct broadcasting address

valid hosts : 62.
2^6-2 host / subnet

shortcut (ad rule)

0 0 | 0 1 | 1 0 | 1 1

128 64 | 128 64 | 128 64 | 128 64



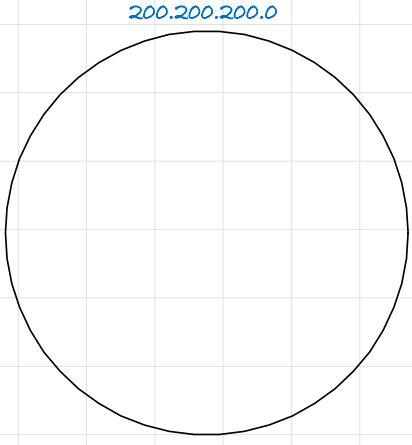
1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.63

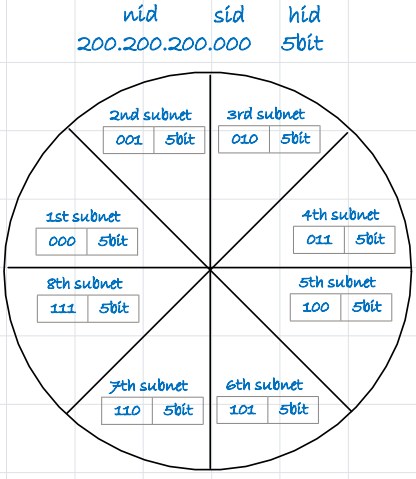
2nd subnet
- sid : 200.200.200.64
- dba : 200.200.200.127

3rd subnet
- sid : 200.200.200.128
- dba : 200.200.200.191

4th subnet
- sid : 200.200.200.192
- dba : 200.200.200.255

example 2 :





class : C

class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 3 bits in order to make 8 subnets

- hid : 5 bit
2^5-2 host / subnet
30 host / subnet

3bit borrowed : 2^3 = 8 subnet

- possible combinations :
S_1 : 000 - 1st subnet
S_2 : 001 - 2nd subnet
S_3 : 010 - 3rd subnet
S_4 : 011 - 4th subnet
S_5 : 100 - 5th subnet
S_6 : 101 - 6th subnet
S_7 : 110 - 7th subnet
S_8 : 100 - 8th subnet

8 subnet x 30 host = 24 host
256 IP addresses - 240 host = 16 IP addresses wasted

first subnet

nid	sid	hid
200.200.200.000		5bit

possible combination:

200.200.200.000	00000	200.200.200.0	subnet id
200.200.200.000	00001	200.200.200.1	valid hosts : 30 (2^5-2 host / subnet)
200.200.200.000	00010	200.200.200.2	
.		.	
.		.	
200.200.200.000	11110	200.200.200.30	
200.200.200.000	11111	200.200.200.31	direct broadcasting address

second subnet

second subnet

nid	sid	hid
200.200.200.001		5bit

possible combination:

200.200.200.001 00000	200.200.200.32 — subnet id
200.200.200.001 00001	200.200.200.33
200.200.200.001 00010	200.200.200.34
.	.
.	.
200.200.200.001 11110	200.200.200.62
200.200.200.001 11111	200.200.200.63 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

third subnet

nid	sid	hid
200.200.200.010		5bit

possible combination:

200.200.200.010 00000	200.200.200.64 — subnet id
200.200.200.010 00001	200.200.200.65
200.200.200.010 00010	200.200.200.66
.	.
.	.
200.200.200.010 11110	200.200.200.94
200.200.200.010 11111	200.200.200.95 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

fourth subnet

nid	sid	hid
200.200.200.011		5bit

possible combination:

200.200.200.011 00000	200.200.200.96 — subnet id
200.200.200.011 00001	200.200.200.97
200.200.200.011 00010	200.200.200.98
.	.
.	.
200.200.200.011 11110	200.200.200.126
200.200.200.011 11111	200.200.200.127 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

.		.
200.200.200.011	11110	200.200.200.126
200.200.200.011	11111	200.200.200.127 — direct broadcasting address

fifth subnet

nid	sid	hid
200.200.200.100		5bit

possible combination:

200.200.200.100	00000	200.200.200.128 — subnet id
200.200.200.100	00001	200.200.200.129
200.200.200.100	00010	200.200.200.130
.		.
.		.
200.200.200.100	11110	200.200.200.158
200.200.200.100	11111	200.200.200.159 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

sixth subnet

nid	sid	hid
200.200.200.101		5bit

possible combination:

200.200.200.101	00000	200.200.200.160 — subnet id
200.200.200.101	00001	200.200.200.161
200.200.200.101	00010	200.200.200.162
.		.
.		.
200.200.200.101	11110	200.200.200.190
200.200.200.101	11111	200.200.200.191 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

seventh subnet

nid	sid	hid
200.200.200.110		5bit

possible combination:

200.200.200.110	00000	200.200.200.192 — subnet id

possible combination:

200.200.200.110	00000	200.200.200.192 — subnet id
200.200.200.110	00001	200.200.200.193
200.200.200.110	00010	200.200.200.194
.		.
.		.
200.200.200.110	11110	200.200.200.222
200.200.200.110	11111	200.200.200.223 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

eighth subnet

nid	sid	hid
200.200.200.111		5bit

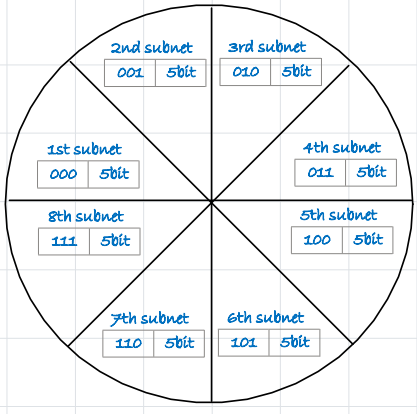
possible combination:

200.200.200.111	00000	200.200.200.224 — subnet id
200.200.200.111	00001	200.200.200.225
200.200.200.111	00010	200.200.200.226
.		.
.		.
200.200.200.111	11110	200.200.200.254
200.200.200.111	11111	200.200.200.255 — direct broadcasting address

valid hosts : 30
2^5-2 host / subnet

shortcut (ad rule)

nid	sid	hid
200.200.200.000		5bit



0	0	0	0	0	1	0	1	0	0	1	1
128	64	32	128	64	32	128	64	32	128	64	32
1	0	0	1	0	1	1	1	0	1	1	1
128	64	32	128	64	32	128	64	32	128	64	32

1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.31

5th subnet
- sid : 200.200.200.128
- dba : 200.200.200.159

1st subnet
- dba : 200.200.200.31

2nd subnet
- sid : 200.200.200.32
- dba : 200.200.200.63

3rd subnet
- sid : 200.200.200.64
- dba : 200.200.200.95

4th subnet
- sid : 200.200.200.96
- dba : 200.200.200.127

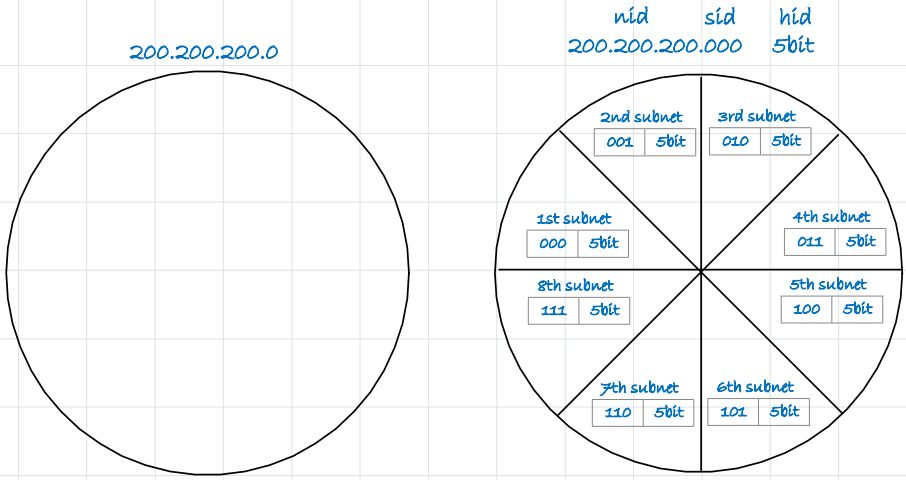
5th subnet
- dba : 200.200.200.159

6th subnet
- sid : 200.200.200.160
- dba : 200.200.200.191

7th subnet
- sid : 200.200.200.192
- dba : 200.200.200.223

8th subnet
- sid : 200.200.200.224
- dba : 200.200.200.255

shortcut (ad rule 2.0)



(0) decimal ⟵ 000 ⟶ 1st subnet

(1) decimal ⟵ 001 ⟶ 2nd subnet

(2) decimal ⟵ 010 ⟶ 3rd subnet

(3) decimal ⟵ 011 ⟶ 4th subnet

(4) decimal ⟵ 100 ⟶ 5th subnet

(5) decimal ⟵ 101 ⟶ 6th subnet

(6) decimal ⟵ 110 ⟶ 7th subnet

(7) decimal ⟵ 111 ⟶ 8th subnet

(7) decimal ⟵ 111 ⟶ 8th subnet

(i) 4th Subnet [SID& DBA] _____
(ii) 6th Subnet [SID& DBA] _____
(iii) 7th Subnet [SID& DBA] _____

(i) 4th Subnet [SID& DBA] _____

sol.

4th subnet
sid : 3bits
hid : 5bits

binary : 011
decimal : 3

sid : 200.200.200.011 00000
200.200.200.96 (63+32)

dba : 200.200.200.011 11111
200.200.200.127 (255-128)

(ii) 6th Subnet [SID& DBA] _____

sol.

6th subnet
sid : 3bits
hid : 5bits

binary : 101
decimal : 5

sid : 200.200.200.101 00000
200.200.200.160 (128+32)

dba : 200.200.200.101 11111
200.200.200.191 (255-64)

(iii) 7th Subnet [SID& DBA] _____

sol.

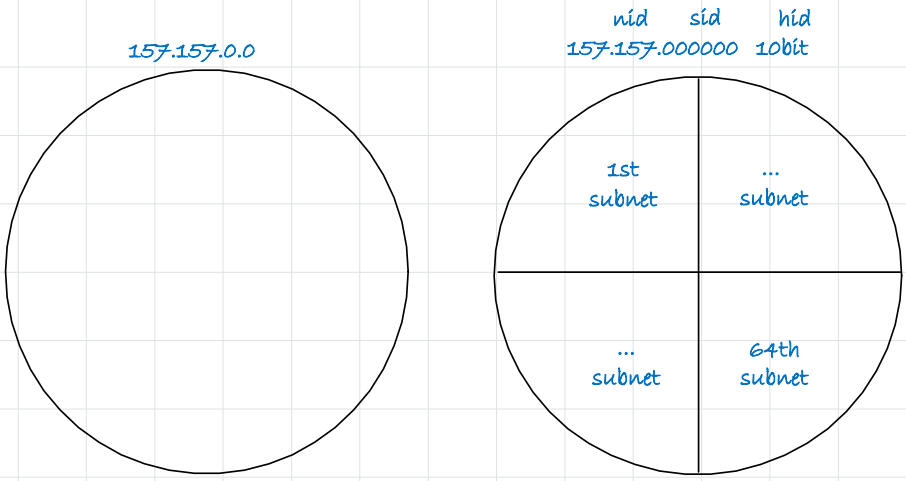
7th subnet
sid : 3bits
hid : 5bits

binary : 110
decimal : 6

sid : 200.200.200.110 00000
200.200.200.192 (128+64)

dba : 200.200.200.110 11111
200.200.200.223 (255-32)

example 3 :



class : B

- nid : 16 bit
hid : 16 bit
2^{16} = 65536 IP addresses
i have to borrow 6 bits in order to make 64 subnets

- hid : 10 bit
2^{10}-2 host / subnet
1022 host / subnet

6bit borrowed : 2^6 = 64 subnet

64 subnet x 1022 host = 65408 host
65536 IP addresses - 65408 host = 128 IP addresses wasted

(i) 8th Subnet [SID& DBA] _____
(ii) 17th Subnet [SID& DBA] _____
(iii) 28th Subnet [SID& DBA] _____
(iV) 61th Subnet [SID& DBA] _____

(i) 8th Subnet [SID& DBA] _____

sol.

8th subnet
sid : 6bits
hid : 10bits

binary : 000111
decimal : 7

sid : 157.157.000111 0000000000
157.157.28.0 (16+8+4)

dba : 157.157.000111 1111111111
157.157.31.255 (255-128-64-32)

(ii) 17th Subnet [SID& DBA] _____

sol.

17th subnet
sid : 6bits
hid : 10bits

binary : 010000
decimal : 16

sid : 157.157.010000 0000000000
157.157.64.0 (128)

dba : 157.157.010000 1111111111
157.157.67.255 (255-128-32-16-8-4)

(iii) 28th Subnet [SID& DBA] _____

sol.

28th subnet
sid : 6bits
hid : 10bits

binary : 011011
decimal : 27

sid : 157.157.011011 0000000000
157.157.108.0 (64+32+8+4)

dba : 157.157.011011 1111111111
157.157.111.255 (255-128-16)

(iV) 61th Subnet [SID& DBA] _____

sol.

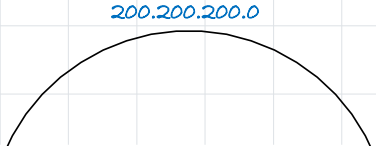
61th subnet
sid : 6bits
hid : 10bits

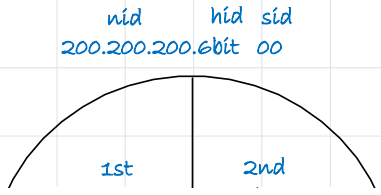
binary : 111100
decimal : 60

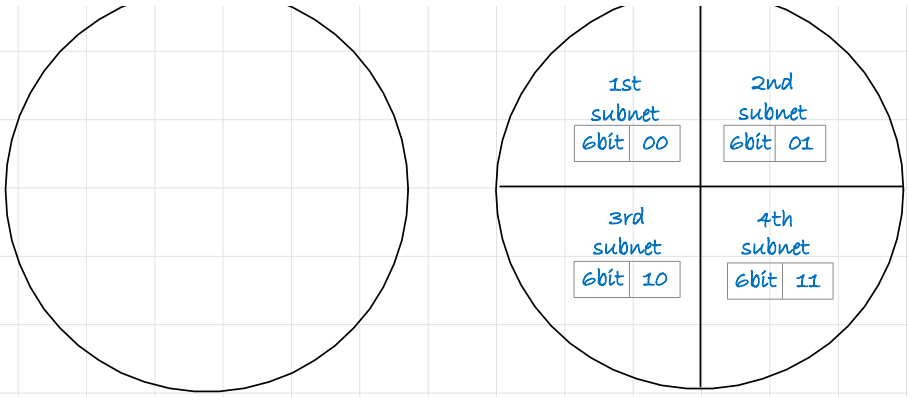
sid : 157.157.111100 0000000000
157.157.240.0 (128+64+32+16)

dba : 157.157.111100 1111111111
157.157.243 (255-8-4)

example 4 : borrowing last two bits from hid







class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

- hid : 6 bit
2^6-2 host / subnet
62 host / subnet

2bit borrowed : 2^2 = 4 subnet

- possible combinations :
S_1 : 00 - 1st subnet
S_2 : 01 - 2nd subnet
S_3 : 10 - 3rd subnet
S_4 : 11 - 4th subnet

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

first subnet

nid	hid	sid
200.200.200.	6bit	00

possible combination:

200.200.200.000000 00	200.200.200.0 ——— subnet id
200.200.200.000001 00	200.200.200.4
200.200.200.000010 00	200.200.200.8
.	.
.	.

.	.
.	.
200.200.200.111110 00	200.200.200.248
200.200.200.111111 00	200.200.200.252 — direct broadcasting address

second subnet

nid hid sid
200.200.200.6bit 00

possible combination:

200.200.200.000000 01	200.200.200.1 — subnet id
200.200.200.000001 01	200.200.200.5
200.200.200.000010 01	200.200.200.9
.	.
.	.
200.200.200.111110 01	200.200.200.249
200.200.200.111111 01	200.200.200.253 — direct broadcasting address

third subnet

nid hid sid
200.200.200.6bit 00

possible combination:

200.200.200.000000 10	200.200.200.2 — subnet id
200.200.200.000001 10	200.200.200.6
200.200.200.000010 10	200.200.200.10
.	.
.	.
200.200.200.111110 10	200.200.200.250
200.200.200.111111 10	200.200.200.254 — direct broadcasting address

fourth subnet

nid hid sid
200.200.200.6bit 00

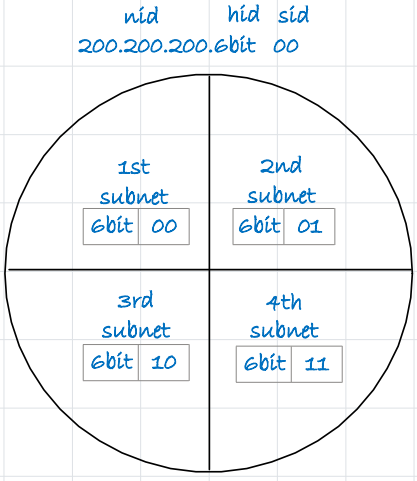
possible combination:

200.200.200.000000 11	200.200.200.3 — subnet id
200.200.200.000001 11	200.200.200.7
200.200.200.000010 11	200.200.200.11
.	.
.	.
200.200.200.111110 11	200.200.200.251
200.200.200.111111 11	200.200.200.255 — direct broadcasting address

note : this is not a valid subnet, in any network, IP address must be continious, i can broadcast direct or limited only if IP address is continious

shortcut (ad rule)

0	0	0	1	1	0	1	1
2	1	2	1	2	1	2	1



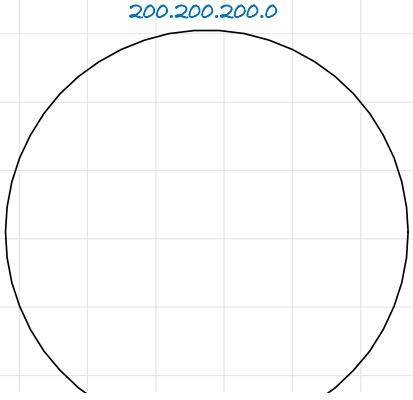
1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.252

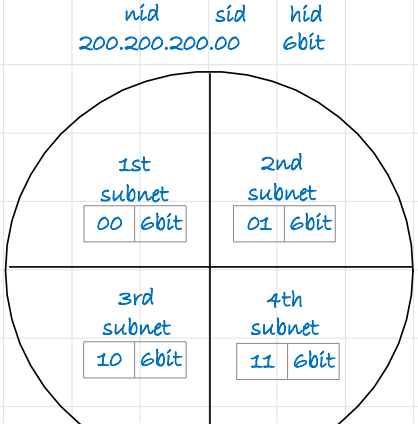
2nd subnet
- sid : 200.200.200.1
- dba : 200.200.200.253

3rd subnet
- sid : 200.200.200.2
- dba : 200.200.200.254

4th subnet
- sid : 200.200.200.3
- dba : 200.200.200.255

example 1 :





class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

- hid : 6 bit
2^6-2 host / subnet
62 host / subnet

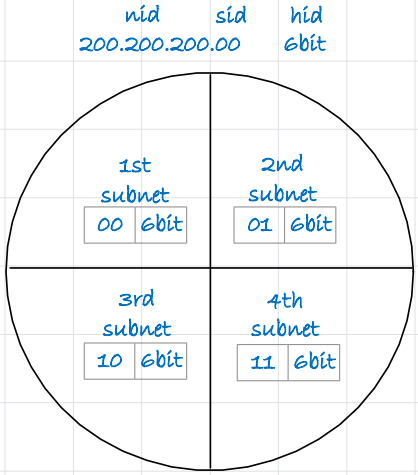
2bit borrowed : 2^2 = 4 subnet

- possible combinations :
S_1 : 00 - 1st subnet
S_2 : 01 - 2nd subnet
S_3 : 10 - 3rd subnet
S_4 : 11 - 4th subnet

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

shortcut (ad rule)

0 0	0 1	1 0	1 1
128 64	128 64	128 64	128 64



1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.63

2nd subnet
- sid : 200.200.200.64
- dba : 200.200.200.127

3rd subnet
- sid : 200.200.200.128
- dba : 200.200.200.191

4th subnet
- sid : 200.200.200.192
- dba : 200.200.200.255

nid of whole network : 200.200.200.0 (sid of first subnet)

dba of whole network : 200.200.200.255 (dba of last subnet)

q. the message will transfer to complete network as the dba of whole network is 200.200.200.255 or the message will transfer to 4th subnet only as the dba of 4th subnet is also 200.200.200.255.

	sip	dip
data	_____	200.200.200.255

- if packet is coming from outside the network then 200.200.200.255 will represent the dba of entire network.

