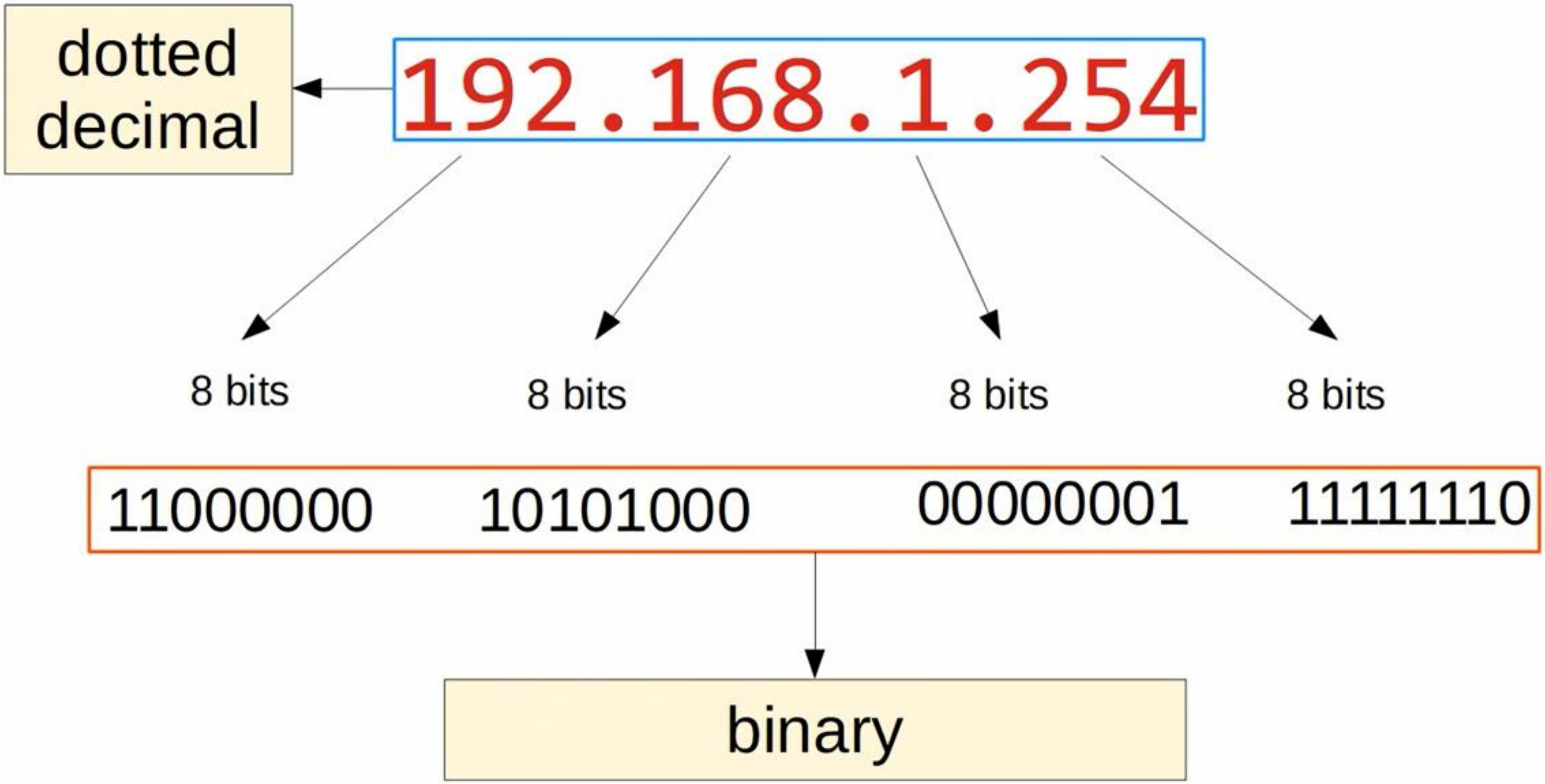
IPv4 Addressing, CIDR, Subnets


dotted
decimal
192.168.1.254
8 bits
8 bits
8 bits
8 bits
11000000
10101000
00000001
11111110
binary

192

1	1	0	0	0	0	0	0
1 * 128	**1 * 64**	0 * 32	0 * 16	0 * 8	0 * 4	0 * 2	0 * 1

128 + 64 = 192

Binary → Decimal (1)

128	64	32	16	8	4	2	1
1	0	0	0	1	1	1	1

128 + 8 + 4 + 2 + 1

= 143

Binary → Decimal (3)

1	1	1	0	1	1	0	0
128 +	64 +	32	+	8 +	4		

$$= 236$$

221

128	64	32	16	8	4	2	1
1	1	0	1	1	1	0	0
221	93		28	12	4		
-128	-64		-16	-8	-4		
= 93	= 28		= 12	= 4	= 0		

