Computer networks

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Based on the work of Dr. Mohamed BELAOUED

Addressing : IPv4 - CIDR and subnetting

Class	First octet (binary)	First octet range (decimal)	
A	0xxxxxxx	0 - 127	0.0.0.0 ~ 127.255.255.255
B	10xxxxxx	128 - 191	128.0.0.0 ~ 191.255.255.255
C	110xxxxx	192 - 223	192.0.0.0 ~ 223.255.255.255
D	1110xxxx	224 - 239	224.0.0.0 ~ 239.255.255.255
E	1111xxxx	240 - 255	240.0.0.0 ~ 255.255.255.255

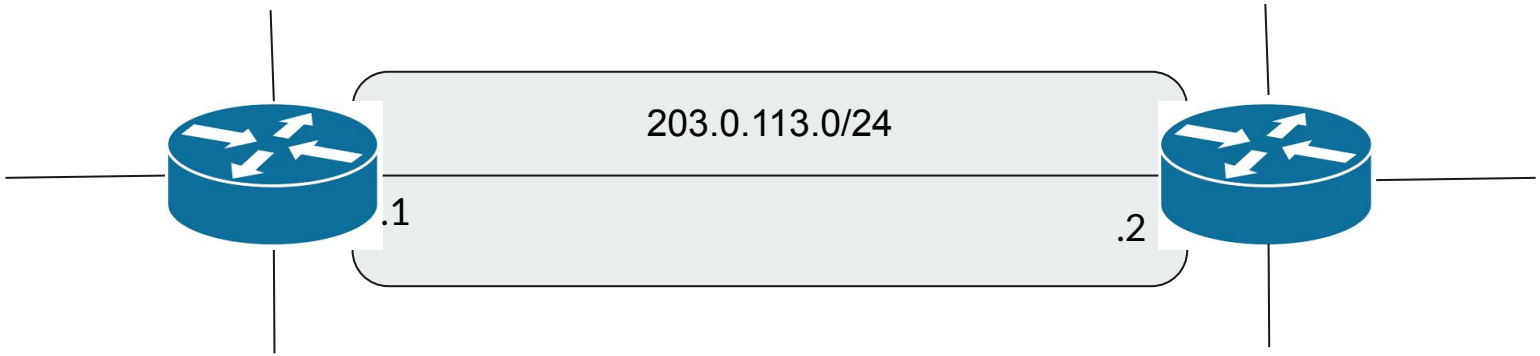
Addressing : IPv4 - CIDR and subnetting

Class	First octet	First octet numeric range	Prefix Length
A	0xxxxxxx	0-127	/8
B	10xxxxxx	128-191	/16
C	110xxxxx	192-223	/24

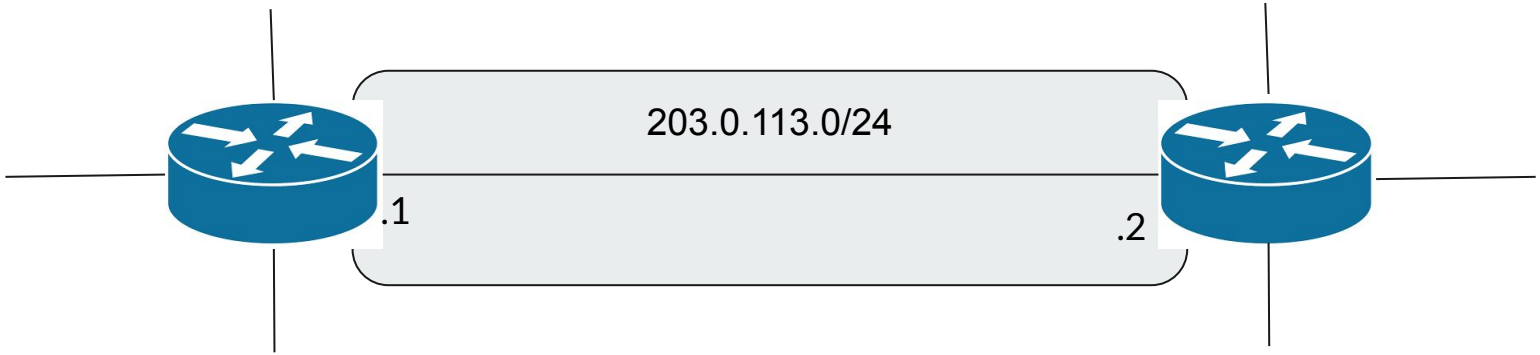
Addressing : IPv4 - CIDR and subnetting

- 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.

Addressing : IPv4 - CIDR and subnetting

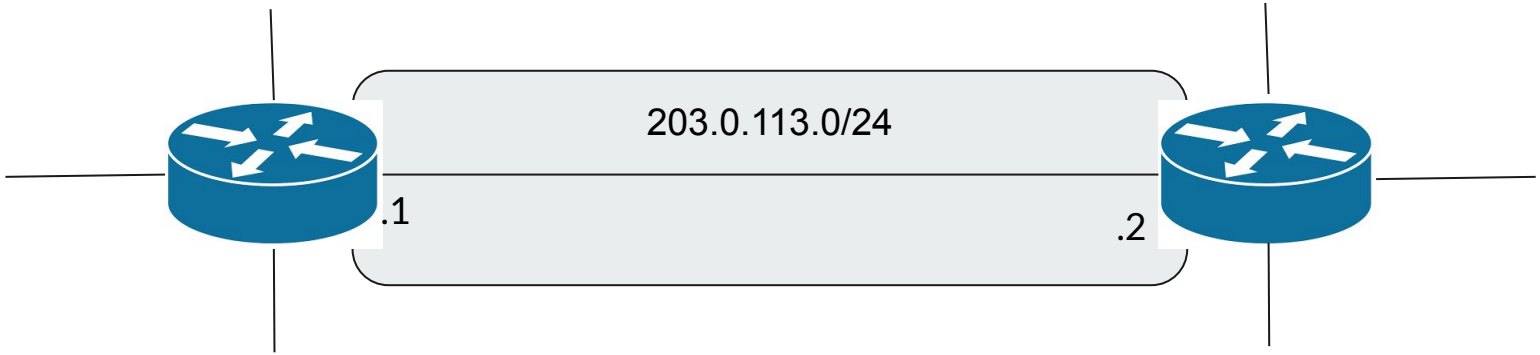


Addressing : IPv4 - CIDR and subnetting



-1 network address (203.0.113.0)
-1 broadcast address (203.0.113.255)
-1 R1’s address (203.0.113.1)
-1 R2’s address (203.0.113.2)

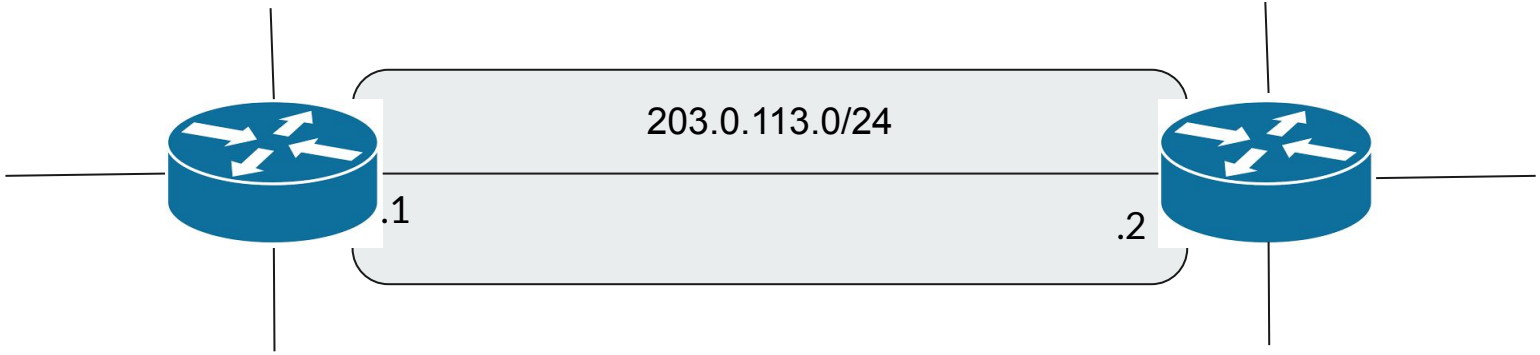
Addressing : IPv4 - CIDR and subnetting



-1 network address (203.0.113.0)
-1 broadcast address (203.0.113.255)
-1 R1's address (203.0.113.1)
-1 R2's address (203.0.113.2)

→ = 252 IP addresses wasted

Addressing : IPv4 - CIDR and subnetting



-1 network address (203.0.113.0)
-1 broadcast address (203.0.113.255)
-1 R1's address (203.0.113.1)
-1 R2's address (203.0.113.2)

→ = 252 IP addresses wasted

The IETF (Internet Engineering Task Force) introduced CIDR in 1993 to replace the 'classful' addressing system.

