CS & IT ENGINEERING

COMPUTER NETWORKS

IPv4 Addressing

Lecture No-19

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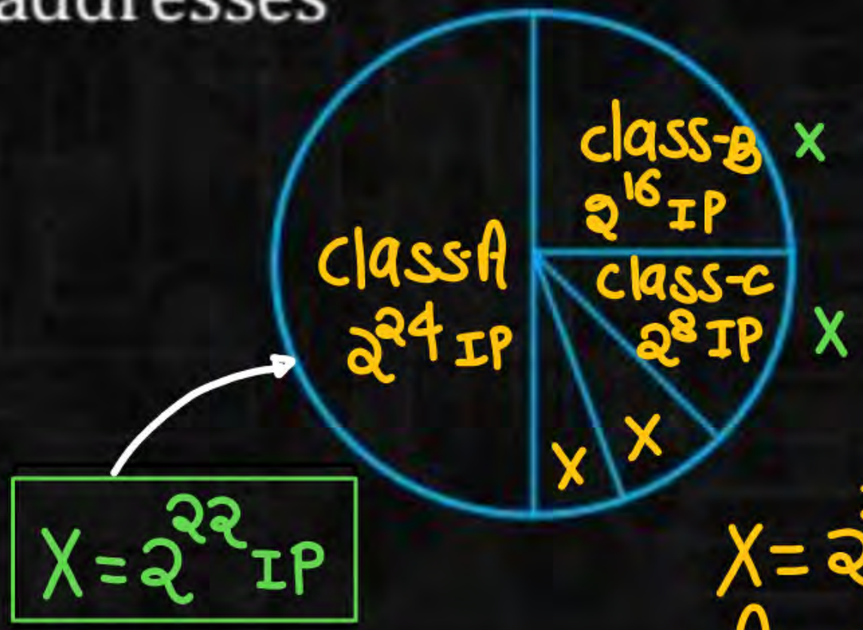
- Classless Addressing Part - 1
- classless Addressing Part - 2

Classful Addressing

Class A → 2^{24} IP Addresses in one network
Class B → 2^{16} IP Addresses in one network
Class C → 2^{8} IP Addresses in one network

I: Organization X need = 2^{22} IP addresses



$X = 2^{22}$
$A = 2^{22}$
$B = 2^{22}$
$C = 2^{22}$

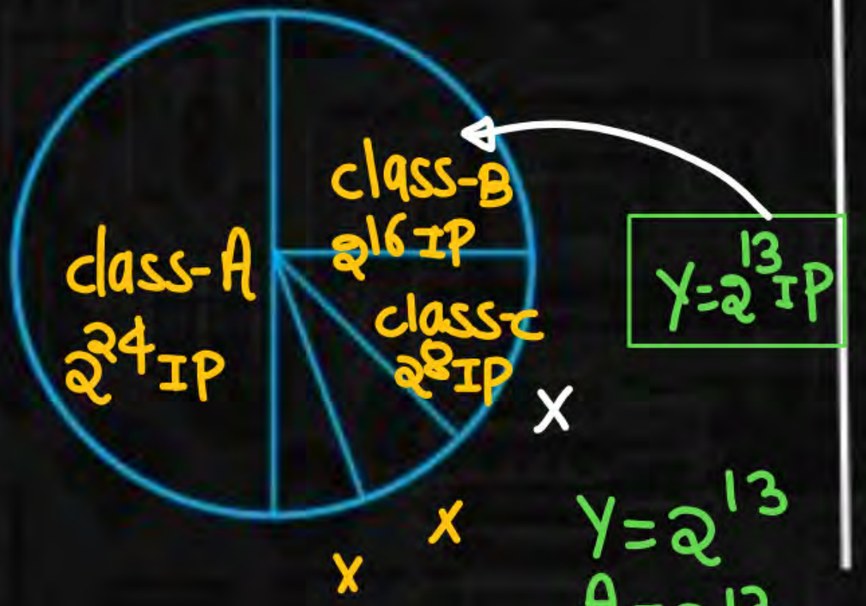
$4 * 2^{22} = 2^2 * 2^{22} = 2^{24}$

IP addresses wasted = $2^{24} - 2^{22}$
$= 2^2 * 2^{22} - 2^{22}$
$= 4 * 2^{22} - 2^{22}$
$= 3 * 2^{22}$
$= 3 * 2^2 * 2^{20}$
$= 12 * 2^{20}$
$= 12M$
$= 12,582,912$

