Subnetting vs Supernetting:

- **Subnetting:** Divide one larger network into smaller networks.
    - **Example:** Breaking 200.100.50.0/24 into /25 subnets.
- **Supernetting:** Combining multiple smaller networks into one larger network.
    - Often used in **route summarization** to reduce the size of routing tables.

LAN & WAN Protocols:

- **LAN Protocols** → Typically Ethernet (IEEE 802.3). Works at **Layer 2 (Data Link)**.
- **WAN Protocols** → Used for long-distance, point-to-point connections:
    - **HDLC** (High-Level Data Link Control)
    - **ATM** (Asynchronous Transfer Mode)
- The **Internet** relies on **IP (Layer 3)** and **routers** for packet forwarding.

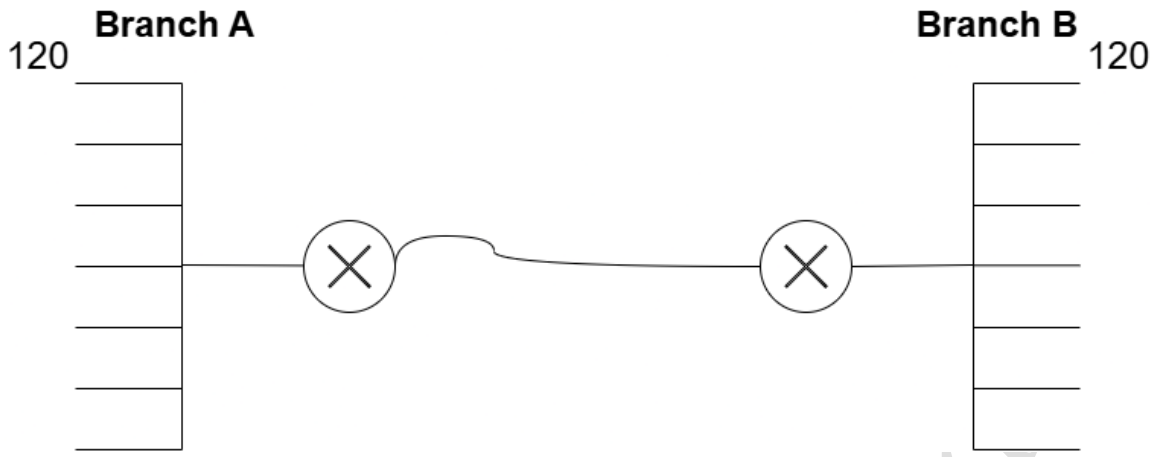
Switching & Addressing:

- **Layer 2 Switch (Basic switch)** → Works only with **MAC addresses**.
- **Layer 3 Switch (or multilayer switch)** → Works with **both MAC (Layer 2) and IP (Layer 3)** addresses.

SUBNETTING

Example Network: 200.100.50.0/24

- This is a **Class C** network.
- /24 means → **24 network bits** + **8 host bits**.
- Total addresses = 2^8 = 256.
- Usable addresses = 2^8 - 2 = 254 (network + broadcast excluded).
- Usable range: 200.100.50.1 → 200.100.50.254.



Example: Subnetting for Two Branches

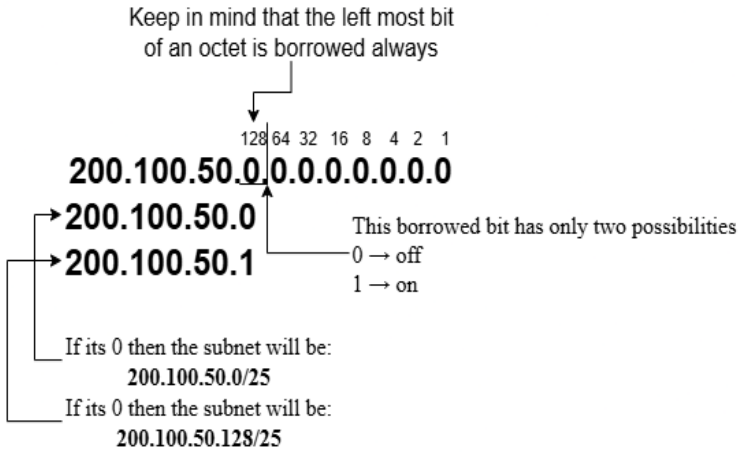
Suppose we have two branches (A and B), each requiring around 120 IP addresses.

We are given the network: 200.100.50.0/24.

A /24 network has:

- 8 host bits → 2^8 - 2 = 254 usable hosts.
- That's enough for one branch, but since we need **two separate networks**, we must subnet.

Step 1: Borrow host bits



Step 2: Calculate new capacity

- Hosts per subnet = `2^7 - 2 = 126 usable`.
- This is enough for ~120 users + router/switch IPs.

