Internet Protocol : IPV4

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IP is the network layer protocol

Design was based on following assumptions-

1. IP should provide an unreliable connectionless service.
2. Must have fixed 32 bit size address
3. IP hosts should be able to exchange variable length packets

Address assignment

Appropriate network layer address allocation is key to the efficiency & Scalability of internet.

// Note

A naive allocation scheme would be to provide an IPV4 address to each host when the host is attached to internet on first come, first served basis. With this solution a host in Belgium could have 2.3.4.5 as IP while another in India would use 2.3.4.6.

This would force all routers to maintain a specific route towards all ≈1 Billion hosts on Internet viz not scalable

* Subnetting

One sol^n is that routers should only maintain routes towards "Blocks of addresses" & not towards individual hosts. For this blocks of IP addresses are assigned to ISP's. The ISP's assign sub block of the assigned address space in a hierarchical manner. These sub-blocks are called "Subnets"

A typical subnet groups all the hosts that are part of same enterprise. An enterprise network is usually composed of several LAN's interconnected by routers. A small block of IP addresses from the enterprise block is usually assigned to a LAN.

// IP address has 2 parts

10001010001100000000 11010000 00001

Subnetwork IP Host ID

Address Classes

When a router needs to send a packet it must know the subnet of the dest address to be able to consult it's routing table to forward the packet.

It was proposed to use the high order bits of address to encode the length of Subnet identifier.

We have 5 classes → A, B, C, D, E

- # In class A, the first bit is always 0
- # In class A, we have 2^{31} IP address, bcz 1st bit is fixed
- # In class A, first 8 bit octet represent network ID. The rest of the bits represent host.
- # No. of network ID is class A is 2^7
- # first address is network address & last one i.e X.255.255.255 is broadcast address.

→ Default mask of class A → 255.0.0.0

Helps in detect the network address for class A by doing bitwise mask.

★ Class B

first 2 bits are set as 1, 0.

(- - - - - - - -) (2^{nd} octet) (3^{rd} octet) (4^{th} octet)

128 10000000 ← host →

191 10111111 network

Range → 128 − 191 for first octet

No. of total IP addresses → 2^{30}

No. of networks → first 2 octet tell about network & rest about host

Total network IP address = $2^6 \times 2^8 = 64 \times 256 = 16384$

No. of hosts = $2^{16} = 65536$

Default Mask → 255.255.0.0

★ Class C

The first 3 prefix are fixed as 1, 1, 0.

Range → 192 − 223

Total IP addresses → 2^{29} (due to first 3 o bits)

No. of Networks → 2^{21}

Total no. of hosts → 2^8

★ Class D

Default mask → 255.255.0.0

The first four no. are 1, 1, 1, 0

Range → 224 − 239

No. of IP address → 2^{28}

No network or host here. Reserved for specific purpose

★ Class E

first four bits are 1, 1, 1, 0

These are reserved for military purpose.

Range → 240 − 255

Disadvantage of Classful IP address.

→ Wastage of IP address.

→ Maintainance and time consuming.

→ More prone to error.

★ Classless Addressing

→ No class

→ Only blocks

Notation

x.y.z.w /n → mask / no. of bit to represent block

(← 32 → | Block IP | Host ID)