- if packet is coming from inside the network then 200.200.200.255 will represent the dba of last subnet.

old RFC - 950

sid : n bit
no. of subnets : 2^n-2

latest RFC - 1812

sid : n bit
no. of subnets : 2^n

note :
in the past there were limitations to use of a subnet 0 (all subnet bits are set to 0) and all ones subnet (all subnet bits set to one). some devices would not allow the use of these subnets.

subnetting category - 2

subnet mask

it is a 32-bit number used to indicate number of bits borrowed from host-id and there positions (subnet mask se bata sakte host id se kitni bit borrow li thi aur unki position kya hai) based on following rules :

rule 1 :number of 1's in the subnet mask indicate NID + SID

rule 2 :number of 0's in the subnet mask indicate HID part

default subnet mask

class A : 255.0.0.0

class B : 255.255.0.0

class C : 255.255.255.0

(i) class A : 255.0.0.0

1111 1111 . 0000 0000 . 0000 0000 . 0000 0000

nid : 8bit, hid : 24bit

number of 1's = 8	number of 0's = 24
NID + SID = 8 8 + SID = 8 SID = 8-8 = 0 no bits borrowed.	HID = 24

Q. If NID = 200.200.200.0 and the subnet Mask = 255.255.255.192 then identify:

I. Number of bit borrowed from Host-id. 2

II. Number of subnet possible and their subnet id's. 4

III. Number of Host/subnet. 62

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.192
1111 1111 . 1111 1111 . 1111 1111 . 1100 0000
nid sid hid

number of 1's : 26
number of 0's : 6

number of 1's : NID + SID = 26
24 + SID = 26
SID = 26 - 24 = 2
SID : 2bit

number of subnet : $2^2 = 4$

number of host / subnet : $2^6-2 = 62$

concept : subnet id's

200.200.200. __ ______
nid sid hid

shortcut (ad rule)

0 0 0 1 1 0 1 1
128 64 128 64 128 64 128 64

200.200.200. 00 000000 ⟶ 200.200.200.0
200.200.200. 01 000000 ⟶ 200.200.200.64
200.200.200. 10 000000 ⟶ 200.200.200.128
200.200.200. 11 000000 ⟶ 200.200.200.192

Q. If NID = 200.200.200.0 and the subnet Mask = 255.255.255.224 then identify:

I. Number of bit borrowed from Host-id. 3

II. Number of Subnet possible and their subnet id's. 8

III. Number of Host/Subnet. 30

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.224
1111 1111 . 1111 1111 . 1111 1111 . 111 00000
nid sid hid

number of 1's : 27
number of 0's : 6

number of 1's : NID + SID = 27
24 + SID = 27
SID = 27 - 24 = 3
SID : 3bit

number of subnet : $2^3 = 8$

number of host / subnet : $2^5 - 2 = 30$

subnet id's

200.200.200. ___ ------
nid sid hid

shortcut (ad rule)

0 0 0	0 0 1	0 1 0	0 1 1
128 64 32	128 64 32	128 64 32	128 64 32
1 0 0	1 0 1	1 1 0	1 1 1
128 64 32	128 64 32	128 64 32	128 64 32

200.200.200. 000 00000 ⟶ 200.200.200.0
200.200.200. 001 00000 ⟶ 200.200.200.32
200.200.200. 010 00000 ⟶ 200.200.200.64
200.200.200. 011 00000 ⟶ 200.200.200.96
200.200.200. 100 00000 ⟶ 200.200.200.128
200.200.200. 101 00000 ⟶ 200.200.200.160

200.200.200. 100 00000 ⟶ 200.200.200.128
200.200.200. 101 00000 ⟶ 200.200.200.160
200.200.200. 110 00000 ⟶ 200.200.200.192
200.200.200. 111 00000 ⟶ 200.200.200.224

Q. If NID = 200.200.200.0 and the subnet Mask = 255.255.255.44 then identify

I. Number of bit borrowed from Host-id 3

II. Number of subnet possible and their subnet id's 8

III. Number of Host/subnet 30

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.44
1111 1111 . 1111 1111 . 1111 1111 . 00101100
nid
h s h s h

number of 1's : 27
number of 0's : 6

number of 1's : NID + SID = 27
24 + SID = 27
SID = 27 - 24 = 3
SID : 3bit

number of subnet : $2^3 = 8$

number of host / subnet : $2^5-2 = 30$

subnet id's

200.200.200. ___ ______
nid sid hid

shortcut (ad rule)

0	0	0	0	0	1	0	1	0	0	1	1
32	8	4	32	8	4	32	8	4	32	8	4
1	0	0	1	0	1	1	1	0	1	1	1
32	8	4	32	8	4	32	8	4	32	8	4

200.200.200. 000 00000 ⟶ 200.200.200.0
200.200.200. 001 00000 ⟶ 200.200.200.4
200.200.200. 010 00000 ⟶ 200.200.200.8
200.200.200. 011 00000 ⟶ 200.200.200.12
200.200.200. 100 00000 ⟶ 200.200.200.32
200.200.200. 101 00000 ⟶ 200.200.200.36
200.200.200. 110 00000 ⟶ 200.200.200.40
200.200.200. 111 00000 ⟶ 200.200.200.44

note : jo bhi bit borrow li hai uska weightage likh lo

Q. If NID = 200.200.200.0 and the subnet Mask = 255.255.255.200 then identify

I. Number of bit borrowed from Host-id 3

II. Number of subnet possible and their subnet id's 8

III. Number of Host/subnet 30

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.200
1111 1111 . 1111 1111 . 1111 1111 . 11001000
nid — s h s h

number of 1's : 27
number of 0's : 6

number of 1's : NID + SID = 27
24 + SID = 27
SID = 27 - 24 = 3
SID : 3bit

number of subnet : $2^3 = 8$

number of host / subnet : $2^5-2 = 30$

subnet id's

200.200.200. ___ ------

nid sid hid

shortcut (ad rule)

0 0 0	0 0 1	0 1 0	0 1 1
128 64 8	128 64 8	128 64 8	128 64 8
1 0 0	1 0 1	1 1 0	1 1 1
128 64 8	128 64 8	128 64 8	128 64 8

200.200.200. 000 00000 ⟶ 200.200.200.0
200.200.200. 001 00000 ⟶ 200.200.200.8
200.200.200. 010 00000 ⟶ 200.200.200.64
200.200.200. 011 00000 ⟶ 200.200.200.72
200.200.200. 100 00000 ⟶ 200.200.200.128
200.200.200. 101 00000 ⟶ 200.200.200.136
200.200.200. 110 00000 ⟶ 200.200.200.192
200.200.200. 111 00000 ⟶ 200.200.200.200

Q. If NID = 173.173.0.0 and the subnet Mask = 255.255.128.128 then identify

I. Number of bit borrowed from Host-id 2

II. Number of subnet possible and their subnet id's 4

III. Number of Host/subnet $2^{14}-2$

class : B
NID : 16bit
HID : 16bit

subnet mask : 255.255.128.128
1111 1111 . 1111 1111 . 1000 0000 . 1000 0000
nid s h s h

number of 1's : 18
number of 0's : 14

number of 1's : NID + SID = 18
16 + SID = 18
SID = 18 - 16 = 2
SID : 2bit

number of subnet : $2^2 = 4$

number of host / subnet : $2^{14}-2$ =

concept : subnet id's

173.173. __ ______
nid sid hid

shortcut (ad rule)

0 0 0 1 1 0 1 1
128 128 128 128 128 128 128 128

173.173.0.0
173.173.0.128
173.173.128.0
173.173.128.128

Problem Solving

Q. Which of the following is the default mask for the address 198.0.46.201? (Assuming Classful addressing scheme is followed)

A. 255.0.0.0

B. 255.255.255.0

C. 255.255.0

D. 255.255.255.255

class : C
range : 192 - 223
NID : 24bit
HID : 8bit

Q. If a class B network on the Internet has a subnet mask of 255.255.248.0. What is the maximum number of hosts per subnet? (Assuming Classful addressing scheme is followed) **GATE 2008**

A. 1022

B. 1023

C. 2046

D. 2047

class : B
NID : 16bit
HID : 16bit

subnet mask : 255.255.248.0

1111 1111 . 1111 1111 . 1111 1000 . 0000 0000

nid s h

number of 1's : 21
number of 0's : 11

number of 1's : NID + SID = 21
16 + SID = 21
SID = 21 - 16 = 5
SID : 5bit

number of subnet : $2^5 = 32$

number of host / subnet : $2^{11}-2 = 2048 - 2 = 2046$

Q. A subnet has assigned a subnet mask of 255.255.255.192. What is the maximum number of hosts that can belong to this subnet ? **GATE 2004**

A. 14

B. 30

A. 14

B. 30

C. 62

D. 126

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.192

1111 1111 . 1111 1111 . 1111 1111 . 1100 0000

nid | s | h

number of 1's : 26
number of 0's : 6

number of 1's : NID + SID = 26
24 + SID = 26
SID = 26 - 24 = 2
SID : 2bit

number of subnet : $2^2 = 4$

number of host / subnet : $2^6-2 = 64 - 2 = 62$

Q. In a class B network on the Internet has a subnet mask of 255.255.240.0. What is the maximum number of hosts per subnet? (Assuming Classful addressing scheme is followed) **ISRO**

A. 4096

B. 4094

C. 4092

D. 4090

class : B
NID : 16bit
HID : 16bit

subnet mask : 255.255.240.0

1111 1111 . 1111 1111 . 1111 0000 . 0000 0000

nid | s | h

number of 1's : 20
number of 0's : 12

number of 1's : NID + SID = 20
16 + SID = 20
SID = 20 - 16 = 4
SID : 4bit

number of subnet : $2^4 = 16$

number of host / subnet : $2^{12}-2 = 4096 - 2 = 4094$

Q. An organization has a class B network and wishes to form subnets for 64 departments. The subnet mask would be: **GATE 2005**

A. 255.255.0.0

B. 255.255.64.0

C. 255.255.128.0

D. 255.255.252.0

class : B
NID : 16bit
HID : 16bit

number of subnet : $64 = 2^6$
SID : 6bit
HID : 10bit

number of host / subnet : $2^{10}-2 = 1024 - 2 = 1022$

subnet mask : 1111 1111 . 1111 1111 . 1111 1100 . 0000 0000
nid s h

255.255.252.0

Q. Consider default subnet mask for a network is 255.255.255.0.
How many number of hosts per subnet possible if 'm' bits are borrowed from Host ID (HID)

A. $2^{HID-m}-2$

B. 2^{HID}

C. $2^{HID} - m$

D. 2^m

class : C
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.0
1111 1111 . 1111 1111 . 1111 1111 . 0000 0000
nid h

number of 1's : 24
number of 0's : 8

number of 1's : NID + SID = 24
24 + SID = 24
SID = 24 - 24 = 0
SID : 0bit

number of subnet : $2^0 = 0$ subnets
number of bits borrowed : 0 (m)

number of host / subnet : 2^8-2
number of host / subnet : $2^{8-0}-2$
number of host / subnet : $2^{HID-m}-2$

Q. A university has LANs with 100 hosts in each LAN. If it uses class B then the subnet mask in Dotted Decimal Notation is 255.255.255.128

class : B
NID : 16bit
HID : 16bit

number of host / subnet : $100 = 2^7 - 28 = 128 - 28 = 100$

number of subnet : $2^9 = 128$

SID : 9bit
HID : 7bit

subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 1000 0000
nid s h

255.255.255.128

Q. A university has 150 LANs. Use Class B address and then the subnet mask in Doted Decimal notation is 255.255.255.0

class : B
NID : 16bit
HID : 16bit

number of subnet : $150 = 2^8$

SID : 8bit
HID : 8bit

subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 0000 0000
nid s h

255.255.255.0

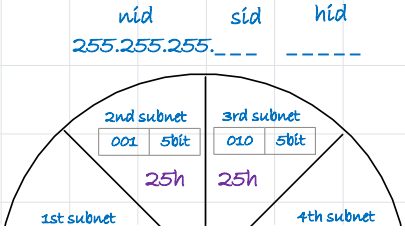
subnetting category - 3

multiple subnet masks to match options :

q. consider a class C network with 7-subnets and 25 hosts per subnet. an appropriate subnet mask for this network?

sol. $7 \times 25 = 175 \leq 2^8-2$, solution exists

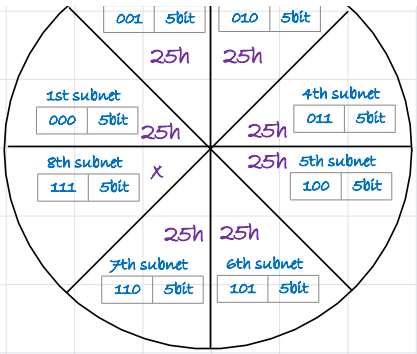
class C
NID : 24bit
HID : 8bit



NID : 24bit
HID : 8bit

hosts per subnet : 25 = 2^5-2
HID : 5

total subnets : 7 = 2^3 = 3
SID : 3



number of 1's possible in the subnet mask : NID + SID

24 + SID = 27
SID = 27 - 24
SID = 23

number of 0's possible in the subnet mask (HID) : 5

there are many subnet mask possible :

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 111 00000
  255.255.255.224

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 000 00111
  255.255.255.7

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 100 00011
  255.255.255.131

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 000 11100
  255.255.255.28

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 101 01000
  255.255.255.168

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 110 00001
  255.255.255.193

so, check through options

serial.	subnet mask	number of 1's
1.	255.255.255.8 (0000 1000)	25 (invalid)
2.	255.255.255.9 (0000 1001)	26 (invalid)
3.	255.255.255.10 (0000 1010)	26 (invalid)
4.	255.255.255.11 (0000 1011)	27 (valid)
5.	255.255.255.12 (0000 1100)	26 (invalid)
6.	255.255.255.13 (0000 1101)	27 (valid)
7.	255.255.255.14 (0000 1110)	27 (valid)
8.	255.255.255.15 (0000 1111)	28 (invalid)
9.	255.255.255.16 (0001 0000)	25 (invalid)
10.	255.255.255.17 (0001 0001)	26 (invalid)

we have 3 options correct.

q. consider a class B network with 180-subnets and 200 hosts per subnet. an appropriate subnet mask for this network?

sol. $180 \times 200 = 36{,}000 \leq 2^{16}-2$, solution exists

class B
NID : 16bit
HID : 16bit

hosts per subnet : $200 = 2^8-2$
HID : 8

total subnets : $180 = 2^8 = 8$
SID : 8

number of 1's possible in the subnet mask : NID + SID
16 + SID = 24

SID = 24 - 16
SID = 8

number of 0's possible in the subnet mask (HID) : 8

there are many subnet mask possible :

- subnet mask : 1111 1111 . 1111 1111 . 1111 1111 . 0000 0000
  255.255.255.0

- subnet mask : 1111 1111 . 1111 1111 . 1111 0000 . 1111 0000
  255.255.240.240

- subnet mask : 1111 1111 . 1111 1111 . 1111 0000 . 0000 1111
  255.255.240.15

- subnet mask : 1111 1111 . 1111 1111 . 0000 1111 . 1111 0000
  255.255.15.240

- subnet mask : 1111 1111 . 1111 1111 . 0000 1111 . 0000 1111
  255.255.15.15

so, check through options, the correct option will have 24 1's

q. consider a class C network with 15-subnets and 20 hosts per subnet. an appropriate subnet mask for this network?

sol. $15 \times 20 = 300 \leq 2^8-2$,
$15 \times 20 = 300 \leq 256-2$
$15 \times 20 = 300 \leq 254$, solution does not exists

class B
NID : 24bit
HID : 8bit

total subnets : $15 = 2^4 = 4$
SID : 4

hosts per subnet : $= 2^4-2 = 16-2 = 14$ (but hosts per subnet given are 20 hence not possible.
HID : 4

q. consider a class C network with 3-subnets and 60,60,120 hosts per subnet. an appropriate subnet mask for this network?

sol. $60+60+120 = 240 \leq 2^8-2$, solution does not exists

class B
NID : 24 bit
HID : 8 bit

(i) 60
hosts per subnet : $60 = 2^6-2 = 62$ host / network
HID : 6

total subnets : $3 = 2^2 = 4$
SID : 2

number of 1's possible in the subnet mask : NID + SID
24 + SID = 26
SID = 26 - 24
SID = 2

number of 0's possible in the subnet mask (HID) : 6

(ii) 60
hosts per subnet : $60 = 2^6-2$
HID : 6

total subnets : $3 = 2^2 = 4$
SID : 2

number of 1's possible in the subnet mask : NID + SID
24 + SID = 26
SID = 26 - 24
SID = 2

number of 0's possible in the subnet mask (HID) : 6

(iii) 120
hosts per subnet : $120 = 2^7-2$
HID : 7

total subnets : $3 = 2^2 = 4$
SID : 2

there is no subnet that can connect 120 computers.

note : to solve this problem this problem we use variable length subnet mask (VLSM) technique

- if subnet ka size fix nahi hai then fixed length subnet is also not possible, humare pass subnet bhi variable hoga.

subnetting category - 4

(variable length subnet mask)

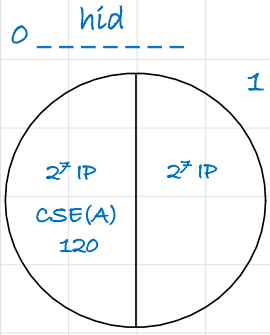
q. consider a class C network with 3-subnets and 60,60,120 hosts per subnet and NID given as 200.200.200.0 . an appropriate subnet mask for this network?

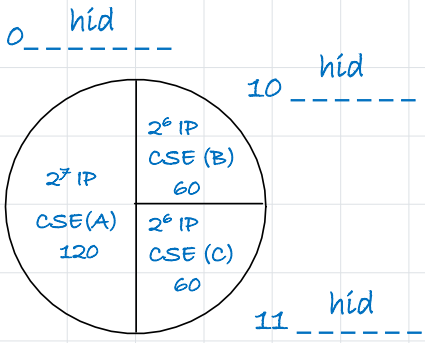
CSE (A) : 120
CSE (B) : 60
CSE (C) : 60

$240 \leq 2^8-2$, solution exist.

(i) CSE (A) : 120
hosts per subnet : $2^7-2 = 128-2 = 126$
HID : 7

total subnets : $2^1 = 2$
SID : 1





$2^7-2 = 128-2$

$2^6-2 = 64-2 = 62$

$2^7-2 = 128-2$
126 host / subnet

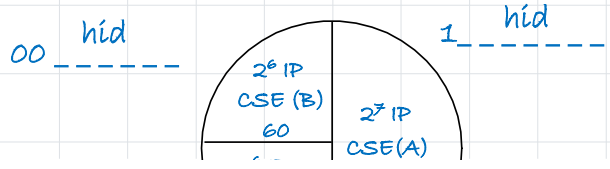
$2^6-2 = 64-2 = 62$
62 host / subnet

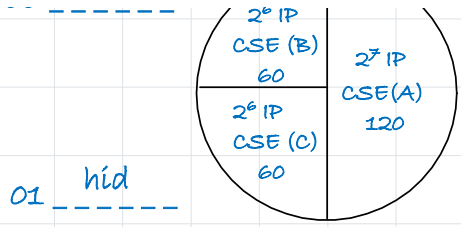
CSE (A)
- sid : 200.200.200.0 (0 all bits 0)
- dba : 200.200.200.127 (0 then all bits 1)
- s.m. : no. of bits borrowed : 1
  no. of 1's in the subnet mask : 24 + 1 = 25
  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000
  255.255.255.128

CSE (B)
- sid : 200.200.200.128 (10 then all bits 0)
- dba : 200.200.200.191 (10 then all bits 1)
- s.m. : no. of bits borrowed : 2
  no. of 1's in the subnet mask : 24 + 2 = 26
  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000
  255.255.255.192

CSE (C)
- sid : 200.200.200.192 (11 then all bits 0)
- dba : 200.200.200.255 (11 then all bits 1)
- s.m. : no. of bits borrowed : 2
  no. of 1's in the subnet mask : 24 + 2 = 26
  1111 1111 . 1111 1111 . 1111 1111 . 1100 0000
  255.255.255.192

another way :





$2^6-2 = 64-2 = 62$

62 host / subnet

CSE (A)

- sid : 200.200.200.128 (1 all bits 0)
- dba : 200.200.200.255 (1 then all bits 1)
- s.m. : no. of bits borrowed : 1

  no. of 1's in the subnet mask : 24 + 1 = 25

  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000

  255.255.255.128

CSE (B)

- sid : 200.200.200.0 (00 then all bits 0)
- dba : 200.200.200.63 (00 then all bits 1)
- s.m. : no. of bits borrowed : 2

  no. of 1's in the subnet mask : 24 + 2 = 26

  1111 1111 . 1111 1111 . 1111 1111 . 0000 0000

  255.255.255.192

CSE (C)

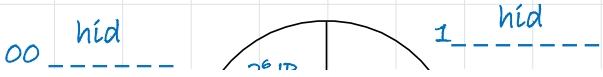
- sid : 200.200.200.64 (01 then all bits 0)
- dba : 200.200.200.127 (01 then all bits 1)
- s.m. : no. of bits borrowed : 2

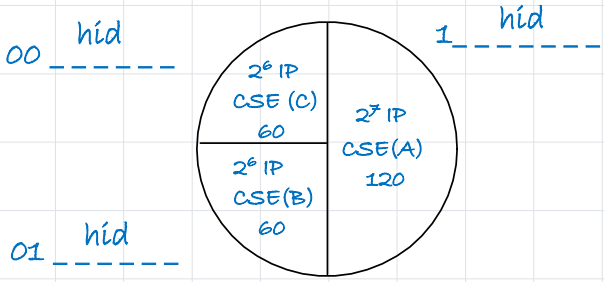
  no. of 1's in the subnet mask : 24 + 2 = 26

  1111 1111 . 1111 1111 . 1111 1111 . 0100 0000

  255.255.255.192

another way : interchange CSE (B) and CSE (C)





2^6-2 = 64-2 =62

62 host / subnet

CSE (A)
- sid : 200.200.200.128 (1 all bits 0)
- dba : 200.200.200.255 (1 then all bits 1)
- s.m. : no. of bits borrowed : 1

  no. of 1's in the subnet mask : 24 + 1 = 25

  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000

  255.255.255.128

CSE (B)
- sid : 200.200.200.64 (01 then all bits 0)
- dba : 200.200.200.127 (01 then all bits 1)
- s.m. : no. of bits borrowed : 2

  no. of 1's in the subnet mask : 24 + 2 = 26

  1111 1111 . 1111 1111 . 1111 1111 . 0100 0000

  255.255.255.192

CSE (C)
- sid : 200.200.200.0 (00 then all bits 0)
- dba : 200.200.200.63 (00 then all bits 1)
- s.m. : no. of bits borrowed : 2

  no. of 1's in the subnet mask : 24 + 2 = 26

  1111 1111 . 1111 1111 . 1111 1111 . 0000 0000

  255.255.255.192

q. consider a class C network with 3-subnets and 60,60,120 hosts per subnet and NID given as 200.200.200.0 . an appropriate subnet mask for this network?

