# CS & IT ENGINEERING

## COMPUTER NETWORKS

## IPv4 Addressing

**Lecture No-02**

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# Topics to be covered

- Introduction to IPv4

# Basics of IP Addressing

$2^1 = 2$

$2^2 = 4$

$2^3 = 8$

$2^4 = 16$

⋮

$2^9 = 512$

$2^{10} = 1024 = 1K$ (Kilo)

$2^{20} = 1024 \times 1024 = 1M$ (Mega)

$2^{30} = 1024 \times 1024 \times 1024 = 1G$ (Giga)

$2^{40} = 1\ T$ (Tera)

$2^{50} = 1\ P$ (Peta)

$2^{60} = 1\ E$ (Exa)

$2^{70} = 1\ Z$ (Zetta)

$2^{80} = 1\ Y$ (Yotta)

# Basics of IP Addressing

Data

1 Byte = 8 bits

1 KB = 1024 Bytes

1 MB = 1024 KB (Kilo Byte)

1 GB = 1024 MB (Mega Byte)

1 TB = 1024 GB (Giga Byte)

1 PB = 1024 TB (Tera Byte)

1 EB = 1024 PB (Peta Byte)

1 ZB = 1024 EB (Exa Byte)

1 YB = 1024 ZB (Zetta Byte)

Bit → b

Byte → B

8 bit

128 64 32 16 8 4 2 1

# Basics of IP Addressing

| Binary Number (128 64 32 16 8 4 2 1) | Decimal Value |
|---|---|
| 0 0 0 0 0 0 0 0 | 0 |
| 0 0 0 0 0 0 0 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 $[2^8-1]$ |

