📘 Lecture 5 – Class B Subnetting, Class A Subnetting,VLSM

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1. Class B Subnetting

What is Class B Address?

- An IPv4 Class B address ranges from 128.0.0.0 to 191.255.255.255.
- Default subnet mask = **/16** (first 16 bits represent network, last 16 bits host).

Example Given:

IP Address: 172.168.10.0/22

Explanation of /22

- Default Class B mask = **/16**
- Given mask = **/22**
- **Borrowed bits = 22 – 16 = 6 bits**
- These 6 bits are taken from the host portion and added to network portion.

A. How many subnets?

Formula:

$$\text{Number of Subnets} = 2^n (n = \text{borrowed bits})$$

Here **n = 6**

$$2^6 = 64 \text{ subnets}$$

B. Number of IP Addresses per Subnet

Remaining host bits =

$$32 - 22 = 10 \text{ bits}$$

Formula:

$$2^{\text{host bits}} = 2^{10} = 1024 \text{ IPs per subnet}$$

Usable hosts =

$$1024 - 2 = 1022$$

Why subtract 2?

- 1st = Network Address
- Last = Broadcast Address

C. Finding the Network Ranges

Borrowed bits include the 3rd and 4th octet.
The increment depends on the **last borrowed bit**.

Borrowed bits from host include **2 bits of the 3rd octet**:

$$2^2 = 4$$

So block size = **4** in the 3rd octet.

Subnets:

1st subnet:
172.168.0.0 – 172.168.3.255

- Network ID: 172.168.0.0
- Broadcast: 172.168.3.255
- Usable hosts: 172.168.0.1 – 172.168.3.254

2nd subnet:
172.168.4.0 – 172.168.7.255
and so on… up to 64 networks.

Daily Life Analogy

Think of a large apartment building (Class B network).
You divide floors into 64 sections (subnets).
Each section has 1024 rooms (IP addresses).
Two rooms are reserved:

- Reception = Network address
- Security = Broadcast address

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2. Class A Subnetting

What is a Class A Address?

- Range: 1.0.0.0 to 126.255.255.255
- Default mask = **/8**
- Host bits = 24

Example Given:

IP: 10.0.0.0/30

Explanation

- Default: /8
- Given: /30
- Borrowed bits = **30 − 8 = 22 bits**

A. Number of Subnets

$$2^{22} = 4{,}194{,}304 \text{ subnets}$$

B. Number of Hosts per Subnet

Remaining host bits =

$$32 - 30 = 2 \text{ bits}$$

IP per subnet =

$$2^2 = 4$$

Usable hosts =

$$4 - 2 = 2$$

C. Network Ranges

Block size =

$$2^2 = 4$$

So networks:

- 10.0.0.0 – 10.0.0.3
- 10.0.0.4 – 10.0.0.7
- 10.0.0.8 – 10.0.0.11
- … and so on for 4 million+ networks

Each network has:

- Network ID (e.g., 10.0.0.0)
- Broadcast ID (e.g., 10.0.0.3)
- 2 usable hosts (10.0.0.1, 10.0.0.2)

Daily Life Analogy

Imagine a giant company (Class A network).
You break it into millions of tiny teams (subnets), each team having only 2 workers (hosts).
Useful for point-to-point links like between routers.

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3. VLSM – Variable Length Subnet Mask

What is VLSM?

VLSM allows you to create **subnets of different sizes** within the same network.

Why it is used?

- Prevents **IP wastage**
- Allows creating subnets **based on actual host requirement**
- Provides **flexibility** compared to fixed subnetting

How it works?

- Larger subnets get larger masks (more hosts)
- Smaller subnets get smaller masks (fewer hosts)
- You always assign the **largest subnet first** to avoid overlaps.

Easy Explanation:

Normally, when you subnet a network, all subnets are of **equal size** (using the same subnet mask). But with **VLSM,** you can use **different subnet masks** within the same network — so you don't waste IP addresses

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Daily Life Analogy

Think of distributing lunch boxes:

- Sales team needs 100 boxes
- HR needs 50
- IT needs 20
- Admin needs 10

You give exactly what each team needs instead of giving everyone 100, which wastes boxes.

VLSM Example

Network: 192.168.10.0/24

Departments & hosts:

Department	Hosts
Sales	100
HR	50
IT	20
Admin	10

Step 1: Sort hosts from biggest → smallest

1. 100
2. 50
3. 20
4. 10

Step 2: Find required subnet mask

Hosts Needed	Nearest Power of 2	Total IPs	Subnet Mask	CIDR
100	128	128	255.255.255.128	/25
50	64	64	255.255.255.192	/26
20	32	32	255.255.255.224	/27
10	16	16	255.255.255.240	/28

Step 3: Assign Networks

1. **Sales (100 hosts)**
   Network: 192.168.10.0/25
   Range: 192.168.10.1 – 192.168.10.126
   Broadcast: 192.168.10.127
2. **HR (50 hosts)**
   Next block starts: 128
   Network: 192.168.10.128/26
   Range: 192.168.10.129 – 192.168.10.190
   Broadcast: 192.168.10.191
3. **IT (20 hosts)**
   Next block: 192
   Network: 192.168.10.192/27
   Range: 192.168.10.193 – 192.168.10.222
   Broadcast: 192.168.10.223
4. **Admin (10 hosts)**
   Next block: 224
   Network: 192.168.10.224/28
   Range: 192.168.10.225 – 192.168.10.238
   Broadcast: 192.168.10.239

Why VLSM is important in real life?

- Used by ISPs to efficiently allocate IP addresses
- Used by companies to avoid wasting IP space
- Helps in hierarchical network design (core → distribution → access)