

DAY 13 - Subnetting

Subnetting

Topics:

1. **CIDR** (Classless Inter-Domain Routing)
 2. **Subnetting**
-

IPv4 Classes

Class	First Octet	First Octet Range	Prefix
A	0 xxxxxxx	0 - 127	/8
B	10 xxxxxx	128 - 191	/16
C	110 xxxxx	192 - 223	/24
D	1110 xxxx	224 - 239	-
E	1111 xxxx	240 - 255	-

Remember: Only **Class A**, **B**, **C** IP addresses can be assigned as a device's address.

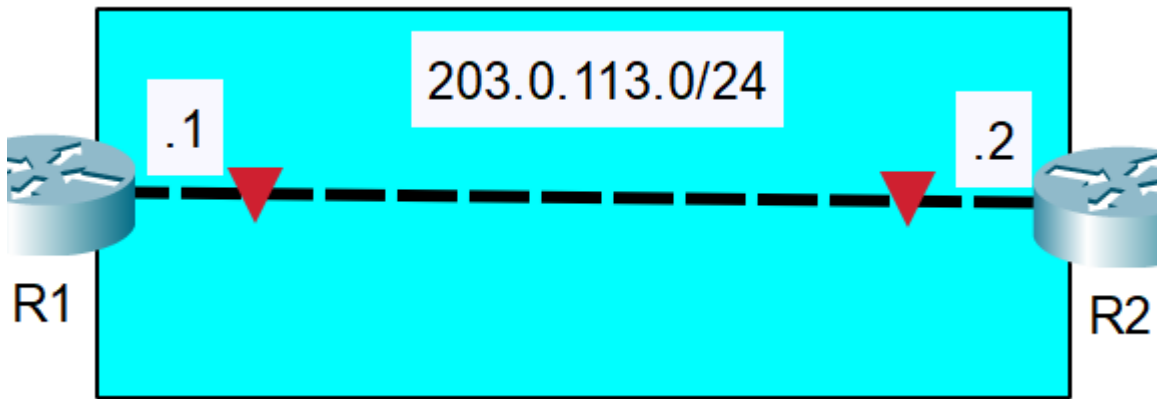
Who Assigned IP Classes?

The **IANA (Internet Assigned Numbers Authority)** assigns IPv4 addresses/networks to companies based on their size.

For example, a very large company might receive a **Class A** or **Class B** network, while a small company might receive a **Class C** network.

However, this led to *many wasted* IP addresses.

IP Wasting



- 203.0.113.0/24 **Class C** Network:
 - 203.0.113.0 = **Network ID**
 - 203.0.113.255 = **Broadcast IP**
 - 203.0.113.1 = R1
 - 203.0.113.2 = R2
 - 252 out of 256 IP wasted!

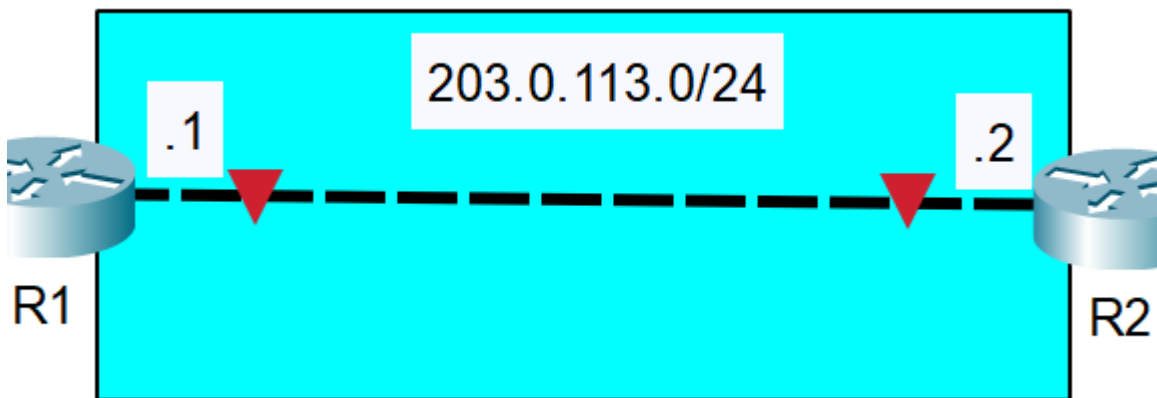
To fix IP wasting, **IETF (Internet Engineering Task Force)** introduced **CIDR** in 1993 to replace the "classful" addressing system.