2^{24}

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

II: Organization Y need = 2^{13} IP addresses



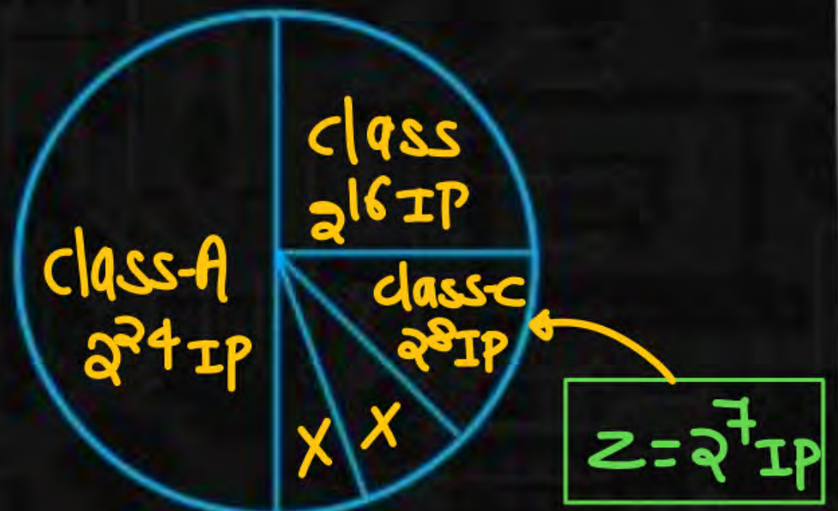
Y=2^{13}
A=2^{13}
B=2^{13}
C=2^{13}
D=2^{13}
E=2^{13}
F=2^{13}
G=2^{13}

$8*2^{13}$
2^3*2^{13}
$=2^{16}$

IP addresses wasted = $2^{16} - 2^{13}$
$= 2^3*2^{13}-2^{13}$
$= 8*2^{13}-2^{13}$
$= 7*2^{13}$
$= 7*2^3*2^{10}$
$= 56*2^{10}$
$= 56K$
$= 57,344$