CSE (A) : 75
CSE (B) : 35
CSE (C) : 25
CSE (D) : 20

$240 \leq 2^8-2$, solution exist.

(i) CSE (A) : 75
hosts per subnet : $2^7-2 = 128-2 = 126$
HID : 7

total subnets : $2^1 = 2$
SID : 1

(ii) CSE (B) : 35
hosts per subnet : $2^6-2 = 64 - 2 = 62$
HID : 6

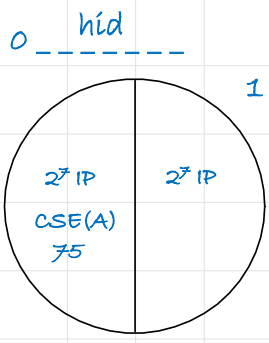
total subnets : $2^2 = 4$
SID : 2

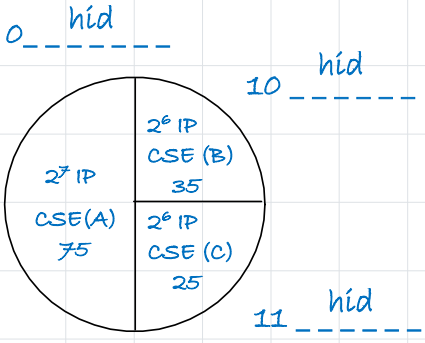
(iii) CSE (C) : 25
hosts per subnet : $2^5-2 = 32-2 = 30$
HID : 5

total subnets : $2^3 = 8$
SID : 3

(iv) CSE (D) : 20
hosts per subnet : $2^5-2 = 32-2 = 30$
HID : 5

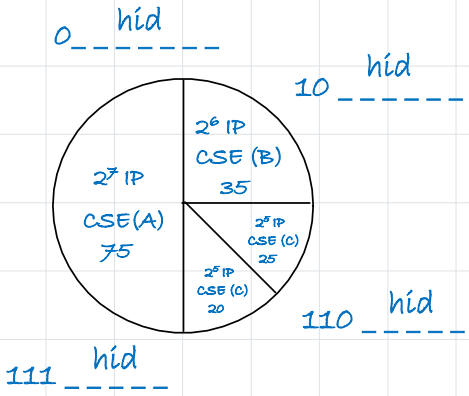
total subnets : $2^3 = 8$
SID : 3





$2^7-2 = 128-2$
126 host / subnet

$2^6-2 = 64-2 = 62$
62 host / subnet



CSE (A)
- sid : 200.200.200.0 (0 all bits 0)
- dba : 200.200.200.127 (0 then all bits 1)
- s.m. : no. of bits borrowed : 1
  no. of 1's in the subnet mask : 24 + 1 = 25
  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000
  255.255.255.128

CSE (B)
- sid : 200.200.200.128 (10 then all bits 0)
- dba : 200.200.200.191 (10 then all bits 1)
- s.m. : no. of bits borrowed : 2
  no. of 1's in the subnet mask : 24 + 2 = 26
  1111 1111 . 1111 1111 . 1111 1111 . 1000 0000
  255.255.255.192

CSE (C)
- sid : 200.200.200.192 (110 then all bits 0)
- dba : 200.200.200.223 (110 then all bits 1)
- s.m. : no. of bits borrowed : 3
  no. of 1's in the subnet mask : 24 + 3 = 27
  1111 1111 . 1111 1111 . 1111 1111 . 1100 0000
  255.255.255.224

CSE (D)
- sid : 200.200.200.224 (111 then all bits 0)
- dba : 200.200.200.255 (111 then all bits 1)
- s.m. : no. of bits borrowed : 3
  no. of 1's in the subnet mask : 24 + 3 = 27
  1111 1111 . 1111 1111 . 1111 1111 . 1110 0000
  255.255.255.224

q. consider a class C network with 3-subnets and 130,50,50 hosts per subnet and NID given as 200.200.200.0 . an appropriate subnet mask for this network?
CSE (A) : 130
CSE (B) : 50
CSE (C) : 50

$200 \leq 2^8-2$, solution exist.

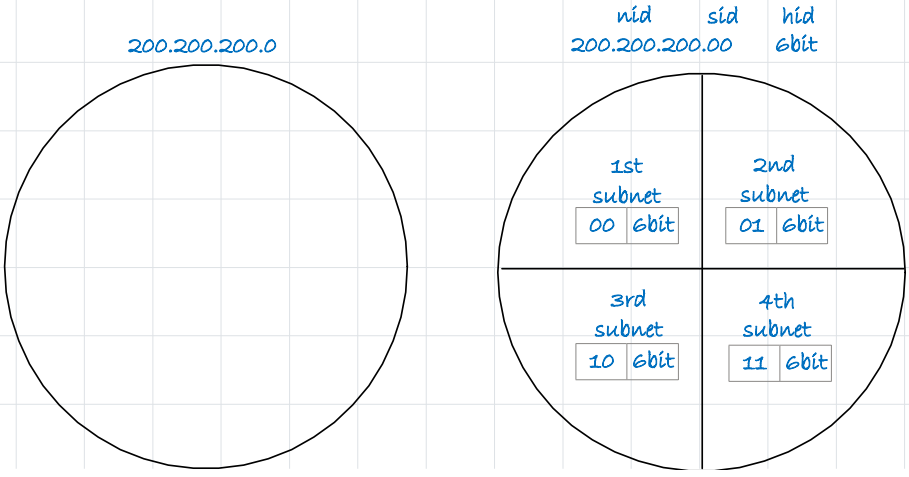
(i) CSE (A) : 130
hosts per subnet : $2^8-2 = 256-2 = 254$
HID : 8

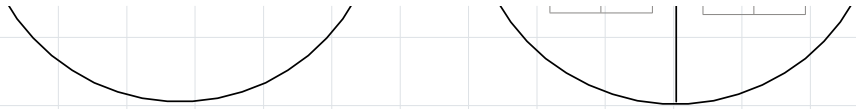
total subnets : $2^0 = 0$
SID : 0
even with vlsm technique, it is not possible.

subnetting category - 5

(separate SID and HID)

example 1 :





class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

- hid : 6 bit
2^6-2 host / subnet
62 host / subnet

2bit borrowed : 2^2 = 4 subnet

- possible combinations :
S_1 : 00 - 1st subnet
S_2 : 01 - 2nd subnet
S_3 : 10 - 3rd subnet
S_4 : 11 - 4th subnet

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.63

2nd subnet
- sid : 200.200.200.64
- dba : 200.200.200.127

3rd subnet
- sid : 200.200.200.128
- dba : 200.200.200.191

4th subnet
- sid : 200.200.200.192
- dba : 200.200.200.255

SID of all subnet 255.255.255.192 (two bits borrowed 128 + 64)

lets take 2nd subnet

subnet id :

220.200.200.0100 0000 ⟶ 200.200.200.64

220.200.200.0100 0001 ⟶ 200.200.200.65

.

.

220.200.200.0111 1111 ⟶ 200.200.200.127

q. separate 65 and tell me about the SID and HID

220.200.200.0100 0001 ⟶ 200.200.200.65

- sid : 200.200.200.64 (subnet 2 - pure subnet ki id)
- hid : 200.200.200.1

q. separate 66 and tell me about the SID and HID

220.200.200.0100 0010 ⟶ 200.200.200.66

- sid : 200.200.200.64 (subnet 2 - pure subnet ki id)
- hid : 200.200.200.2

q. separate 66 and tell me about the SID and HID

220.200.200.0100 0010 ⟶ 200.200.200.127 (dba)

- sid : 200.200.200.64 (subnet 2 - pure subnet ki id)
- hid : 200.200.200.63

Q.1 IP Address = 200.200.200.126
Subnet Mask = 255.255.255.192 then find the SID and HID?

class C : 24bit
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.192
1111 1111 . 1111 1111 . 1111 1111 . 1100 0000
SID HID

IP address : 200.200.200.126
200.200.200. 0111 1110
SID HID

0	1	1	1	1	1	1	0
128	64	32	16	8	4	2	1

SID : 128 x 0 + 64 x 1 = 64
200.200.200.64

HID : 32 x 1 + 16 x 1 + 8 x 1 + 4 x 1 + 2 x 1 + 1 x 0 = 62
200.200.200.62

another way

IP address : 200.200.200.0111 1110
AND
subnet mask : 200.200.200.1100 0000
SID : 200.200.200.0100 0000

SID : 200.200.200.64

AD rule :

SID : 64

HID = IP add - SID
= 126 - 64
= 62

note :
- IP address ANDING with network mask : nid
- IP address ANDING with subnet mask : sid

Q.2 IP Address = 200.200.200.120
Subnet Mask = 255.255.255.240 then find the SID and HID?

class C : 24bit
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.240
1111 1111 . 1111 1111 . 1111 1111 . 1111 0000
SID HID

IP address : 200.200.200.120
200.200.200. 0111 1000
SID HID

0	1	1	1	1	0	0	0
128	64	32	16	8	4	2	1

SID : 128 x 0 + 64 x 1 + 32 x 1 + 16 x 1 = 112
200.200.200.112

HID : 8 x 1 + 4 x 0 + 2 x 0 + 1 x 0 = 8
200.200.200.8

another way

IP address : 200.200.200.0111 1000
AND
subnet mask : 200.200.200.1111 0000
SID : 200.200.200.0111 0000

SID : 200.200.200.112

AD rule :

SID : 112

HID = IP add - SID
= 120 - 112
= 9

Q.3 IP Address = 200.200.200.120
subnet Mask = 255.255.255.41 then find the SID and HID?

class C : 24bit
NID : 24bit
HID : 8bit

subnet mask : 255.255.255.41
1111 1111 . 1111 1111 . 1111 1111 . 0010 1001
HSHSHS

IP address : 200.200.200.120
200.200.200. 0111 1000
SID HID

0	1	1	1	1	0	0	0
128	64	32	16	8	4	2	1

SID : 32 x 1 + 8 x 1 + 1 x 0 = 40
200.200.200.40

HID : 128 x 0 + 64 x 1 + 16 x 1 + 4 x 0 + 2 x 0 = 80
200.200.200.88

HID : 128 x 0 + 64 x 1 + 16 x 1 + 4 x 0 + 2 x 0 = 80
200.200.200.88

another way

IP address : 200.200.200.0111 1000
AND
subnet mask : 200.200.200.0010 1001
SID : 200.200.200.00101000

SID : 200.200.200.40

AD rule :

SID : 40

HID = IP add - SID
= 120 - 40 = 80
= 9

Q.4 Find the subnet Address for the Following

IP Address: 200.34.22.156 [128+16+8+4] = 144

Mask: 255.255.255.240 [128+64+32+16]

A. 200.33.22.144

B. 200.34.22.143

C. 200.34.22.13

D. 200.34.22.144

IP address : 200.200.200.1001 1100
AND
subnet mask : 200.200.200.1111 0000
SID : 200.200.200.1001 0000

SID : 200.200.200.144

AD rule :

SID : 144

HID = IP add - SID
= 156 - 144
= 12

note : network id depends upon the class, so to find sid, class is important.
in subnet id, number of zeroes indicate hid

subnetting category - 6

(subnet according to class)

Q.1 If Subnet Mask is 255.255.255.224 then find

A. Number of IP Address/subnet possible 2^5

B. Number of Host/subnet possible 2^5-2

C. Number of subnet in class A 2^{19}

D. Number of subnet in class B 2^{11}

E. Number of subnet in class C 2^3

A. Number of IP Address/subnet possible ____

255 . 255 . 255 . 1110 0000

SID : 2^3

no. of IP add / subnet : 2^5

B. Number of Host/subnet possible ____

HID : 2^5-2

C. Number of subnet in class A ____

255 . 1111 1111 . 1111 1111 . 1110 0000

SID : 2^{19}

D. Number of subnet in class B ____

255 . 255 . 1111 1111 . 1110 0000

SID : 2^{11}

E. Number of subnet in class C ____

255 . 255 . 255 . 1110 0000

SID : 2^3

Q.2 If Subnet Mask is 255.255.255.240 then find

A. Number of IP Address/subnet possible 2^4

B. Number of Host/subnet possible 2^4-2

A. Number of IP Address/subnet possible ___

B. Number of Host/subnet possible 2^4-2

C. Number of subnet in class A 2^{20}

D. Number of subnet in class B 2^{12}

E. Number of subnet in class C 2^4

A. Number of IP Address/subnet possible ____

255 . 255 . 255 . 1111 0000
SID : 2^4
no. of IP add / subnet : 2^4

B. Number of Host/subnet possible ____

HID : 2^4-2

C. Number of subnet in class A ____

255 . 1111 1111 . 1111 1111 . 1111 0000

SID : 2^{20}

D. Number of subnet in class B ____

255 . 255 . 1111 1111 . 1111 0000

SID : 2^{12}

E. Number of subnet in class C ____

255 . 255 . 255 . 1111 0000

SID : 2^4

Q.3 If Subnet Mask is 255.255.252.0 then find

A. Number of IP Address/subnet possible 2^{10}

B. Number of Host/subnet possible $2^{10}-2$

C. Number of subnet in class A 2^{20}

D. Number of subnet in class B 2^{12}

E. Number of subnet in class C X

A. Number of IP Address/subnet possible ____

255 . 255 . 1111 1100 . 0000 0000
SID : 2^0
no. of IP add / subnet : 2^{10}

B. Number of Host/subnet possible ____

HID : $2^{10}-2$

C. Number of subnet in class A ____

255 . 1111 1111 . 1111 1100 . 0000 0000

SID : 2^{14}

D. Number of subnet in class B ____

255 . 255 . 1111 1100 . 0000 0000

SID : 2^{6}

E. Number of subnet in class C ____

mask not possible.

Q.4 If Subnet Mask is 255.252.0.0 then find

A. Number of IP Address/subnet possible 2^{18}

B. Number of Host/subnet possible $2^{18}-2$

C. Number of subnet in class A 2^{6}

D. Number of subnet in class B X

E. Number of subnet in class C X

A. Number of IP Address/subnet possible ____

255 . 1111 1100 . 0000 0000 . 0000 0000

SID : 2^{0}

no. of IP add / subnet : 2^{18}

B. Number of Host/subnet possible ____

HID : $2^{18}-2$

C. Number of subnet in class A ____

255 . 1111 1100 . 0000 0000 . 0000 0000

SID : 2^{6}

D. Number of subnet in class B ____

mask not possible

E. Number of subnet in class C ____

mask not possible.

subnetting category - 7

(DBA is given and asks for mask)

Q.1 If Direct Broadcast Address is 200.200.200.31
Which of the following can be Subnet Mask ?

A. 255.255.255.192

B. 255.255.255.224

C. 255.255.255.248

D. 255.255.255.128

DBA : 200.200.200.31
200.200.200.0001 1111

note : in DBA '1' represents HID part

(i) DBA : 200.200.200.31
200.200.200.0001 1111
SID HID
NID : 24bit
HID : 5bit
SID : 3bit

(ii) DBA : 200.200.200.31
200.200.200.0001 1111
SID HID
NID : 24bit
HID : 4bit
SID : 4bit

(iii) DBA : 200.200.200.31
200.200.200.0001 1111
SID HID
NID : 24bit
HID : 3bit
SID : 5bit

(iv) DBA : 200.200.200.31
200.200.200.0001 1111
SID HID
NID : 24bit
HID : 2bit
SID : 6bit

(v) DBA : 200.200.200.31
200.200.200.0001 1111
SID HID
NID : 24bit
HID : 1bit
SID : 7bit

note : i cant say host ID is of 5 bit. i can say that host id can be maximum 5 bits. HID ≤ 5bit

so, lets try by options.

A. 255.255.255.192

255.255.255.192

255.255.255.1100 0000
n s h

given ip : class - C
NID : 24bit
HID : 6bit
SID : 2bit

according to this subnet mask, 2bits are borrowed.

sid	hid(dba)	dba
00	111111	63
01	111111	127
10	111111	191
11	111111	253

200.200.200.31 not found.

B. 255.255.255.224

255.255.255.224

255.255.255.111 00000
n s h

given ip : class - C
NID : 24bit
HID : 5bit
SID : 3bit

according to this subnet mask, 3bits are borrowed.

sid	hid(dba)	dba
000	11111	31
001	11111	63

sid	hid(dba)		dba
000	11111	⟶	31
001	11111	⟶	63
010	11111	⟶	95
011	11111	⟶	127
100	11111	⟶	159
101	11111	⟶	101
110	11111	⟶	223
111	11111	⟶	255

200.200.200.31 found.

hence, option B is correct.

C. 255.255.255.248

255.255.255.248

255.255.255.1111 1000
n s h

given ip : class - C
NID : 24bit
HID : 3bit
SID : 5bit

according to this subnet mask, 5bits are borrowed.

total combinations : 2^5

31 : 0001 1111
hhhs ssss

255.255.255.1111 1000
n s h

1111 1000
ssss shhh

in dba, all host id : 1

1111 1000
ssss shhh
111

to write 31 : 0001 1111
we already have three 1's in hid.
required : 0001 1

SID : 5bit
total combinations : 32

in total combinations there will be a combination that will give :

1111 1000
ssss shhh
0001 1111

D. 255.255.255.128

255.255.255.128

255.255.255.1000 0000
n s h

given ip : class - C
NID : 24bit
HID : 7bit
SID : 1bit

according to this subnet mask, 1bit is borrowed.

total combinations : $2^1 = 2$

sid	hid (dba)		dba
0	1111111	⟶	127
1	1111111	⟶	255

not found.

shortcut (ad rule)

(A) 255.255.255.192

HID = 6bit, HID ≤ 5bit (no, option A is incorrect)

(B) 255.255.255.224

HID = 5bit, HID ≤ 5bit (option B is correct)

(C) 255.255.255.248

HID = 3bit, HID ≤ 5bit (option C is correct)

(D) 255.255.255.128

HID = 7bit, HID ≤ 5bit (no, option D is incorrect)

Q.2 If Direct Broadcast Address is 200.200.200.31
Which of the following can be Subnet Mask?

A. 255.255.255.192

B. 255.255.255.224

C. 255.255.255.248

D. 255.255.255.240

DBA : 200.200.200.31
200.200.200.0001 1111
HID : 5bit

(A) 255.255.255.192
255.255.255.1100 0000
HID : 6bit
HID = 6bit, HID ≤ 5bit (no, option A is incorrect)

(B) 255.255.255.224
255.255.255.1110 0000
HID : 5bit
HID = 5bit, HID ≤ 5bit (option B is correct)

(C) 255.255.255.248
255.255.255.1111 1000
HID : 3bit
HID = 3bit, HID ≤ 5bit (option C is correct)

(D) 255.255.255.240
255.255.255.1111 0000
HID : 4bit
HID = 4bit, HID ≤ 5bit (option D is correct)

Q.3 What could be the Network Mask, if DBA of a Network is 168.17.7.255?

A. 255.255.248.0

168.17.7.255?

