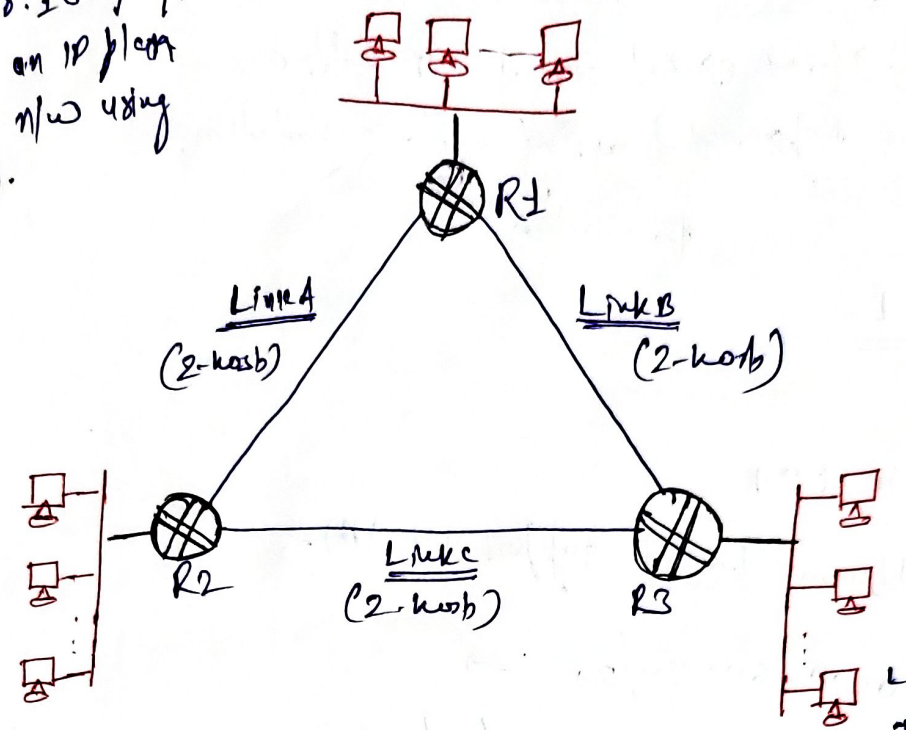
Q) With an ID range 174.168.10.0/24. Design an IP plan for the n/w using VLSM.




LAN-1 ⇒ No. of hosts = 58

LAN-2 ⇒ No. of hosts = 27

LAN-3 → No. of host = 12

Step-1) Arrange the networks from the largest to the smallest.

Step-2) Select the subnet of largest n/w.

Step-3) Select the subnet of second largest n/w.

Last Step) Select the last n/w.

→ S-1)
i) LAN-1 (58 hosts)
ii) LAN-2 (27 hosts)
iii) LAN-3 (12 hosts)
iv) Link A (2 hosts)
v) Link B (—)
vi) Link C (—)

→ S-2)

| Subnet | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 |
|---|---|---|---|---|---|---|---|---|---|
| Host | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| Subnet Mask | /24 | /25 | /26 | /27 | /28 | /29 | /30 | /31 | /32 |
| | | | LAN1 | LAN2 | LAN3 | | Link A/B/C | | |

→ Cannot assign ip address to any host bcoz 2 addresses are always reserved for Network id & Directed Broadcast.

→ Given Range 174.168.10.0/24

| Network Id | Subnet Mask | Host | Network |
|---|---|---|---|
| 174.168.10.0 | /26 (255.255.255.192) | 64-2 | LAN-1 |
| 174.168.10.64 | —"— | —"— | Unused |
| 174.168.10.128 | —"— | —"— | —"— |
| 174.168.10.192 | —"— | —"— | —"— |

S-3)

| Network Id | Subnet Mask | Host | Network |
|---|---|---|---|
| 174.168.10.0 | /26 | 64-2 | LAN-1 |
| 174.168.10.64 | /27 | 32-2 | LAN-2 |
| 174.168.10.96 | /27 | 32-2 | Unused |
| 174.168.10.128 | /26 | 64-2 | —"— |
| 192.168.10.192 | /26 | —"— | —"— |

S-4)

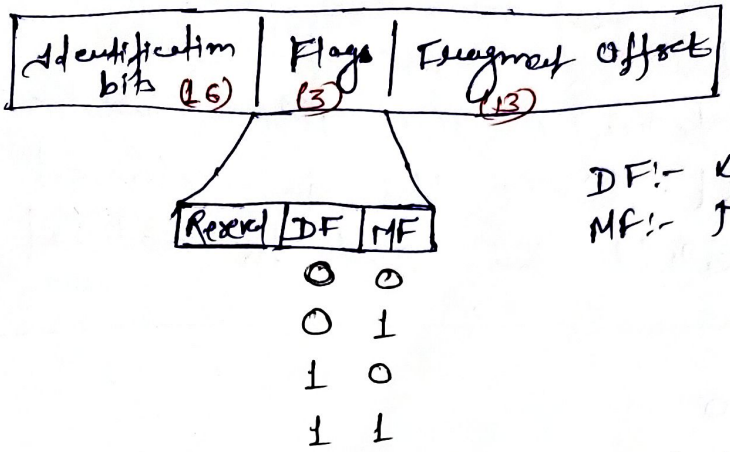
| | | | |
|---|---|---|---|
| 174.168.10.96 | /28 | 16-2 | LAN-3 |
| 174.168.10.112 | /28 | 16-2 | Unused |

S-5)

| | | | |
|---|---|---|---|
| 174.168.10.112 | /30 | 4-2 | Link A |
| 174.168.10.116 | /30 | 4-2 | Link B |
| 174.168.10.120 | /30 | 4-2 | Link C |
| 174.168.10.124 | /30 | 4-2 | Unused |

* N can do any no. of subnetting N want.