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

III: Organization Z need = 2^7 IP addresses

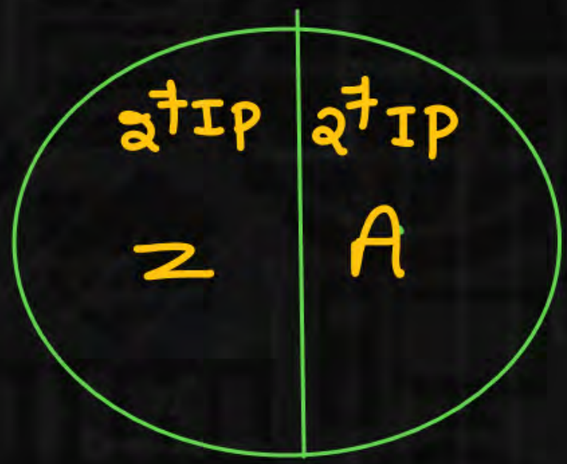


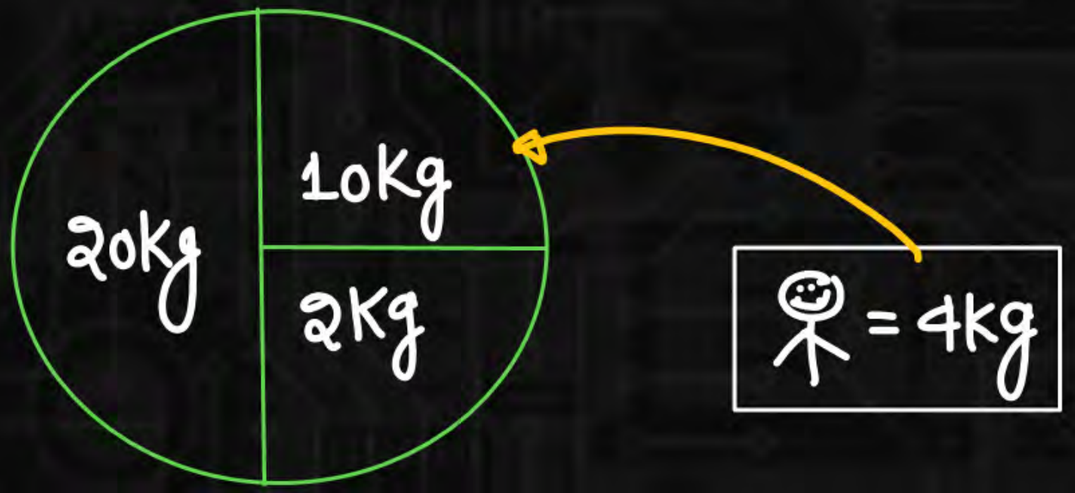
$Z = 2^7$