8bit

↓

Range → 0 to 255

Range → 0 to $2^8-1$

nbit

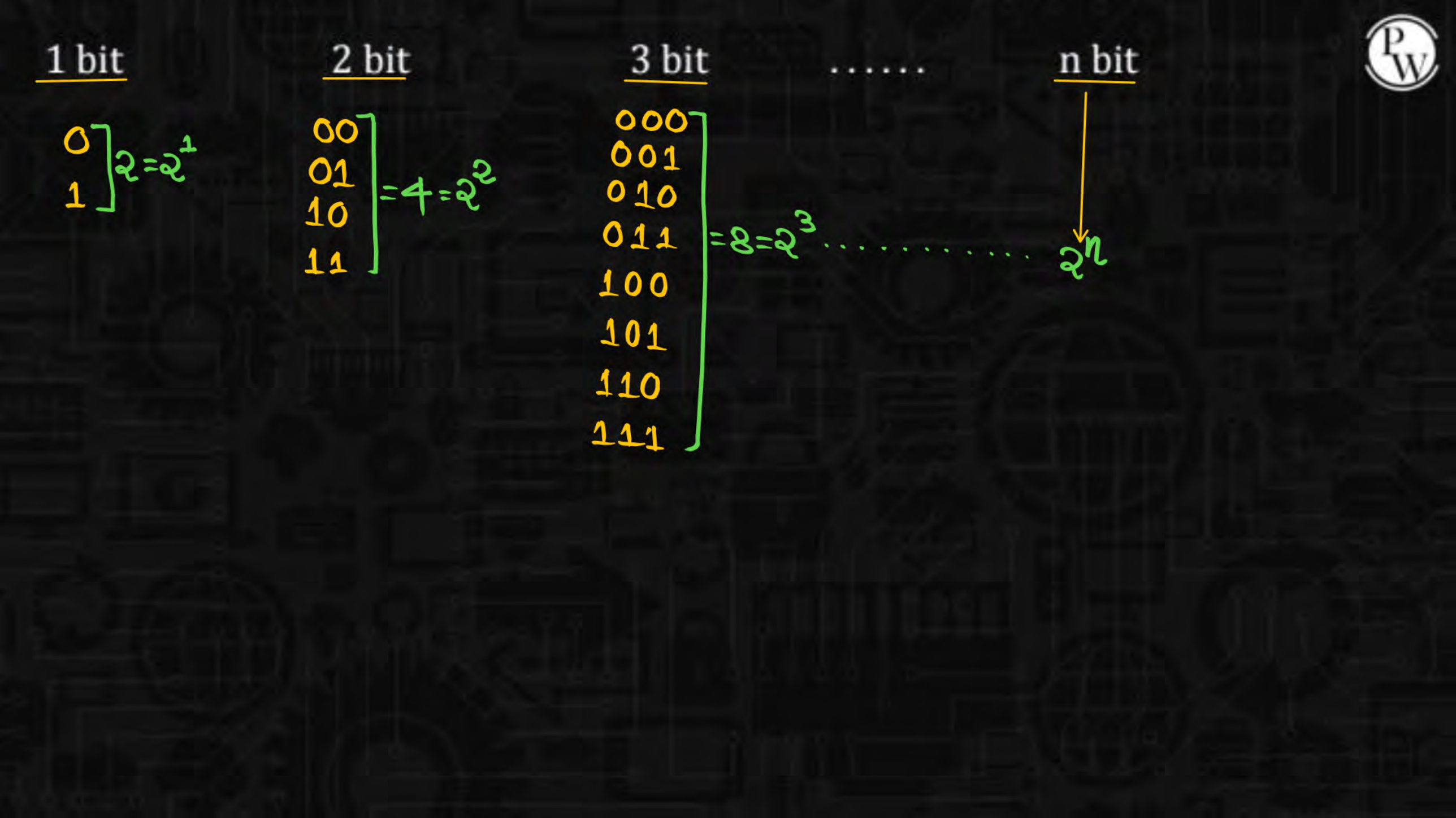
⇓

Range → 0 to $2^n-1$

# Basics of IP Addressing

| Binary Number (128 64 32 16 8 4 2 1) | Decimal Value |
|---|---|
| 10000000 | 128 |
| 11000000 | 192 |
| 11100000 | २२४ |
| 11110000 | २४० [२५५-१५] |
| 11111000 | २४८ [२५५-७] |
| 11111100 | २५२ [२५५-३] |
| 11111110 | २५४ [२५५-१] |
| 11111111 | २५५ |

128
+64
192
+32
२२४
+16
२४०


1 bit
2 bit
3 bit
.....
n bit
0
1
=2=2^1
00
01
10
11
=4=2^2
000
001
010
011
100
101
110
111
=8=2^3
.....
2^n