# Fragmentation




DF:- Don't Fragment (0/1)
MF:- More Fragment (0/1)

* IP layer (Network layer) follows's datagram service, which means the datagram may follow any route to reach the destination. (connection-less) Therefore, whenever fragmentation is done, each time header is added to each frame.

Q.) A datagram of length 5000 Bytes with 20 Bytes of header in it reached a router. The router has to forward the datagram on the link where MTU is 700 bytes. How many fragments the router has to do? Determine the total length of each fragmented packet, the M-bit and the fragmentation offset.

Sol:- 5000 (20 + 4980), $\lceil \frac{4980}{680} \rceil \approx 8$ → ceiling value / upper value

| | FP1 (680+20) | FP2 (680+20) | FP3 (680+20) | FP4 (680+20) | FP5 (680+20) | FP6 (680+20) | FP7 (680+20) | FP8 (220+20) |
|---|---|---|---|---|---|---|---|---|
| M-bit | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 0 |
| Fragmentation offset | 0 | 85 | 170 | 255 | 340 | 425 | 510 | 595 |

No. of hosts = 500

$n \simeq 9$ ($2^n = 500$)

Network Mask = 255.255.254.0
(Address Mask)

171.43.16.37/23

171.43. 0 0 0 1 0 0 0 0

0 0 1 0 0 1 0 1

0 0 0 0 0 0 0 0

0 0 0 0 0 0 0 1

1 1 1 1 1 1 1 1

⇒ 171.43.16.0 (network id)

171.43.17.255 (Directed Broadcast)

⇒ 2 ip's reserved

⇒ 512-2 ⇒ 510 ip's available, 500 used, 10 remaining ips.

1.2.3.4/23

1.2. 0 0 0 0 0 0 0 1

1 . 0 0 0 0 0 1 0 0

0 . 0 0 0 0 0 0 0 0

1 . 1 1 1 1 1 1 1 1

⇒ 1.2.2.0

1.2.3.255

# Classless Addressing

CIDR ( Classless Interdomain Routing)

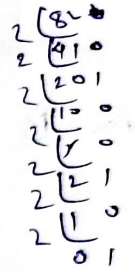
x.x.x.x/n → prefix length

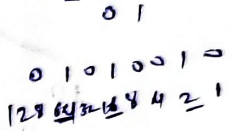
Ex:- 46.82.19.7/8

31.14.87.91/12


No. of networks = $2^n$

No. of hosts in a network = $2^{32-n}$





**Rules:** ① All ip addresses should be contingeous (it should not be scattered here and there)

② Demand of ip addresses should be in the form of $2^n$ (size of the block)

③ First ip address in the block should be evenly divisible by the size of the block. (It can be checked by looking the n least significant bits to be 0)

Example:- 74.10.7.32 ↔ 74.10.7.47

R1 ✓ R2 — 16 ip address = $2^4$ R3 74.10.7.32 ≃ 74.10.7.00100000

⇒ check this is a valid IP ??

* Determine the range of ip addresses in

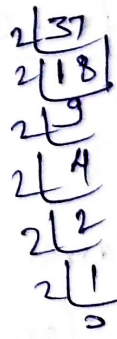
171.43.16.37/27

.00100101

00000

00001

11111



171.43.16.32

:

171.43.16.63

10101100

* Representation can be done by choosing any ip-address from the range 171.43.16.60/27

* Extracting information from an Address

(1) No. of addresses in the block → $N = 2^{32-n}$

(2) To find the first address, keep the 'n' leftmost bits as it is and set the (32-n) rightmost bits all to 0's.

(3) —"— last address, keep the —"— and set the (32-n) rightmost bits all to 1's.

(4) → Private addresses:- 10.0.0.0/8, 172.16.0.0/12, 192.168.0.0/16, 169.254.0.0/16

## Subnetting

* Dividing a n/w into sub-networks.

→ Consider class 'C' ip address (asked from students)

218.13.42.0

0 | _ _ _ _ _ _ _ | 0 0 0 0 0 0 0 0 ... 1 1 1 1 1 1 1

1 | _ _ _ _ _ _ _ | 0 0 0 0 0 0 0 1 ... 1 1 1 1 1 1 1

218.13.42.0 → subnet id of 1st n/w

218.13.42.127 → Directed Broadcast add. of 1st n/w

218.13.42.128 → subnet id of 2nd n/w

218.13.42.255 → Directed broadcast add. of 2nd subnet