$A = 2^7$

$2 * 2^7 = 2^8$

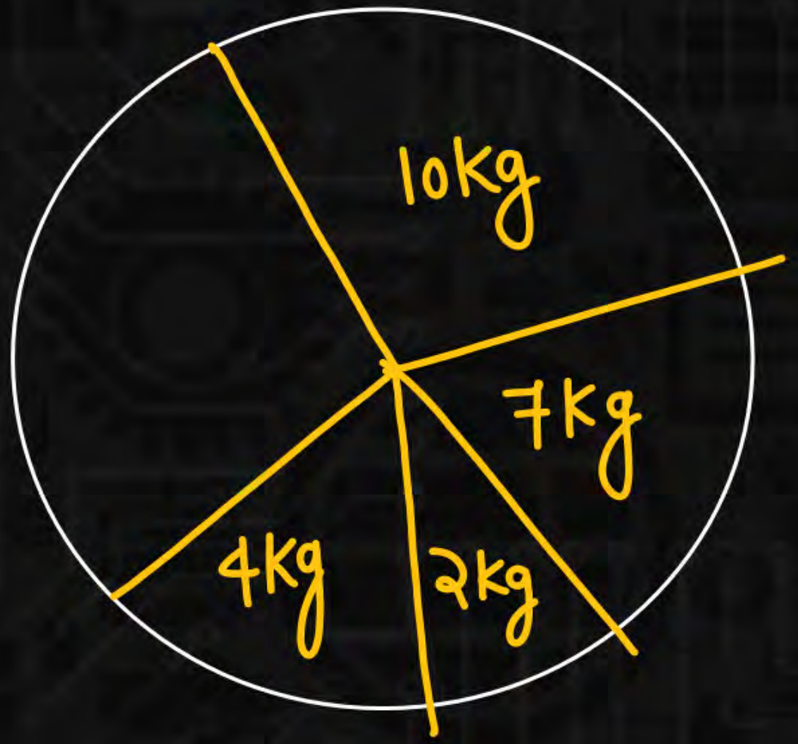
IP addresses wasted = $2^8 - 2^7$
= 128

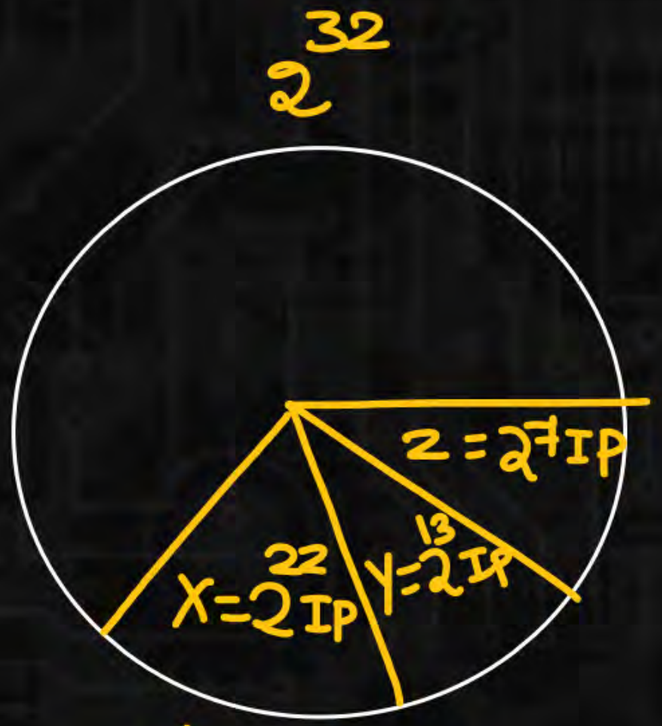




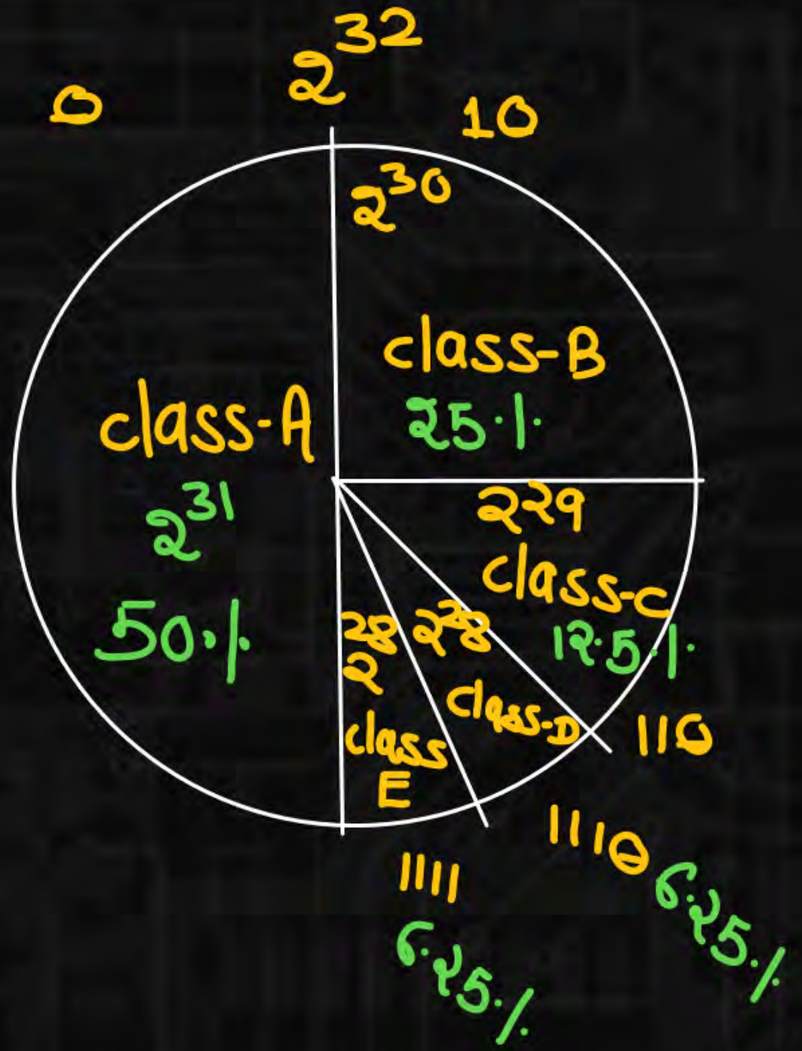