A. 255.255.248.0

B. 255.255.252.0

C. 255.255.254.0

D. All the above

DBA : 168.17.7.255
Class : B
168.17.7.255
168 . 17 . 0000 0111 . 1111 1111

HID : 11bit

(A) 255.255.248.0
255.255. 1111 1000 . 0000 0000
HID : 11bit
HID = 11bit, HID ≤ 11bit (option A is correct)

(B) 255.255.252.0
255 . 255 . 1111 1100 . 0000 0000
HID : 10bit
HID = 10bit, HID ≤ 11bit (option B is correct)

(C) 255.255.254.0
255 . 255 . 1111 1110 . 0000 0000
HID : 9bit
HID = 9bit, HID ≤ 11bit (option C is correct)

Q.4 A Subnetted Class B network has the following broadcast address : 144.16.95.255. Its subnet mask

A. is necessarily 255.255.224.0

B. is necessarily 255.255.240.0

C. is necessarily 255.255.248.0

D. could be any one of 255.255.224.0, 255.255.240.0, 255.255.248.0

DBA : 144.16.95.255
Class : B
144 . 16 . 0101 1111 . 1111 1111

HID : 14bit

(A) 255.255.224.0
255.255. 1110 0000 . 0000 0000
HID : 13bit
HID = 13bit, HID ≤ 14bit (option A is correct)

(B) 255.255.240.0
255 . 255 . 1111 0000 . 0000 0000
HID : 12bit
HID = 12bit, HID ≤ 14bit (option B is correct)

(C) 255.255.248.0
255 . 255 . 1111 1000 . 0000 0000
HID : 11bit
HID = 11bit, HID ≤ 14bit (option C is correct)

Q.5 Given broadcast address 125.25.63.255 of a subnetwork. What can be Mask of this subnetwork :

A. 255.255.128.0

B. 255.255.192.0

C. 255.255.224.0

D. Both B and C

DBA : 125.25.63.255
Class : A
125 . 0001 1001 . 0011 1111 . 1111 1111
HID : 14bit

(A) 255.255.128.0
255. 1111 1111 . 1000 0000 . 0000 0000
HID : 15bit
HID = 15bit, HID ≤ 14bit (no, option A is incorrect)

(B) 255.255.192.0
255 . 1111 1111 . 1100 0000 . 0000 0000
HID : 14bit
HID = 14bit, HID ≤ 14bit (option B is correct)

(C) 255.255.224.0
255 . 1111 1111 . 1110 0000 . 0000 0000
HID : 13bit
HID = 13bit, HID ≤ 14bit (option C is correct)

note : you always have to take continious 1's in HID for DBA

Q.6 If Direct Broadcast address is 200.200.200.31 Which of the following can be Subnet Mask ?

A. 255.255.255.192

B. 255.255.255.224

C. 255.255.255.198

D. 255.255.255.128

DBA : 200.200.200.31
Class : C
200.200.200. 0001 1111
HID : 5bit

(A) 255.255.255.192
255. 255 . 255 . 1100 0000
HID : 6bit
HID = 6bit, HID ≤ 5bit (no, option A is incorrect)

255. 255 . 255 . 1100 0000
HID : 6bit
HID = 6bit, HID ≤ 5bit (no, option A is incorrect)

(B) 255.255.255.224
255 . 255 . 255 . 1110 0000
HID : 5bit
HID = 5bit, HID ≤ 5bit (option B is correct)

(C) 255.255.255.198
255 . 255 . 255 . 1100 0110
(no, option C is incorrect)

note : AD rule will only work when HID is continious in mask.

(C) 255.255.255.198

31 : 0001 1111
hhhs ssss

DBA : all hid part must be 1

255.255.255. 1100 0110
nid sshh hssh

128	64	32	16	8	4	2	1
s	s	h	h	h	s	s	h
0	0	1	1	1	0	0	1

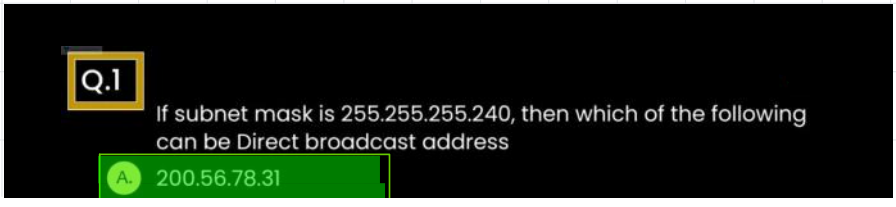
0011 1001 : 57
0011 1011 : 59
0011 1101 : 61

in order to get 31 there must be 32 subnets
so, 6th bit must be zero also : 0001 1111
but here 6th bit is also 1.
so, subnets are $2^4 = 16$
hence, no DBA = 31.

(D) 255.255.255.128
255 . 255 . 255 . 1000 0000
HID : 7bit
HID = 7bit, HID ≤ 5bit (no, option D is incorrect)

subnetting category - 8

(mask is given and asks for DBA)



If subnet mask is 255.255.255.240, then which of the following can be Direct broadcast address

A. 200.56.78.31

B. 200.56.78.15

C. 200.56.78.10

D. 200.56.78.47

subnet mask : 255.255.255.240
Class : C (200)

255.255.255.1111 0000
hid

note : in mask '0' represent HID part.

HID : 4bit
check last 4 bits, if they are '1' then it is DBA

(A) 200.56.78.31
200.56.78.0001 1111
(option A is correct)

(B) 200.56.78.15
255.56.78.0000 1111
(option B is correct)

(C) 200.56.78.10
200.56.78.0000 1010
(no, option C is incorrect)

(D) 200.56.78.47
200.56.78.0010 1111
(option D is correct)

Q.2

If subnet mask is 255.255.255.248, then which of the following can be Direct broadcast address

A. 200.32.64.135

B. 200.32.64.240

C. 200.32.64.207

D. 200.32.64.231

subnet mask : 255.255.255.248
Class : C (200)

255.255.255.1111 1000
hid

HID : 3bit
check last 3 bits, if they are '1' then it is DBA

(A) 200.32.64.135
200.32.64.1000 0111
(option A is correct)

(B) 200.32.64.240
255.56.78.1111 0000
(no, option B is incorrect)

(no, option B is incorrect)

(C) 200.32.64.207
200.56.78.1100 1111
(option C is correct)

(D) 200.32.64.231
200.32.64.1110 0111
(option D is correct)

Q.3

If subnet mask is 255.255.240.0, then which of the following can be Direct broadcast address

A. 157.157.15.255

B. 157.157.7.255

C. 157.157.15.250

D. 157.157.31.255

subnet mask : 255.255.240.0
Class : B (157)

255.255.1111 0000. 0000 0000
hid

HID : 12bit
check last 12 bits, if they are '1' then it is DBA

(A) 157.157.15.255
157.157.0000 1111. 1111 1111
(option A is correct)

(B) 157.157.7.255
157.157.0000 0111. 1111 1111
(no, option B is incorrect)

(C) 157.157.15.250
157.157.0000 1111 . 1111 1010
(no, option C is incorrect)

(D) 157.157.31.255
157.157.0001 1111. 1111 1111
(option D is correct)

Q.4

If subnet mask is 255.224.0.0, then which of the following can be Direct broadcast address

A. 100.31.255.255

B. 100.7.255.255

C. 100.63.255.255

D. 100.30.255.255

subnet mask : 255.244.0.0
Class : A (100)

255. 1111 0100 . 0000 0000 . 0000 0000
hid

HID : 18bit
check last 18 bits, if they are '1' then it is DBA

(A) 100.31.255.255
100 . 0001 1111 . 1111 1111 . 1111 1111
(option A is correct)

(B) 100.7.255.255
100 . 0000 0111 . 1111 1111 . 1111 1111
(option B is correct)

(C) 100.63.255.255
100 . 0011 1111 . 1111 1111 . 1111 1111
(option C is correct)

(D) 100.30.255.255
100 . 0001 1110 . 1111 1111 . 1111 1111
(no, option D is incorrect)

Q.5

If subnet mask 255.255.255.224, which of the following will be Direct Broadcast address?

A. 202.15.19.127

B. 202.15.19.63

C. Both a and b

D. None of the above

subnet mask : 255.255.255.224
Class : C (202)

255.255.255. 1110 0000
hid

HID : 5bit
check last 5 bits, if they are '1' then it is DBA

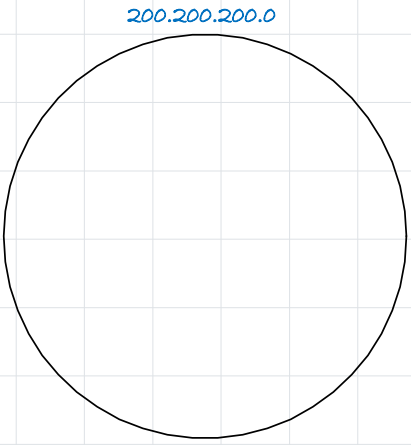
(A) 202.15.19.127
202.15.19. 0111 1111
(option A is correct)

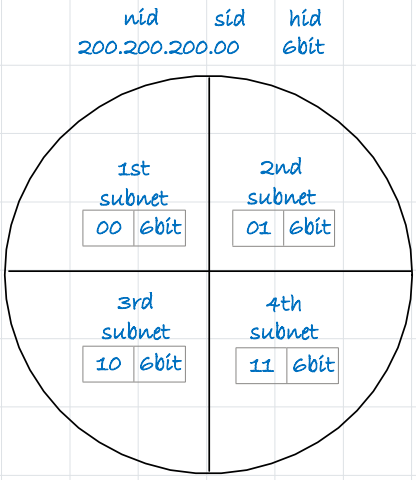
(B) 202.15.19.63
202.15.19. 0011 1111
(option B is correct)

★ subnetting category - 9

(mask is given and asks for DBA)

example 1 :





class : C

- nid : 24 bit
hid : 8 bit
2^8 = 256 IP addresses
i have to borrow 2 bits in order to make 4 subnets

- hid : 6 bit
2^6-2 host / subnet
62 host / subnet

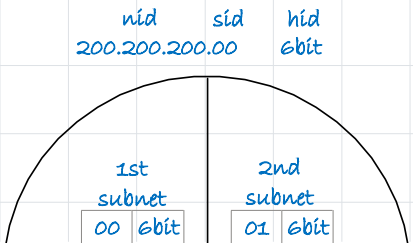
2bit borrowed : 2^2 = 4 subnet

- possible combinations :
S_1 : 00 - 1st subnet
S_2 : 01 - 2nd subnet
S_3 : 10 - 3rd subnet
S_4 : 11 - 4th subnet

4 subnet x 62 host = 248 host
256 IP addresses - 248 host = 8 IP addresses wasted

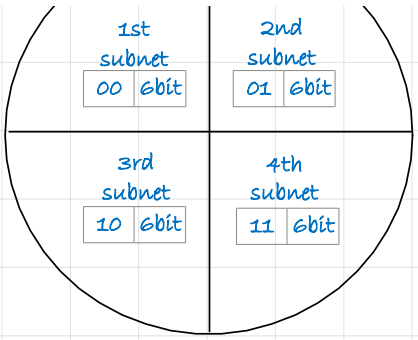
shortcut (ad rule)

0 0	0 1	1 0	1 1
128 64	128 64	128 64	128 64



1st subnet
- sid : 200.200.200.0 (nid)
- dba : 200.200.200.63

2nd subnet
- sid : 200.200.200.64 (nid)

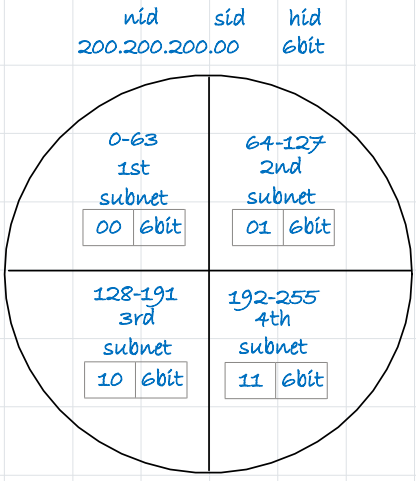


2nd subnet
- sid : 200.200.200.64 (nid)
- dba : 200.200.200.127

3rd subnet
- sid : 200.200.200.128 (nid)
- dba : 200.200.200.191

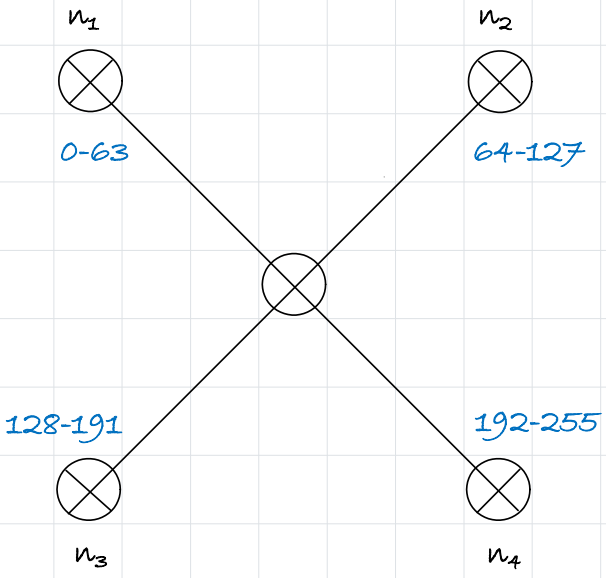
4th subnet
- sid : 200.200.200.192 (nid)
- dba : 200.200.200.255

logical view :



subnet mask : 255.255.255.192 (2 bits borrowed 128+64)

physical view :



every router have routing table

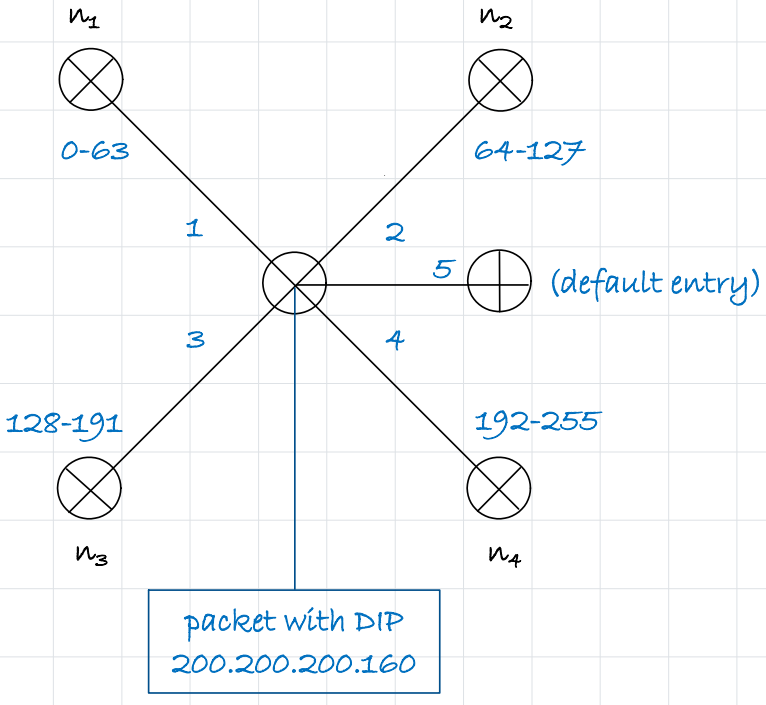
jitne bhi network kisi router se associated honge utni router entry hogi.

routing table

nid	subnet mask	interface
200.200.200.0	200.200.200.192	1
200.200.200.64	200.200.200.192	2
200.200.200.128	200.200.200.192	3
200.200.200.192	200.200.200.192	4
0.0.0.0	0.0.0.0	5

note : subnet mask is same because the network size of all networks are also same

if a packet with destination IP : 200.200.200.160 comes then router will forward the packet to the interface where in the network DIP 200.200.200.160 is present.



procedure :

jaise hi koi packet router ke pass ata hai toh router jo pehla subnet mask (255.255.255.192) table mai given hota hai uske sath bitwise ANDING karta hai, bitwise ANDING karne ke baad agar NID mai agar 200.200.200.0 aagya toh phir router us interface mai packet ko send kardeta hai.

if match nahi hua then vo second subnet mask (255.255.255.192) consider karta hai aur phir uske sath again bitwise ANDING karta hai , bitwise ANDING karne ke baad agar NID mai 200.200.200.64 aagya toh phir router us interface mai packet ko send kardeta hai.

if agar vo kisi NID se match nahi hua then har router ke pass ek default router hota hai toh yeh default router ko send kardeta hai jisme default mask (0.0.0.0) hota hai. usme bitwise ANDING karne par same hi network aajata hai.

example : 0000 0000 . 0000 0000 . 0000 0000 . 0000 0000
1001 1101 . 1001 1101 . 0010 0111 . 0000 0010
0000 0000 . 0000 0000 . 0000 0000 . 0000 0000

q. a packet bearing a DIP 200.200.200.160 arrives on a router. on which interface this packet will be forwarded by router?

(a) 1
(b) 2
(c) 3
(d) 4

sol.

(a) 1 (not matched with interface 1)

DIP : 200.200.200.1010 0000 (160)
AND
SM : 255.255.255.1100 0000 (192)
200.200.200.1000 0000
NID: 200.200.200.128

(b) 2 (not matched with interface 2)

DIP : 200.200.200.1010 0000 (160)
AND
SM : 255.255.255.1100 0000 (192)
200.200.200.1000 0000
NID: 200.200.200.128

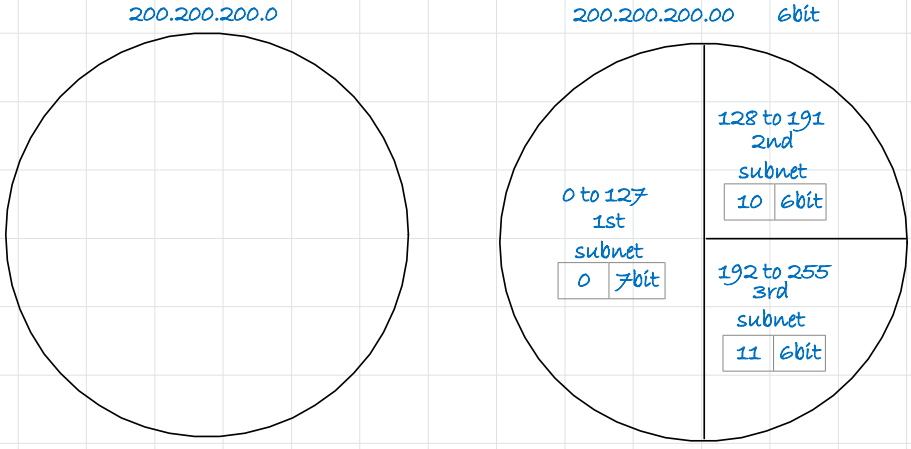
(c) 3 (matched with interface 3)

DIP : 200.200.200.1010 0000 (160)
AND
SM : 255.255.255.1100 0000 (192)
200.200.200.1000 0000
NID: 200.200.200.128

(d) 4 (not matched with interface 4)

DIP : 200.200.200.1010 0000 (160)
AND
SM : 255.255.255.1100 0000 (192)
200.200.200.1000 0000
NID: 200.200.200.128

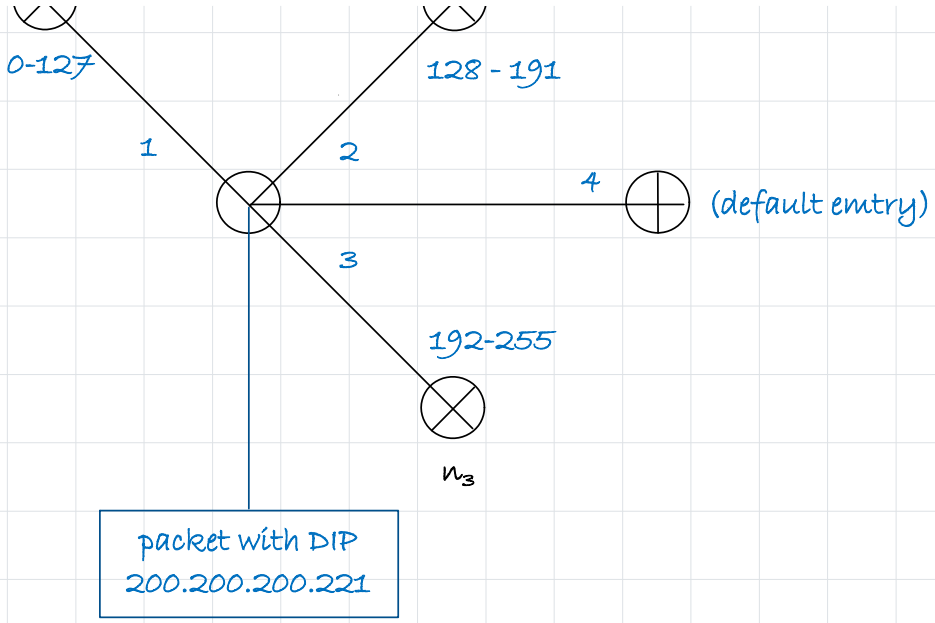
example 2 :



class : C

- nid : 24 bit
hid : 8 bit
$2^8 = 256$ IP addresses

physical view :



routing table

nid	subnet mask	interface
200.200.200.0	255.255.255.128	1
200.200.200.128	255.255.255.192	2
200.200.200.192	255.255.255.192	3
0.0.0.0	0.0.0.0	4

q. packet bearing a DIP 200.200.200.221 arrives on a router. on which interface this packet will be forwarded by router?