CIDR

- With **CIDR**, the requirements of
 - **Class A** = /8
 - **Class B** = /16
 - **Class C** = /24
 - *were removed.*
- This allowed larger networks to be split into smaller networks.
- These smaller networks are called **Subnetworks** or **Subnets**.

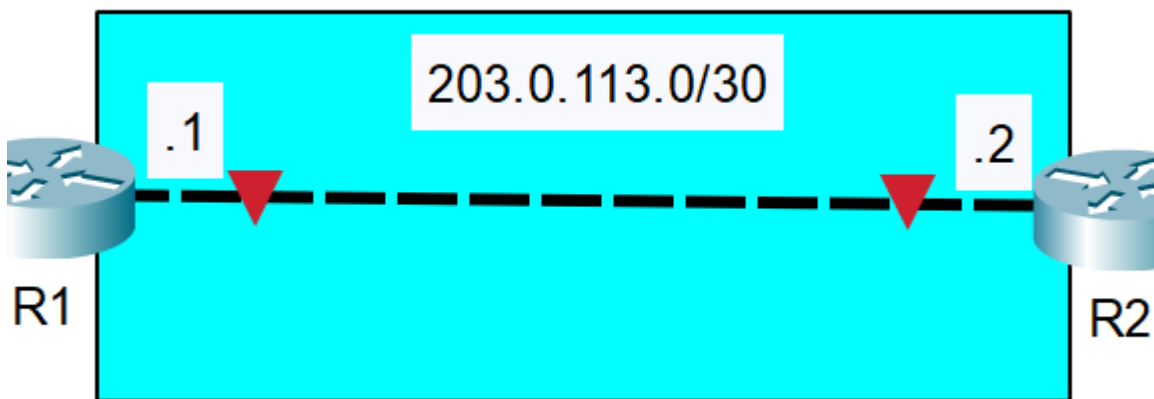
CIDR Example:

From the previous example:



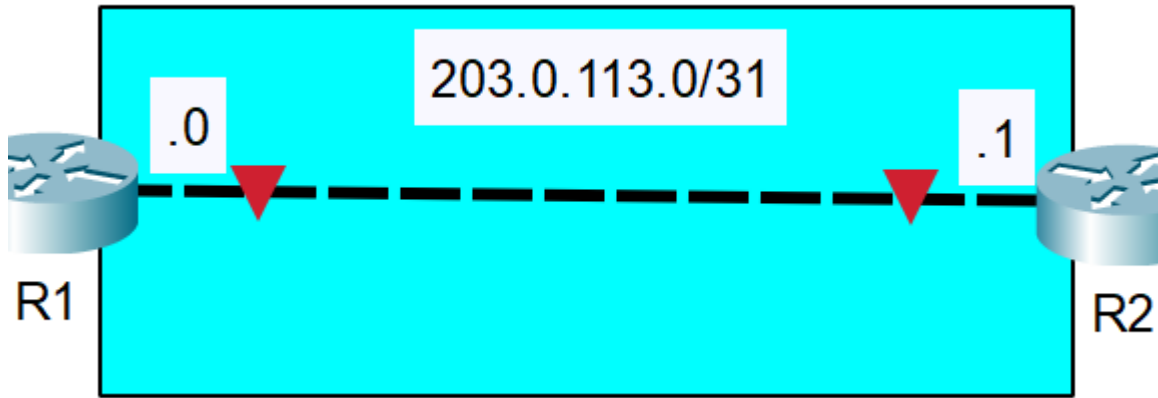
- **Originally (/24):**
 - **Address:** 11001011.00000000.01110001.00000000
 - **Mask:** 11111111.11111111.11111111.00000000
 - Gives 256 - 2 Hosts
 - 252 IP Wasted
- **Changing/Borrowing 1 bit (/25):**
 - **Address:** 11111111.11111111.11111111.0 0000000
 - **Mask:** 11111111.11111111.11111111.1 0000000 (128)
 - Gives 128 - 2 Hosts = 126 Hosts
 - 124 IP Wasted (Used 2 for R1 & R2 IP addresses)
- **Changing/Borrowing 2 bits (/26):**
 - **Address:** 11111111.11111111.11111111.00 000000
 - **Mask:** 11111111.11111111.11111111.11 000000 (192)
 - Gives 64 - 2 Hosts
 - 60 IP Wasted
- **Changing/Borrowing 3 bits (/27):**
 - **Address:** 11111111.11111111.11111111.000 00000
 - **Mask:** 11111111.11111111.11111111.111 00000 (224)
 - Gives 32 - 2 Hosts
 - 28 IP Wasted
- **Changing/Borrowing 4 bits (/28):**
 - **Address:** 11111111.11111111.11111111.0000 0000
 - **Mask:** 11111111.11111111.11111111.1111 0000 (240)
 - Gives 16 - 2 Hosts
 - 12 IP Wasted
- **Changing/Borrowing 5 bits (/29):**