Ex 200.10.20.40/28 → | 28 | 4 |

↳ No. of Hosts → $2^4 = 16$

How to calc Mask → 28 ones

11111111.11111111.11111111.11110000

255.255.255.240

Network →

↳ 200.10.20.40

200.10.20.00101000

200.10.20.32/28 → network address

OR

AND with the Mask

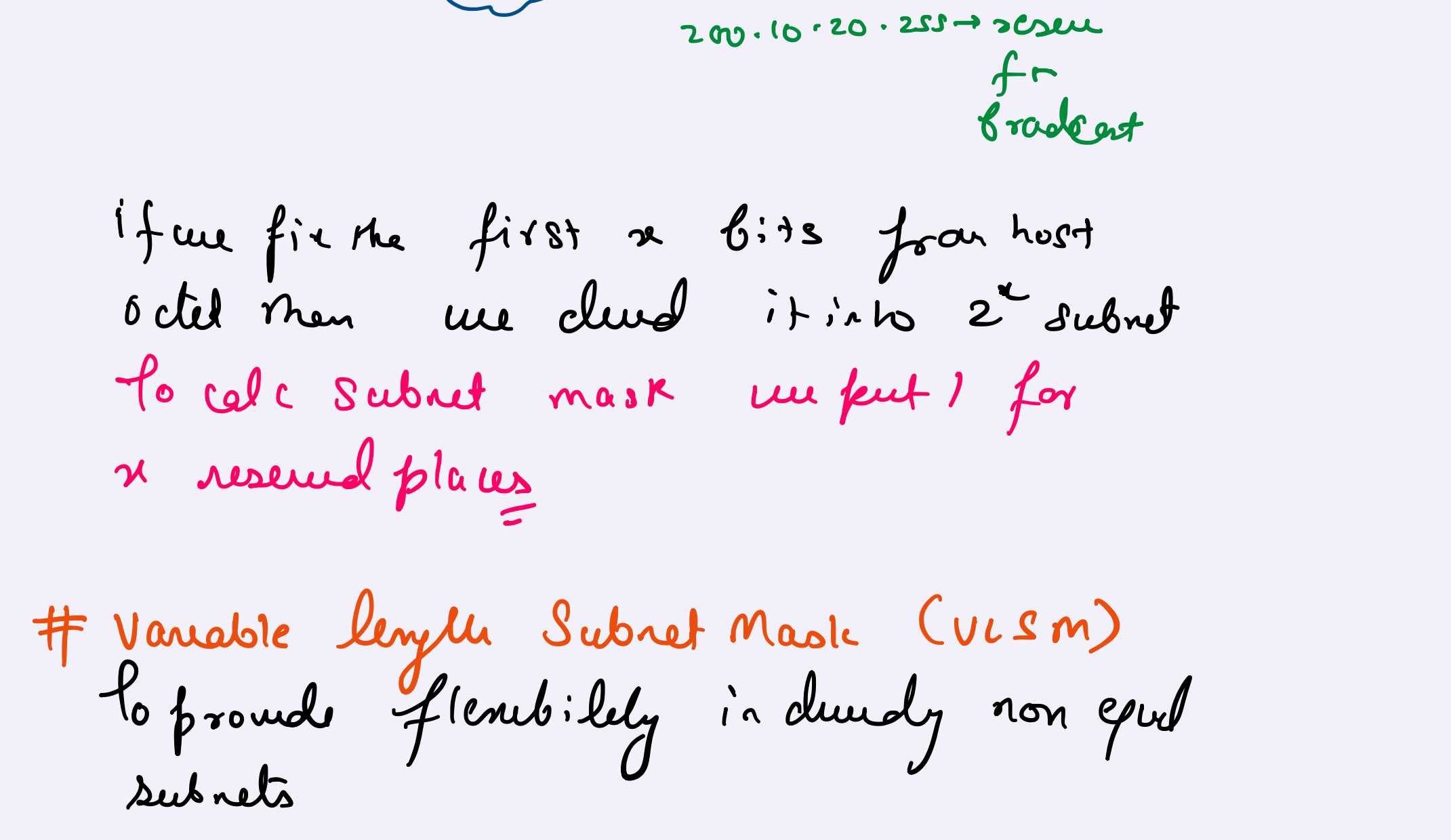
Rules

1. addresses should be continuous
2. No. of addresses in a block must be a power of 2
3. first address or network address should be divisible with size of block