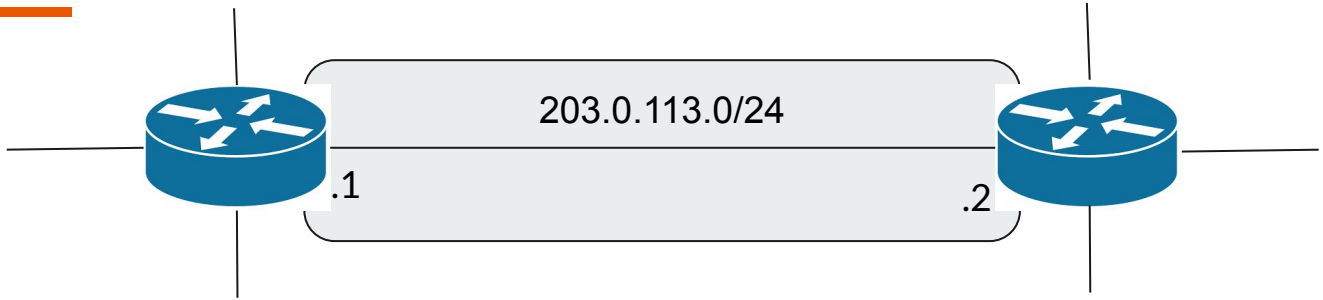
Addressing : IPv4 - CIDR and subnetting

CIDR (Classless Interdomain routing) abandons the notion of classes, by keeping the network prefix in IP address arbitrary.
The Size of the **subnetwork** prefix must be provided with an IP address.

A subnet, is a logical subdivision of a network. Typically you create a subnet to represent computers at some kind of geographical or physical location. They allow :

- Improve network performance.
- Reduce network congestion.
- Improve network security.
- Control network growth.
- Ease management.

Addressing : IPv4 - CIDR and subnetting



Address

1 1 0 0 1 0 1 1 . 0 0 0 0 0 0 0 0 . 0 1 1 1 0 0 0 1 . 0 0 0 0 0 0 0 0

203 . 0 . 113 . 0

Mask

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0

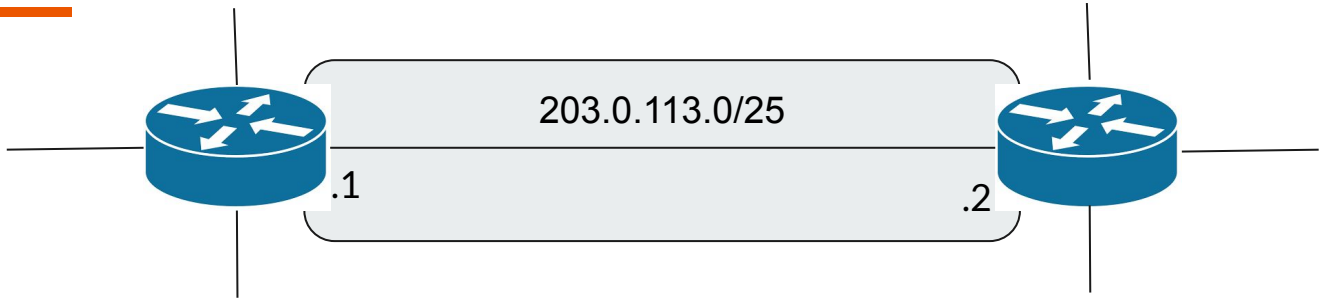
255 . 255 . 255 . 0

network address, broadcast address

$2^8 - 2 = 254$ usable addresses.

number of host bits

Addressing : IPv4 - CIDR and subnetting



Address

1 1 0 0 1 0 1 1 . 0 0 0 0 0 0 0 0 . 0 1 1 1 0 0 0 1 . 0 0 0 0 0 0 0 0

203 . 0 . 113 . 0

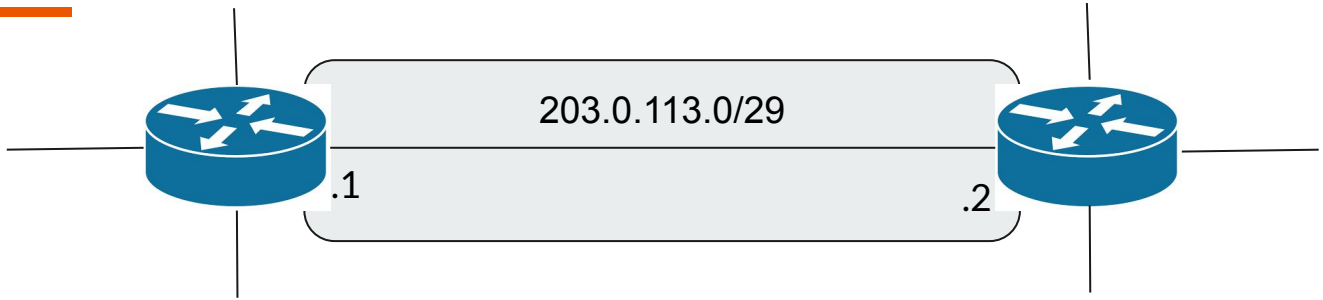
Mask

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 0 0 0 0 0 0 0

255 . 255 . 255 . 128

$2^7 - 2 = 126$ usable addresses.

Addressing : IPv4 - CIDR and subnetting



Address

1 1 0 0 1 0 1 1 . 0 0 0 0 0 0 0 0 . 0 1 1 1 0 0 0 1 . 0 0 0 0 0 0 0 0

203 . 0 . 113 . 0

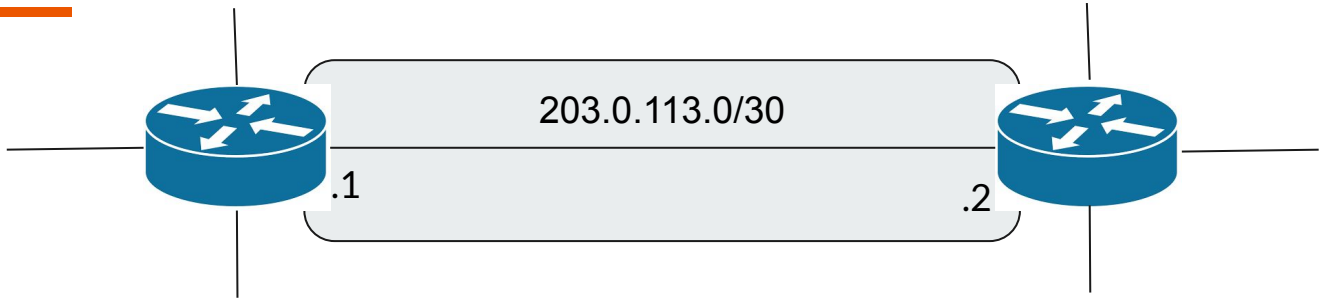
Mask

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 0 0 0

255 . 255 . 255 . 248

$2^3 - 2 = 6$ usable addresses.

Addressing : IPv4 - CIDR and subnetting



Address

1 1 0 0 1 0 1 1 . 0 0 0 0 0 0 0 0 . 0 1 1 1 0 0 0 1 . 0 0 0 0 0 0 0 0

203 . 0 . 113 . 0

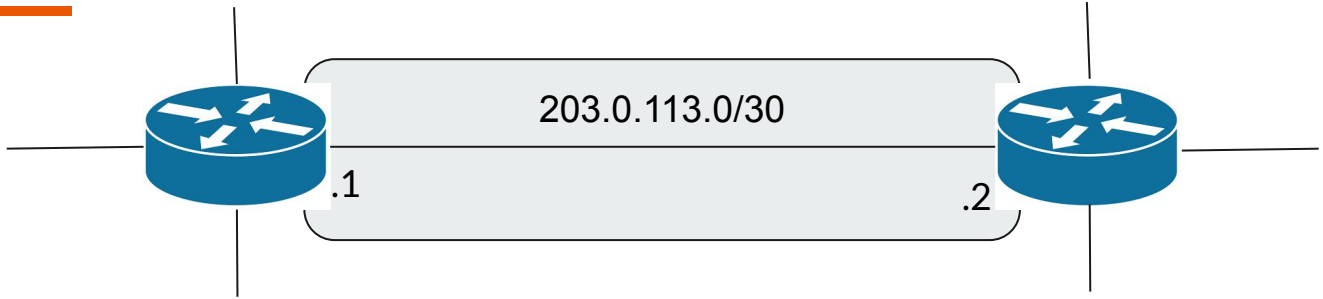
Mask

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 0 0

255 . 255 . 255 . 252

$2^2 - 2 = 2$ usable addresses.