11011100

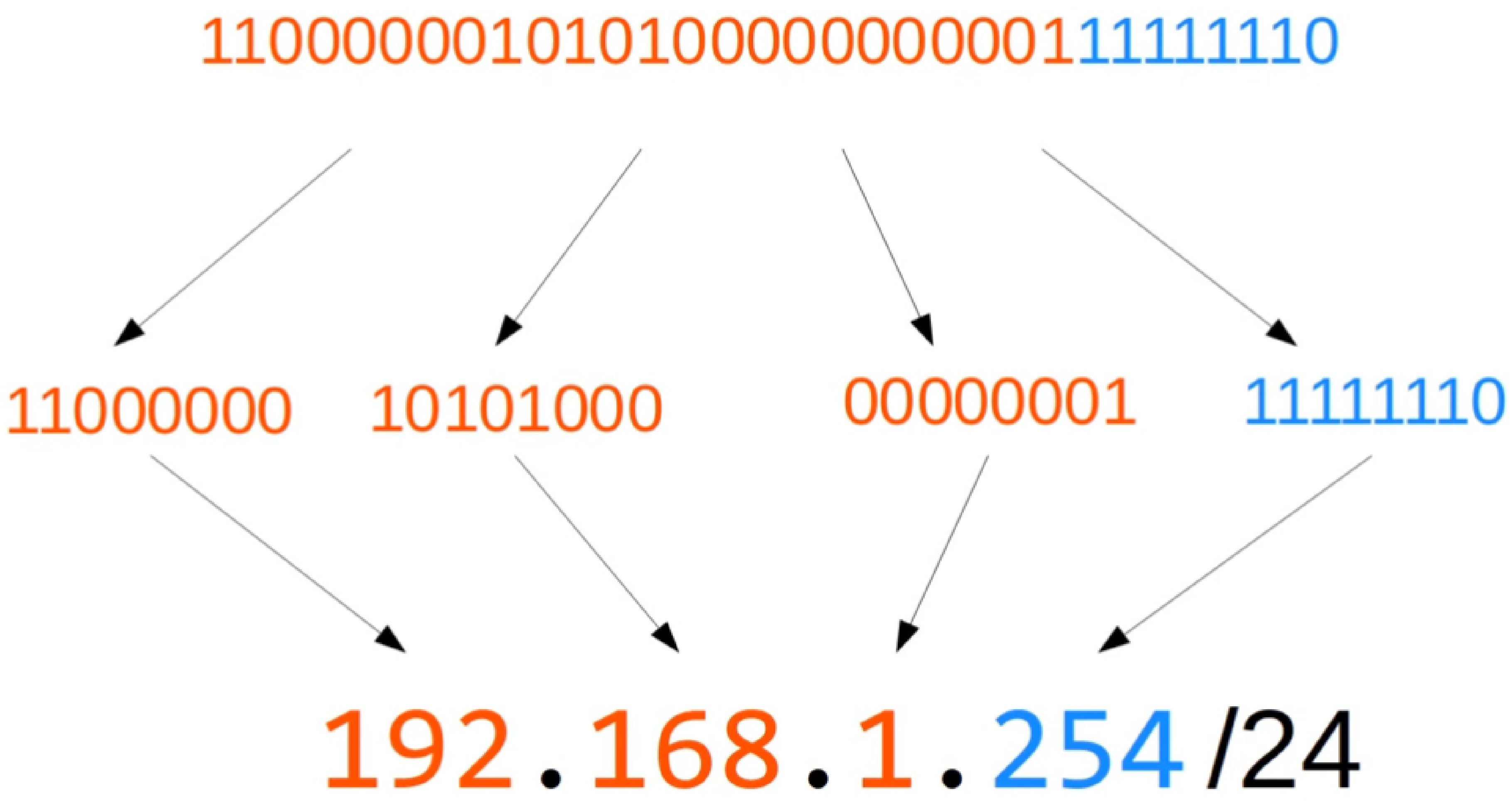
128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	0

