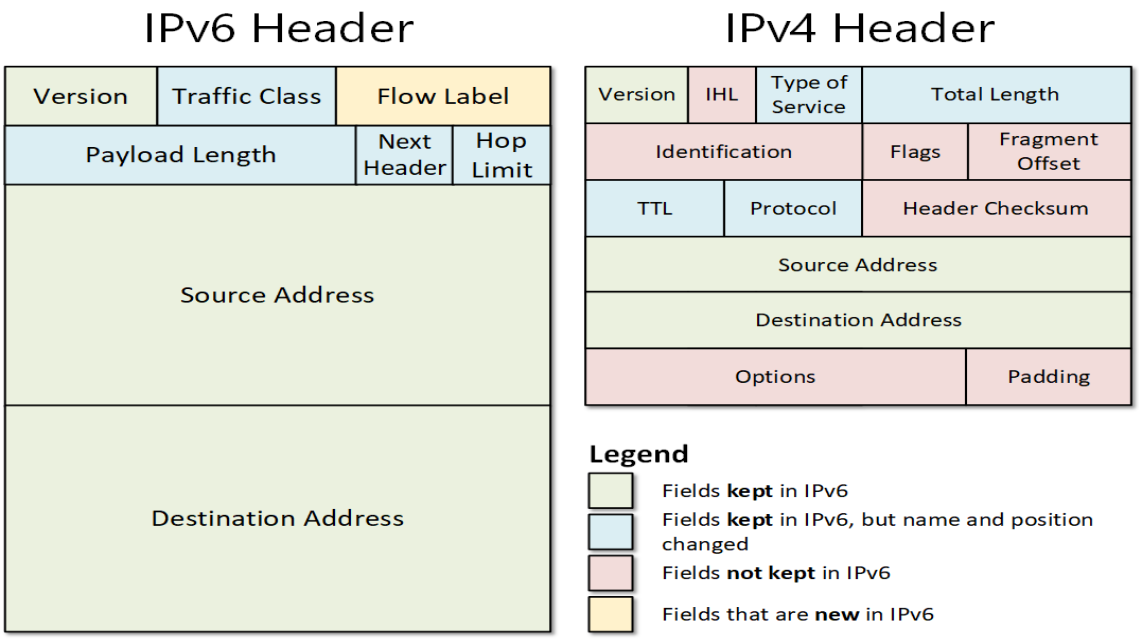
1. IPv4 vs IPv6



What is IPv4?

- IPv4 stands for **Internet Protocol version 4**
- Uses **32-bit** address
- Example: **192.168.1.1**
- Maximum addresses: **4.3 billion**
- Uses **dot-decimal** notation
- Supports NAT due to limited addresses

What is IPv6?

- IPv6 stands for **Internet Protocol version 6**
- Uses **128-bit** address
- Example: **2001:0db8:85a3:0000:0000:8a2e:0370:7334**
- Almost **unlimited addresses** (3.4×10^{38})
- Uses **hexadecimal & colon notation**
- Better security & performance
- No need for NAT (has enough addresses)

Key Differences

Feature	IPv4	IPv6
Address Size	32-bit	128-bit
Format	Decimal	Hexadecimal
Example	192.168.0.1	fe80::1a2b:3c4d
Total Addresses	4.3 billion	Unlimited
Security	Optional (IPSec)	Built-in
NAT Required	Yes	No
Speed	Slower	Faster routing

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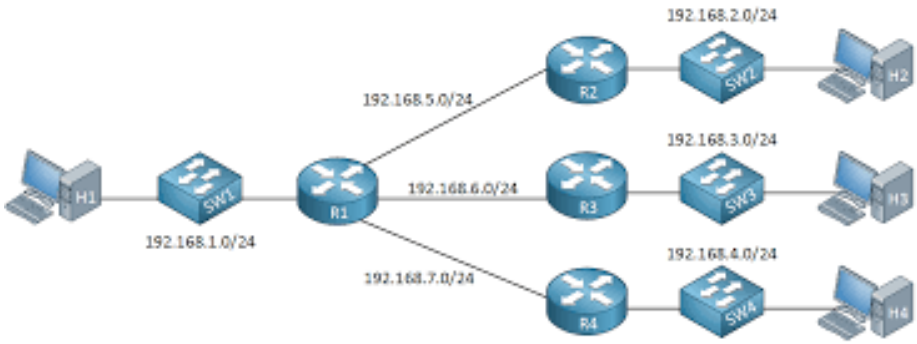
2. Subnet / Subnetting



What is Subnetting?