Wastage = 10kg - 4kg

= 6kg





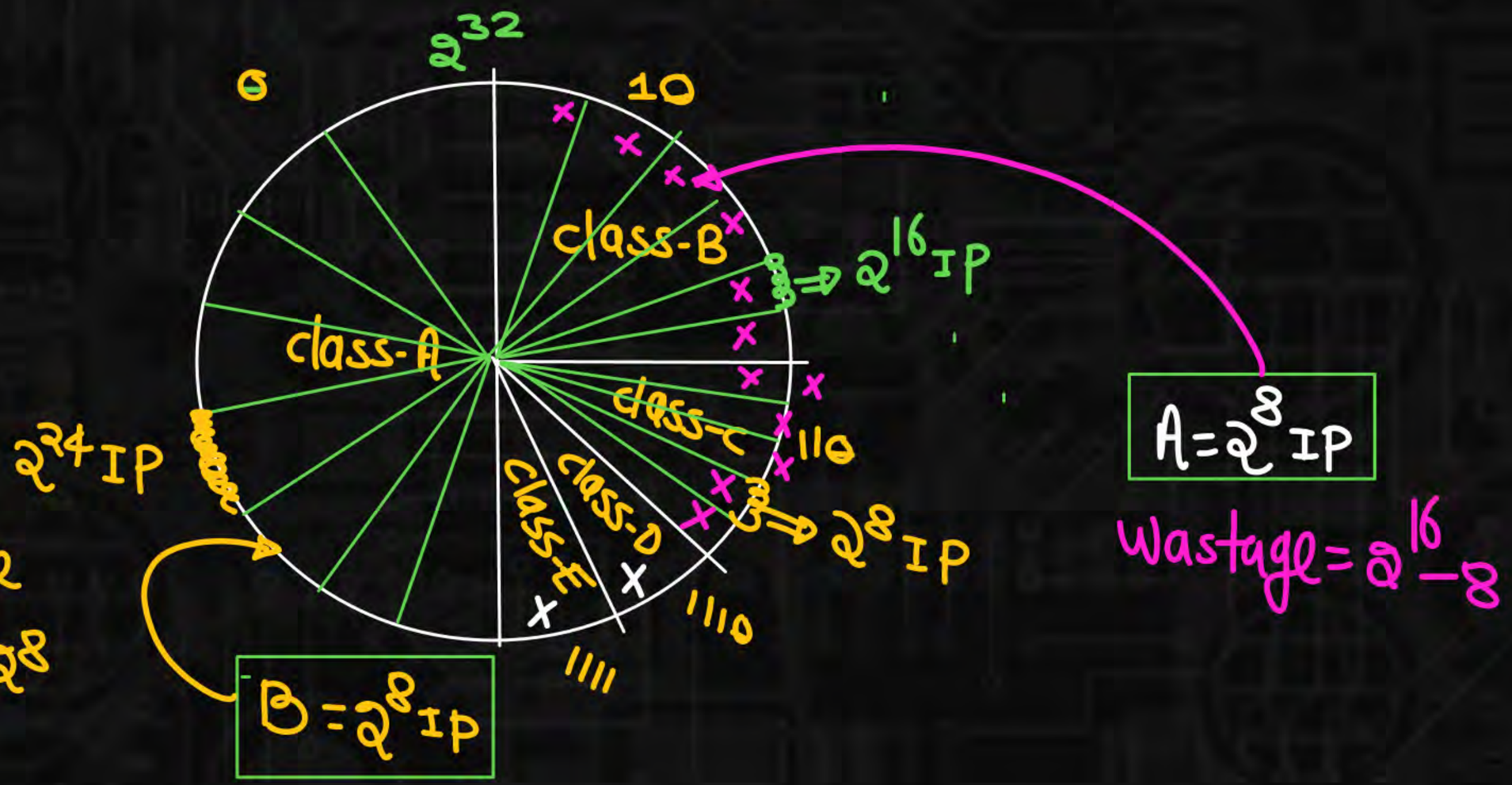
Classless Addressing



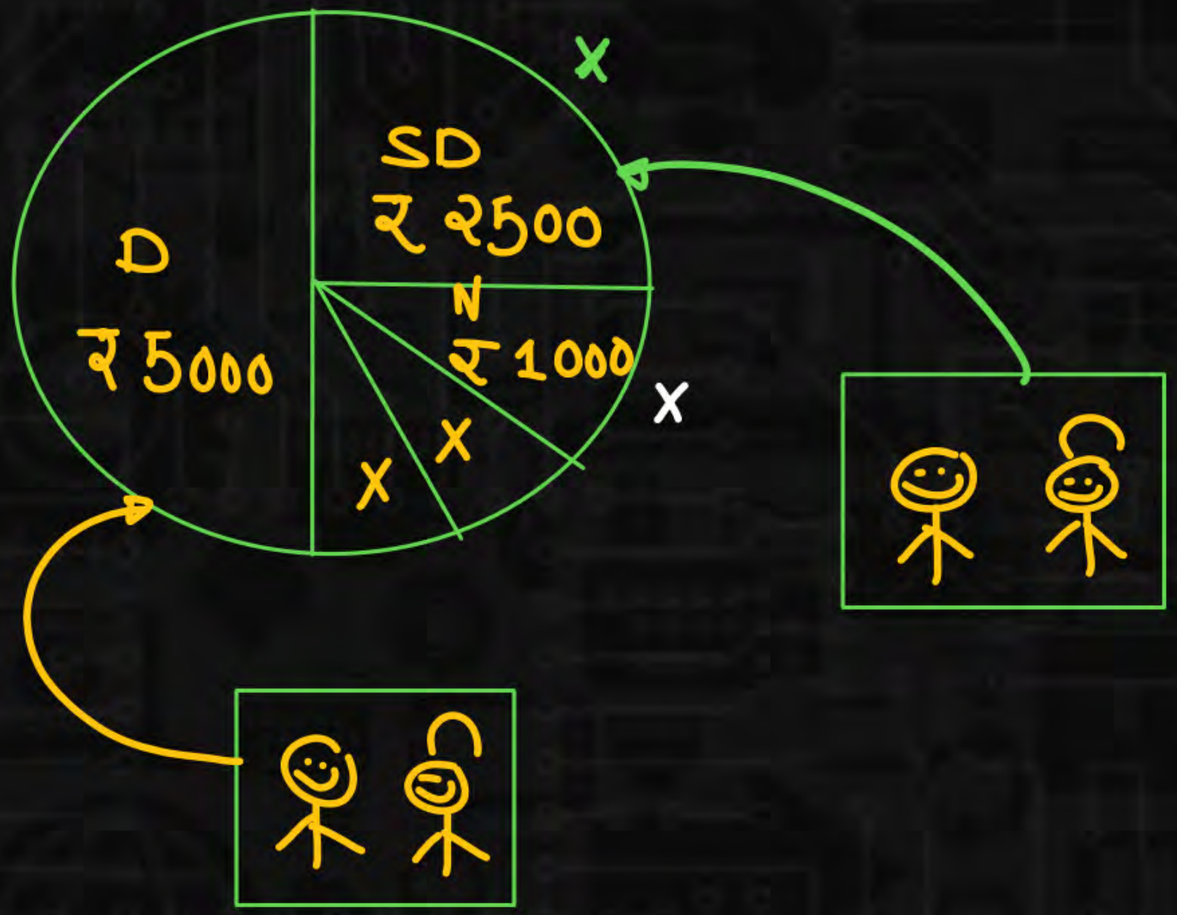
No. of IP Addresses in class A $= 2^{31}$