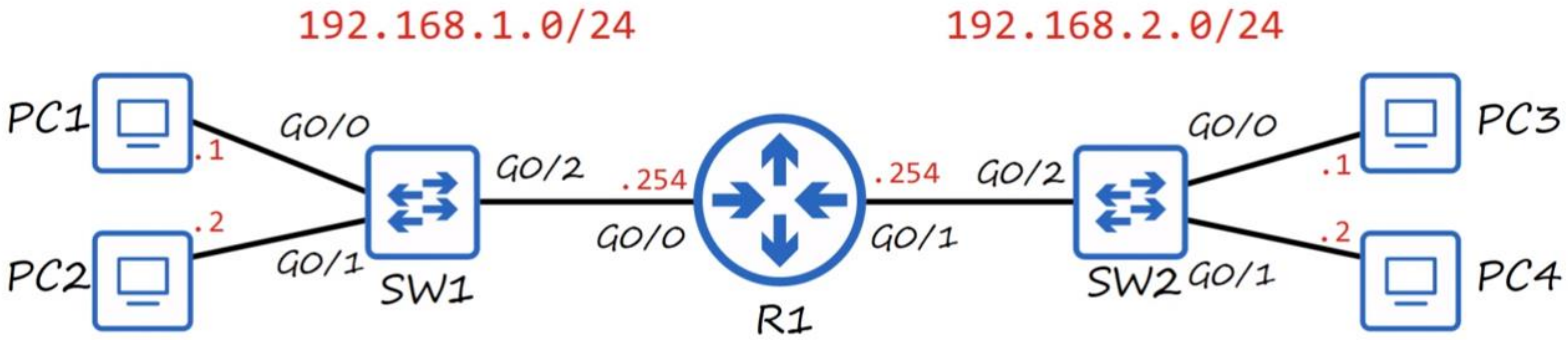
= 0

128	64	32	16	8	4	2	1
1	1	1	1	1	1	1	1

= 255

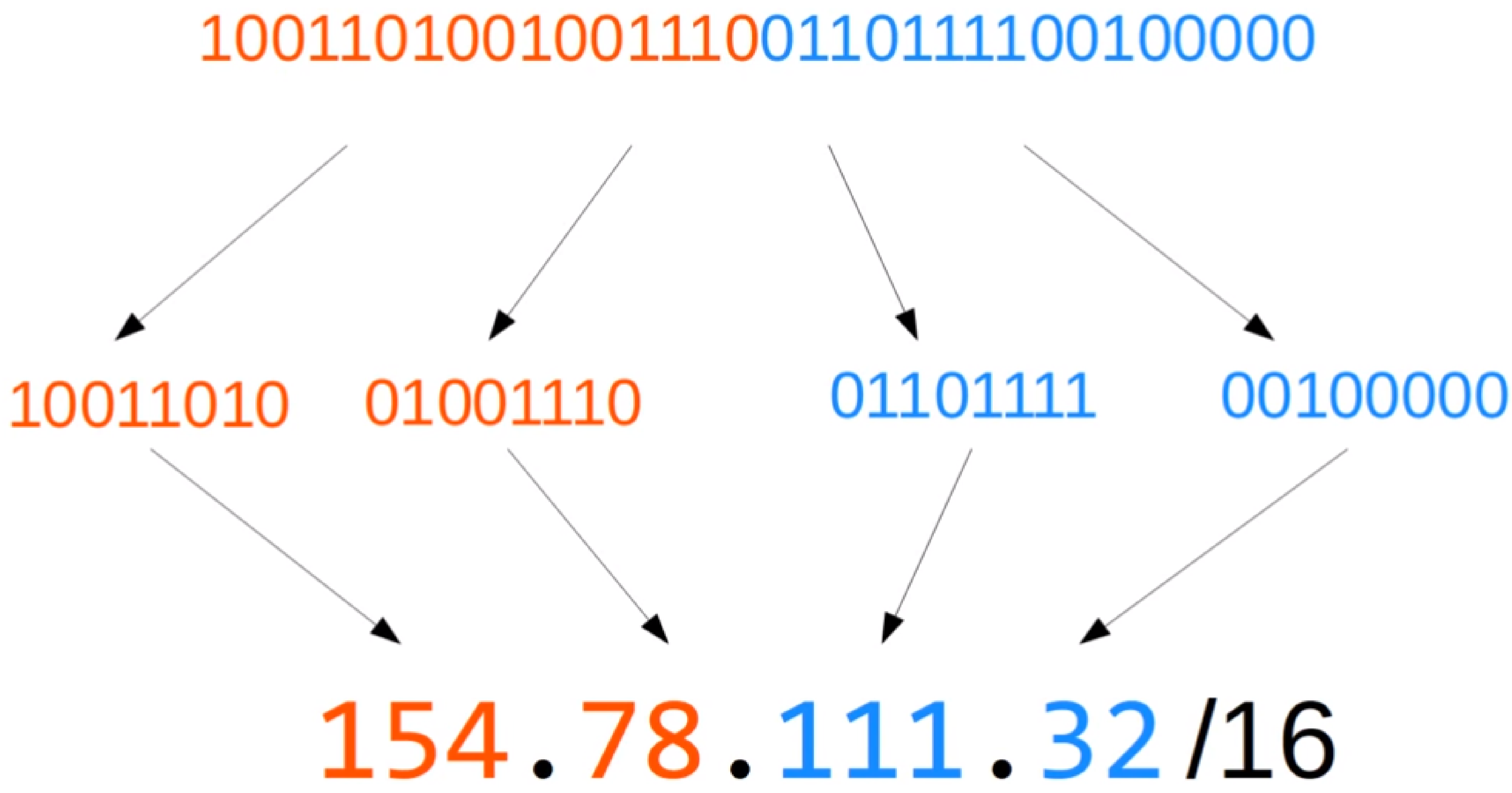
IPv4 Addresses

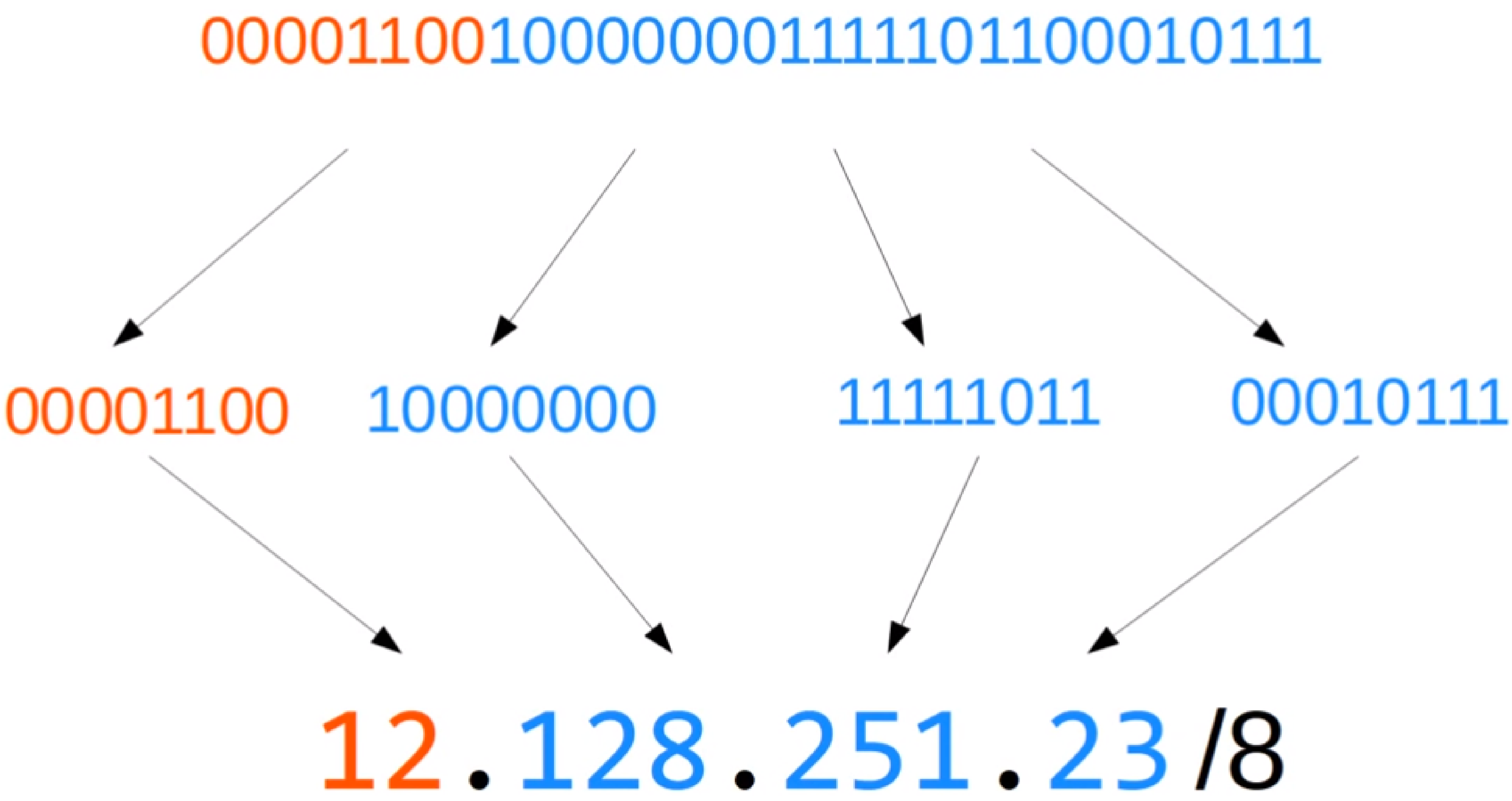




192.168.1.1/24
192.168.1.2/24
192.168.1.254/24

192.168.2.1/24
192.168.2.2/24
192.168.2.254/24


10011010010011100110111100100000
10011010
01001110
01101111
00100000
154.78.111.32/16


00001100100000001111101100010111
00001100
10000000
11111011
00010111
12.128.251.23/8

IPv4 Address Classes

Class	First octet	First octet numeric range
A	0xxxxxxx	0-127
B	10xxxxxx	128-191
C	110xxxxx	192-223
D	1110xxxx	224-239
E	1111xxxx	240-255

	Class	First octet	First octet numeric range
	A	0xxxxxxx	0-~~127~~ 126
	B	10xxxxxx	128-191
	C	110xxxxx	192-223
Multicast addresses →	D	1110xxxx	224-239
Reserved (experimental) →	E	1111xxxx	240-255

- Address range 127.0.0.0 – 127.255.255.255
- Used to test the 'network stack' (think OSI, TCP/IP model) on the local device

```
C:\Users\user>ping 127.0.0.1

Pinging 127.0.0.1 with 32 bytes of data:
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128
Reply from 127.0.0.1: bytes=32 time<1ms TTL=128

Ping statistics for 127.0.0.1:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

```
C:\Users\user>ping 127.23.68.241

Pinging 127.23.68.241 with 32 bytes of data:
Reply from 127.23.68.241: bytes=32 time<1ms TTL=128
Reply from 127.23.68.241: bytes=32 time<1ms TTL=128
Reply from 127.23.68.241: bytes=32 time<1ms TTL=128
Reply from 127.23.68.241: bytes=32 time<1ms TTL=128