Addressing : IPv4 - CIDR and subnetting

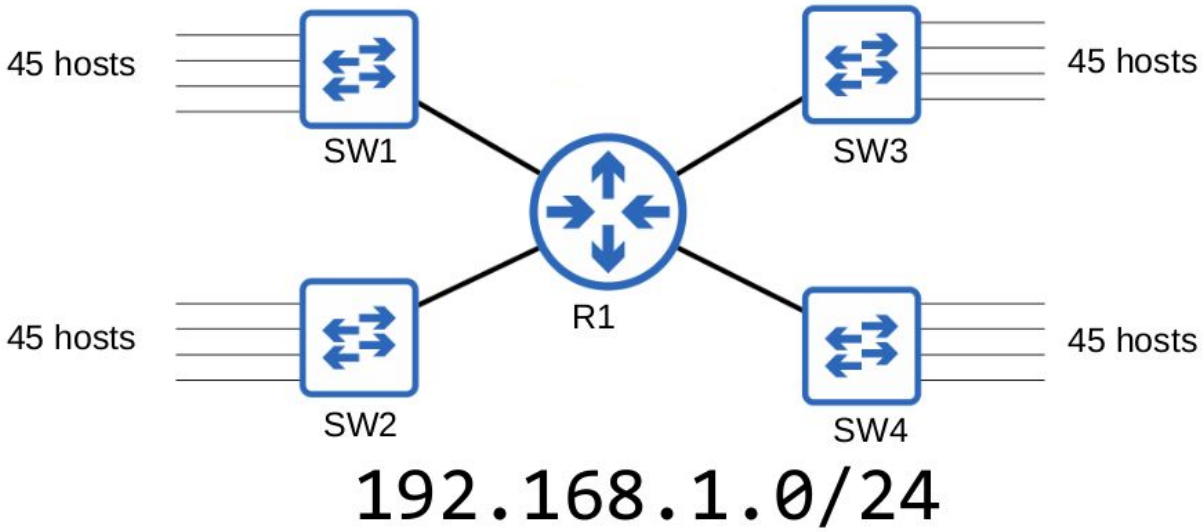


203.0.113.0/30
= 203.0.113.0 – 203.0.113.3

```
11001011.00000000.01110001.00000000
11001011.00000000.01110001.00000001
11001011.00000000.01110001.00000010
11001011.00000000.01110001.00000011
```

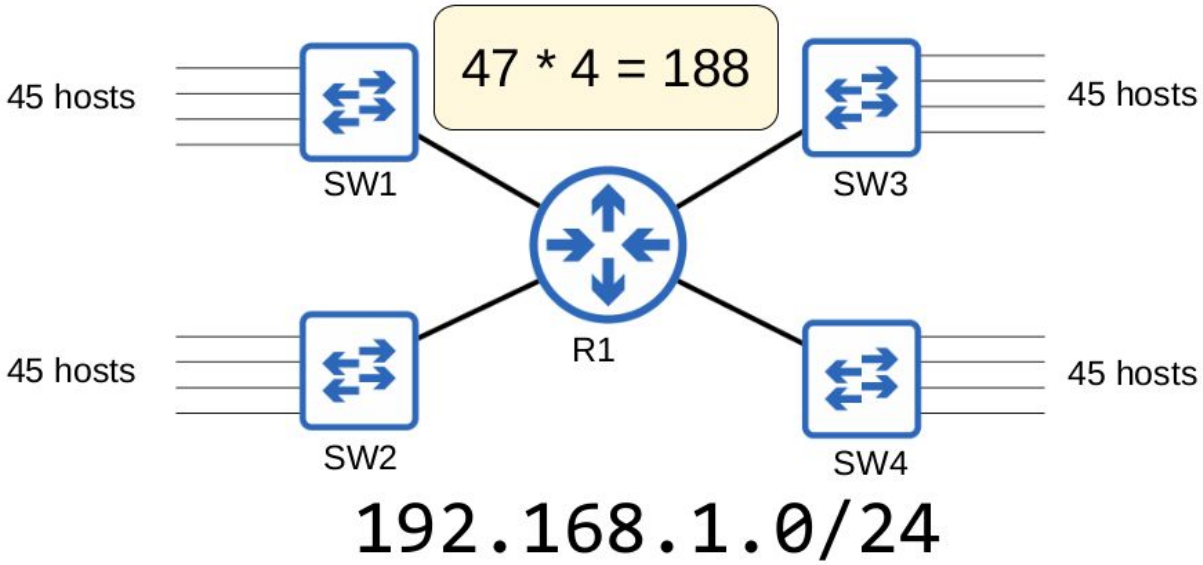
The remaining addresses can be used by other subnets

Addressing : IPv4 - CIDR and subnetting



Divide the 192.168.1.0/24 network into four subnets that can accommodate the number of hosts required.

Addressing : IPv4 - CIDR and subnetting



Divide the 192.168.1.0/24 network into four subnets that can accommodate the number of hosts required.

Addressing : IPv4 - CIDR and subnetting

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 0 0 0 0 0 0 0

192 . 168 . 1 . 0

1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 1 1 1 1 1 1 . 1 1 0 0 0 0 0 0

255 . 255 . 255 . 192

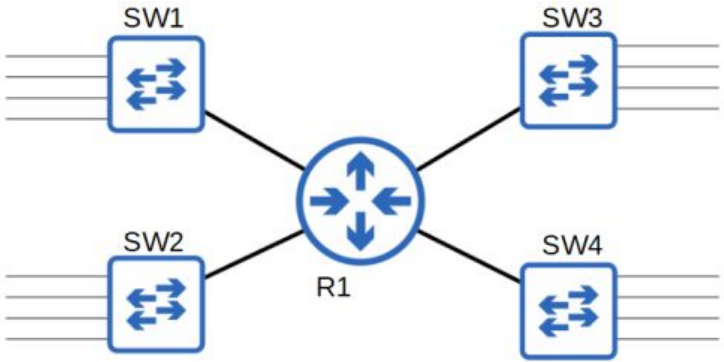
$2^6 - 2 =$ 62 usable addresses

$2 * 2 * 2 * 2 * 2 * 2 = 64$

Addressing : IPv4 - CIDR and subnetting

Subnet 1:
192.168.1.0/26

Subnet 2:
( )/26



Subnet 3:
( )/26

Subnet 4:
( )/26

192.168.1.0/24

Addressing : IPv4 - CIDR and subnetting

Subnet 1: 192.168.1.0/26

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 0 0 0 0 0 0 0

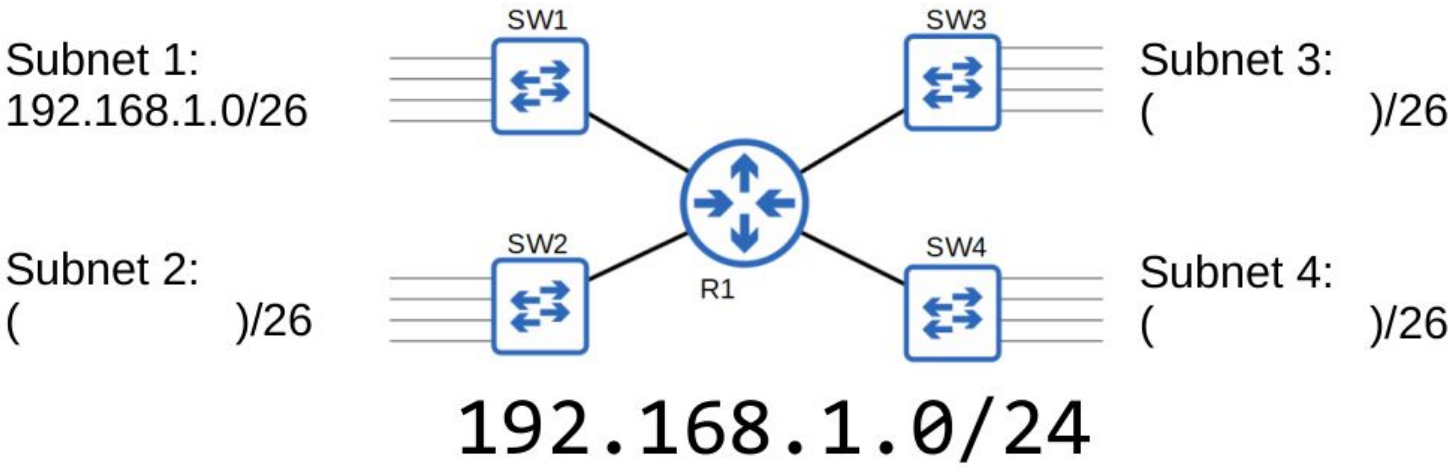
192 . 168 . 1 . 0

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 0 1 1 1 1 1 1

192 . 168 . 1 . 63

192.168.1.0 – 192.168.1.63

Addressing : IPv4 - CIDR and subnetting



To divide any network into subnetworks :

- Find the broadcast address of the first subnet.
- The next address is the network address of the next subnet.
- Repeat the process for the rest of the subnets.