2 bit

00

01

10

11

3 bit

$P_1$: 000, 001 } 2

$P_2$: 010, 011 } 2

$P_3$: 100, 101 } 2

$P_4$: 110, 111 } 2

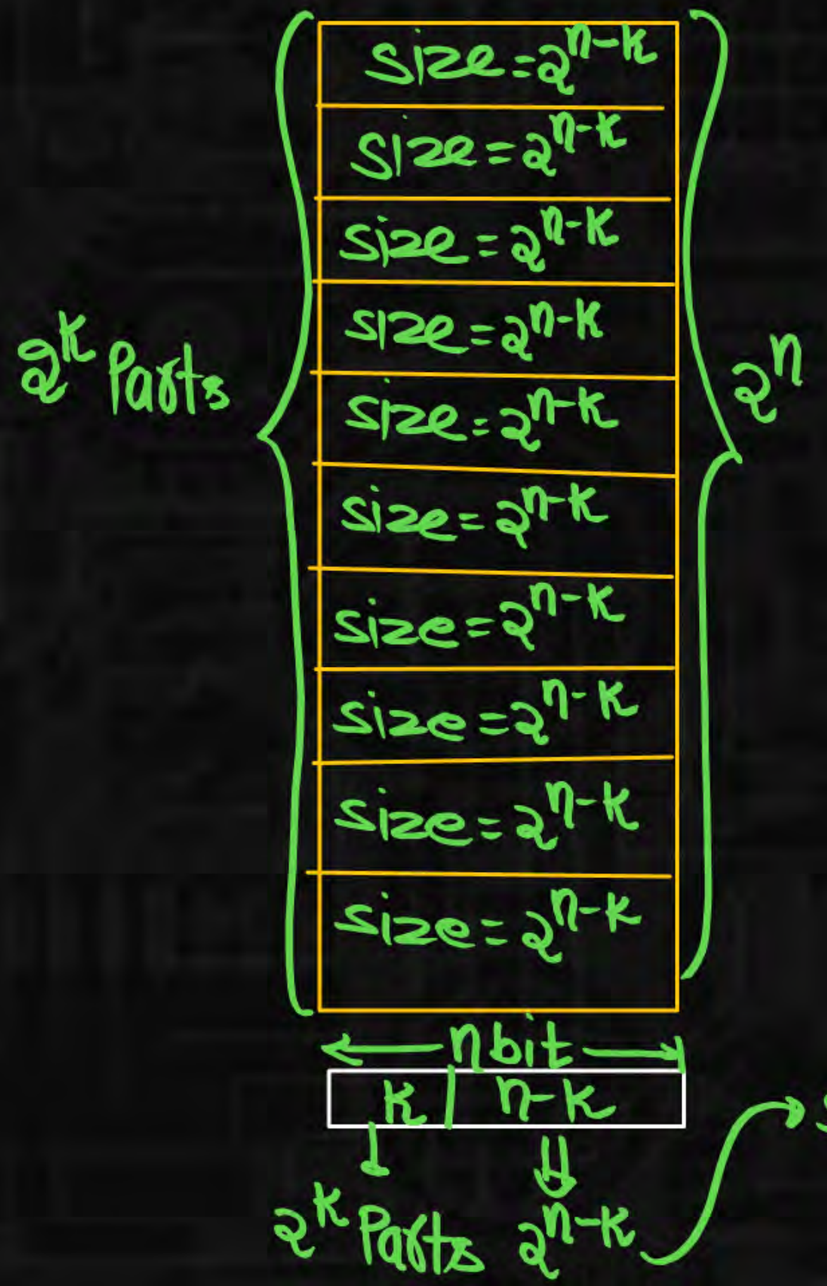
1 bit ⟶ 2 Parts $= 2^1$ Parts

2 bit ⟶ 4 Parts $= 2^2$ Parts

⋮

K bit ⟶ $2^K$ Parts

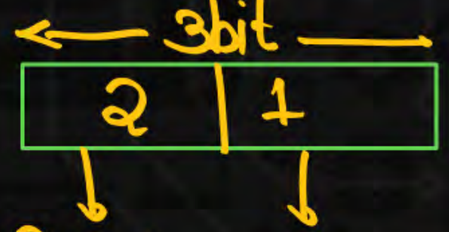
..... n bit



$2^k$ Parts ⟶ $2^n$

1 Part ⟶ $\frac{2^n}{2^k}$

$= 2^{n-k}$




$2^2$ Parts $2^1 = 2$ (size of each part)

4 Parts

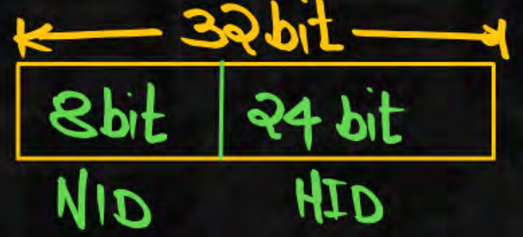
# Introduction to IP Addressing

IPv4 Address = 32 bit → $2^2 * 2^{30}$ → 4G IP Addresses

Total number of IP addresses = $2^{32}$ = 4,294,967,296

Initially in 1980's IP Addresses was divided into two Fixed Parts i.e.,

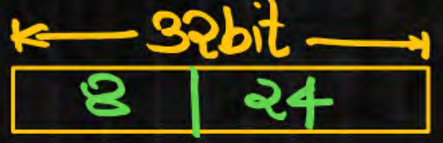
NID = 8 bit, and HID = 24 bit.

