# **15. SUBNETTING (VLSM): PART 3**

## **Introduction**

### **Subnetting Class A Networks**

Given a 10.0.0.0/8 network, we need to create **2000 subnets** distributed across various enterprises.

#### **Steps:**

1. Determine the number of bits to borrow:
   * 2^10 = 1024 (not enough), so 2^11 = 2048 (sufficient).
   * Borrow 11 bits (from left to right).
2. Update the subnet mask:
   * Original subnet mask: /8.
   * Add borrowed bits: /8 + /11 = /19.

#### **Calculations:**

* **Subnet Mask**: 255.255.224.0.
* **Hosts per Subnet**:
  + Remaining host bits = 32 - 19 = 13.
  + Hosts = 2^13 - 2 = 8190 hosts per subnet.

## **Variable-Length Subnet Masks (VLSM)**

### **Key Concepts**

* **FLSM (Fixed-Length Subnet Masks)**: All subnets use the same prefix length (e.g., /26 for a Class C network).
* **VLSM**: Subnets of different sizes are created to optimize IP address usage.

### **Example Scenario**

#### **Requirements:**

* **TOKYO LAN A**: 110 hosts.
* **TORONTO LAN B**: 45 hosts.
* **TORONTO LAN A**: 29 hosts.
* **TOKYO LAN B**: 8 hosts.
* **Point-to-Point Connection**: 2 hosts.

#### **Starting Network:**

192.168.1.0/24

### **Step-by-Step Subnet Allocation**

#### **1. TOKYO LAN A (110 Hosts)**

* Hosts required: 110.
* Next power of 2: 2^7 = 128 (sufficient).
* Borrow 1 host bit, leaving 7 host bits.

**Details:**

* **Network Address**: 192.168.1.0/25.
* **Subnet Mask**: 255.255.255.128.
* **Broadcast Address**: 192.168.1.127/25.
* **Usable Hosts**: 126 (2^7 - 2).
* **Range**: 192.168.1.1 to 192.168.1.126.

#### **2. TORONTO LAN B (45 Hosts)**

* Hosts required: 45.
* Next power of 2: 2^6 = 64 (sufficient).
* Borrow 2 host bits, leaving 6 host bits.

**Details:**

* **Network Address**: 192.168.1.128/26.
* **Subnet Mask**: 255.255.255.192.
* **Broadcast Address**: 192.168.1.191/26.
* **Usable Hosts**: 62 (2^6 - 2).
* **Range**: 192.168.1.129 to 192.168.1.190.

#### **3. TORONTO LAN A (29 Hosts)**

* Hosts required: 29.
* Next power of 2: 2^5 = 32 (sufficient).
* Borrow 3 host bits, leaving 5 host bits.

**Details:**

* **Network Address**: 192.168.1.192/27.
* **Subnet Mask**: 255.255.255.224.
* **Broadcast Address**: 192.168.1.223/27.
* **Usable Hosts**: 30 (2^5 - 2).
* **Range**: 192.168.1.193 to 192.168.1.222.

#### **4. TOKYO LAN B (8 Hosts)**

* Hosts required: 8.
* Next power of 2: 2^4 = 16 (sufficient).
* Borrow 4 host bits, leaving 4 host bits.

**Details:**

* **Network Address**: 192.168.1.224/28.
* **Subnet Mask**: 255.255.255.240.
* **Broadcast Address**: 192.168.1.239/28.
* **Usable Hosts**: 14 (2^4 - 2).
* **Range**: 192.168.1.225 to 192.168.1.238.

#### **5. Point-to-Point Connection (2 Hosts)**

* Hosts required: 2.
* Next power of 2: 2^2 = 4 (sufficient).
* Borrow 6 host bits, leaving 2 host bits.

**Details:**

* **Network Address**: 192.168.1.240/30.
* **Subnet Mask**: 255.255.255.252.
* **Broadcast Address**: 192.168.1.243/30.
* **Usable Hosts**: 2 (2^2 - 2).
* **Range**: 192.168.1.241 to 192.168.1.242.

### **Summary Table:**

| **Subnet** | **Network Address** | **Broadcast Address** | **Prefix** | **Usable Hosts** | **Host Range** |
| --- | --- | --- | --- | --- | --- |
| TOKYO LAN A | 192.168.1.0 | 192.168.1.127 | /25 | 126 | 192.168.1.1 - 192.168.1.126 |
| TORONTO LAN B | 192.168.1.128 | 192.168.1.191 | /26 | 62 | 192.168.1.129 - 192.168.1.190 |
| TORONTO LAN A | 192.168.1.192 | 192.168.1.223 | /27 | 30 | 192.168.1.193 - 192.168.1.222 |
| TOKYO LAN B | 192.168.1.224 | 192.168.1.239 | /28 | 14 | 192.168.1.225 - 192.168.1.238 |
| Point-to-Point | 192.168.1.240 | 192.168.1.243 | /30 | 2 | 192.168.1.241 - 192.168.1.242 |

## **Additional Resources**

* [SubnettingQuestions.com](http://www.subnettingquestions.com/)
* [Subnetting.org](http://subnetting.org/)
* [SubnettingPractice.com](https://subnettingpractice.com/) (**Preferred site**).