Ping statistics for 127.23.68.241:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 0ms, Maximum = 0ms, Average = 0ms
```

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

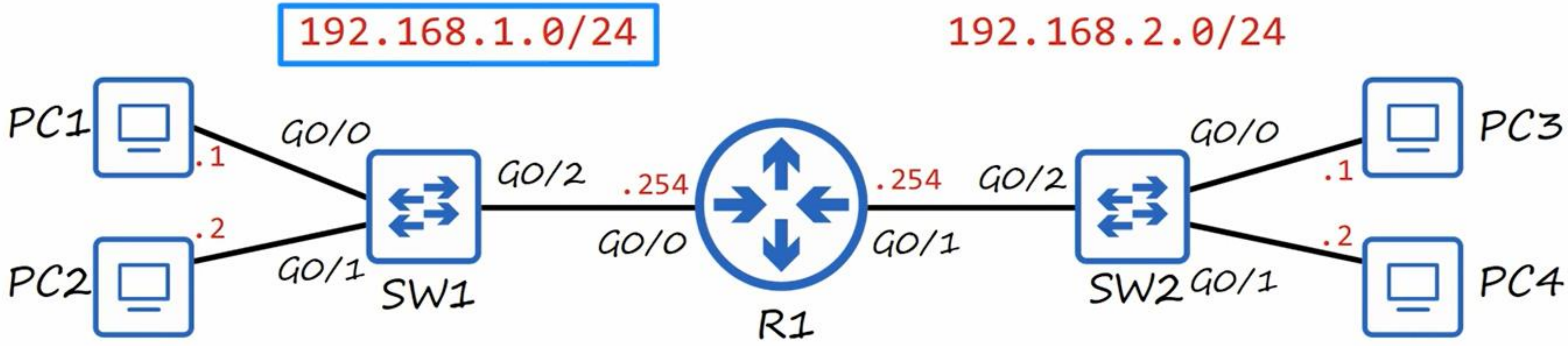
Class A: 12.128.251.23/8

Class B: 154.78.111.32 /16

Class C: 192.168.1.254 /24

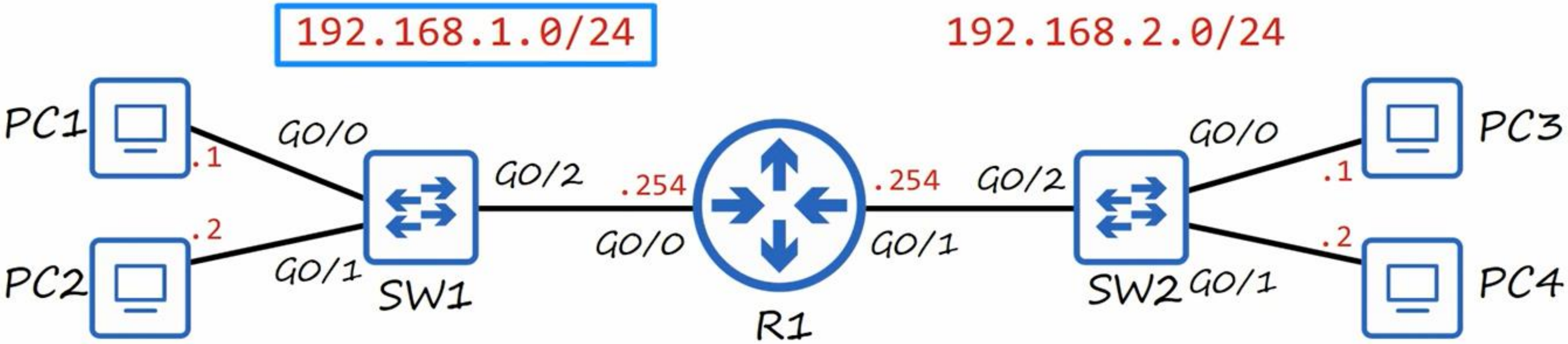
Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)

Class A:	/8	255.0.0.0 (11111111 00000000 00000000 00000000)
Class B:	/16	255.255.0.0 (11111111 11111111 00000000 00000000)
Class C:	/24	255.255.255.0 (11111111 11111111 11111111 00000000)



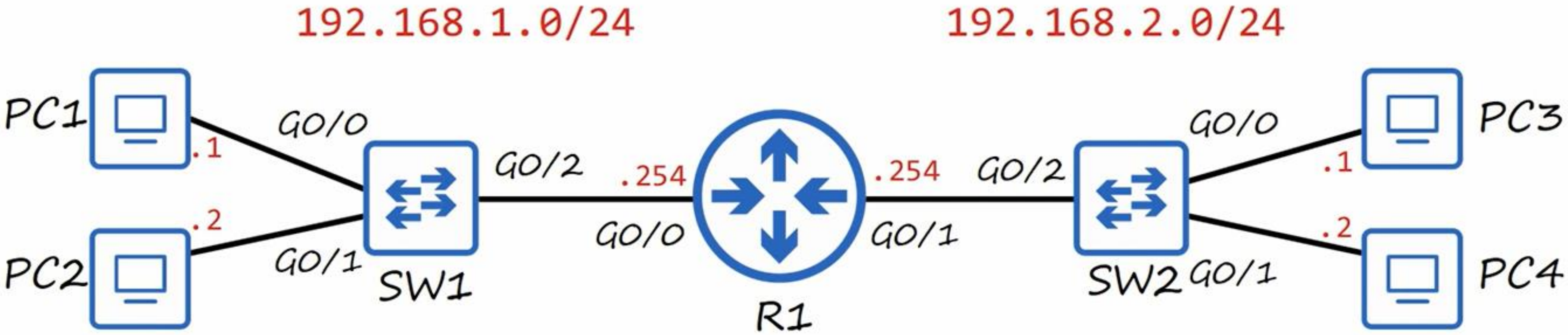
Host portion of the address is all 1's = **Broadcast Address**

The **broadcast address** CANNOT be assigned to a host.



Host portion of the address is all 0's = **Network Address**

The **network address** CANNOT be assigned to a host.



Dst. IP: 192.168.1.255

Dst. MAC: ???????????

192.168.1.0/24 → 192.168.1.255/24