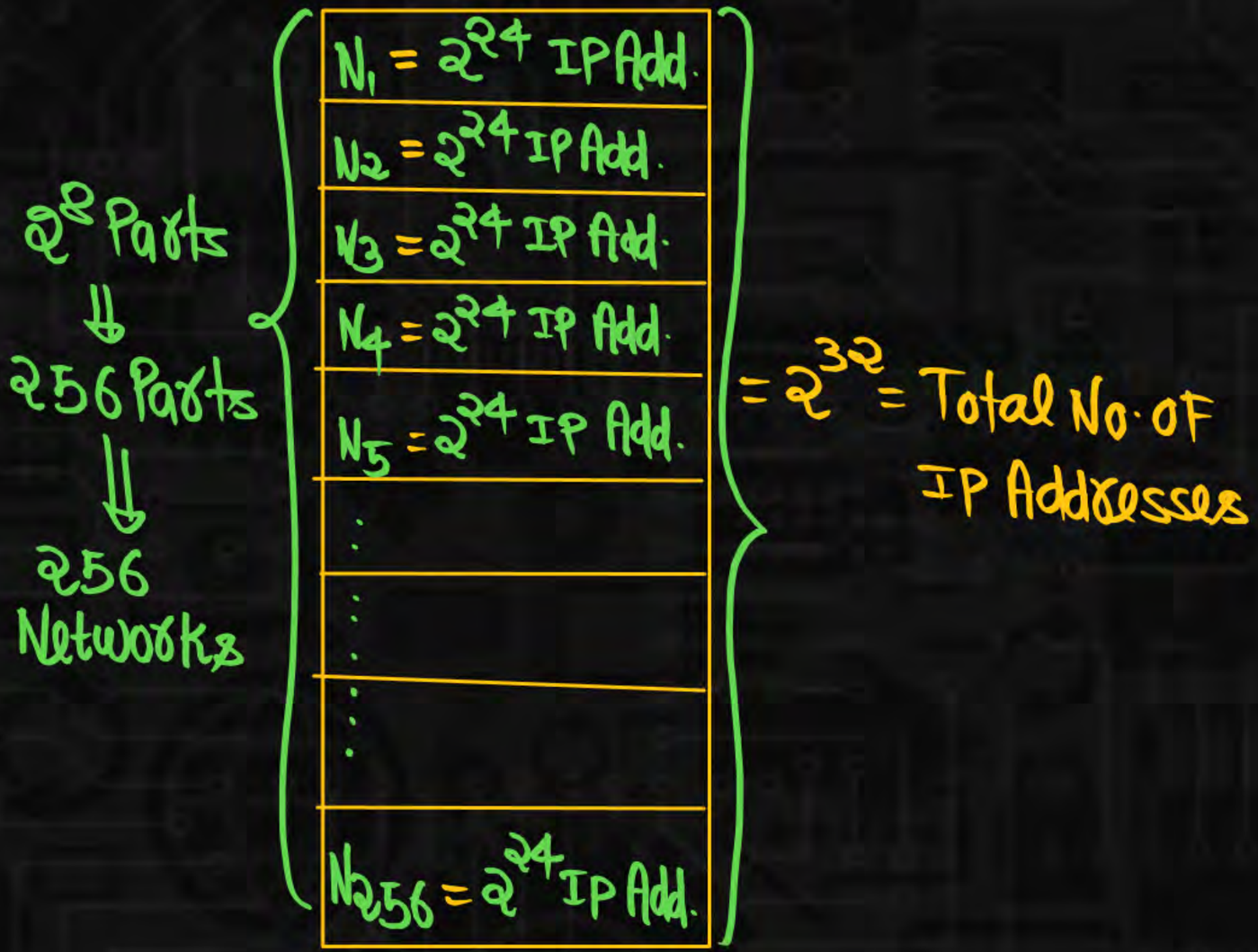



IANA → Internet Assigned Number Authority

$2^8$ Networks
256 Network

$2^{24}$ Host/Network
$= 2^4 * 2^{20}$
= 16M ≅ 1.6 Cr. Host/Network





$2^8$ Parts
256 Parts

$2^{24}$ → size of each Part

# Introduction to IP Addressing

## Disadvantage

There are only 256 Network's, and even a small organization must buy 16M computer (HOST) to purchase one network.