(a) 1
(b) 2
(c) 3
(d) 4

sol.

(a) 1 (not matched with interface 1)

DIP : 200.200.200.1101 1101 (221)
AND
SM : 255.255.255.1000 0000 (128)

200.200.200.1000 0000

NID: 200.200.200.128

(b) 2 (not matched with interface 2)

DIP : 200.200.200.1101 1101 (221)

AND

SM : 255.255.255.1100 0000 (192)

200.200.200.1100 0000

NID: 200.200.200.192

(C) 3 (matched with interface 3)

DIP : 200.200.200.1101 1101 (221)

AND

SM : 255.255.255.1100 0000 (192)

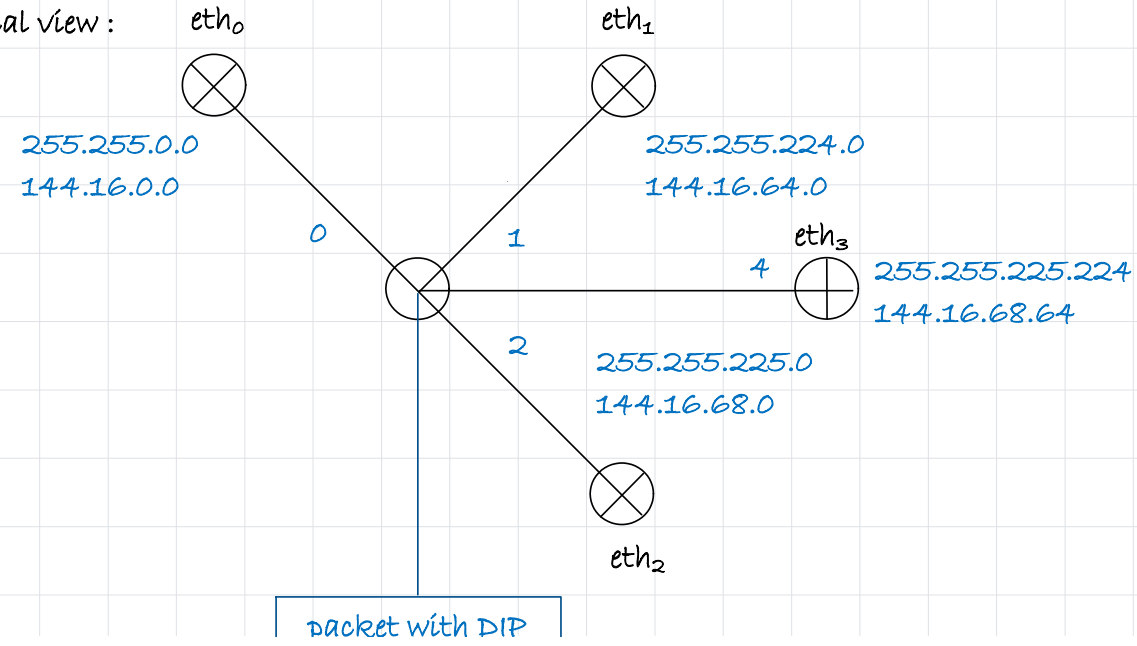
200.200.200.1100 0000

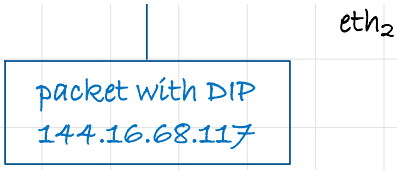
NID: 200.200.200.192

note : jo network id aa rahi ha aur wahi table mai hai that means it is matched

example 3 :

physical view :





q. a packet bearing a DIP 144.16.68.117 arrives on a router. on which interface this packet will be forwarded by router?

class : B
nid : 16bit
hid : 16bit

routing table

nid	subnet mask	interface
144.16.0.0	255.255.0.0	1
144.16.64.0	255.255.224.0	2
144.16.68.0	255.255.255.0	3
144.16.68.64	255.255.255.224	4

(a) 1
(b) 2
(c) 3
(d) 4

sol.

(a) 1 eth_0 (matched with interface 1)

DIP : 144.16.0100 0100.0111 0101
AND
SM : 255.255.0000 0000.0000 0000
144.16.0000 0000.0000 0000
NID: 144.16.0.0

(b) 2 eth_1 (matched with interface 2)

DIP : 144.16.0100 0100.0111 0101
AND
SM : 255.255.1110 0000.0000 0000
144.16.0100 0000.0000 0000
NID: 144.16.64.0

(C) 3 eth_2 (matched with interface 3)

DIP : 144.16.0100 0100.0111 0101
AND
SM : 255.255.1111 1111.0000 0000
144.16.0100 0100.0000 0000
NID: 144.16.68.0

(d) 4 eth_3 (not matched with interface 4)

DIP : 144.16.0100 0100.0111 0101
AND
SM : 255.255.1111 1111.1110 0000
144.16.0100 0100.0110 0000
NID: 144.16.68.96

matched with eth_0, eth_1, eth_2

longest : eth_2 (selected)

note : if destination IP matched with more than one interface then router will forward the packet to the interface which have longest subnet mask

longest subnet mask : more number of 1's in the subnet mask.

note : always start (or) match with the longest subnet mask (more number of 1's) because at the end we will be selecting the longest subnet mask as answer between multiple answers.

Q.1 The routing table of a router is shown below:

Destination	Subnet Mask	Interface
128.75.43.0	255.255.255.0	Eth0
128.75.43.0	255.255.255.128	Eth1
192.12.17.5	255.255.255.255	Eth3
default		Eth2

On which interfaces will the router forward packets addressed to destinations 128.75.43.16? [GATE CS 2004]

(a) eth_3 (not matched)

DIP : 128.75.0010 1011.0001 0000
AND
SM : 255.255.1111 1111. 1111 1111
128.75.0010 1011. 0001 0000
NID: 128.75.43.16

(b) eth_1 (matched)

DIP : 128.75.0010 1011.0001 0000
AND
SM : 255.255.1111 1111.1000 0000
128.75.0010 1011.0000 0000
NID: 128.75.43.0

no need to match more because even if it match with other, we will still select this one as the longest subnet mask.

Q.2 A router uses the following routing table:

Destination	Mask	Interface
144.16.0.0	255.255.0.0	eth0
144.16.64.0	255.255.224.0	eth1
144.16.68.0	255.255.255.0	eth2
144.16.68.64	255.255.255.224	eth3

A packet bearing a destination address 144.16.68.117 arrives at the router. On which interface will it be forwarded? [GATE CS 2006]

(a) eth_3 (not matched)

DIP : 144.16.0100 0100.0111 0101 (144.16.68.117)
AND
SM : 255.255.1111 1111.1110 0000 (255.255.255.224)
128.16.0100 0100.0110 0000 (128.75.68.96)
NID: 128.16.68.96

(b) eth_2 (matched)

DIP : 144.16.0100 0100. 0111 0101 (144.16.68.117)
AND
SM : 255.255.1111 1111.0000 0000 (255.255.255.0)
128.16.0100 0100.0000 0000 (128.75.68.0)
NID: 128.16.68.0

no need to match more because even if it match with other, we

NID: 128.16.68.0

no need to match more because even if it match with other, we will still select this one as the longest subnet mask.

Q.3 The forwarding table of a router is shown below.

Subnet Number	Subnet Mask	Interface ID
200.150.0.0	255.255.0.0	1
200.150.64.0	255.255.224.0	2
200.150.68.0	255.255.255.0	3
200.150.68.64	255.255.255.224	4
Default		0

A Packet addressed to a destination address 200.150.68.118 arrives at the router. It will be forwarded to the interface with ID _____.

[GATE CS 2023]

(a) 4 (not matched)

DIP : 200.150.68.0111 0110 (200.150.68.118)
AND
SM : 255.255.255.1110 0000 (255.255.255.224)
200.150.68.0110 0000 (200.150.68.96)
NID: 200.150.68.96

(b) 3 (matched)

DIP : 200.150.68.0111 0110 (200.150.68.118)
AND
SM : 255.255.255.0000 0000 (255.255.255.0)
200.150.68.0000 0000 (200.150.68.0)
NID: 200.150.68.0

no need to match more because even if it match with other, we will still select this one as the longest subnet mask.

Q.4 An IP router implementing Classless Inter-domain Routing (CIDR) receives a packet with address 131.23.151.76. The router's routing table has the following entries:

Prefix	Output Interface Identifier
131.16.0.0/12	3
131.28.0.0/14	5
131.19.0.0/16	2
131.22.0.0/15	1

they indicate the number of 1's for subnet mask

The identifier of the output interface on which this packet will be forwarded is _____ .

[GATE CS 2014]

routing table

nid	subnet mask	interface
131.16.0.0	255.240.0.0	3
131.28.0.0	255.252.0.0	5
131.19.0.0	255.255.0.0	2
131.22.0.0	255.255.254.0	1

(a) 1 (not matched)

DIP : 131.0001 0111.1001 0111.0100 1100 (131.23.151.76)
AND

AND
SM : 255.1111 1111.1111 1110.0000 0000 (255.255.254.0)
131.0001 0111.1001 0110.0000 0000 (131.23.120.0)
NID: 131.23.120.0

(b) 2 (not matched)

DIP : 131.0001 0111.1001 0111.0100 1100 (131.23.151.76)
AND
SM : 255.1111 1111.0000 0000.0000 0000 (255.255.0.0)
131.0001 0111. 0000 0000. 0000 0000 (131.23.0.0)
NID: 131.23.0.0

(c) 5 (not matched)

DIP : 131.0001 0111.1001 0111.0100 1100 (131.23.151.76)
AND
SM : 255.1111 1100.0000 0000.0000 0000 (255.252.0.0)
131.0001 0100.0000 0000.0000 0000 (131.20.0.0)
NID: 131.20.0.0

(d) 3 (matched)

DIP : 131.0001 0111.1001 0111.0100 1100 (131.23.151.76)
AND
SM : 255.1111 0000.0000 0000.0000 0000 (255.240.0.0)
131.0001 0000.0000 0000.0000 0000 (131.16.0.0)
NID: 131.16.0.0

Q.5

Consider the entries shown below in the forwarding table of an IP router. Each entry consists of an IP prefix and the corresponding next hop router for packets whose destination IP address matches the prefix. The notation "/N" in a prefix indicates a subnet mask with the most significant N bits set to 1.

Prefix	Next hop router
10.1.1.0/24	R1
10.1.1.128/25	R2
10.1.1.64/26	R3
10.1.1.192/26	R2

This router forwards 20 packets each to 5 hosts. The IP address of the hosts are 10.1.1.16, 10.1.1.72, 10.1.1.132, 10.1.1.191 and 10.1.1.205. The number of packets forward via the next hop router R2 is_____.

routing table

nid	subnet mask	next hop router
10.1.1.0	255.255.255.0	R1
10.1.1.128	255.255.255.128	R2
10.1.1.64	255.255.255.192	R3
10.1.1.192	255.255.255.192	R2

ip addresses :

10.1.1.16 : 10.1.1. 0001 0000

10.1.1.72 : 10.1.1. 0100 1000

10.1.1.132 : 10.1.1. 1000 0100

10.1.1.191 : 10.1.1. 1011 1111

10.1.1.205 : 10.1.1.1100 1101

(a) R2 (not matched)

DIP : 10.1.1.0001 0000 (10.1.1.16)
AND
SM : 255.255.255.1100 0000 (255.255.255.192)
10.1.1.0000 0000 (10.1.1.0)
NID: 10.1.1.0

(b) R2 (not matched)

DIP : 10.1.1.0001 0000 (10.1.1.16)
AND
SM : 255.255.255.1000 0000 (255.255.255.128)
10.1.1.0000 0000 (10.1.1.0)
NID: 10.1.1.0

(a) R2 (not matched)

DIP : 10.1.1.0100 1000 (10.1.1.72)
AND
SM : 255.255.255.1100 0000 (255.255.255.192)
10.1.1.0100 0000 (10.1.1.64)
NID: 10.1.1.64

(b) R2 (not matched)

DIP : 10.1.1.0100 1000 (10.1.1.72)
AND
SM : 255.255.255.1000 0000 (255.255.255.128)
10.1.1.0000 0000 (10.1.1.0)
NID: 10.1.1.0

(a) R2 (not matched)

DIP : 10.1.1. 1000 0100 (10.1.1.132)
AND
SM : 255.255.255.1100 0000 (255.255.255.192)
10.1.1.1000 0000 (10.1.1.128)
NID: 10.1.1.128

(b) R2 (matched)

DIP : 10.1.1. 1000 0100 (10.1.1.132)
AND
SM : 255.255.255.1000 0000 (255.255.255.128)
10.1.1.1000 0000 (10.1.1.0)
NID: 10.1.1.1

(a) R2 (not matched)

DIP : 10.1.1. 1011 1111 (10.1.1.191)
AND
SM : 255.255.255.1100 0000 (255.255.255.192)
10.1.1.1000 0000 (10.1.1.128)
NID: 10.1.1.128

(b) R2 (matched)

DIP : 10.1.1. 1011 1111 (10.1.1.191)
AND
SM : 255.255.255.1000 0000 (255.255.255.128)
10.1.1.1000 0000 (10.1.1.128)
NID: 10.1.1.128

(a) R2 (matched)

NID: 10.1.1.128

(a) R2 (matched)

DIP : 10.1.1.1100 1101 (10.1.1.205)
AND
SM : 255.255.255.1100 0000 (255.255.255.192)
10.1.1.1100 0000 (10.1.1.192)
NID: 10.1.1.192

(b) R2 (matched)

DIP : 10.1.1.1100 1101 (10.1.1.205)
AND
SM : 255.255.255.1000 0000 (255.255.255.128)
10.1.1.1000 0000 (10.1.1.128)
NID: 10.1.1.128

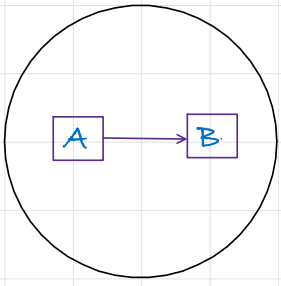
number of packets forward via the next hop router R2 is 80

subnetting category - 10

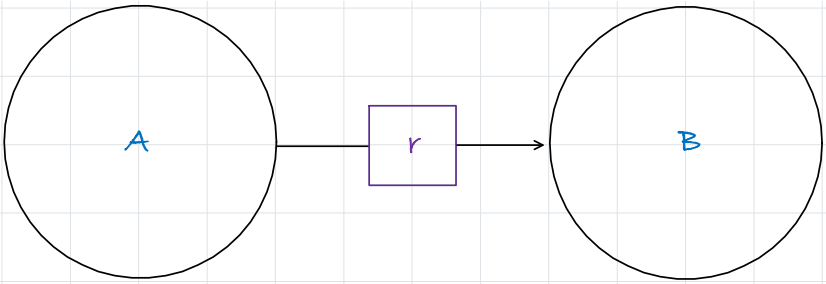
(experimental : failed concept of computer network)

A wants to send a message to B

(i) if B is within the same network



(ii) if B is in the other network



IP address : IP_A
subnet mask : SMA

IP_A
AND
SMA
NID_{AA} (according to A)

IP address : IP_B
subnet mask : SMA

IP_B
AND
SMA
NID_{BA} (according to A)
because A is computing

i know the IP address but the subnet mask is unknown.

q. how 'A' will know the destination 'B' is present is other network or within the same network?

- if $NID_{AA} = NID_{BA}$ then A will assume that B is present in the same network
- if $NID_{AA} \neq NID_{BA}$ then A will assume that B is present in the different network

example : 1 (B according to A)

$IP_A = 200.200.200.15$
$SM_A = 255.255.255.128$

$IP_A = 200.200.200.0000\ 1111$
AND
$SM_A = 255.255.255.1000\ 0000$
NID_{AA} : 200.200.200.0

$IP_B = 200.200.200.132$
$SM_A = 255.255.255.128$

$IP_A = 200.200.200.1000\ 0100$
AND
$SM_A = 255.255.255.1000\ 0000$
NID_{BA} : 200.200.200.128

$NID_{AA} \neq NID_{BA}$, A will assume that B is present in the different network

example : 2 (B according to A)

$IP_A = 200.200.200.15$
$SM_A = 255.255.255.128$

$IP_A = 200.200.200.0000\ 1111$
AND
$SM_A = 255.255.255.1000\ 0000$

$IP_B = 200.200.200.96$
$SM_A = 255.255.255.128$

$IP_A = 200.200.200.0110\ 0000$
AND
$SM_A = 255.255.255.0000\ 0000$

IP_A = 200.200.200.0000 1111
AND
SM_A = 255.255.255.1000 0000
NID_{AA} : 200.200.200.0

IP_A = 200.200.200.0110 0000
AND
SM_A = 255.255.255.0000 0000
NID_{BA} : 200.200.200.0

NID_{AA} = NID_{BA}, A will assume that B is present in the same network

example : 3 (B according to B)

IP_A = 200.200.200.15
SM_A = 255.255.255.128

IP_B = 200.200.200.66
SM_B = 255.255.255.192

IP_A = 200.200.200.0000 1111
AND
SM_A = 255.255.255.1000 0000
NID_{AA} : 200.200.200.0

IP_A = 200.200.200.0100 0010
AND
SM_A = 255.255.255.1100 0000
NID_{BB} : 200.200.200.64

NID of B using subnet mask of A

IP_A = 200.200.200.15
SM_A = 255.255.255.128

IP_A = 200.200.200.0000 1111
AND
SM_A = 255.255.255.1000 0000
NID_{BA} : 200.200.200.0

NID of A using subnet mask of B

IP_A = 200.200.200.15
SM_B = 255.255.255.192

IP_A = 200.200.200.0000 1111
AND
SM_A = 255.255.255.1100 0000
NID_{AB} : 200.200.200.0

NID_{AA} = NID_{BA}, A will assume that B is present in the same network

$NID_{BB} \neq NID_{AB}$, B will assume that A is present in the different network

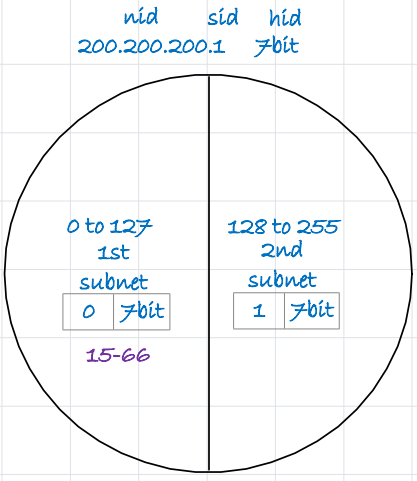
contradict statement : A says B is in my network but B says A is in different network

IP_A = 200.200.200.15
SM_A = 255.255.255.128

Class : C
NID : 24bit
HID : 8bit

IP_A = 200.200.200.0000 1111
SM_A = 255.255.255.1000 0000
s h

subnet : 2^1 = 2 (0 and 1)
host : 2^7-2 = 126 host / subnet



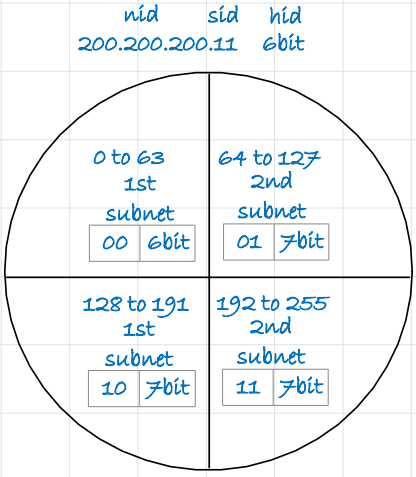
according to A, $IP_{A \text{ and } B}$ 15-66 both are present in A

IP_B = 200.200.200.66
SM_B = 255.255.255.192

Class : C
NID : 24bit
HID : 8bit

IP_A = 200.200.200.0100 0010
AND
SM_B = 255.255.255.1100 0000
s h

subnet : 2^2 = 4 (00,01,10 and 11)
host : 2^6-2 = 62 host / subnet



according to B, $IP_{A \text{ and } B}$ 15-66 are present in different network.

q. why this concept is failed?
because with the help of the subnet mask of A i am trying to find the NID of B but there is possibility that subnet mask of B is different. this concept will only work when mask is same.

it is not the responsibility of host (A) to check whether B is present in another network or same network. it simply sends the packet to router, it is the responsibility of router to check whether B is present in same network or in another network through routing table.

in routing table we have complete imformation of NID and subnet mask.