Host portion = 8 bits = $2^8 = 256$

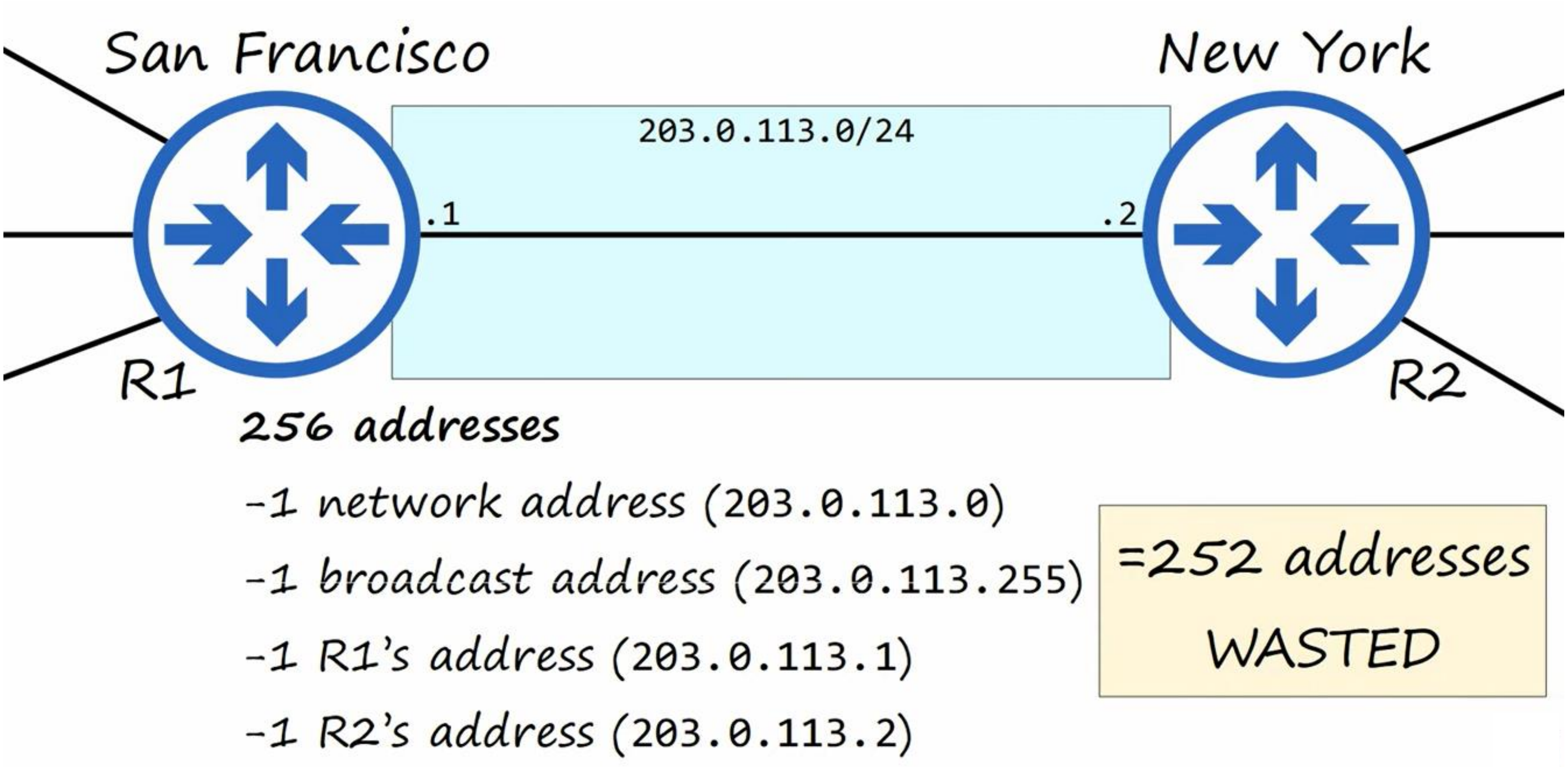
Host portion all 0s = **network address** (network ID)

Host portion all 1s = **broadcast address**

Maximum hosts per network = $2^8 - 2 = 254$

- 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.

IPV4 Address classes



IPV4 Address classes

- Company X needs IP addressing for 5000 end hosts.
- A class C network does not provide enough addresses, so a class B network must be assigned.
- This will result in about 60000 addresses being wasted.

IPV4 Address classes

- When the Internet was first created, the creators did not predict that the Internet would become as large as it is today.
- This resulted in wasted address space

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

CIDR (Classless Inter-Domain Routing)

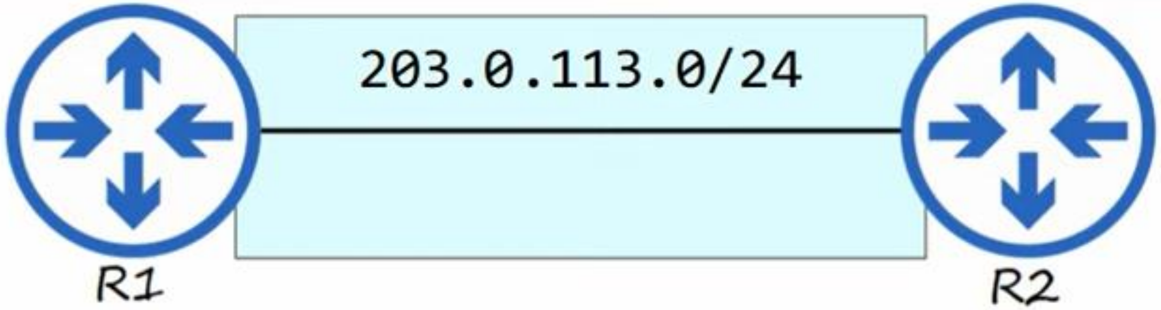
- With CIDR, the requirements of…

  Class A = /8

  Class B = /16

  Class C = /24

  …were removed.