Soln: classful Addressing

# Telephone Networks

1. 11 digit Number
2. Two Parts
   - STD
   - TID
3. Unique

# Telephone Networks

| City | |
|---|---|
| 3 / STD | 8 / TID |
| 011 | २३१५१९२३ |

| Town | |
|---|---|
| 4 / STD | 7 / TID |
| 0120 | २४५६१७२ |

| Villages | |
|---|---|
| 5 / STD | 6 / TID |
| 05924 | २६४२९७ |

City

STD Code = 3

000
001
002
003
004
005
.
.
.
.
999

1000

TID = 8

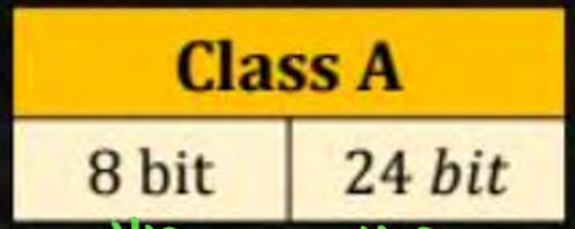
00000000
.
.
.
.
.
9,99,99,999

10 Cr

# Computer Networks

1. 32 bit Number [ ▭ . ▭ . ▭ . ▭ ]
2. Two Parts → NID, HID
3. Unique

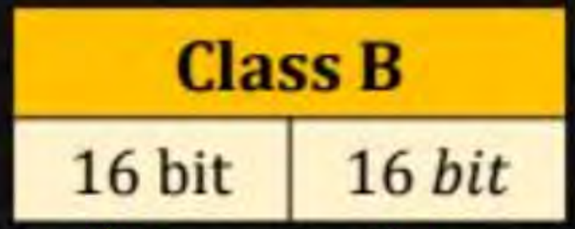
# Computer Networks




NID → $2^8$ Networks
$2^8 = 256$ Networks

HID → $2^{24}$ Host/Net.
$2^4 * 2^{20}$
16 M Host/Net.
$\cong$ 1.6 cr Host/Net

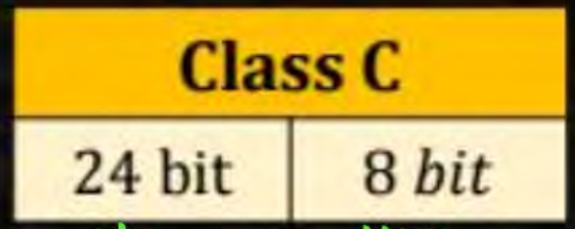
Note: For Big govt. organization
For ex: NASA




NID → $2^{16}$ Networks
$2^6 * 2^{10}$
64 K Networks

HID → $2^{16}$ Host/Net.
64K Host/Net.

Note: For MNC's
For ex: IBM, WIPRO, TCS etc

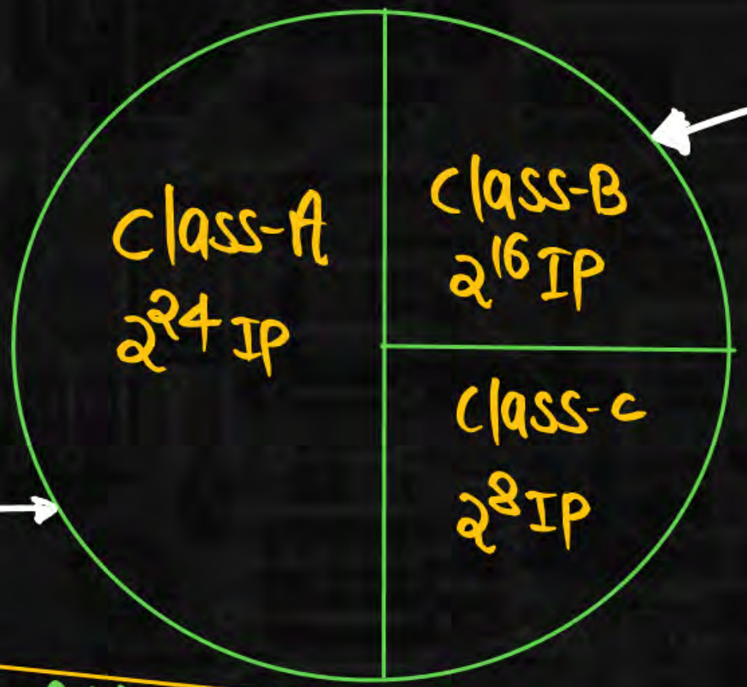



NID → $2^{24}$ Networks
$2^4 * 2^{20}$
16 M Networks
$\cong$ 1.6 cr Networks

HID → $2^8$ Host/Net.
256 Host/Net.