Addressing : IPv4 - CIDR and subnetting

Subnet 2: 192.168.1.64/26

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 1 0 0 0 0 0 0

192 . 168 . 1 . 64

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 0 1 1 1 1 1 1 1

192 . 168 . 1 . 127

192.168.1.64 – 192.168.1.127

Addressing : IPv4 - CIDR and subnetting

Subnet 3: 192.168.1.128/26

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 0 0 0 0 0 0 0

192 . 168 . 1 . 128

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 0 1 1 1 1 1 1

192 . 168 . 1 . 191

192.168.1.128 – 192.168.1.191

Addressing : IPv4 - CIDR and subnetting

Subnet 4: 192.168.1.192/26

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 0 0 0 0 0 0

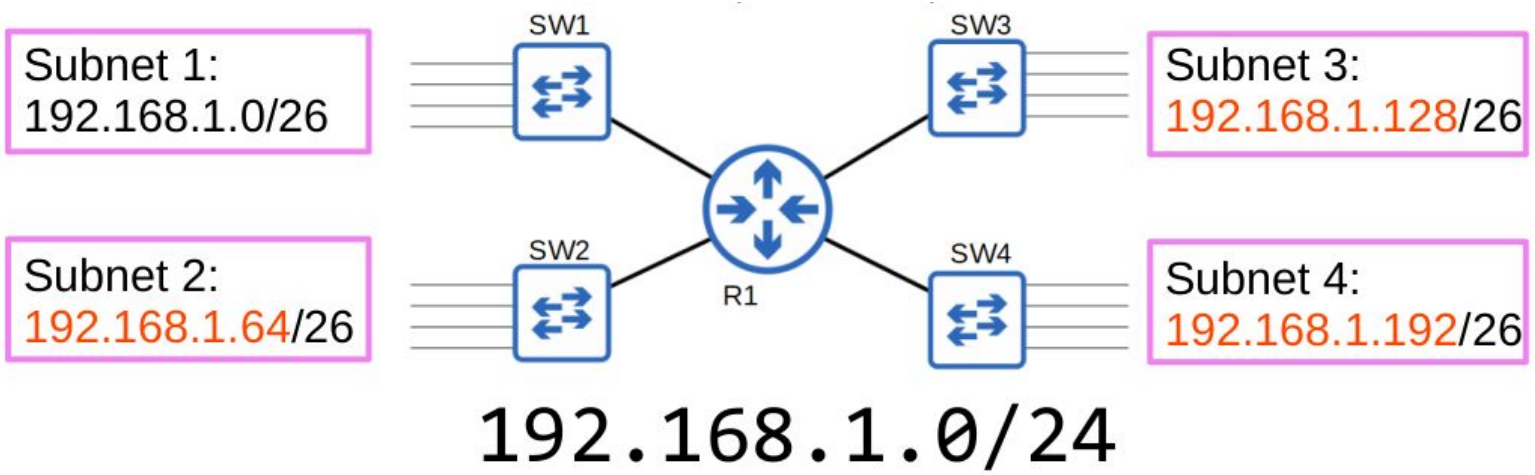
192 . 168 . 1 . 192

1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 0 0 1 . 1 1 1 1 1 1 1 1

192 . 168 . 1 . 255

192.168.1.192 – 192.168.1.255

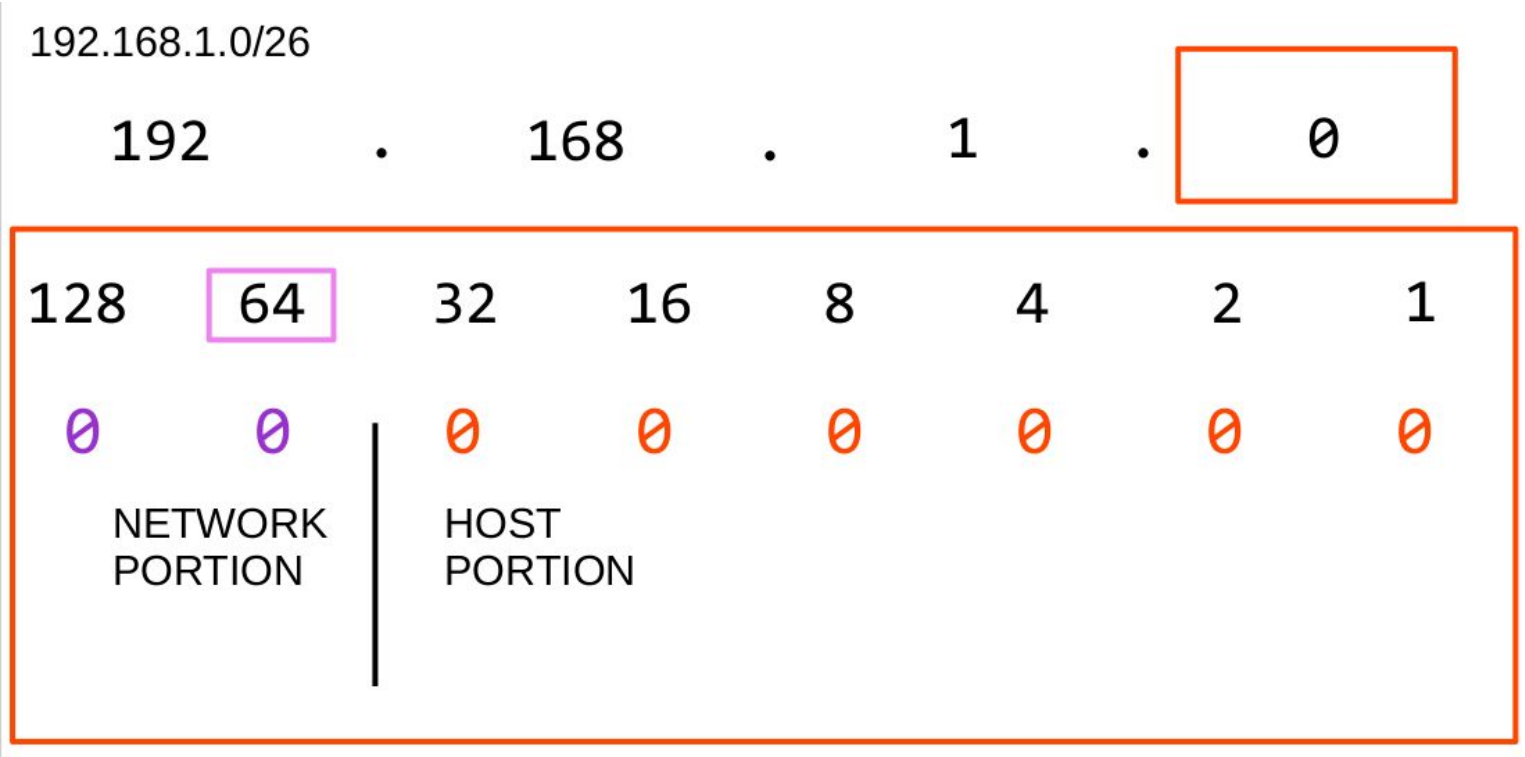
Addressing : IPv4 - CIDR and subnetting



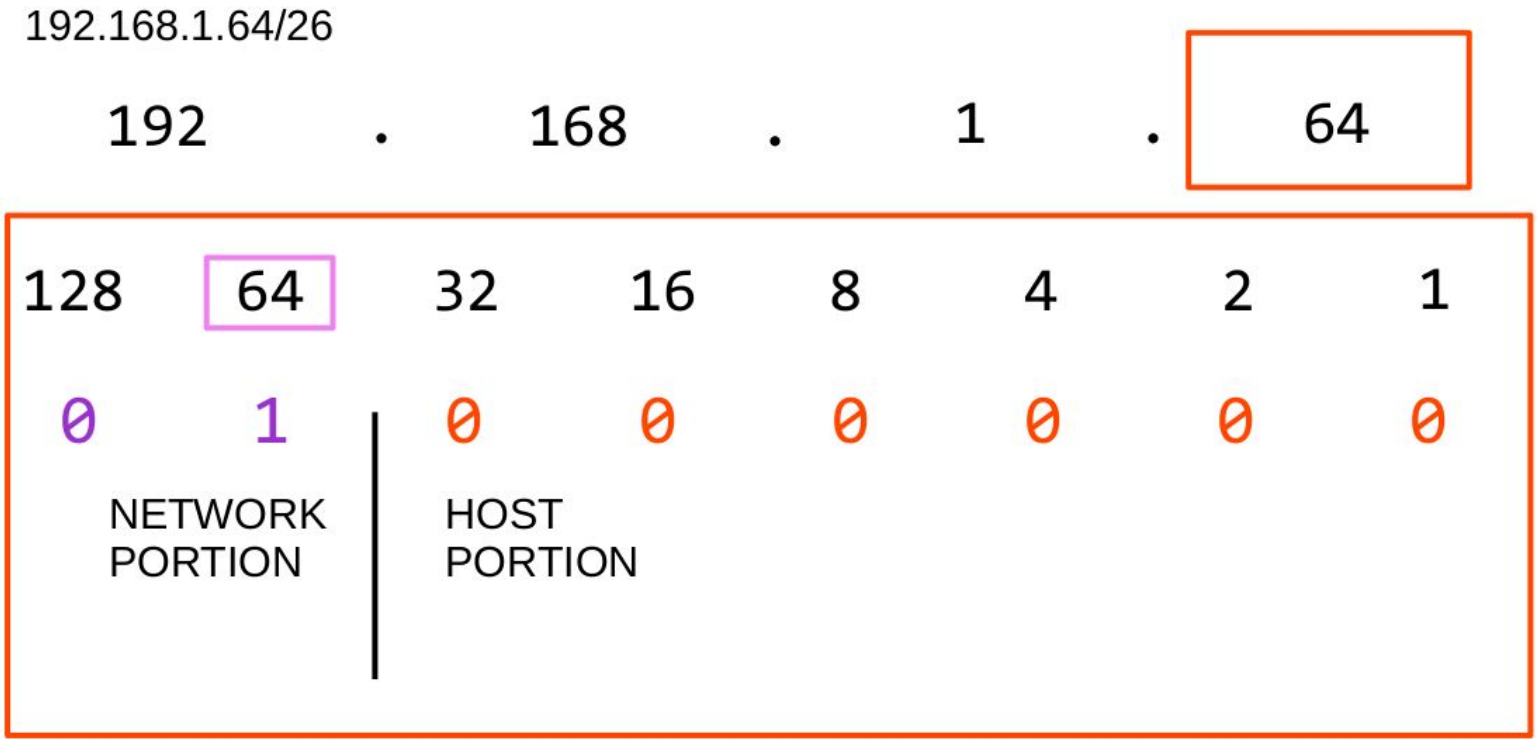
To divide any network into subnetworks :

- Find the broadcast address of the first subnet.
- The next address is the network address of the next subnet.
- Repeat the process for the rest of the subnets.