- This allowed larger networks to be split into smaller networks, allowing greater efficiency.
- These smaller networks are called 'subnetworks' or 'subnets'.



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

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

CIDR Practice

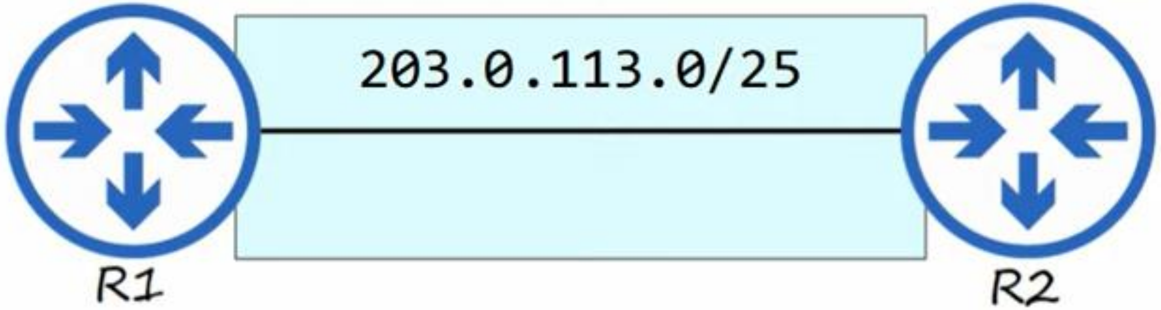
How many usable addresses are there in each network?

- 203.0.113.0/25
- 203.0.113.0/26
- 203.0.113.0/27
- 203.0.113.0/28
- 203.0.113.0/29
- 203.0.113.0/30
- 203.0.113.0/31
- 203.0.113.0/32

$2^n - 2$ = usable addresses

n = number of host bits

CIDR (/25)



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

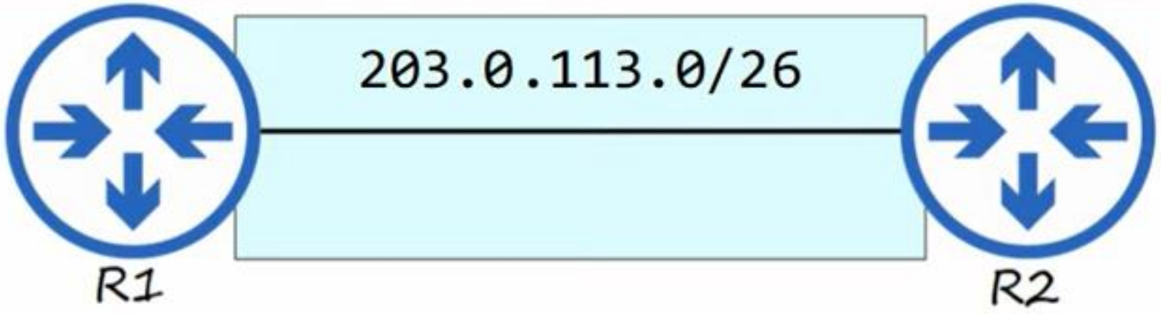
203 . 0 . 113 . 0

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.

CIDR (/26)



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

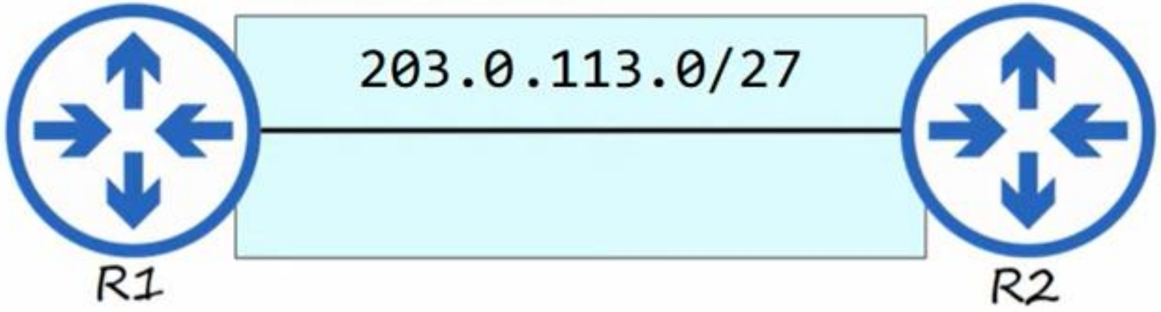
203 . 0 . 113 . 0

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.

CIDR (/27)