Step 3: Subnet ranges

Subnet 1 → `200.100.50.0/25`

Network: `200.100.50.0`

Usable range: `200.100.50.1 → 200.100.50.126`

Broadcast: `200.100.50.127`

Assign to **Branch A**.

Router IP example: `200.100.50.1`

Switch management IP example: `200.100.50.2`

Hosts: `200.100.50.3 → 200.100.50.126`

Subnet 2 → `200.100.50.128/25`

Network: `200.100.50.128`

Usable range: `200.100.50.129 → 200.100.50.254`

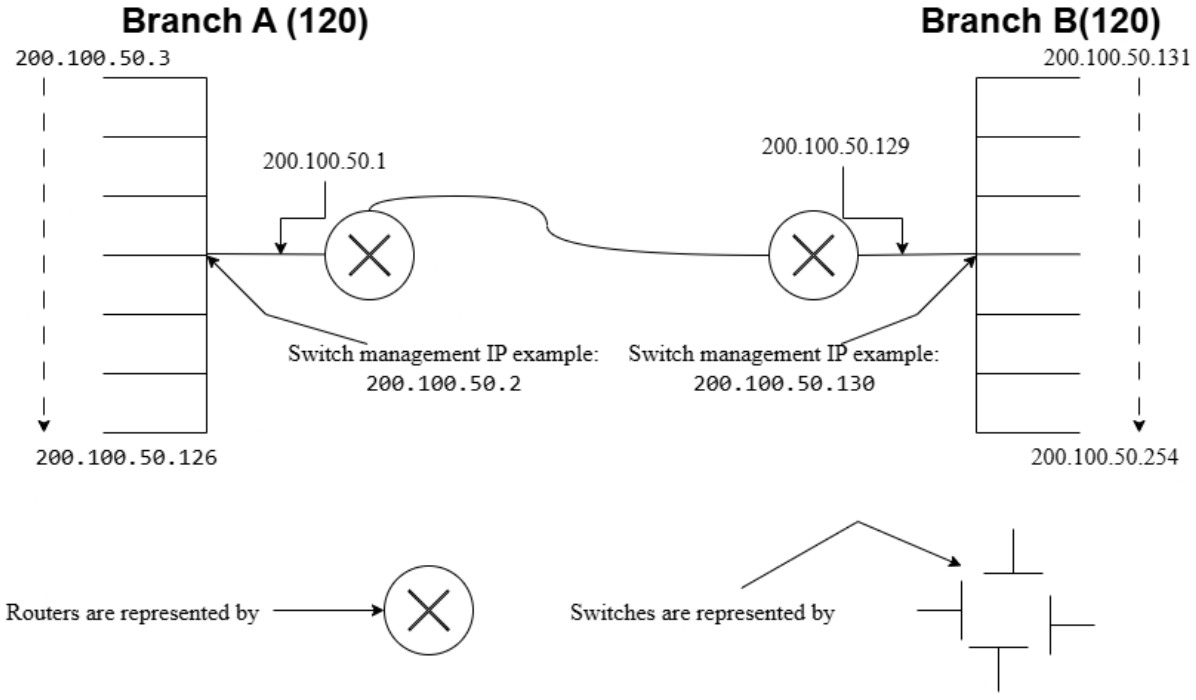
Broadcast: `200.100.50.255`

Assign to **Branch B**.

Router IP example: `200.100.50.129`

Switch management IP example: `200.100.50.130`

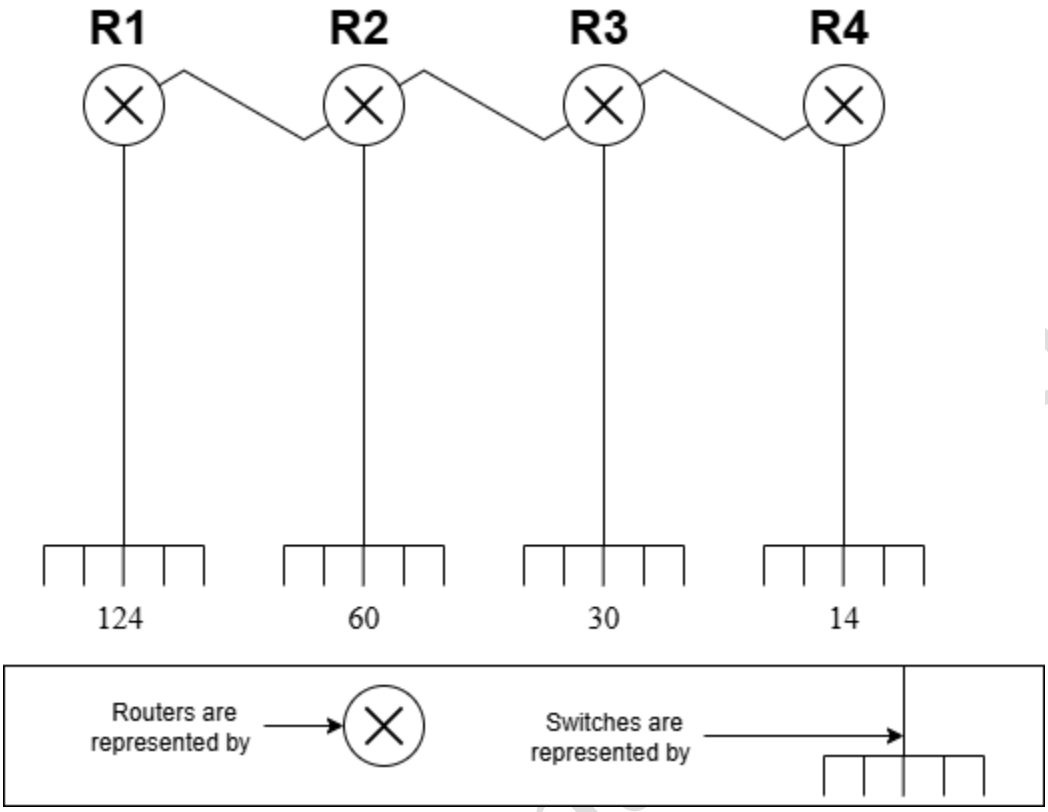
Hosts: `200.100.50.131 → 200.100.50.254`