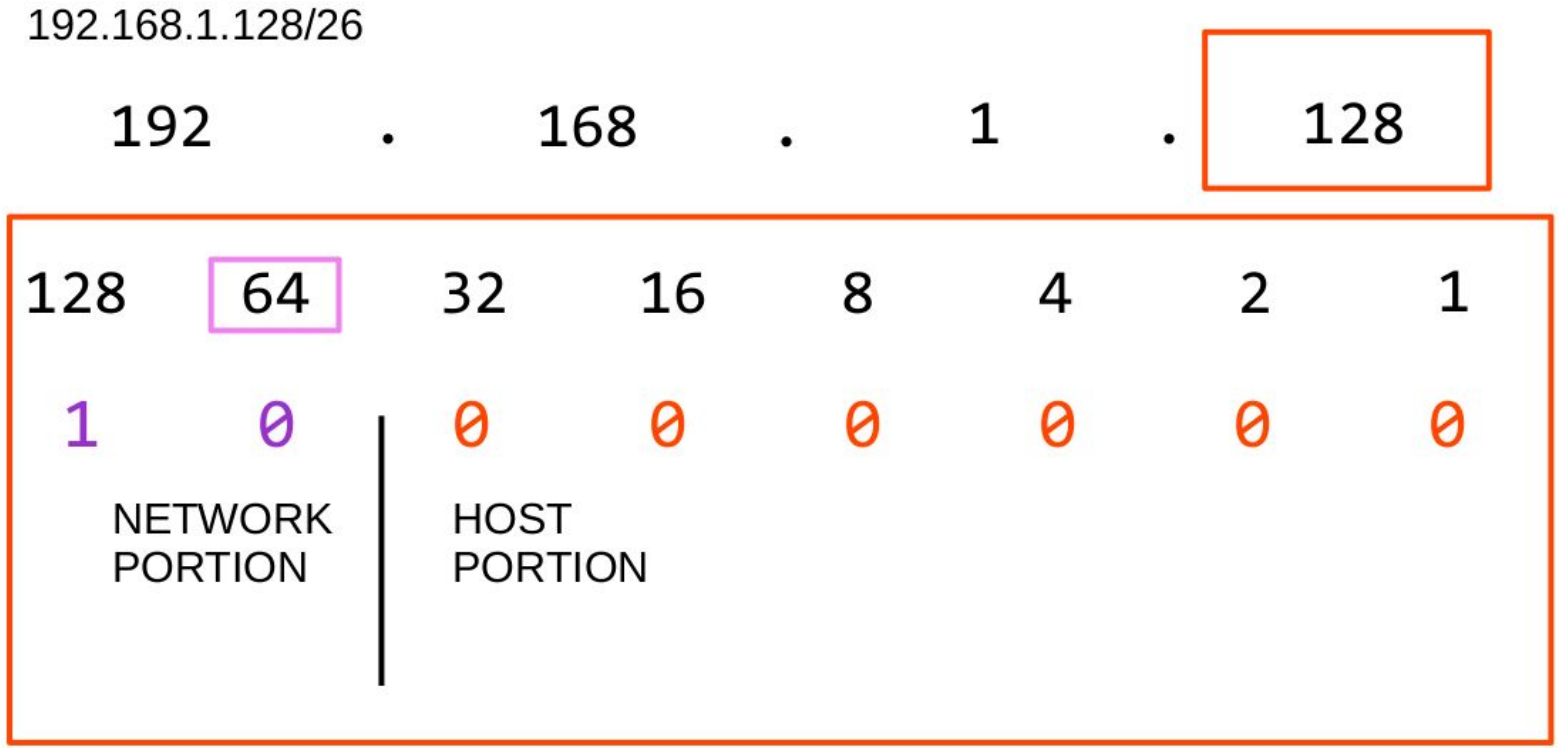
Addressing : IPv4 - CIDR and subnetting



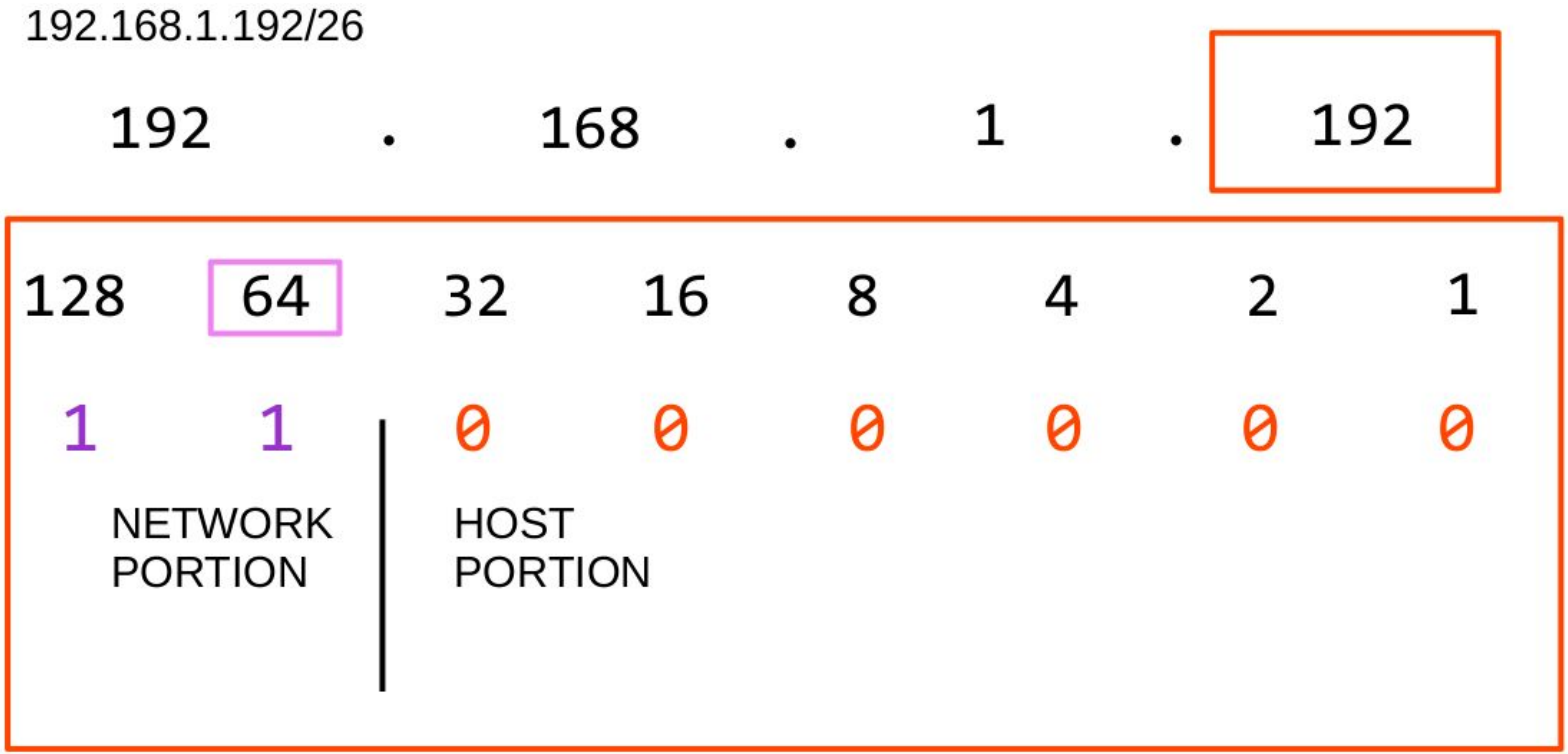
Addressing : IPv4 - CIDR and subnetting



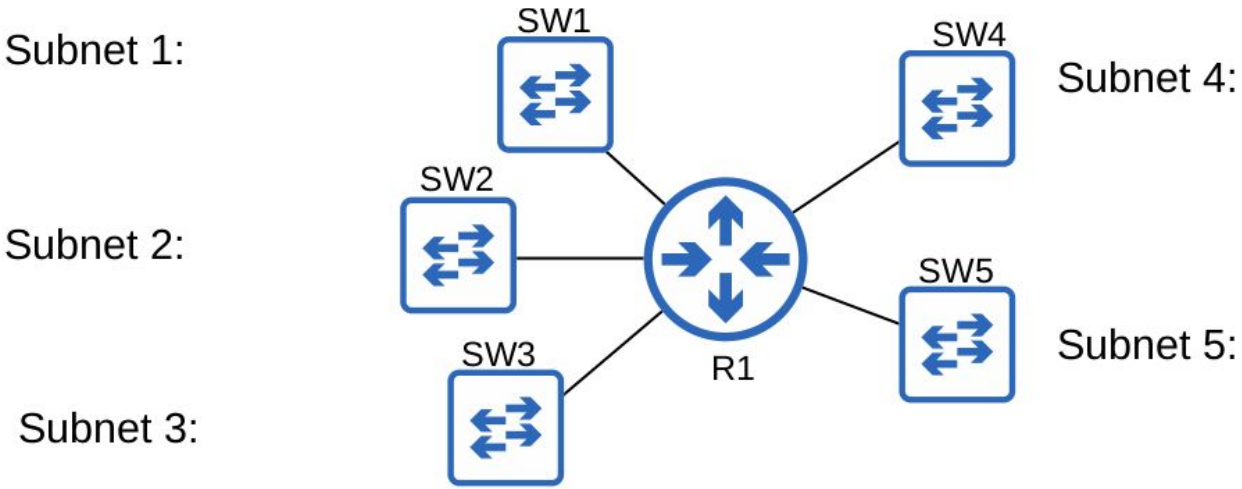
Addressing : IPv4 - CIDR and subnetting



Addressing : IPv4 - CIDR and subnetting

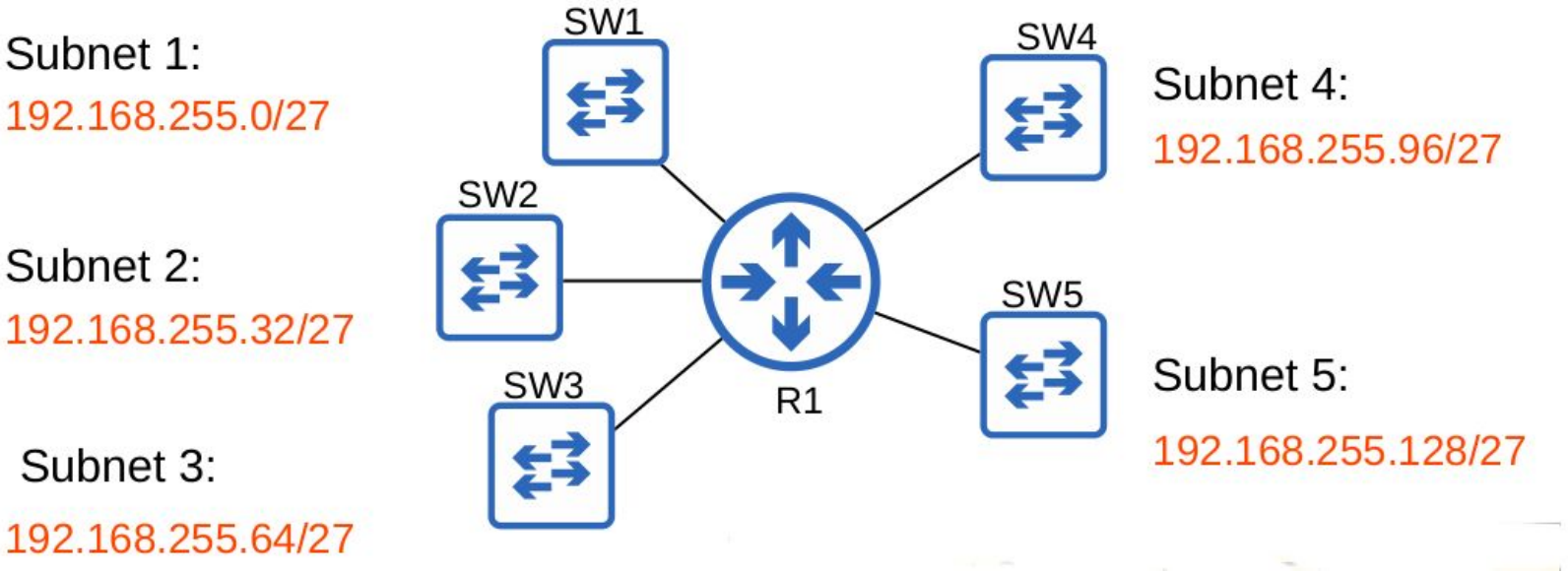


Addressing : IPv4 - CIDR and subnetting



Divide the 192.168.255.0/24 network into five subnets that can accommodate the number of hosts required.

Addressing : IPv4 - CIDR and subnetting



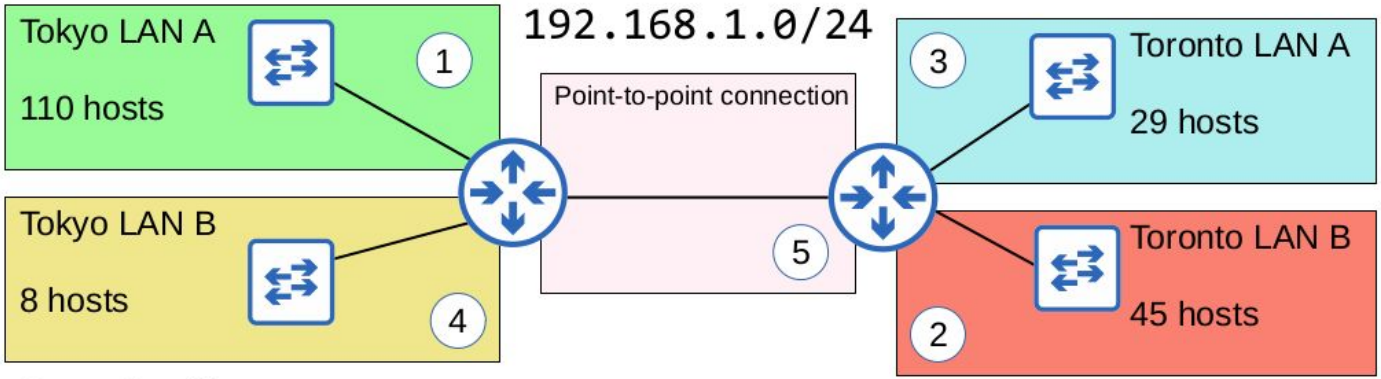
Divide the 192.168.255.0/24 network into five subnets that can accommodate the number of hosts required.

Addressing : IPv4 - CIDR and subnetting

- Until now, we have practiced subnetting using FLSM (Fixed-Length Subnet Masks).
- This means that all of the subnets use the same prefix length (ie. subnetting a class C network into 4 subnets using /26).

