### **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=2^Host Bits−2{Usable Hosts}

* 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=255.255.255.128
* **Group Size:** Group Size=2 ^ Host 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 = 2 ^ Host 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) -> Point to Point | 2 |
| /32 | 255.255.255.255 | 1 (Special Use) -> Static Route to a specific host | 1 |

### **Examples**

#### **Example 1: /25 (203.0.113.0/25)**

1. **Subnet Mask:** 255.255.255.128
2. **Group Size:** 2^{7} = 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:** 255.255.255.240
2. **Group Size:** 2^{4} = 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.