class-B $= 2^{30}$

class-C $= 2^{29}$



Hotel



Disadvantage of classful Addressing

① Wastage of IP Addresses

② class-C was generally more used compared to class-A and class-B

Advantage of classful Addressing

① 10.19.32.55
NID HID

class-A

NID	HID
8	24

10.0.0.0

Size = 2^{24} IP

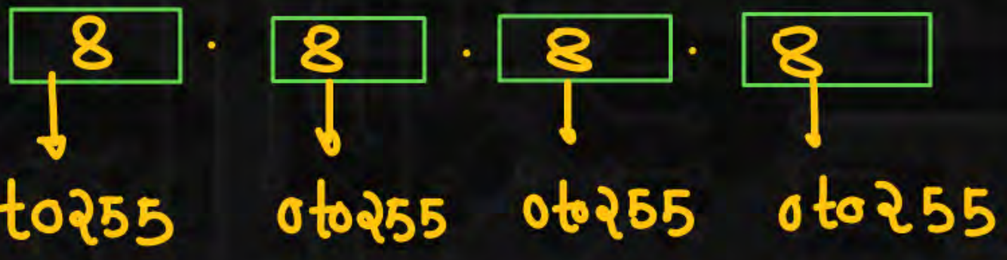
② 157.163.95.62
NID HID

class-B

NID	HID
16	16

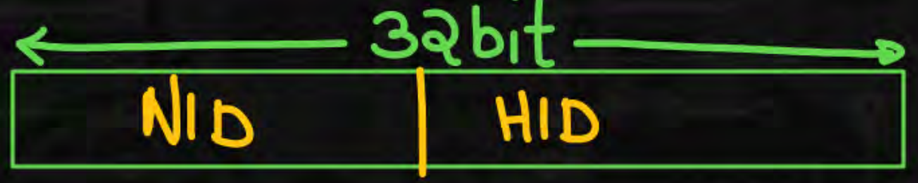
157.163.0.0

Size = 2^{16} IP



ClassFul Addressing

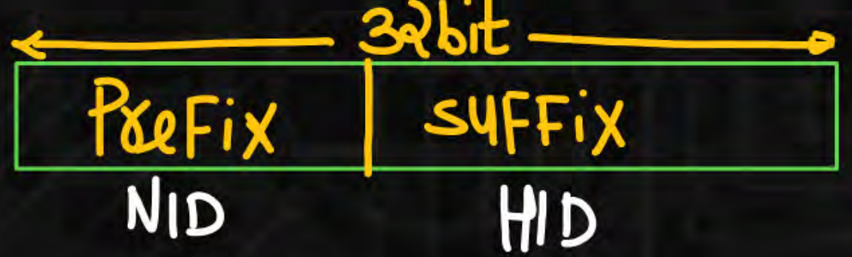
a.b.c.d



classless Addressing

a.b.c.d | n

n → NID or subnet Mask



10.32.94.64 | 22

$n = 22$, $32 - n = 32 - 22 = 10$

NID = 22 bit

HID = 32 - 22 = 10 bit

No. of IP Addresses Possible $= 2^{10} = 2^{32-22} = 2^{10}$

No. of Host Possible $= 2^{10} - 2$

10.32.0101111 | 10.01000000

8 + 8 + 6 | 10

NID | HID

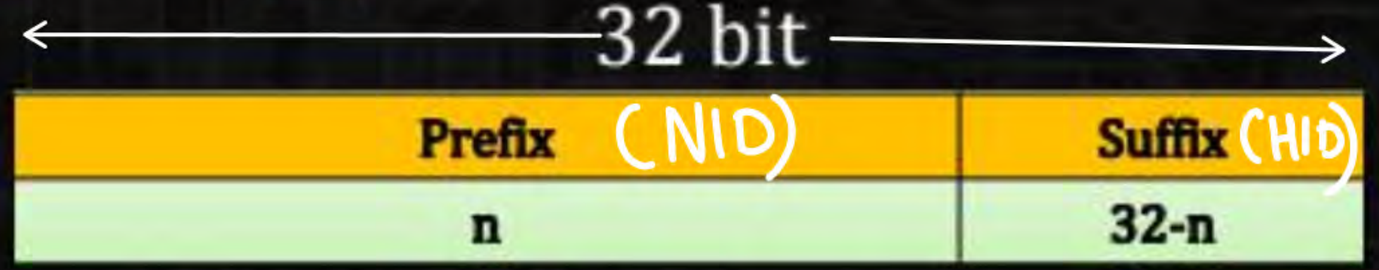
10.32.0101111.00.00000000 → 10.32.92.0] NID

10.32.0101111.11.11111111 → 10.32.95.255] DBA

CIDR Notation or slash notation

a.b.c.d/n

n→ NID or subnet mask



1. No of IP addresses in the Block = 2^{32-n}
2. To find first address, we keep the n leftmost bits and set the (32-n) right most bit all to o's.
3. To find last address, we keep the n left most bits and set the (32-n) right most bit all to 1's.

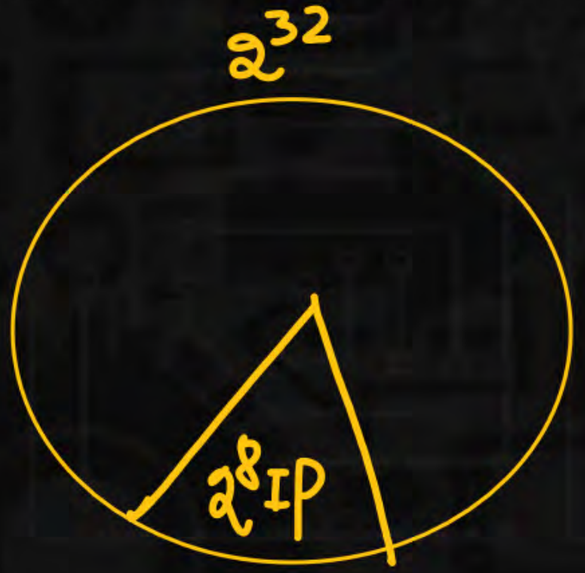
Rules for CIDR

CIDR [Class less inter Domain Routing]

When ever any customer wants a Block of IP Address IANA or ISP will create the Block & assigned to customer