Note that this kind of subnetting is called

Fixed Length Subnet Mask

Variable Length Subnet Masking



Suppose we have 4 branches connected through routers:

- **Branch 1:** Have 120 users
- **Branch 2:** Have 60 users
- **Branch 3:** Have 30 users
- **Branch 4:** Have 14 users

And our ISP has given us the block:

200.100.100.0/24 (256 Addresses, 254 Usable).

We will use **Variable Length Subnet Masking** so we don't waste addresses.

Step 1 Arrange by size:

Always start with largest branch first so we don't block ourselves later.

So order = 124, 60, 30, 14.

Step 2 Subnet Branch 1:

Branch 1 needs 124 hosts.

Formula = required hosts + 2(for network and broadcast)

124 + 2 = 126.
So:

			128	64	32	16	8	4	2	1
200	100	100	**0**	0	0	0	0	0	0	0

We will borrow the left most bit from the Host octet in this case

128
0

We will get two IPs from this which are:

200.100.100.0/25 and **200.100.100.128/25**

The second IP we found will be used in further subnetting.

So branch 1 IP will be: **200.100.100.0/25**

Range: 0 – 127.

Usable Hosts: 1 – 126 (126 usable)

Broadcast: 127.

Step 3 Subnet Branch 2:

Now we will use the Second IP we got while subnetting for Branch 1 and further do subnetting on that IP: **200.100.100.128/25**

Branch 2 needs 60 hosts.

Formula = required hosts + 2(for network and broadcast)

60 + 2 = 62

So:

			64	32	16	8	4	2	1
200	100	100	**0**	0	0	0	0	0	0

We will borrow the left most bit from the Host octet in this case:

64
0

We will get two IPs from this which are:

200.100.100.128/26 and **200.100.100.192/26**

The second IP we found will be used in further subnetting.

So branch 2 IP will be: **200.100.100.128/26.**

Range: 128 – 191.

Usable Host: 129 – 190 (62 usable)

Broadcast: 191.

Step 4 Subnet Branch 3:

Now we will use the Second IP we got while subnetting for Branch 2 and further do subnetting on that IP: **200.100.100.192/26**

Branch 3 needs 30 hosts

Formula = required hosts + 2(for network and broadcast)

30 + 2 = 32.

So:

			32	16	8	4	2	1
200	100	100	**0**	0	0	0	0	0

We will borrow the left most bit from the Host octet in this case:

32
0

We will get two IPs from this which are:

200.100.100.192/27 and **200.100.100.224/27**

The second IP we found will be used in further subnetting.

So branch 3 IP will be: **200.100.100.192/27.**

Range: 192 – 223.

Usable Host: 193 – 222 (30 usable)

Broadcast: 223.

Step 5 Subnet Branch 4:

Now we will use the Second IP we got while subnetting for Branch 3 and further do subnetting on that IP: **200.100.100.224/27**

Branch 4 needs 14 hosts

Formula = required hosts + 2(for network and broadcast)

14 + 2 = 16.

So:

			16	8	4	2	1
200	100	100	**0**	0	0	0	0

We will borrow the left most bit from the Host octet in this case:

16
0

We will get two IPs from this which are:

200.100.100.224/28 and **200.100.100.240/28**

So branch 4 IP will be: **200.100.100.224/28.**

Range: 224 – 239.

Usable Host: 225 – 238 (14 usable)

Broadcast: 239

Step 7 what's left:

After Branch 4 we still have left over **200.100.100.240/28 (16 addresses, 14 usable).** This can be kept for future expansion.