Q. Two computers C1 and C2 are configured as follows. C1 has IP address 203.197.2.53 and netmask 255.255.128.0. C2 has IP address 203.197.75.201 and netmask 255.255.192.0. which one of the following statements is true? [GATE CS 2006]

A. C1 and C2 both assume they are on the same network

B. C2 assumes C1 is on same network, but C1 assumes C2 is on a different network

C. C1 assumes C2 is on same network, but C2 assumes C1 is on a different network

D. C1 and C2 both assume they are on different networks.

IP_{C1} = 203.197.2.53
SM_{C1} = 255.255.128.0

IP_{C1} = 203.197.2.0011 0101
AND
SM_{C1} = 255.255.128.0000 0000
NID_{C1C1} : 203.197.0.0

IP_{C2} = 203.197.75.201
SM_{C2} = 255.255.192.0

IP_{C2} = 203.197.0100 1011.1100 1001
AND
SM_{C2} = 255.255.255.1100 0000
NID_{C2C2} : 203.197.75.192

IP_{C1} = 203.197.2.53
SM_{C2} = 255.255.192.0

IP_{C1} = 203.197.2.0011 0101
AND
SM_{C2} = 255.255.255.1100 0000
NID_{C1C2} : 203.197.2.0

IP_{C2} = 203.197.75.201
SM_{C1} = 255.255.128.0

IP_{C2} = 203.197.0100 1011.1100 1001
AND
SM_{C1} = 255.255.128.0000 0000
NID_{C2C1} : 203.197.0.0

$NID_{C1C1} = NID_{C2C1}$, C1 will assume that C2 is present in the same network

$NID_{C2C2} \neq NID_{C1C2}$, C2 will assume that C1 is present in the different network

Problem solving on subnetting

Q.1 If subnet mask is 255.255.224.0 then number of subnets are:

A. 2^{11}

B. 2^5

C. 2^{15}

D. 2^3

subnet mask : 255.255.224.0
1111 1111 . 1111 1111 | 1110 0000 . 0000 0000
class B | s | h
class : not given (assume B)
nid : 16bit

1111 1111 . 1111 1111 | 1110 0000 . 0000 0000

class B | s | h

class : not given (assume B)
nid : 16bit
hid : $2^{13} - 2$
sid : 2^3

(or)

1111 1111 | 1111 1111 . 1110 0000 . 0000 0000

class A | s | h

class : not given (assume A)
nid : 8bit
hid : $2^{13} - 2$
sid : 2^{11}

Q.2 If subnet mask is 255.255.255.192 then number of subnets are:

A. 2^{18}
B. 2^5
C. 2^{10}
D. 2^2

subnet mask : 255.255.255.192

1111 1111 | 1111 1111 . 1111 1111 . 1100 0000

class A | s | h

class : not given (assume A)
nid : 8bit
hid : $2^6 - 2$
sid : 2^{18}

(or)

1111 1111 . 1111 1111 | 1111 1111 . 1100 0000

class B | s | h

class : not given (assume B)
nid : 16bit
hid : $2^6 - 2$
sid : 2^{10}

(or)

1111 1111 . 1111 1111 . 1111 1111 | 1100 0000

class C | s | h

class : not given (assume C)
nid : 24bit
hid : $2^6 - 2$
sid : 2^2

- problem solving on subnetting

Monday, July 8, 2024 4:11 AM

Problem solving on subnetting

Q.1 If subnet mask is 255.255.224.0 then number of subnets are:

A. 2^{11}

B. 2^5

C. 2^{15}

D. 2^3

subnet mask : 255.255.224.0

1111 1111 . 1111 1111 . 1110 0000 . 0000 0000

class B | s | h

class : not given (assume B)
nid : 16bit
hid : $2^{13} - 2$
sid : 2^3

(or)

1111 1111 | 1111 1111 . 1110 0000 . 0000 0000

class A | s | h

class : not given (assume A)
nid : 8bit
hid : $2^{13} - 2$
sid : 2^{11}

Q.2 If subnet mask is 255.255.255.192 then number of subnets are:

A. 2^{18}

B. 2^5

C. 2^{10}

D. 2^2

subnet mask : 255.255.255.192

1111 1111 | 1111 1111 . 1111 1111 . 1100 0000

class A | s | h

class : not given (assume A)
nid : 8bit
hid : $2^6 - 2$
sid : 2^{18}

(or)

1111 1111 . 1111 1111 . 1111 1111 . 1100 0000

class B | s | h

1111 1111 . 1111 1111 . 1111 1111 . 1100 0000

class B | s | h

class : not given (assume B)
nid : 16bit
hid : $2^6 - 2$
sid : 2^{10}

(or)

1111 1111 . 1111 1111 . 1111 1111 . 1100 0000

class C | s | h

class : not given (assume C)
nid : 24bit
hid : $2^6 - 2$
sid : 2^2

Q.3 IP address in a block= 200.200.200.60 and the subnet Mask = 255.255.255.224 then find

(i) Subnet id 200.200.200.32

(ii) Subnet number 2

IP address : 200.200.200.60
subnet mask : 255.255.255.224

(i) Subnet id ____.

IP address : 200.200.200.60
AND
subnet mask : 255.255.255.224
subnet id : 200.200.200.32

(ii) Subnet number ____.

subnet mask : 255.255.255.1110 0000
nid | sid | hid

IP address : 200.200.200.0011 1100
nid | sid | hid

kisi bhi number ki subnet id find karni hai toh
saari ki saari hid bits ko 0 kardo

200.200.200.0010 0000
200.200.200.32

sid : 3bit

decimal	bit	subnets
0	000	: 1st subnet
1	001	: 2nd subnet
2	010	: 3rd subnet
3	011	: 4th subnet
4	100	: 5th subnet
5	101	: 6th subnet
6	110	: 7th subnet
7	111	: 8th subnet

sid : 001
subnet number : 2

Q.4 IP address in a block= 200.200.200.80 and the subnet Mask = 255.255.255.224 then find

(i) Subnet id 200.200.200.32

(ii) Subnet number 3rd

(i) Subnet id _____.

subnet mask : 255.255.255.1110 0000
nid sid hid

IP address : 200.200.200.0101 0000
nid sid hid

kisi bhi number ki subnet id find karni hai toh
saari ki saari hid bits ko 0 kardo

200.200.200.0100 0000
200.200.200.64

(ii) Subnet number ____.

sid : 3bit

decimal	bit	subnets
0	000	: 1st subnet
1	001	: 2nd subnet
2	010	: 3rd subnet
3	011	: 4th subnet
4	100	: 5th subnet
5	101	: 6th subnet
6	110	: 7th subnet
7	111	: 8th subnet

sid : 010
subnet number : 3

Q.5 IP address in a block= 200.200.200.122 and the subnet Mask = 255.255.255.240 then find

(i) Subnet id 200.200.200.112

(ii) Subnet number 8th

(i) Subnet id _____.

subnet mask : 255.255.255.1111 0000
nid sid hid

IP address : 200.200.200.0111 0000
nid sid hid

kisi bhi number ki subnet id find karni hai toh
saari ki saari hid bits ko 0 kardo

200.200.200.0111 0000
200.200.200.112

(ii) Subnet number ____.

sid : 3bit

decimal	bit	subnets
0	000	: 1st subnet
1	001	: 2nd subnet

1	001	: 2nd subnet
2	010	: 3rd subnet
3	011	: 4th subnet
4	100	: 5th subnet
5	101	: 6th subnet
6	110	: 7th subnet
7	111	: 8th subnet

sid : 0111
subnet number : 8

Q.6 IP address in a block = 157.157.52.80 and the subnet Mask = 255.255.224.0 then find

(i) Subnet id 157.157.32.0

(ii) First host 157.157.32.1

(iii) Last host 157.157.32.254

(iv) Direct broadcast address 157.157.32.255

subnet mask : 255.255.1110 0000.1110 0000
nid sid hid

IP address : 157.157.0011 0100 .0110 0000
nid sid hid

subnet id : 157.157.32.

class : B
nid : 16 bit
hid : 16bit
sid : 3bit

157.157.0010 0000 . 0000 0000 : 157.157.32.0
157.157.0010 0000 . 0000 0001 : 157.157.32.1 : first host
.
.
157.157.0011 1111 . 1111 1110 : 157.157.159.254 : last host
157.157.0011 1111 . 1111 1111 : 157.157.159.255 : DBA

Q.7 IP address in a block = 157.157.52.80 and the subnet Mask = 255.255.192.0 then find

(i) Subnet id 157.157.0.0

(ii) First host 157.157.0.1

(iii) Last host 157.157.63.254

(iv) Direct broadcast address 157.157.63.255

subnet mask : 255.255.1100 0000 . 0000 0000
nid sid hid

IP address : 157.157. 0011 1000 .0110 0000
nid sid hid

subnet id : 157.157.0.0

class : B
nid : 16 bit
hid : 16bit
sid : 2bit

hid : 16bit
sid : 2bit

157.157.0000 0000 . 0000 0000 : 157.157.0.0
157.157.0000 0000 . 0000 0001 : 157.157.0.1 : first host
.
.
157.157.0011 1111 . 1111 1110 : 157.157.63.254 : last host
157.157.0011 1111 . 1111 1111 : 157.157.63.255 : DBA

Q.8 IP address in a block = 100.160.50.60 and the subnet Mask = 255.252.0.0 then find H·W

(i) Subnet id _____
(ii) First host _____
(iii) Last host _____
(iv) Direct broadcast address _____.

subnet mask : 255.255.1100 0000 . 0000 0000
nid sid hid

IP address : 157.157. 0011 1000 .0110 0000
nid sid hid

subnet id : 157.157.0.0

class : B
nid : 16 bit
hid : 16bit
sid : 2bit

157.157.0000 0000 . 0000 0000 : 157.157.0.0
157.157.0000 0000 . 0000 0001 : 157.157.0.1 : first host
.
.
157.157.0011 1111 . 1111 1110 : 157.157.63.254 : last host
157.157.0011 1111 . 1111 1111 : 157.157.63.255 : DBA

Q.9 IP address in a block= 200.200.200.90 and the subnet Mask = 255.255.255.224 then find

(i) 3rd Subnet id 200.200.200.64
(ii) 7th Subnet id 200.200.200.192

subnet mask : 255.255.255. 1110 0000
nid sid hid

IP address : 200.200.200.0111 0010
nid sid hid

subnet id : 200.200.200.96

class : C
nid : 24bit
hid : 8bit
sid : 3bit

AD rule
000
001
010 0 0000 : 64

011
100
101
110 0 0000 : 192
111

3rd subnet : 200.200.200.64
7th subnet : 200.200.200.192

AD rule 2.0

sid : 3bits
bits weigtage : 128 64 32
3rd subnet id : 0 1 0 : 64
7th subnet id : 1 1 0 : 192

Q.10 IP address in a block= 200.200.200.90 and the subnet Mask = 255.255.255.240 then find

(i) 4th Subnet id 200.200.200.48

(ii) 6th Subnet id 200.200.200.80

subnet mask : 255.255.255. 1111 0000
nid sid hid

IP address : 200.200.200.0111 0010
nid sid hid

subnet id : 200.200.200.112

class : C
nid : 24bit
hid : 8bit
sid : 3bit

AD rule 2.0

sid : 4bits
bits weigtage : 128 64 32 16
4th subnet id : 0 0 1 1 : 48
6th subnet id : 0 1 0 1 : 8

note : remember the decimal value in order to write them in bits.
example : decimal value 5 in 4 bits : 0101 (6th subnet id)

Q.1 IP address in a block= 125.200.100.90 and the subnet Mask = 255.252.0.0 then Find

(i) 3rd host in 2nd Subnet _____

(ii) 4th host in 3rd Subnet _____

(iii) 1st host in 4th Subnet _____

subnet mask : 255.1111 1100. 0000 0000. 0000 0000
nid sid hid

IP address : 125.1100 1000. 0111 0100. 0110 1010
nid sid hid

class : A
nid : 8bit

nid : 8bit
hid : 24bit
sid : 6bit

2nd subnet id : 125.0000 0100. 0000 0000. 0000 0000 : 125.4.0.0
3rd subnet id : 125.0000 1000. 0000 0000. 0000 0000 : 125.8.0.0
4th subnet id : 125.0000 1100. 0000 0000. 0000 0000 : 125.12.0.0

2nd subnet id :
125.0000 0100.0000 0000. 0000 0001 : 125.4.0.1 : 1st host
125.0000 0100.0000 0000. 0000 0010 : 125.4.0.2 : 2nd host
125.0000 0100.0000 0000. 0000 0011 : 125.4.0.3 : 3rd host

3rd subnet id :
125.0000 1000.0000 0000. 0000 0001 : 125.8.0.1 : 1st host
125.0000 1000.0000 0000. 0000 0010 : 125.8.0.2 : 2nd host
125.0000 1000.0000 0000. 0000 0011 : 125.8.0.3 : 3rd host
125.0000 1000.0000 0000. 0000 0100 : 125.8.0.4 : 4th host

4th subnet id :
125.0000 1100. 0000 0000. 0000 0001 : 125.12.0.1 : 1st host

Q.2 IP address in a block= 157.157.100.90 and the subnet Mask = 255.255.224.0 then Find

(i) 3rd host in 2nd Subnet _____
(ii) 4th host in 3rd Subnet _____
(iii) 1st host in 4th Subnet _____

subnet mask : 255.255.1110 0000. 0000 0000
nid sid hid
IP address : 157.157.0110 0100. 0101 1010
nid sid hid

class : B
nid : 16bit
hid : 16bit
sid : 3bit

2nd sid with 3rd host : 157.157.0010 0000. 0000 0011 : 157.157.32.3
3rd sid with 4th host : 157.157.0100 0000. 0000 0100 : 157.157.64.4
4th sid with 1st host : 157.157.0110 0000. 0000 0001 : 157.157.96.1

Q.3 IP address in a block= 200.200.200.90 and the subnet Mask = 255.255.255.240 then Find H.W

(i) 3rd host in 2nd Subnet _____
(ii) 4th host in 3rd Subnet _____
(iii) 1st host in 4th Subnet _____

subnet mask : 255.255.255.1111 0000
nid sid hid
IP address : 200.200.200.0101 1010
nid sid hid

class : B
nid : 24bit
hid : 8bit
sid : 4bit

2nd sid with 3rd host : 200.200.200.0001 0011 : 200.200.200.19
3rd sid with 4th host : 200.200.200.0010 0100 : 200.200.200.36
4th sid with 1st host : 200.200.200.0011 0001 : 200.200.200.49

Q.4 Consider three machines M, N, and P with IP addresses 157.157.38.90, 157.157.48.90, and 157.157.68.90 respectively. The subnet mask is set to 255.255.192.0 for all the three machines. Which one of the following is true?

A. M, N, and P belong to three different subnets

B. Only N and P belong to the same subnet

C. Only M and N belong to the same subnet

D. M, N, and P all belong to the same subnet

(i) M : 157.157.0010 0110.90
subnet : 255.255.1100 0000.0
nid : 157.157.0.0

(ii) N : 157.157.0011 0000.90
subnet : 255.255.1100 0000.0
nid : 157.157.0.0

(iii) M : 157.157.0100 0100.90
subnet : 255.255.1100 0000.0
nid : 157.157.64.0

AD rule

m : 38 : 0010 0110
n : 48 : 0011 0000
p : 68 : 0100 0100

first 2 bit matters because baaki saari bits 0 hai

AD rule 2.0

	128	64
m : 38 :	0	0
n : 48 :	0	0
p : 68 :	0	1

Q.5 Consider three machines M, N, and P with IP addresses 157.157.38.90, 157.157.48.90, and 157.157.68.90 respectively. The subnet mask is set to 255.255.240.0 for all the three machines. Which one of the following is true?

A. M, N, and P belong to three different subnets

B. Only N and P belong to the same subnet

C. Only M and N belong to the same subnet

D. M, N, and P all belong to the same subnet

subnet mask : 255.255.240.0
255.255. 1111 0000 . 0000 0000

AD rule 2.0

255.255.1111 0000 . 0000 0000

AD rule 2.0

	128	64	32	16
m : 38 :	0	0	1	0
n : 48 :	0	0	1	1
p : 68 :	0	1	0	0

Q.6 Consider three machines M, N, and P with IP addresses 100.40.38.90, 100.92.48.90, and 100.80.68.90 respectively. The subnet mask is set to 255.224.0.0 for all the three machines. Which one of the following is true?

A. M, N, and P belong to three different subnets

B. Only N and P belong to the same subnet

C. Only M and N belong to the same subnet

D. M, N, and P all belong to the same subnet

subnet mask : 255.224.0.0

255. 1110 0000 . 0000 0000 . 0000 0000

AD rule 2.0

	128	64	32
m : 40 :	0	0	1
n : 92 :	0	1	0
p : 80 :	0	1	0

Q.7 Consider three machines M, N, and P with IP addresses

M = 200.40.38.50,

N = 200.92.48.40,

P = 200.80.68.60,

subnet mask = 255.255.255.224, then find which host of which subnet

subnet mask : 255.255.255.1110 0000

(i) M : 200.40.38.0011 0010
sid host

2nd subnet id + 18th host

(ii) N : 200.92.48.0010 1000
sid host

2nd subnet id 8th host

(iii) P : 200.80.68.0011 1100
sid host

2nd subnet id + 28th host

Q.8 Consider three machines M, N, and P with IP addresses

M=157.157.40.50,

N= 157.157.48.40,

P= 157.157.80.60,

subnet mask= 255.255.252.0, then find which host of which subnet

subnet mask : 255.255.1111 1100.0

(i) M : 157.157.0010 1000.0011 0010
sid host

11th subnet id + 50th host

(ii) N : 157.157.0011 0000 . 0010 1000
sid host

13th subnet id + 40th host

(iii) P : 157.157.0101 0000 . 0011 1100
sid host

21st subnet id + 60th host

Q.9 Consider three machines M, N, and P with IP addresses

M =100.40.0.10,

N = 100.96.0.22,

P = 200.80.0.15,

subnet mask = 255.252.0.0, then find which host of which subnet

subnet mask : 255.1111 1100.0.0

(i) M : 100.0010 1000 . 0000 0000 . 0000 1010
sid host

11th subnet id + 10th host

(ii) N : 100. 0110 0000 . 0000 0000 . 0001 0110
sid host

25th subnet id + 22nd host

(iii) P : 200.0101 0000 . 0000 0000 . 0000 1111
sid host

21st subnet id + 15th host

Q.10 Consider three machines M, N, and P with IP addresses 100.10.5.2, 100.10.5.5, and 100.10.5.6 respectively. The subnet mask is set to 255.255.255.252 for all the three machines. Which one of the following is true?

A. M, N, and P belong to three different subnets

B. Only N and P belong to the same subnet

Q.10 Consider three machines M, N, and P with IP addresses 100.10.5.2, 100.10.5.5, and 100.10.5.6 respectively. The subnet mask is set to 255.255.255.252 for all the three machines. Which one of the following is true?