Rules to be Followed by IANA or ISP for creating the Block

1. All the IP Address in the Block must be Contiguous



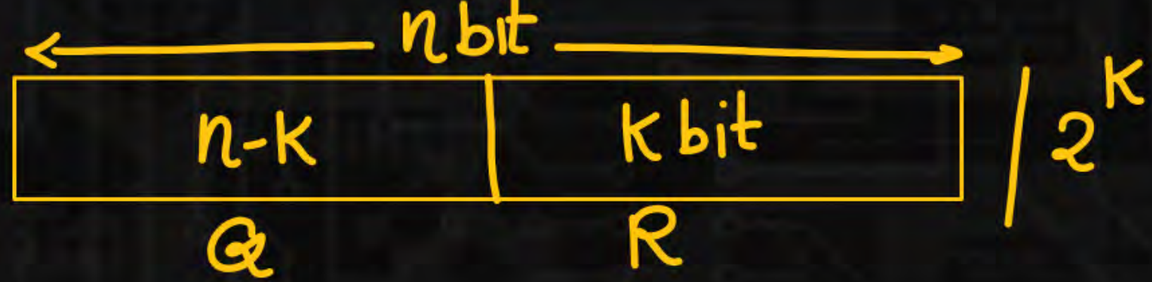
2. Block size must be a Power of 2. $(1 \cdot c\, 2^n)$

$(10101)_2 = 21$

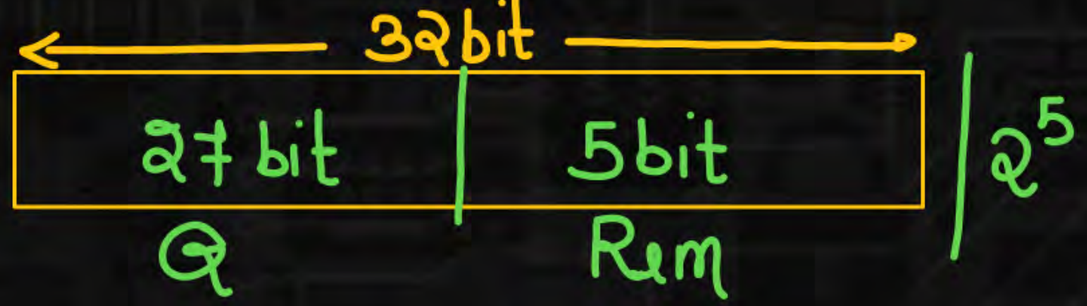
	R	Q
$/2^1$	1	10
$/2^2$	1	5
$/2^3$	5	2
$/2^4$	5	1
$/2^5$	21	0