Note: For small organization
For ex: Schools, colleges etc

| class-A | class-B | class-C |
| --- | --- | --- |
| $2^{24}$ IP Add in one N/w | $2^{16}$ IP Add in one N/w | $2^{8}$ IP Add in one N/w |




X = 500 IP Addresses

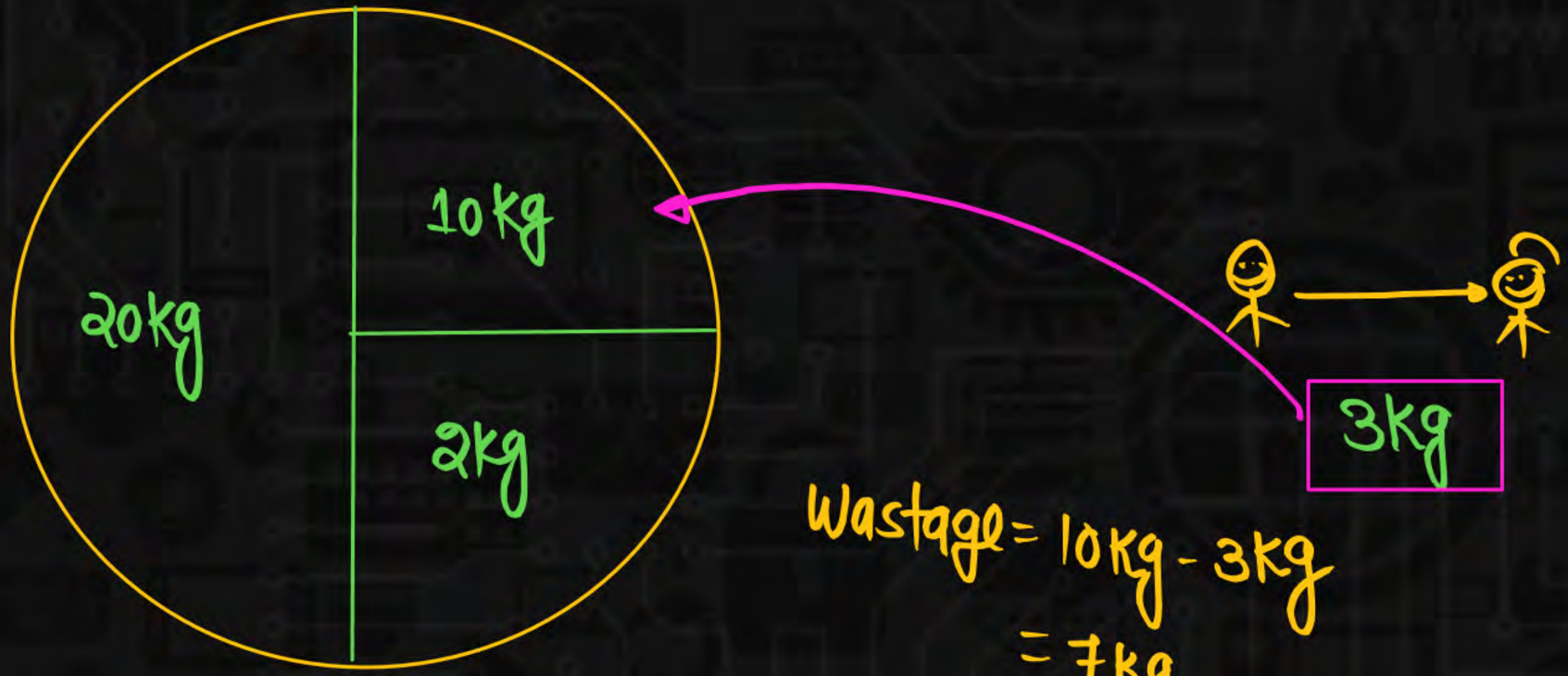
IP Addresses wasted = $2^{16} - 500$

