

## Types of IP Addresses

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1. **IPv4:** A 32-bit address written in dotted decimal format (e.g., 192.168.1.1).
2. **IPv6:** A 128-bit address written in hexadecimal format, separated by colons (e.g., 2001:0db8:85a3:0000:0000:8a2e:0370:7334).

## IPv4 Addressing

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### Address Classes

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IPv4 addresses are categorized into five classes:

- **Class A:** 0.0.0.0 to 127.255.255.255 (Large networks)
  - Default Subnet Mask: 255.0.0.0 (/8)
  - Example: 10.0.0.1
- **Class B:** 128.0.0.0 to 191.255.255.255 (Medium-sized networks)
  - Default Subnet Mask: 255.255.0.0 (/16)
  - Example: 172.16.0.1
- **Class C:** 192.0.0.0 to 223.255.255.255 (Small networks)
  - Default Subnet Mask: 255.255.255.0 (/24)
  - Example: 192.168.1.1
- **Class D:** 224.0.0.0 to 239.255.255.255 (Multicasting)
- **Class E:** 240.0.0.0 to 255.255.255.255 (Experimental)

### Reserved IP Ranges

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- **Private IP Addresses:**
    - Class A: 10.0.0.0 to 10.255.255.255
    - Class B: 172.16.0.0 to 172.31.255.255
    - Class C: 192.168.0.0 to 192.168.255.255
  - **Loopback Address:** 127.0.0.1 (Testing and diagnostics)
  - **APIPA:** 169.254.0.0 to 169.254.255.255 (Automatic IP assignment when no DHCP is available)
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# Subnetting

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Subnetting divides a large network into smaller segments, improving performance and security.

## Subnet Masks

A **subnet mask** defines the boundary between the network ID and host ID. It is written in two formats:

- 1. **Dotted Decimal:** e.g., 255.255.255.0
- 2. **CIDR (Classless Inter-Domain Routing):** e.g., /24

## Common Subnet Masks

CIDR	Subnet Mask	Total Subnets	Hosts per Subnet
/8	255.0.0.0	1	16,777,214
/16	255.255.0.0	256	65,534
/24	255.255.255.0	65,536	254
/30	255.255.255.252	4	2
/32	255.255.255.255	1	1

## Subnetting Example

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Given a network 192.168.1.0/24, to divide it into four subnets:

- New Subnet Mask: /26 (255.255.255.192)
- Subnets:
  - 192.168.1.0 - 192.168.1.63
  - 192.168.1.64 - 192.168.1.127
  - 192.168.1.128 - 192.168.1.191
  - 192.168.1.192 - 192.168.1.255

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# Network Segments

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Network segments are portions of a network separated by devices such as routers or switches.

## Types of Segmentation

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- 1. **Physical Segmentation:** Uses hardware like switches to divide networks.
- 2. **Logical Segmentation:** Uses VLANs or subnets to create virtual divisions.

## Benefits

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- Improved network performance
- Enhanced security

- Better traffic management
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## When to Use Specific Subnets

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### Small Office/Home Office (SOHO)

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- **CIDR:** /24 (e.g., 192.168.1.0/24)
- **Reason:** Supports up to 254 devices, sufficient for small environments.

### Medium-Sized Business

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- **CIDR:** /22 (e.g., 192.168.4.0/22)
- **Reason:** Balances IP space utilization and management.

### Point-to-Point Links

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- **CIDR:** /30 or /31
- **Reason:** Minimal host requirements reduce IP wastage.

### Loopbacks or IDs

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- **CIDR:** /32 (e.g., 1.1.1.1/32)
  - **Reason:** Only one IP for subnet necessary
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## Best Practices for IP Addressing

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#### 1. Plan the IP Scheme:

- Use private IPs for internal networks.
- Reserve IPs for critical devices (e.g., servers, routers).

#### 2. Document the Addressing:

- Maintain a record of assigned addresses.

#### 3. Use DHCP for Dynamic Assignments:

- Simplifies management for large networks.

#### 4. Monitor and Audit:

- Regularly check for conflicts and unused IPs.