

# Subnetting

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## What is Subnetting?

Subnetting is the process of dividing a large network into smaller, more manageable sub-networks (subnets). It helps optimize the use of IP addresses and improves network efficiency.

Each subnet functions as an independent network but remains part of the larger main network. Subnetting is done using a subnet mask, which helps differentiate the network and host portions of an IP address.

## Why is Subnetting Required?

### 1. Efficient IP Address Allocation

Without subnetting, a single large network may waste IP addresses. Subnetting allows better utilization by assigning only the required number of IPs to each subnet.

### 2. Reduced Network Congestion

Subnetting decreases broadcast traffic, reducing network slowdowns and improving overall performance.

### 3. Improved Security

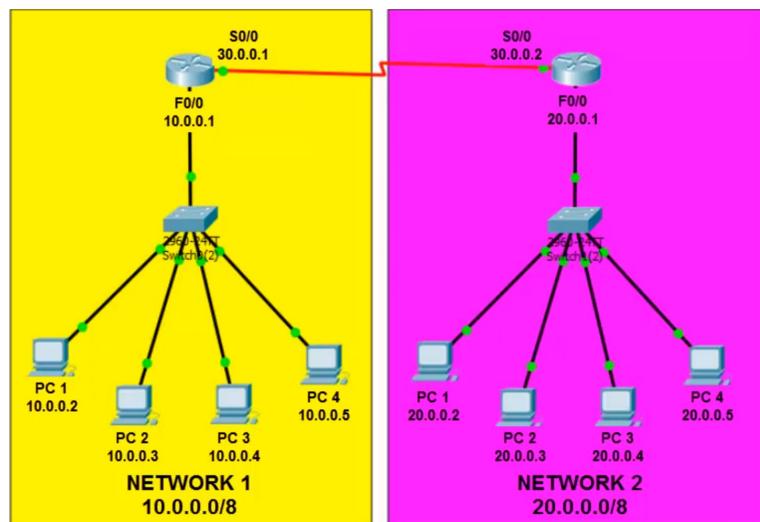
By segmenting a network into smaller subnets, subnetting helps restrict access and contain security threats within a specific subnet.

### 4. Easier Network Management

Smaller subnetworks make it easier to manage, troubleshoot, and control traffic efficiently.

### 5. Better Routing Efficiency

Subnetting reduces the number of entries in a routing table, optimizing network performance and simplifying routing.



## What is a Subnet Mask?

A **subnet mask** is a 32-bit number that divides an IP address into **network** and **host** portions. It helps determine which part of an IP address belongs to the network and which part is for individual devices (hosts).

For example:

- **IP Address:** 192.168.1.10
- **Subnet Mask:** 255.255.255.0
  - **Network Portion:** 192.168.1
  - **Host Portion:** 10

Each subnet mask consists of **binary 1s (network part)** followed by **binary 0s (host part)**.

Example in binary:

- **255.255.255.0** → 1111111.1111111.1111111.00000000
  - First 24 bits represent the network, and the last 8 bits are for hosts.

## What is Network ID and Broadcast Address?

In any subnet, two special addresses are reserved:

### 1. Network ID (Network Address)

- This is the first address in a subnet.
- It identifies the subnet itself and is used for routing purposes.
- **It cannot be assigned to a device.**
- **Example:**
  - IP Address: **192.168.1.10**
  - Subnet Mask: **255.255.255.0**
  - **Network ID: 192.168.1.0**

### 2. Broadcast Address

- This is the last address in a subnet.
- It is used to send messages to all devices within the subnet.
- **It cannot be assigned to a device.**
- **Example:**
  - IP Address: **192.168.1.10**
  - Subnet Mask: **255.255.255.0**
  - **Broadcast Address: 192.168.1.255**

## Why Are They Required?

### Network ID:

- Helps routers and devices identify which subnet an IP belongs to.
- Used for routing and subnet identification.

### Broadcast Address:

- Allows communication with all devices in a subnet at once.
- Used for network-wide announcements, such as ARP requests and DHCP discovery.