★ Subnetting in a Classful addressing

→ Dividing a big network to small networks

→ No affect should be done on network id

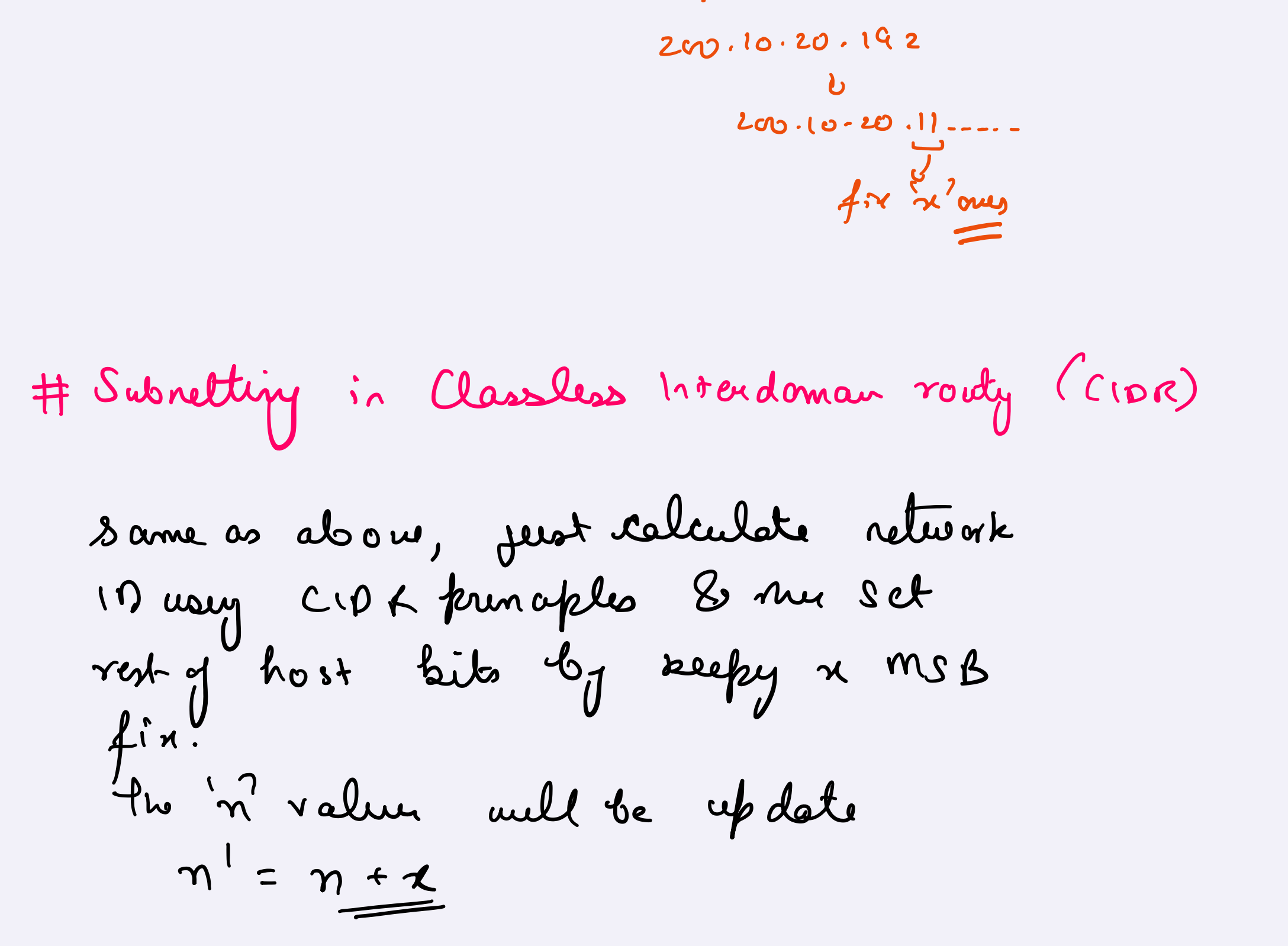


If we fix the first x bits from host octet then we divide it into 2^x subnet

To calc subnet mask we put 1 for x reserved places

Variable length Subnet Mask (VLSM)

To provide flexibility in dividing non equal subnets



Subnetting in Classless Interdomain routing (CIDR)

Same as above, just calculate network ID using CIDR principles & then set rest of host bits by keeping x MSB fix.

The 'n' value will be update

$n' = n + x$

Same for VLSM