A. M, N, and P belong to three different subnets

B. Only N and P belong to the same subnet

C. Only M and N belong to the same subnet

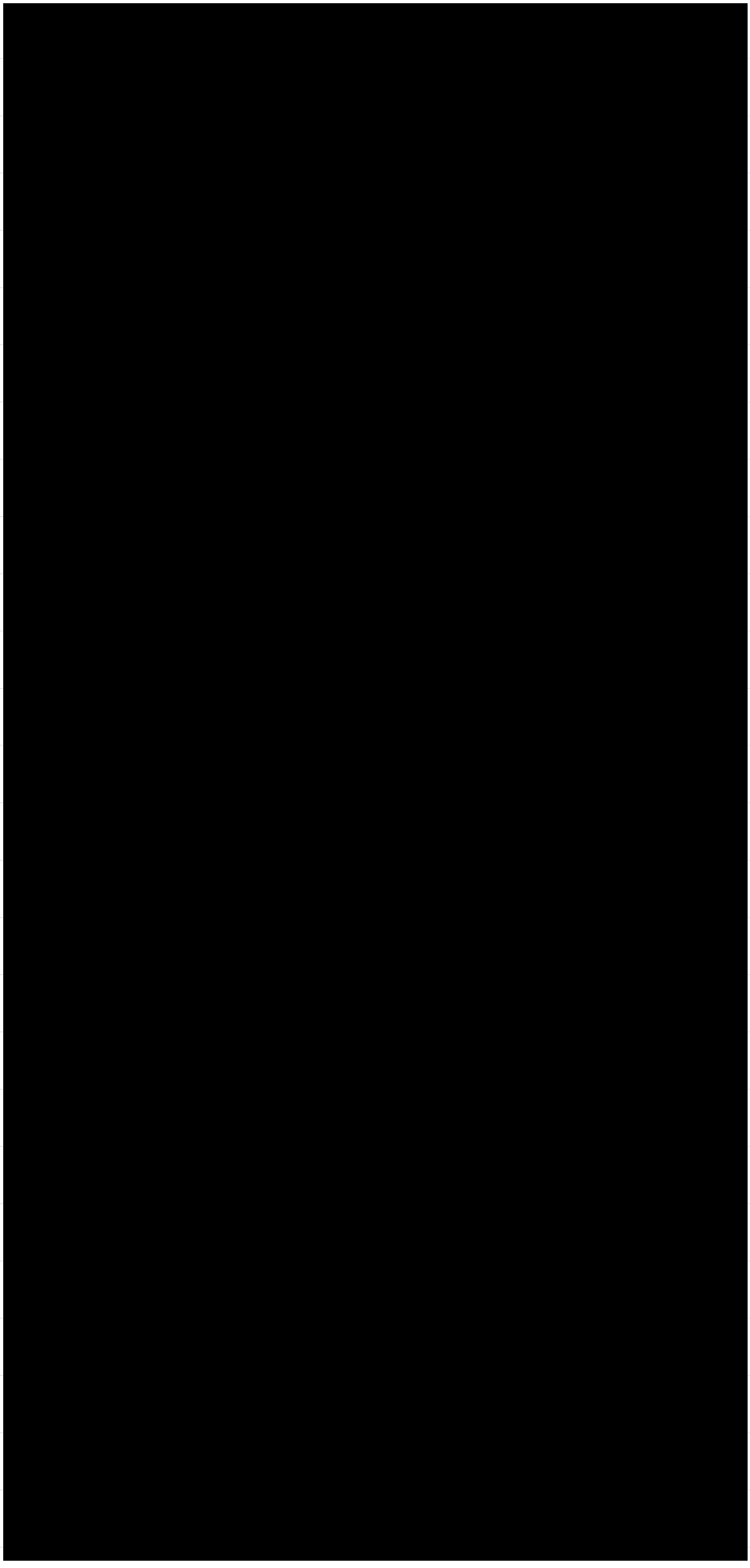
D. M, N, and P all belong to the same subnet

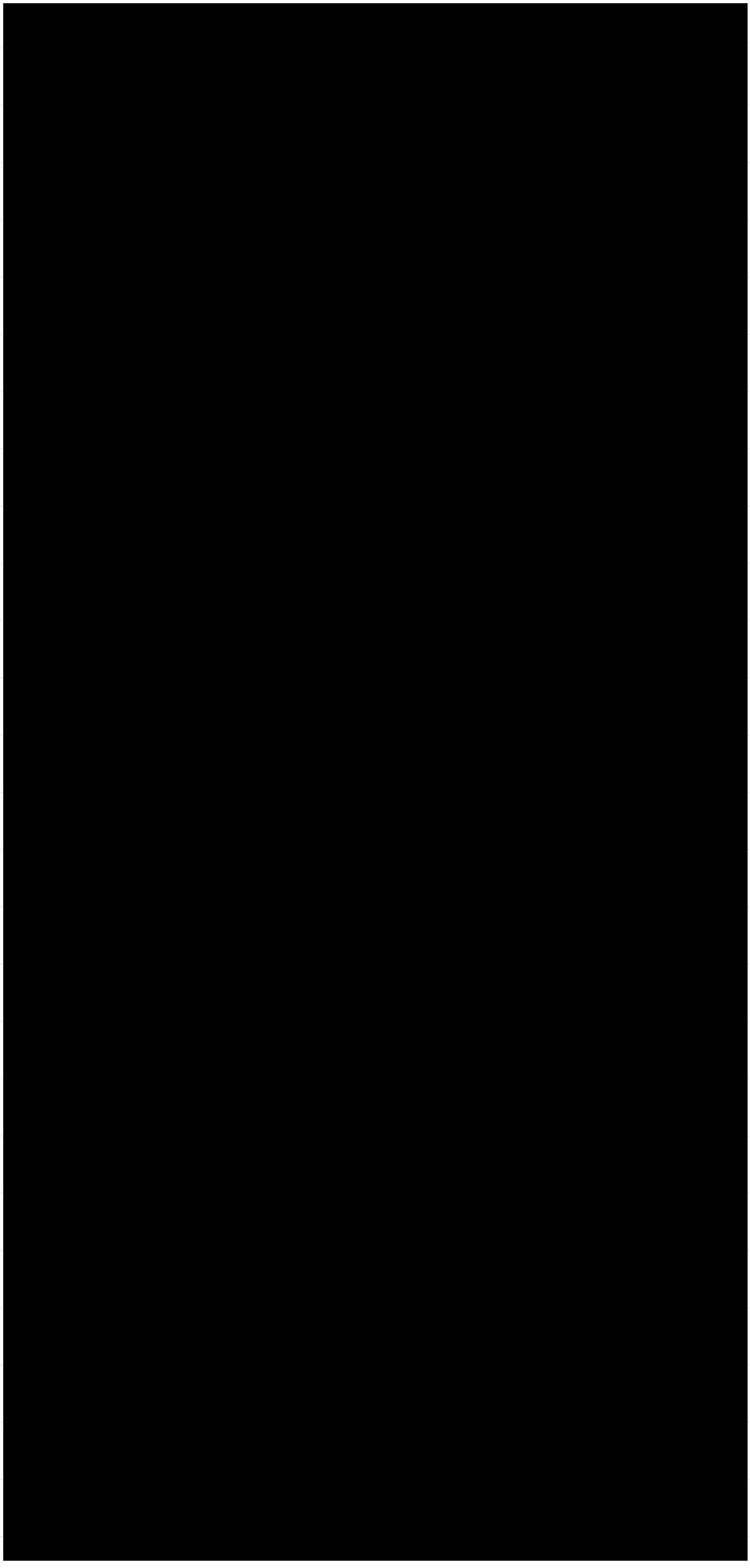
subnet mask : 255.255.255.252

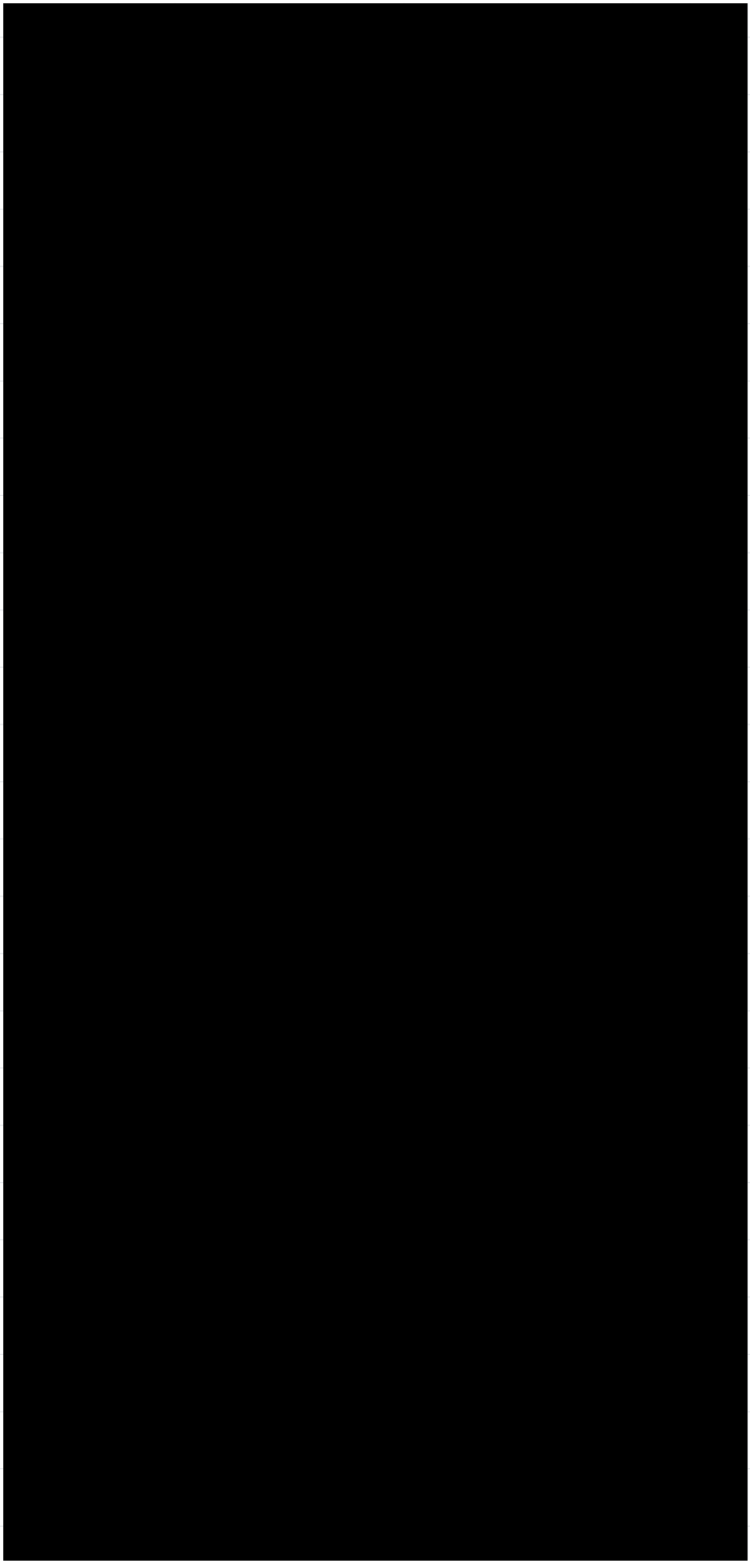
255.255.255.1111 1100

AD rule 2.0

	128	64	32	16	8	4
m : 2 :	0	0	0	0	0	0
n : 5 :	0	0	0	0	0	1
p : 6 :	0	0	0	0	0	1







topic - 3 (classless addressing)

Friday, July 12, 2024 12:03 AM

classless addressing

in classful addressing, IP address divided into 5 classes :

number of IP address in one network in Class - A : 2^{24}
bit fixed in Class - A : 0
50%

number of IP address in one network in Class - B : 2^{16}
bit fixed in Class - B : 10
25%

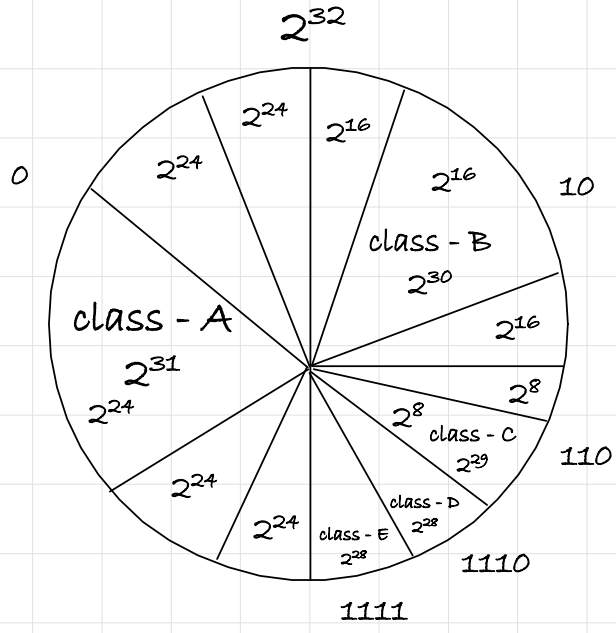
number of IP address in one network in Class - C : 2^{8}
bit fixed in Class - C : 110
12.5%

q.assume a organization X requires : 2^{22} ip address, which class network will be assigned?

class 'A' will be assigned.

number of IP address wasted : $2^{24} - 2^{22}$

$= 2^2.2^{22}-2^{22}$
$= 4.2^{22}-2^{22}$
$= 3.2^{22}$
$= 3.2^2.2^{20}$
$= 3.4.2^{20}$
$= 12.2^{20}$
$= 12M$
$= 12,582,912$



more than 1.2 crore IP address wasted.

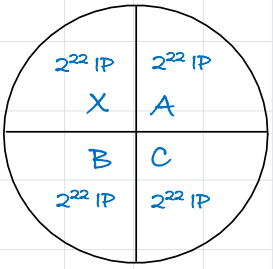
that is why we need subnetting!

so, x organisation purchased the class-A network and searched for 3 other organisations that requires

of same amount IP addresses.

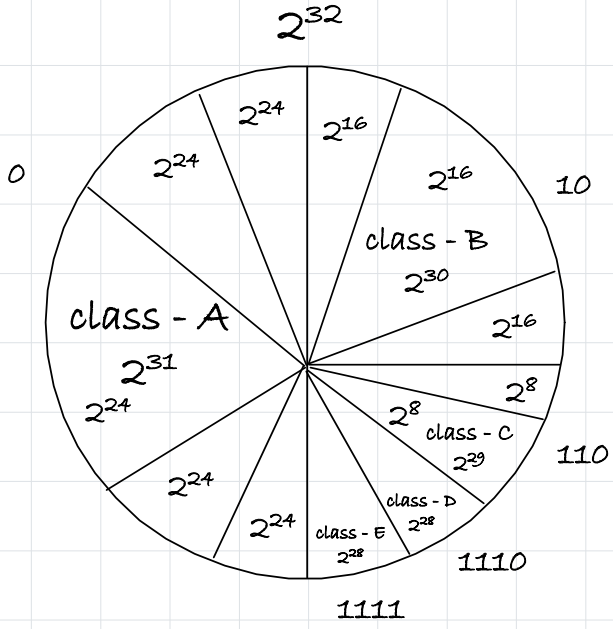
$$\frac{2^{24}}{4} = \frac{2^{24}}{2^2} = 2^{24-2} = 2^{22}$$

X : 2^{22}
A : 2^{22}
B : 2^{22}
C : 2^{22}



so, dividing and sharing the larger IP address into many smaller networks

but subnetting is not a permanent solution



disadvantage :

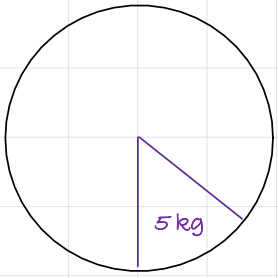
(i) wastage of IP address

(ii) class - c was generally more used compared to class - A and class - B

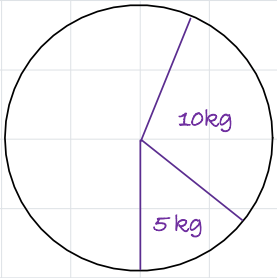
advantage :

(i) IP address = 10.19.32.54
by first octet i can find to which class it belongs and through class i was able to idenity nid and hid.

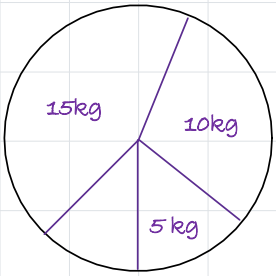
classless addressing



x requires 5 kg cake

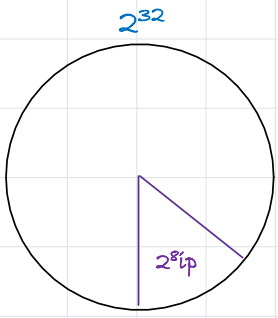


y requires 10 kg cake

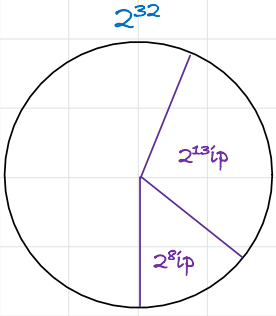


z requires 15 kg cake

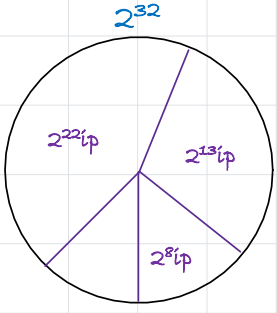
cake is not divided into pieces, shopkeeper gives you according to your requirement.



x requires 2^{8}ip



y requires 2^{13} ip

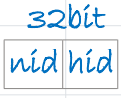


z requires 2^{22} ip

ip address :

8	8	8	8
0 to 255	0 to 255	0 to 255	0 to 255

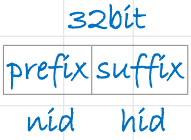
classful addressing :



but how i can tell that particular given ip belongs to which class or what is the size of hid,nid?

CIDR : a.b.c.d/n
n : network id or subnet mask

classless addressing :



example :

(i) 10.19.32.67/22 — yeh ip jis block mai present hai uski block/nid hai 22bit ki

nid : 22bit

hid : 10bit

number of ip address available in the block: 2^{10} — yeh ip jis network mai present hai us block ka size hai 22bit 2^{10}

number of host available in the block: $2^{10}-2$ — aur uske andar $2^{10}-2$ host present hai

NID	HID	
10.19.00100	__.________	
10.19.00100	00.00000000 → 10.19.32.0	BID/NID
10.19.00100	00.00000001 → 10.19.32.1	valid hosts
.		
.		
.		
10.19.00100	11.11111110 → 10.19.32.254	
10.19.00100	11.11111111 → 10.19.32.255	DBA

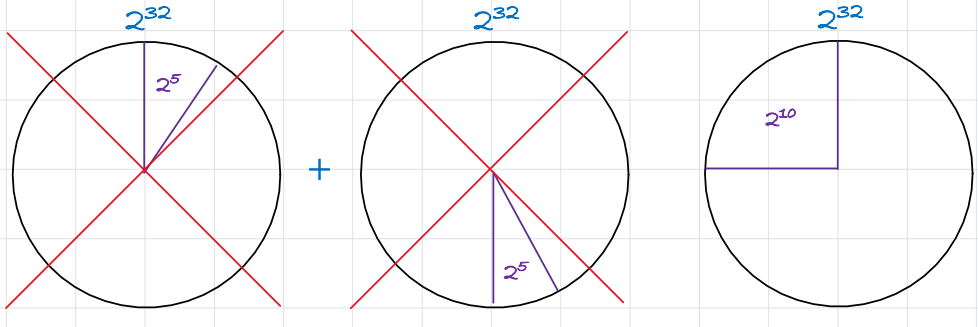
rules for CIDR [class less inter domain routing]

whenever any customer wants a block of IP address IANA or ISP will create the block assigned to customer

rules to be followed by IANA for creating the block :

(i) all the IP address in the block must be contiguous.

example : x requires 2^{10} ip

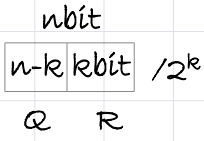


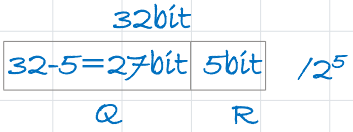
(ii) block size must be a power of 2

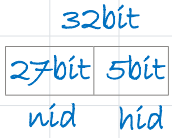
- X requires : 10001P
  block created : 1024IP

- X requires : 3991P
  block created : 5121P

(wastage is minimised)



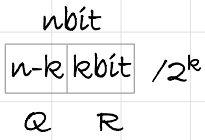


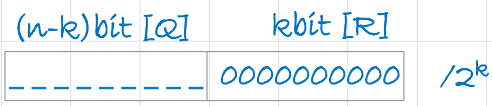


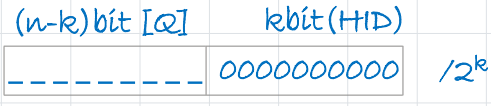
if block size is power of 2 then i can easily find the host id and network id.

(iii) first IP address of the block must be divisible by the size of the block.

divisible means reminder must be zero.







indirectly it is saying that the in first IP address all hid bits must be '0'.
it represents the block id.

> note : first IP address of the block must be used as a block id (all hid 0).
> if rule 1, rule 2, rule 3 is satisfied the DBA will be there automatically.

example :

100.100.100.64
100.100.100.65
100.100.100.66
100.100.100.67
.
100.100.100.127

(i) contiguous : (true) 64-65..127

(ii) block size : (true) 127-64+1=64 (2^6)

(ii) block size : (true) 0110 0100.0110 0100.0110 0100.0100 0000/2^6
rem

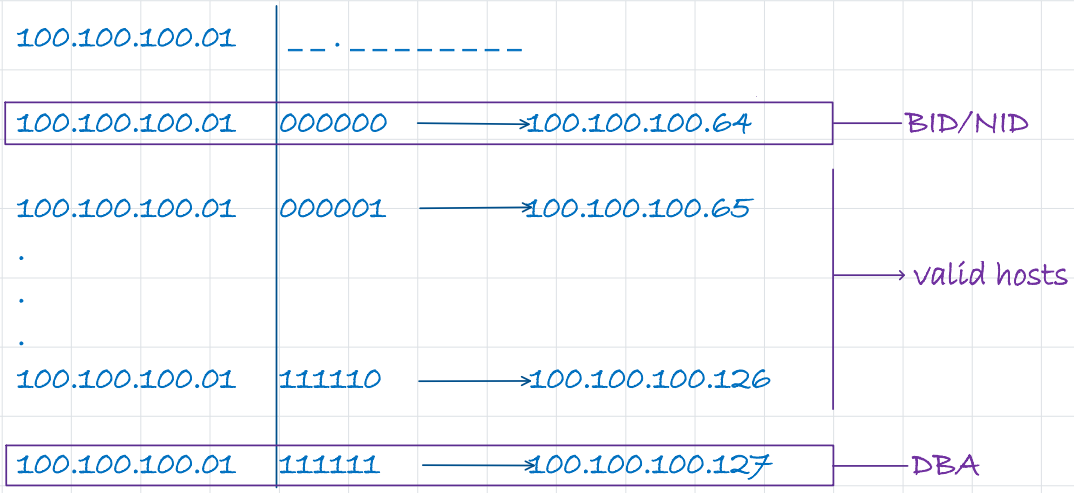
hid : 6bit (remainder - 0)

hence, it is a valid block.