- **Address:** 11111111.11111111.11111111 .000000 000
- **Mask:** 11111111.11111111.11111111 .11111 000 (248)
- Gives 8 - 2 Hosts
 - 4 IP Wasted
- **Changing/Borrowing 6 bits (/30):**
 - **Address:** 11111111.11111111.11111111 .0000000 00
 - **Mask:** 11111111.11111111.11111111 .111111 00 (252)
 - Gives 4 - 2 Hosts = 2 Usable addresses.
 - 0 IP Wasted (Both are used for R1 and R2)



CIDR: /31 Mask

- **Address:** 11111111.11111111.11111111 .00000000 0
- **Mask:** 11111111.11111111.11111111 .11111111 0 (254)
- Gives 2 - 2 Hosts = 0 Usable addresses *but*.
 - Why use this?
 - **For Point-to-Point Connection**
 - Normally we'd need 2 for network address and broadcast address.
 - But for **Point-to-Point** communication, there isn't a need for network address or broadcast address.
 - e.g. 2 routers connection



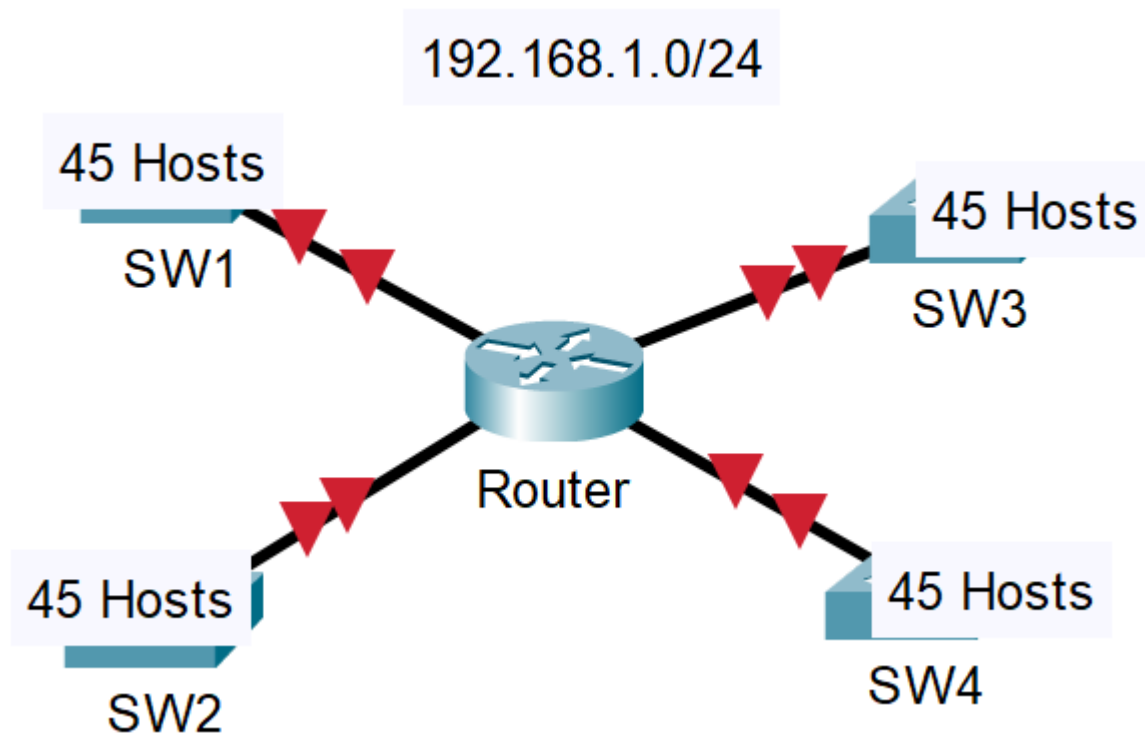
CIDR /32 Mask

- **Address:** 11111111.11111111.11111111 .00000000
- **Mask:** 11111111.11111111.11111111 .11111111 (255)
- Gives $1 - 2 = -1$ Usable Hosts???
 - Why use this?
 - For **Static Route** and some other uses.