$= 65,536 - 500$

$= 65,036$

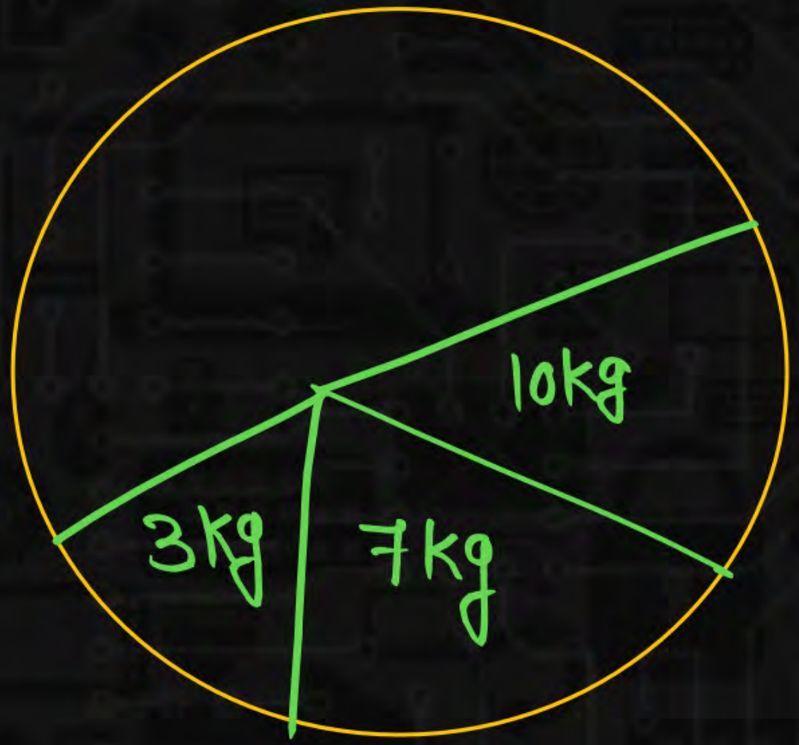
Y = 70,000 IP Addresses

IP Addresses wasted = $2^{24} - 70,000$



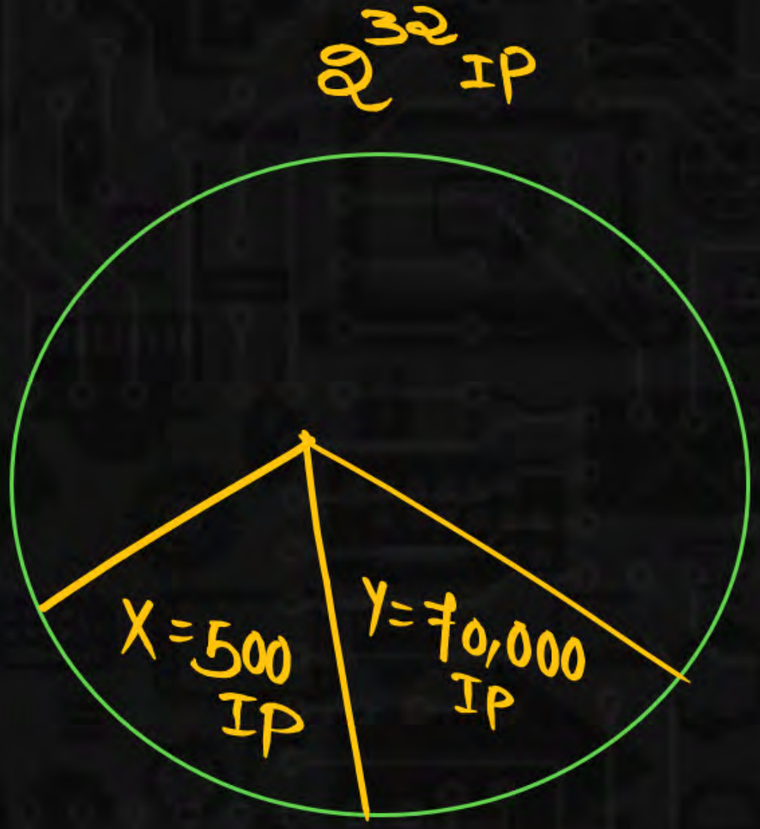

Wastage = 10kg - 3kg

= 7kg


10kg
3kg
7kg


3kg

Soln: Classless Addressing



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