Subnetting: Part 1

Overview of Subnetting

Subnetting is the process of dividing a larger network into smaller, more manageable sub-networks (subnets). It allows efficient use of IP addresses and improves network organization and security.

Key Concepts

1. **Classful Addressing:**
    - Divides IP addresses into fixed classes: A, B, and C.
    - Causes wastage of addresses when a network requires fewer IPs than the assigned class provides.
2. **CIDR (Classless Inter-Domain Routing):**
    - Introduced in 1993 by the IETF to replace classful addressing.
    - Removes the dependency on fixed classes and allows flexible allocation of IP addresses by specifying a **prefix length** (e.g., `/25`).

Usable Addresses Formula

For a given prefix `/n`: Usable Hosts=2Host Bits−2\text{Usable Hosts} = 2^{\text{Host Bits}} - 2Usable Hosts=2Host Bits−2 Where:

- **Host Bits** = 32−n32 - n32−n (for IPv4).
- The subtraction of 2 accounts for the **Network ID** and **Broadcast Address**.

Subnet Mask and Group Size

The subnet mask defines how the IP address is split between the network and host portions.

- **Subnet Mask Calculation:** Flip all **host bits** to 0 and all **network bits** to 1.
  Example: `/25` → 25 network bits → 11111111.11111111.11111111.10000000=255.255.255.12811111111.11111111.11111111.10000000 = 255.255.255.12811111111.11111111.11111111.10000000=255.255.255.128.
- **Group Size:** Group Size=2Host Bits\text{Group Size} = 2^{\text{Host Bits}}Group Size=2Host Bits

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Steps for Subnet Calculation

1. **Identify Prefix and Host Bits:**
    - Prefix (e.g., `/25`) determines the number of network and host bits.
    - Subnet mask is derived from the prefix.
2. **Calculate Subnet Range:**
    - Group Size = 2Host Bits2^{\text{Host Bits}}2Host Bits.
    - Subnet ranges are multiples of the group size.
3. **Find the Subnet for a Given IP:**
    - Divide the relevant octet by the group size.
    - The result gives the **Base Network Address**.
4. **Calculate Broadcast Address:**
    - Add the group size to the base network address and subtract 1.
5. **Determine Usable Addresses:**
    - Subtract 2 from the group size (for Network ID and Broadcast).

Cheat Sheet

CIDR	Subnet Mask	Hosts (Usable)	Group Size
/25	255.255.255.128	126	128
/26	255.255.255.192	62	64
/27	255.255.255.224	30	32
/28	255.255.255.240	14	16
/29	255.255.255.248	6	8
/30	255.255.255.252	2	4
/31	255.255.255.254	0 (Special Use)	2
/32	255.255.255.255	1 (Special Use)	1

Examples

Example 1: `/25` (203.0.113.0/25)

1. **Subnet Mask:** 255.255.255.128255.255.255.128255.255.255.128
2. **Group Size:** 27=1282^{7} = 12827=128
3. **Network Range:**
    - Network ID: `203.0.113.0`
    - Broadcast Address: `203.0.113.127`
    - Usable Addresses: `203.0.113.1` to `203.0.113.126`.

Example 2: `/28` (203.0.113.0/28)

1. **Subnet Mask:** 255.255.255.240255.255.255.240255.255.255.240
2. **Group Size:** 24=162^{4} = 1624=16
3. **Network Range:**
    - Network ID: `203.0.113.0`
    - Broadcast Address: `203.0.113.15`
    - Usable Addresses: `203.0.113.1` to `203.0.113.14`.

Example 3: `/19` (10.4.77.188/19)

1. **Subnet Mask:** 255.255.224.0255.255.224.0255.255.224.0
2. **Group Size:** 256−224=32256 - 224 = 32256−224=32
3. **Network Range:**
    - Identify range in the 3rd octet:
        - Subnet Blocks: `0`, `32`, `64`, `96`, etc.
        - `77` falls between `64` and `96`.
    - Network ID: `10.4.64.0`.
    - Broadcast Address: `10.4.95.255`.
    - Usable Addresses: `10.4.64.1` to `10.4.95.254`.