CIDR Notation Conversion

Dotted Decimal	CIDR Notation
255.255.255.128	/25
255.255.255.192	/26
255.255.255.224	/27
255.255.255.240	/28
255.255.255.248	/29
255.255.255.252	/30
255.255.255.254	/31
255.255.255.255	/32

Subnetting Problems:

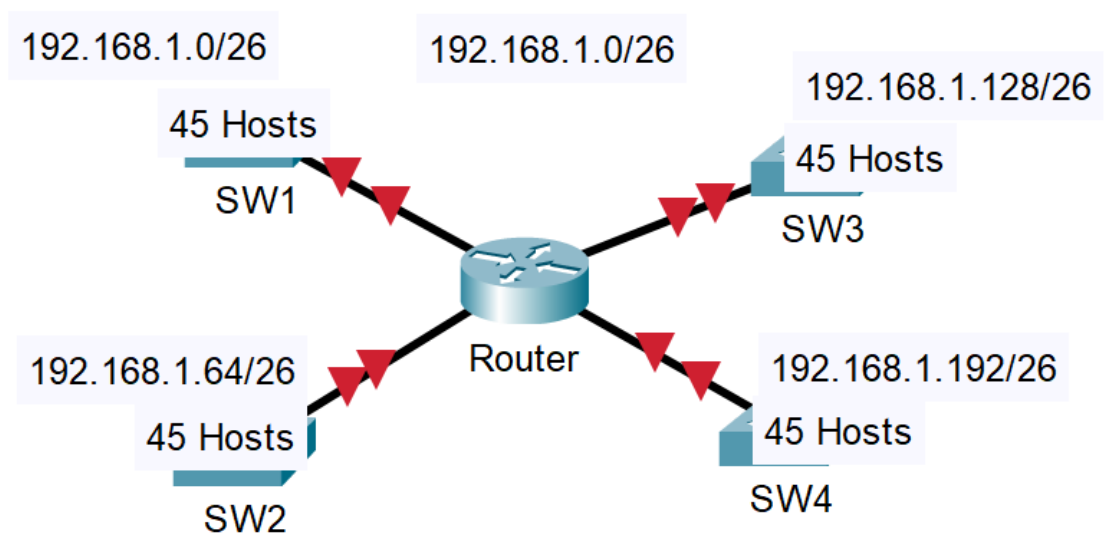


Divide the 192.168.1.0/24 network into four subnets.

My Attempt:

- **Original (/24):**
 - **Addresses:** 11000000.10101000.00000001.00000000
 - **Mask:** 11111111.11111111.11111111.00000000
 - **Hosts:** 256 - 2 = 254
- **Borrow 2 (/26):**
 - **Addresses:** 11000000.10101000.00000001 .00 000000
 - **Mask:** 11111111.11111111.11111111. 11 000000
 - **Hosts:** 64 - 2 = 62 Hosts
 - Note the **bold IP block**
 - **SW1:**
 - **00** part:
 - 192.168.1.0/26
 - Network Address: 192.168.1.0
 - Broadcast Address: 192.168.1.63
 - Last Host: 192.168.1.62
 - First Host: 192.168.1.1
 - Usable: **62 IP**
 - **SW2:**

- 01 part:
- 192.168.1.64/26
- Network Address: 192.168.1.64
- Broadcast Address: 192.168.1.127
- Last Host: 192.168.1.126
- First Host: 192.168.1.65
- Usable: **62 IP**
- **SW3:**
 - 10 part:
 - 192.168.1.128/26
 - Network Address: 192.168.1.128
 - Broadcast Address: 192.168.1.191
 - Last Host: 192.168.1.190
 - First Host: 192.168.1.129
 - Usable: **62 IP**
- **SW4:**
 - 11 part:
 - 192.168.1.192/26
 - Network Address: 192.168.1.192
 - Broadcast Address: 192.168.1.255
 - Last Host: 192.168.1.254
 - First Host: 192.168.1.193
 - Usable: **62 IP**



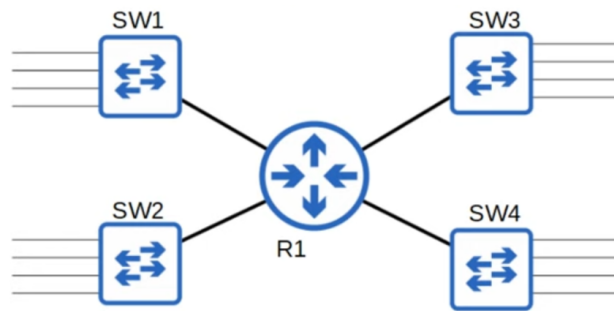
His Attempt:

Subnet 1:
192.168.1.0/26

Subnet 2:
192.168.1.64/26

Subnet 3:
192.168.1.128/26

Subnet 4:
192.168.1.192/26



192.168.1.0/24