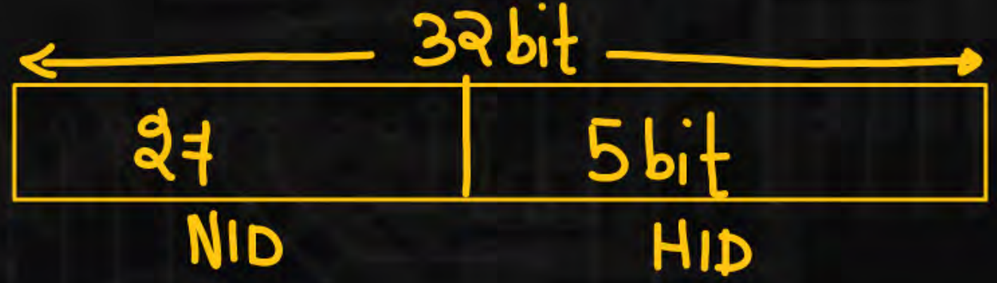
$(8392)_{10}$

	R	Q
$/10^1$	2	839
$/10^2$	92	83
$/10^3$	392	8
$/10^4$	8392	0

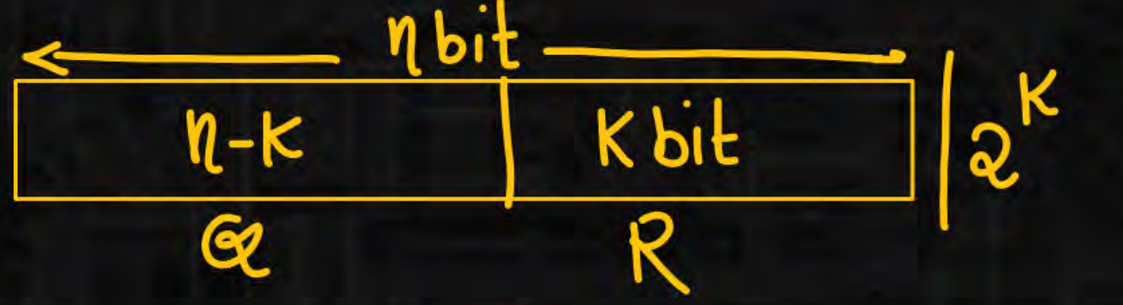


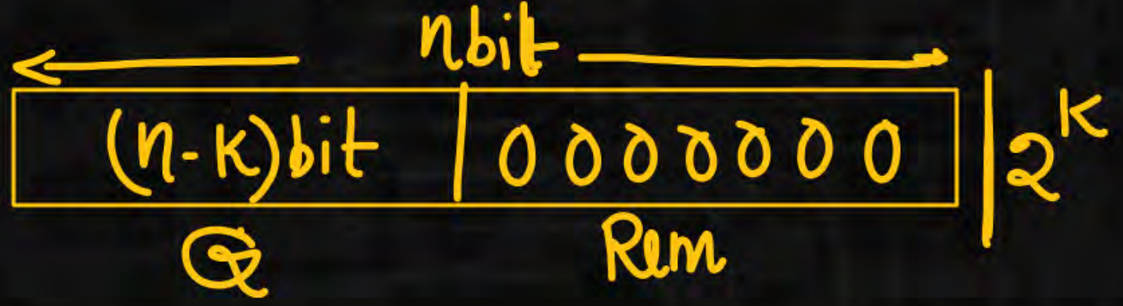
Block size = 2^5





3. First IP Address OF the Block must be divisible by size OF the Block. (block size = 2^K)





Note:

First IP Address must be used as a Block-id

EX – 1.

100.100.100.64
100.100.100.65
100.100.100.66
100.100.100.67
⋮
100.100.100.127

127 - 64 + 1
128 - 64 = 64 = 2^6
(Valid Block)

① All the IP Addresses in the Block must be contiguous (T)

② Block size must be a Power of 2 (True)

Block size = 2^6

③ First IP Address of the Block must be divisible by the size of Block

100 · 100 · 100 · 64

Rem or HID

01100100 · 01100100 · 01100100 · 01 | 000000 | 2^6 (T)

Representation of CIDR

Block size = 2^6

HID = 6 bit, NID = 32 - 6 = 26 bit

100.100.100.64/26

PF NID = 26 bit, HID = 32 - 26 = 6 bit

100.100.100.01 | 000000
8 + 8 + 8 + 2 | HID
NID

100.100.100.01 | 000000 → 100.100.100.64
100.100.100.01 | 000001 → 100.100.100.65
100.100.100.01 | 000010 → 100.100.100.66
⋮
100.100.100.01 | 111111 → 100.100.100.127

OR

100.100.100.127/26

PF: NID=26 bit, HID=32-26=6 bit

100.100.100.01 | 111111
8+8+8+2 | HID
NID

100.100.100.01 000000 → 100.100.100.64
100.100.100.01 000001 → 100.100.100.65
100.100.100.01 000010 → 100.100.100.66
.
.
.
100.100.100.01 111111 → 100.100.100.127

EX – 2.

100.100.100.128
100.100.100.129
100.100.100.130
⋮
100.100.100.255

Valid Block

255 - 128 + 1
256 - 128 = 128 = 2^7

① Contiguous (True)

② Block size = 2^7 (True)

③ 100.100.100.1 | 0000000 | 2^7 (True)
Rem | HID

Representation of CIDR

Block size = 2^7
HID = 7 bit
NID = 32 - 7 = 25 bit
100.100.100.128/25

EX – 3.

100.100.100.1
100.100.100.2
100.100.100.3
⋮
100.100.100.32

$32-1+1 = 32 = 2^5$

It is invalid Block

① Contiguous (True)

② Block size = 2^5

③ 100.100.100.00000001 | 2^5 (False)

Ram

HID

EX – 4. One of the address of the Block is 100.100.100.68/27 then find

NID = 27 bit
HID = 32 - 27 = 5 bit

No. of IP Addresses = 2^5 = 32

i. Number of addresses in a Block = 2^5
ii. Range of IP address : 100.100.100.64 – 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

100.100.100.01000100

8 + 8 + 8 + 3 | 6

NID | HID

100.100.100.010 00000 → 100.100.100.64] Block-id

100.100.100.010 00001 → 100.100.100.65] First Host

100.100.100.010 11110 → 100.100.100.94] Last Host

100.100.100.010 11111 → 100.100.100.95] DBA

EX – 5. One of the address of the Block given as 167.199.128.3/20. then find

i. Number of addresses in a block = 2^{12}
ii. Range of IP address : 167.199.128.0 — 167.199.143.255
iii. Block id : 167.199.128.0
iv. First host : 167.199.128.1
v. Last host : 167.199.143.254
vi. DBA : 167.199.143.255

167.199.128.3/20

NID = 20 bit, HID = 32-20 = 12 bit , No. of IP Addresses = 2^{12}

167.199.1000 0000.00000011

8 + 8 + 4

NID | HID

167.199.1000 0000.00000000 → 167.199.128.0] Block-id

167.199.1000 0000.00000001 → 167.199.128.1] First Host

.

.

.

.

167.199.1000 1111.11111110 → 167.199.143.254] Last Host

167.199.1000 1111.11111111 → 167.199.143.255] DBA


THANK YOU
GW
SOLDIERS !