- **VLSM (Variable-Length Subnet Masks)** is the process of creating subnets of different sizes, to make your use of network addresses more efficient.
- To do so we need :
  a. Assign the largest subnet at the start of the address space.
  b. Assign the second-largest subnet after it
  c. Repeat the process until all subnets have been assigned

Addressing : IPv4 - CIDR and subnetting



Network address:

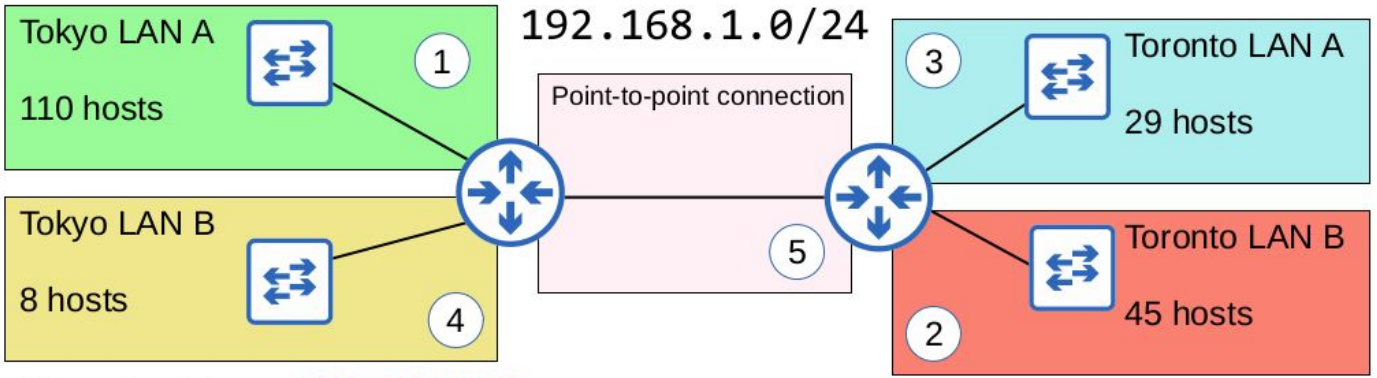
Broadcast address:

First usable address:

Last usable address:

Total number of usable host addresses:

Addressing : IPv4 - CIDR and subnetting



Network address: 192.168.1.0/25

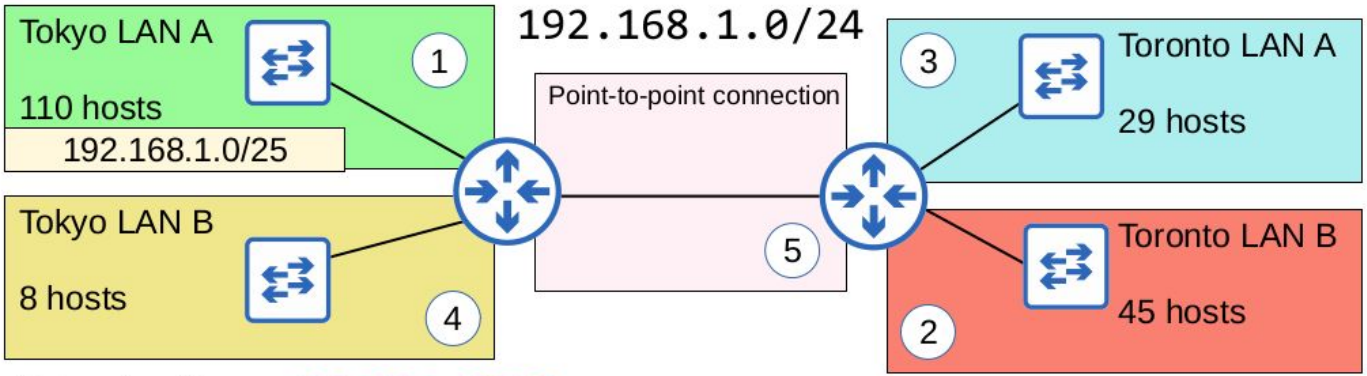
Broadcast address: 192.168.1.127/25

First usable address: 192.168.1.1/25

Last usable address: 192.168.1.126/25

Total number of usable host addresses: 126

Addressing : IPv4 - CIDR and subnetting



Network address: 192.168.1.128/26

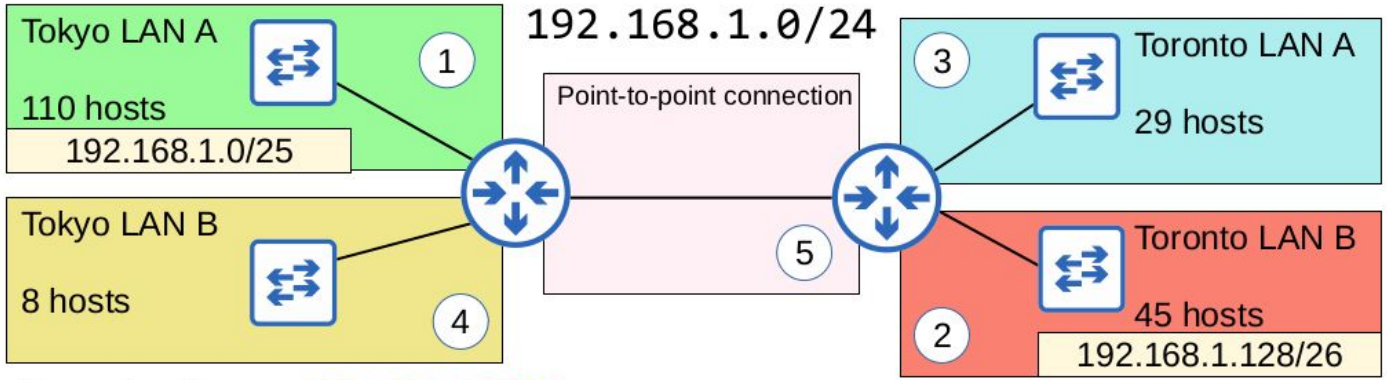
Broadcast address: 192.168.1.191/26

First usable address: 192.168.1.129/26

Last usable address: 192.168.1.190/26

Total number of usable host addresses: 62

Addressing : IPv4 - CIDR and subnetting



Network address: 192.168.1.192/27

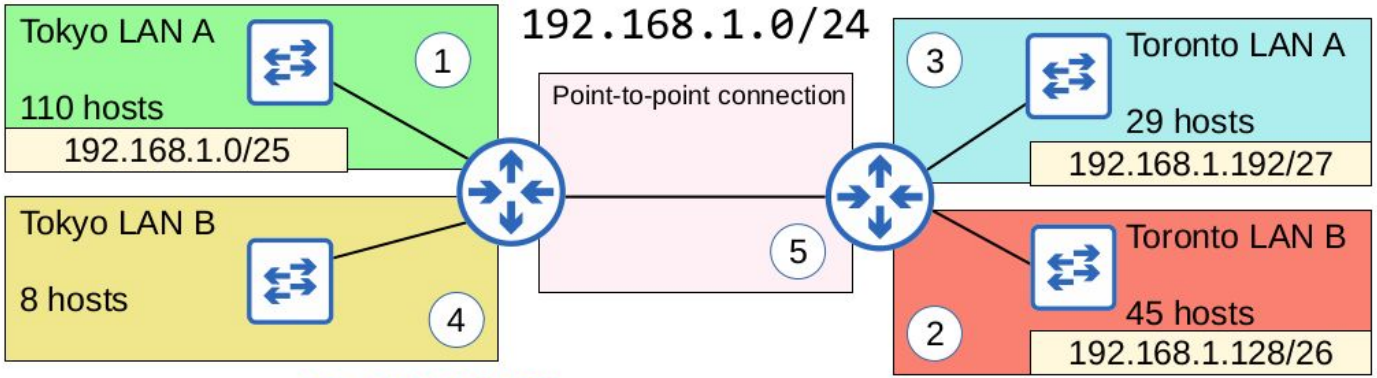
Broadcast address: 192.168.1.223/27

First usable address: 192.168.1.193/27

Last usable address: 192.168.1.222/27

Total number of usable host addresses: 30

Addressing : IPv4 - CIDR and subnetting



Network address: 192.168.1.224/28

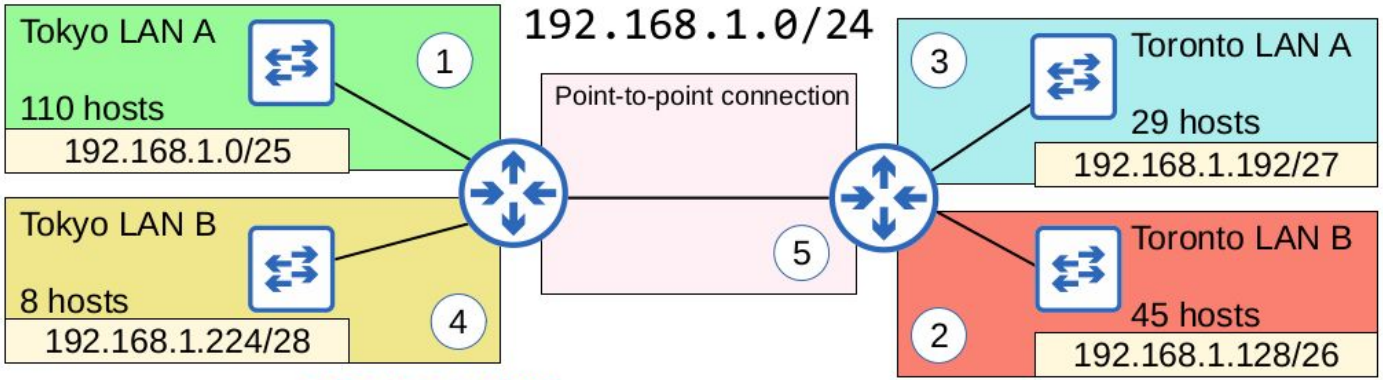
Broadcast address: 192.168.1.239/28

First usable address: 192.168.1.225/28

Last usable address: 192.168.1.238/28

Total number of usable host addresses: 14

Addressing : IPv4 - CIDR and subnetting



Network address: 192.168.1.240/30

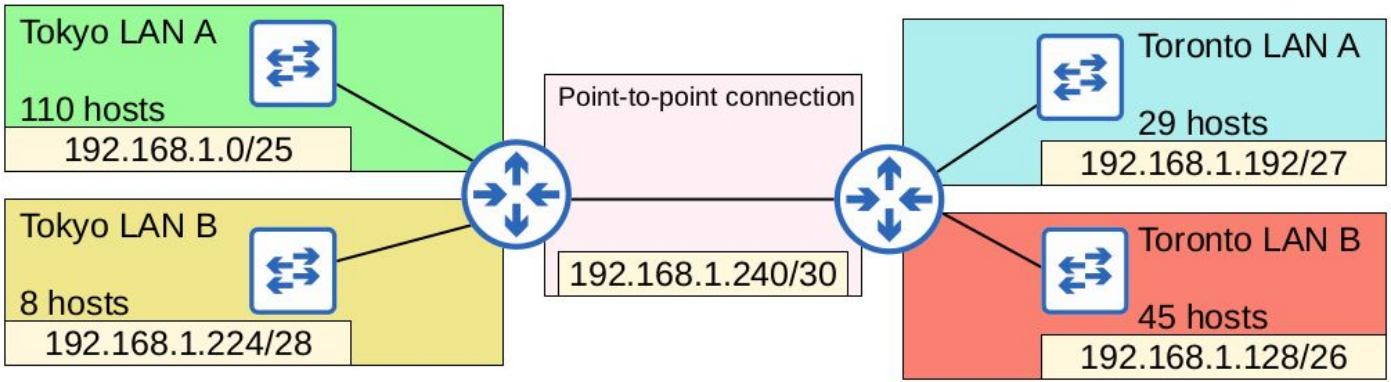
Broadcast address: 192.168.1.243/30

First usable address: 192.168.1.241/30

Last usable address: 192.168.1.242/30

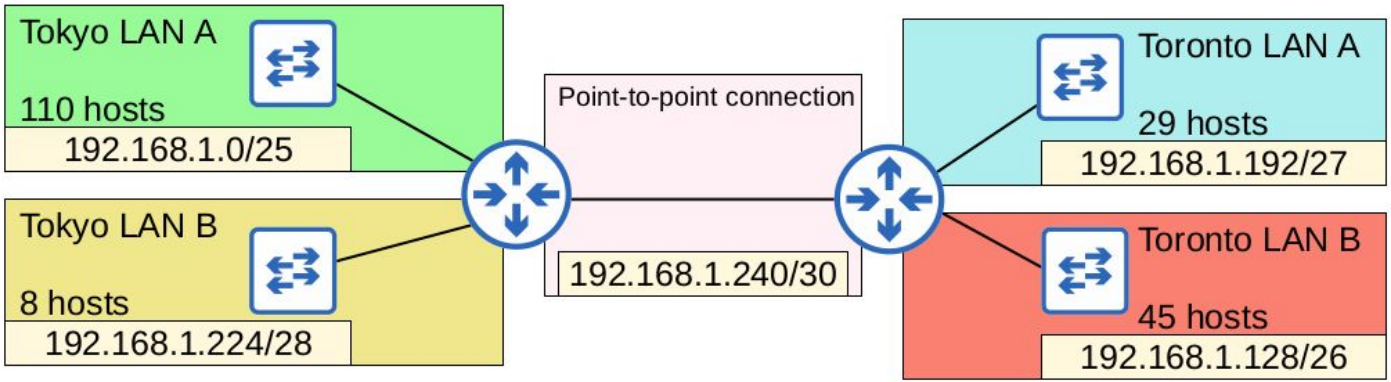
Total number of usable host addresses: 2