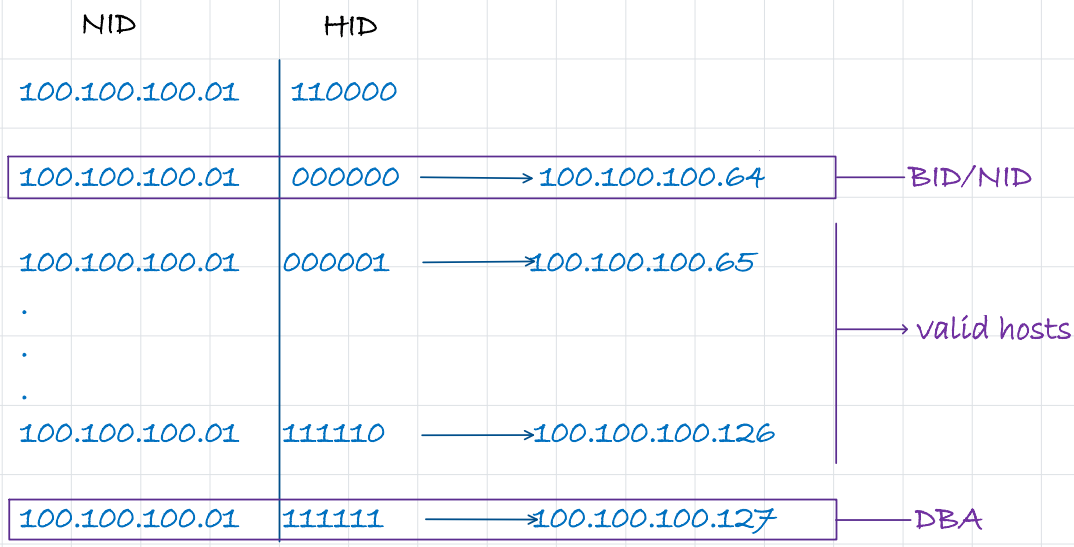
representation of CIDR block

block size : 2^6
HID : 6bit
NID : $2^{32} - 2^6 = 2^{26}$ = 26 bit
this number will represent whole block : 100.100.100.64/26
proof : 100.100.100.64/26
8 + 8 + 8 +8 - 6(HID) = 26 bit

NID HID



HID toh '0' hi rahegi. toh hum kisi bhi number se represent kar sakte hai.



example :

100.100.100.128
100.100.100.129
100.100.100.130
.
.
100.100.100.255

(i) contiguous : (true) 128,129...255

(ii) block size : (true) 255 - 128 + 1 = 128

(ii) block size : (true) 0110 0100.0110 0100.0110 0100.1000 0000/2^7
rem

hid : 7bit (remainder - 0)

hence, it is a valid block.

representation of CIDR block :

block size : 2^7
HID : 7bit
NID : 32-7 = 25bit

representation : 100.100.100.128/25

q. one of the address of the block is 100.100.100.68/27 then find

(i) number of addresses in a block : 2^5 (95-64+1=32)
(ii) range of IP address : 100.100.100.64 to 100.100.100.95
(iii) block id/network id : 100.100.100.64
(iv) first host : 100.100.100.65
(v) last host : 100.100.100.94
(vi) DBA : 100.100.100.95

NID : 27 bit, HID : 32-27 = 5 bit

NID	HID	
100.100.100.010	_ _ _ _ _	
100.100.100.010	00000 → 100.100.100.64	BID/NID
100.100.100.010	00001 → 100.100.100.65	valid hosts
.		
.		
.		
100.100.100.010	11110 → 100.100.100.94	
100.100.100.010	11111 → 100.100.100.95	DBA

subnetting in CIDR

(i) 100.100.100.14/25

NID : 25nit
HID : 7bit

no. of IP address available in this block : 2^7

no. of host available in this block : 2^7-2

NID	HID
100.100.100.0	_ _ _ _ _ _ _

i want to divide this in 2 subnet, so we borrowed 1 bit

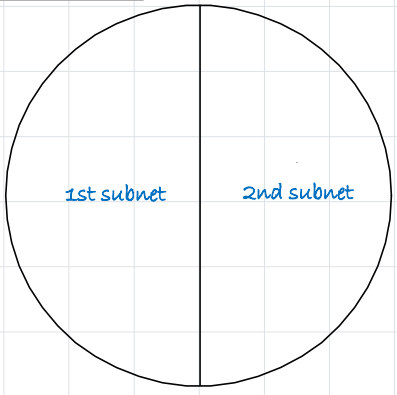
NID		HID
100.100.100.0	s	_ _ _ _ _ _

s_1 : 0 (1st subnet)
s_2 : 1 (2nd subnet)

n	s	hid
0	0	_ _ _ _ _ _

2^7

n	s	hid
0	1	_ _ _ _ _ _



1st subnet
- sid : 200.200.200.0
- dba : 200.200.200.63/26 (255-128-64=63)

2nd subnet
- sid : 200.200.200.64
- dba : 200.200.200.127/26 (255-128=127)

(ii) 100.100.100.14/25

NID : 25nit
HID : 7bit

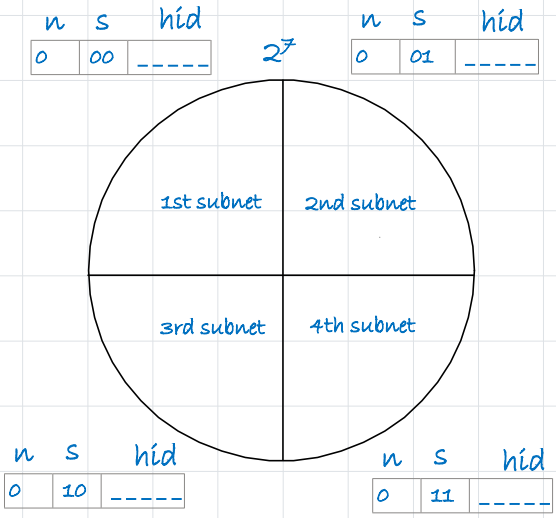
no. of IP address available in this block : 2^7

no. of host available in this block : 2^7-2

NID	HID
100.100.100.0	_ _ _ _ _ _ _

i want to divide this in 4 subnet, so we borrowed 2 bit

NID		HID
100.100.100.0	_ _ (s)	_ _ _ _ _



1st subnet
- sid : 200.200.200.0/27
- dba : 200.200.200.31/27 (255-128-64-32=31)

2nd subnet
- sid : 200.200.200.32/27
- dba : 200.200.200.63/27 (255-128-64=63)

3rd subnet
- sid : 200.200.200.64/27
- dba : 200.200.200.95/27 (255-128-32=95)

4th subnet
- sid : 200.200.200.96/27
- dba : 200.200.200.127/27 (255-128=127)

VLSM (variable length subnet masking) in CIDR

(i) 100.100.100.14/25

NID : 25nit
HID : 7bit

no. of IP address available in this block : 2^7

no. of host available in this block : 2^7-2

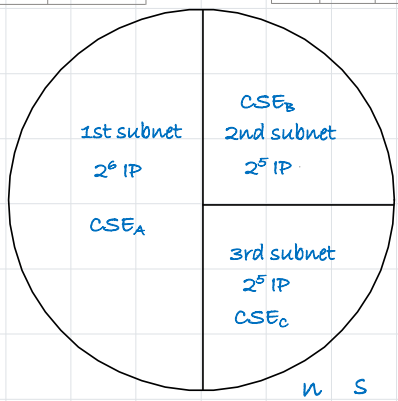
CSE_A : 60
CSE_B : 30
CSE_C : 30

120 ≤ 2^7-2 (yes, solution may exist)

n	s	hid
0	0	------

2^7

n	s	hid
0	10	-----



n	s	hid
0	11	-----

CSE_A
- sid : 200.200.200.0/26
- dba : 200.200.200.63/26

CSE_B
- sid : 200.200.200.64/27
- dba : 200.200.200.95/27

CSE_C
- sid : 200.200.200.96/27
- dba : 200.200.200.127/27

B and C are interchangable

CSE_A
- sid : 200.200.200.0/26
- dba : 200.200.200.63/26

CSE_C
- sid : 200.200.200.64/27
- dba : 200.200.200.95/27

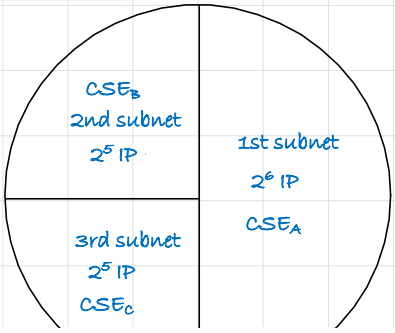
CSE_B
- sid : 200.200.200.96/27
- dba : 200.200.200.127/27

second way :

n	s	hid
0	00	-----

2^7

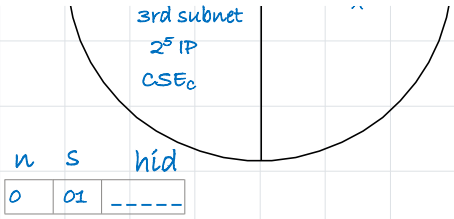
n	s	hid
0	1	------



CSE_A
- sid : 200.200.200.64/26
- dba : 200.200.200.127/26

CSE_B
- sid : 200.200.200.0/27
- dba : 200.200.200.31/27

CSE_C
- sid : 200.200.200.32/27
- dba :



CSE_C
- sid : 200.200.200.32/27
- dba : 200.200.200.63/27

B and C are interchangable

CSE_A
- sid : 200.200.200.64/26
- dba : 200.200.200.127/26

CSE_C
- sid : 200.200.200.0/27
- dba : 200.200.200.31/27

CSE_B
- sid : 200.200.200.32/27
- dba : 200.200.200.63/27

(i) 100.100.14.14/25

NID : 20nit
HID : 12bit

no. of IP address available in this block : 2^{12}

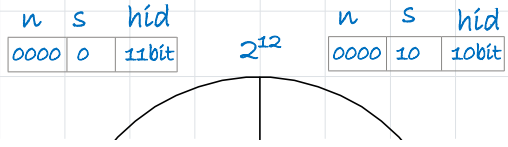
no. of host available in this block : $2^{12}-2$

IBM_D : 2000
IBM_T : 1000
IBM_P : 1000

$4000 \leq 2^{12}-2$ (yes, solution may exist)

NID	HID
100.100.0000	____.________

NID		HID
100.100.0000	0 (s)	___.________

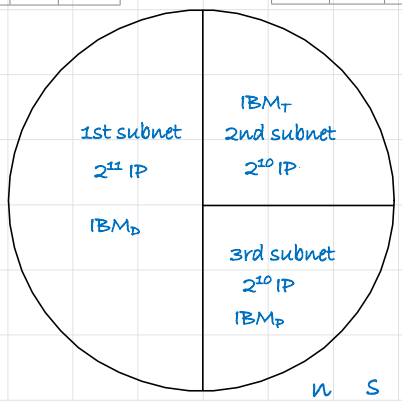


IBM_D
- sid : 100.100.0.0/21
- dba : 100.100.7.255/21

0000	0	11bit

2^{11}

0000	10	10bit



n	s	hid
0000	11	10bit

IBM$_D$
- sid : 100.100.0.0/21
- dba : 100.100.7.255/21

IBM$_T$
- sid : 100.100.8.0/22
- dba : 100.100.11.255/22

IBM$_P$
- sid : 100.100.12.0/22
- dba : 100.100.15.255/22

T and P are interchangable

IBM$_D$
- sid : 100.100.0.0/21
- dba : 100.100.7.255/21

IBM$_P$
- sid : 100.100.8.0/22
- dba : 100.100.11.255/22

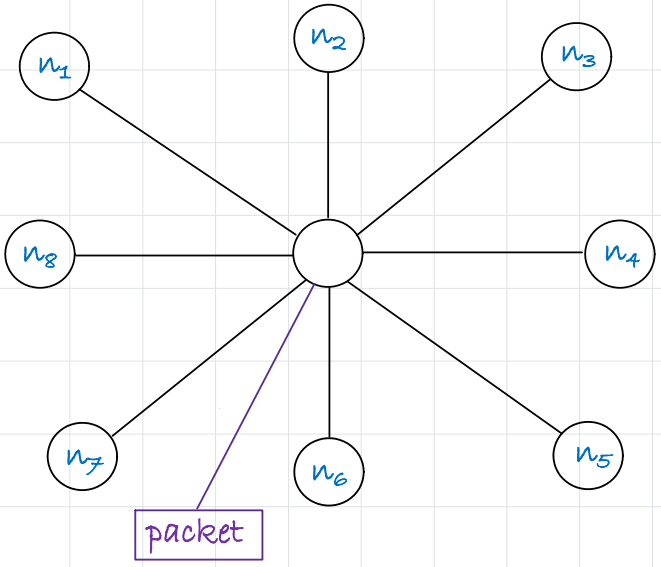
IBM$_T$
- sid : 100.100.12.0/22
- dba : 100.100.15.255/22

supernetting

Sunday, July 14, 2024 1:33 AM

supernetting or aggregation

the process of combining two or more network to get a single network is called supernetting



routing table

nid	sm	i/f
0.0.0.0	0.0.0.0	

number of entries in a routing table depends on the number of network associated to a particular router.

supernet : combining all the 8 network into a single network and that single network is basically supernet.

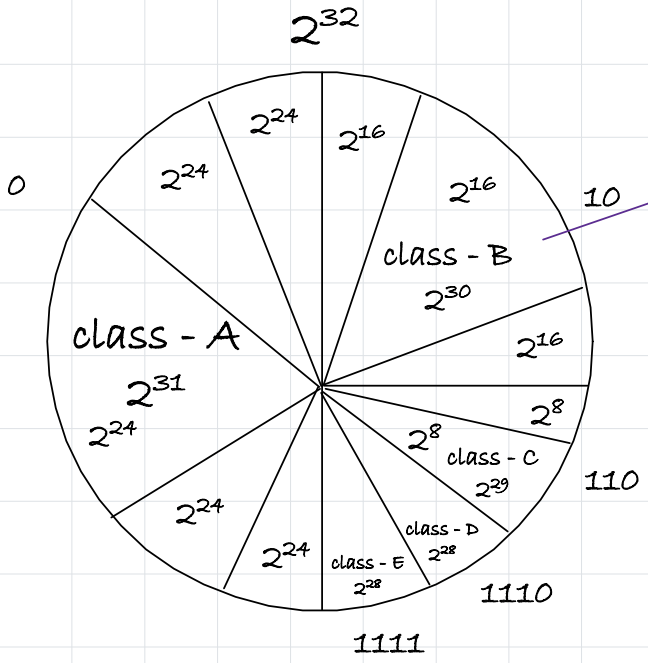
advantage :

(i) supernetting reduces routing table entry.

(ii) router will take less time for processing the packet.

(iii) it improve the flexibility of IP address allotment
i.e.if some one required 500 address then we have no need to purchase class B network we can combine two class C network.

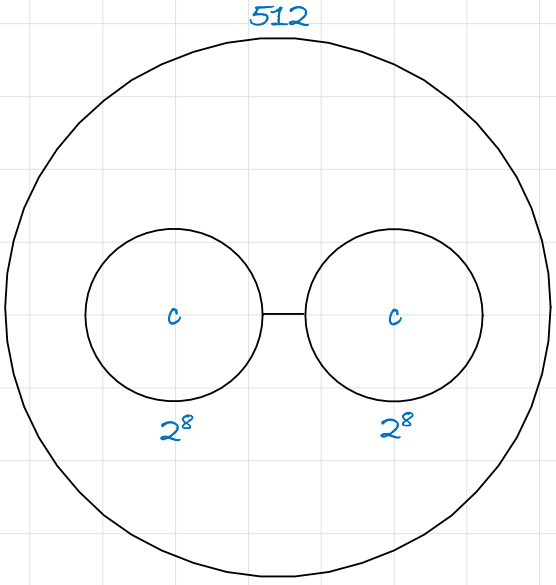
classful addressing :



x = 500 IP address

IP address wasted = 2^{16}-500
= 65,536 - 500
= 65,036

instead combine two class-C network



x = 500 IP address

IP address wasted = 512-500
= 12

note : in supernetting, merging only same class is allowed not of different class.

rules of supernetting :

(i) network id must be contiguous.

(ii) size of the network must be same and no. of network must be in a power of 2 (3,5,7 not possible).

(iii) first network ID must be a div. by total size of supernet.

rule(i) network id must be contiguous.

n_1 : 128.56.24.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_2 : 128.56.25.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_3 : 128.56.26.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_4 : 128.56.27.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

4×2^8
$2^2 \times 2^8$
2^{10}
1024 network

contiguous : all the 1024 ip address must be contiguous. if they are not contiguous then i cannot combine.

n_1 : 128.56.24.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

128.56.24. 0000 0000 ⟶ 128.56.24.0
nid hid

128.56.24. 1111 1111 ⟶ 128.56.24.255

+1

128.56.25.0

128.56.25. 0000 0000 ⟶ 128.56.25.0

nid hid

. .

. .

. .

. .

128.56.25. 1111 1111 ⟶ 128.56.25.255

+1

128.56.26.0

128.56.26. 0000 0000 ⟶ 128.56.26.0

nid hid

. .

. .

. .

. .

128.56.26. 1111 1111 ⟶ 128.56.26.255

+1

128.56.27.0

128.56.27. 0000 0000 ⟶ 128.56.27.0

nid hid

. .

. .

. .

. .

128.56.27. 1111 1111 ⟶ 128.56.27.255

so, contiguous here means ki jahan mera network 1 end ho raha hai (128.56.24.255), n2

network ka pehla ip address (128.56.25.0) se hi shuru hona chaiye and so on.

shortcut (ad rule)

n_1 : 128.56.24.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

h

all bits in hid '0' : same
all bits in hid '1' : 255 + 1 = 128.56.25.0

n_2 : 128.56.25.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

h

all bits in hid '0' : same
all bits in hid '1' : 255 + 1 = 128.56.26.0

n_3 : 128.56.26.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

h

all bits in hid '0' : same
all bits in hid '1' : 255 + 1 = 128.56.27.0

n_4 : 128.56.27.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

h

all bits in hid '0' : same

rule (ii) size of the network must be same and no. of network must be in a power of 2 (3,5,7 not possible).

same size : 2^8
number of networks : $4 = 2^2$

rule (iii) first network ID must be a div. by total size of supernet.

when you combine all four address into a supernet, the first IP address of the supernet id must be divisible by total number of ip addresses in the supernet, the host id must be zero.

n_1 : 128.56.24.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_2 : 128.56.25.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_3 : 128.56.26.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8
n_4 : 128.56.27.0/24 nid : 24bit , hid : 8bit , no. of ip address : 2^8

supernet size : $2^8 + 2^8 + 2^8 + 2^8$

$4(2^8)$

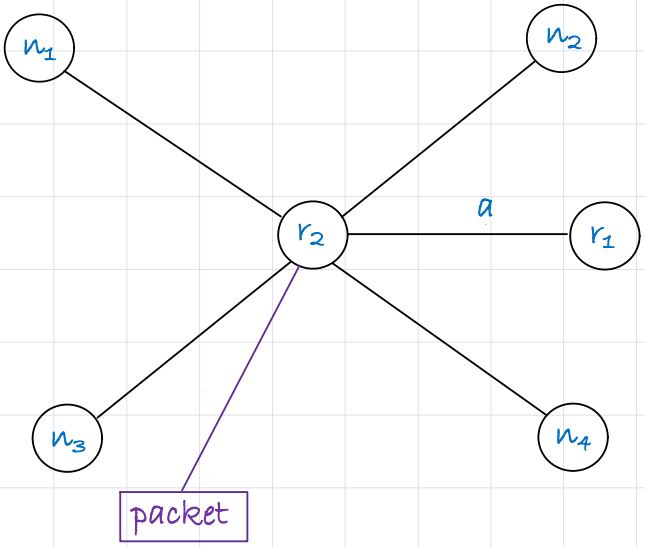
$2^2.2^8 = 2^{10}$

first ip address must be divisible by 2^{10}

n_1 : 128.56.24.0/24

128.56. 0001 1000 . 0000 0000/2^{10} (true)

rem



routing table

nid	sm	i/f
n_1 match		a
n_2 match		a
n_3 match		a
n_4 match		a
0.0.0.0	0.0.0.0	

packet kahin bhi aaye (n_1,n_2,n_3,n_4) r_1 simply r_2 ko hi bejh raha hai
toh 4 entries jo r_1 routing table mai hai vo ek entry se replace ho jaye