Subnetting is the process of dividing a large network into smaller networks called **subnets**.

Why Subnetting is used?

- Better **organization** of networks
- Improved **security**
- Efficient **IP address usage**
- Reduced **network congestion**

Subnet Mask Examples

- /24 → 255.255.255.0
- /16 → 255.255.0.0
- /8 → 255.0.0.0

Simple Example

Network: **192.168.1.0/24**
Subnet into 4 parts → /26 each

	Subnet Range	Hosts
1	192.168.1.0 – 63	62 hosts
2	192.168.1.64 – 127	62 hosts
3	192.168.1.128 – 191	62 hosts
4	192.168.1.192 – 255	62 hosts

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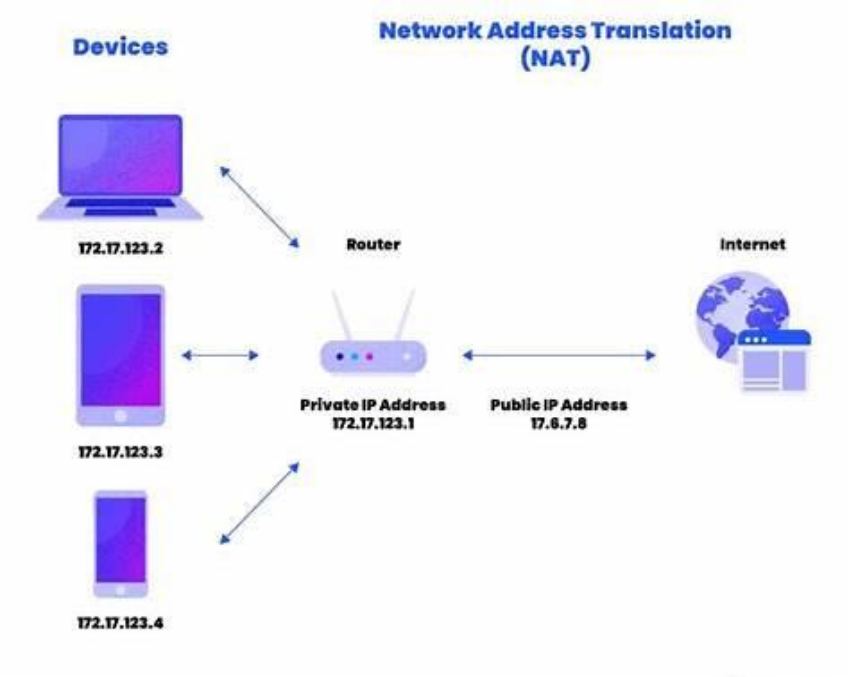
3. NAT (Network Address Translation)



What is NAT?

NAT stands for **Network Address Translation**.
It allows **private IP addresses** to communicate with the **internet** using a **single public IP**.

Why NAT is needed?

- IPv4 addresses are limited
- Protects internal network
- Allows multiple devices to share one IP

Types of NAT

1. Static NAT

- One private IP ↔ One public IP
- Permanent mapping

2. Dynamic NAT

- Private IP → Public IP from a pool
- Changes when connections change

3. PAT (Port Address Translation)

Most common (also called **NAT Overload**)

- Many private IPs share **one public IP**
- Differentiated using **port numbers**

Simple Diagram Explanation

1. Your phone (192.168.1.5)
2. Router NAT changes it to (103.45.23.9:10001)
3. Internet communicates using the public IP
4. Router maps it back to your phone