Addressing : IPv4 - CIDR and subnetting



192.168.1.0/24

Addressing : IPv4 - CIDR and subnetting



192.168.1.0/24

Addressing : IPv4 - CIDR and subnetting

Quiz

Addressing : IPv4 - CIDR and subnetting

What is the maximum number of valid hosts one will have from the network 192.168.207.0 255.255.255.128

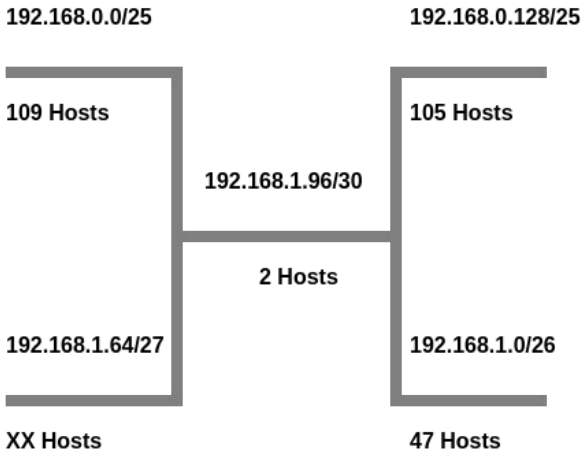
Addressing : IPv4 - CIDR and subnetting

What is the maximum number of valid hosts one will have from the network 192.168.207.0 255.255.255.128

126 hosts

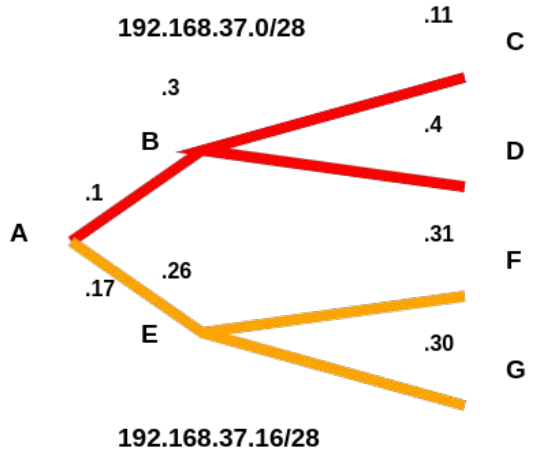
Addressing : IPv4 - CIDR and subnetting

Up to how many hosts can be placed in the subnet which currently reads 'XX' hosts?



Addressing : IPv4 - CIDR and subnetting

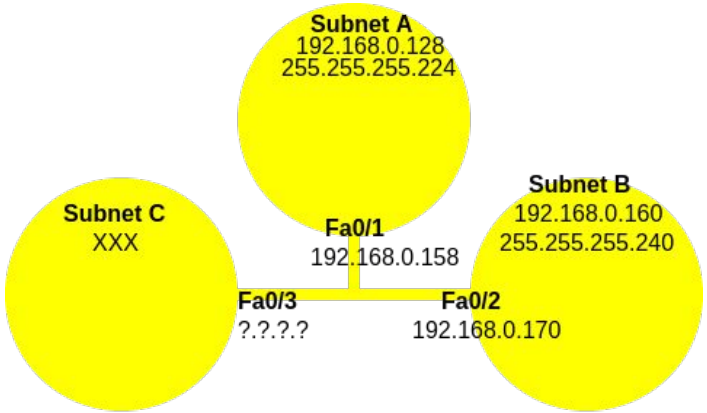
The following shows a network with two subnets. A device on the network is misconfigured. Select the letter of the device which has a an invalid IP address.



Addressing : IPv4 - CIDR and subnetting

Using the diagram below, which of the following IP addresses would be valid to assign to interface Fa0/3 ?

- 192.168.0.71
- 192.168.0.146
- 192.168.0.174



Références

1. Course of Computer networks at ECE Paris given by T. MAGADIS, A. SEWERYN, M. CHAIEB.
2. Cisco Networking Academy materials
3. James Kurose, Computer Networking: A Top-Down Approach
4. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks
5. ED Tittel, Schaum's outlines, Computer networking