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

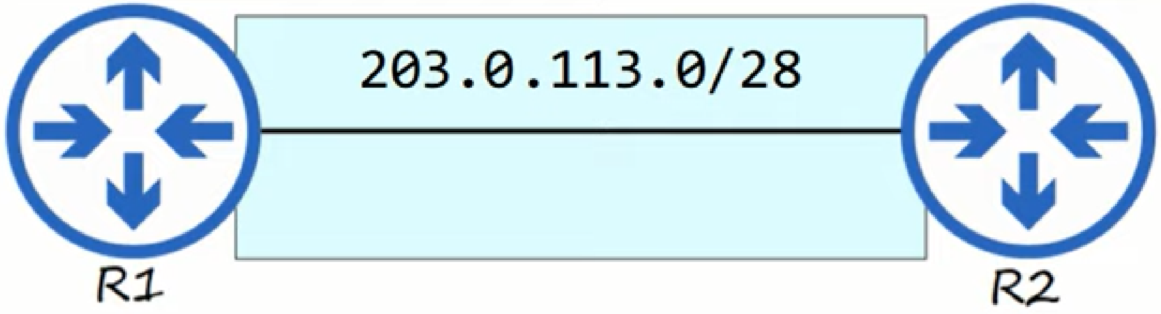
203 . 0 . 113 . 0

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 0 0

255 . 255 . 255 . 224

$2^5 - 2 = 30$ usable addresses.

CIDR (/28)



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

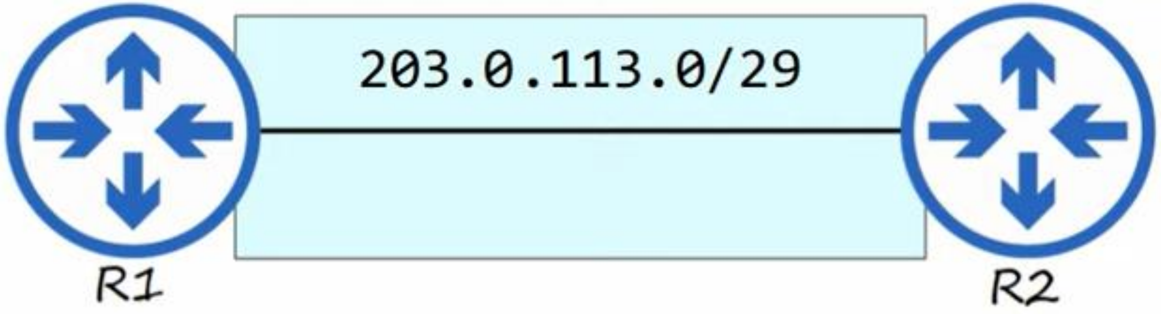
203 . 0 . 113 . 0

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 0

255 . 255 . 255 . 240

$2^4 - 2 = 14$ usable addresses.

CIDR (/29)



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

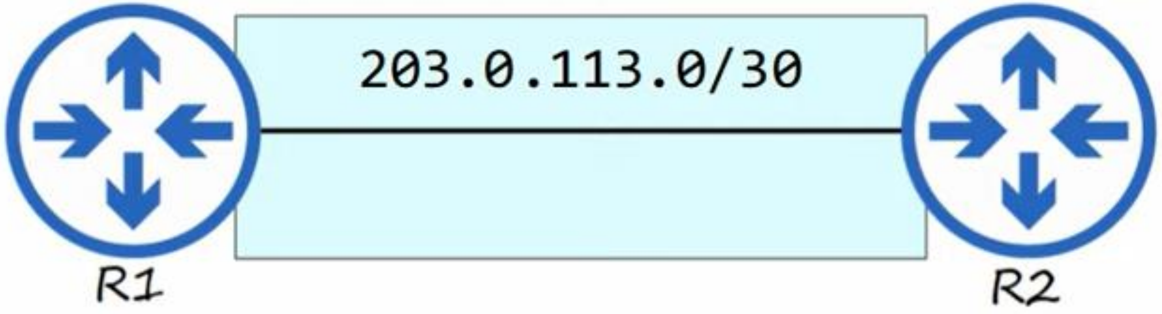
203 . 0 . 113 . 0

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.

CIDR (/30)



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

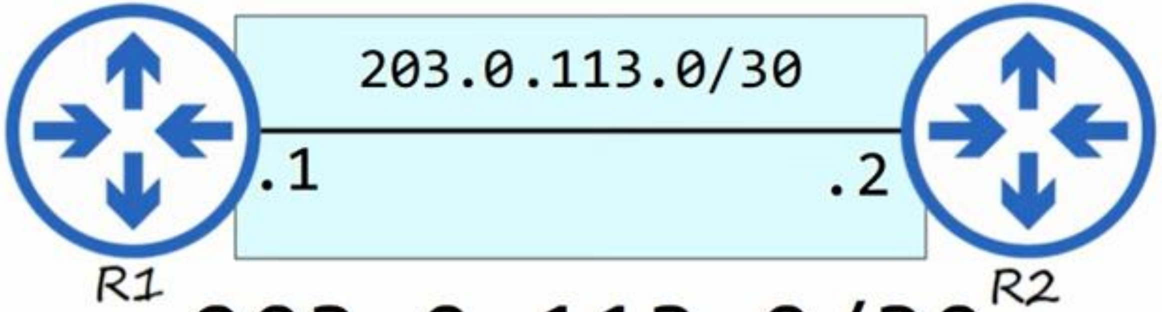
203 . 0 . 113 . 0

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.

CIDR (/30)



203.0.113.0/30

= 203.0.113.0 – 203.0.113.3

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

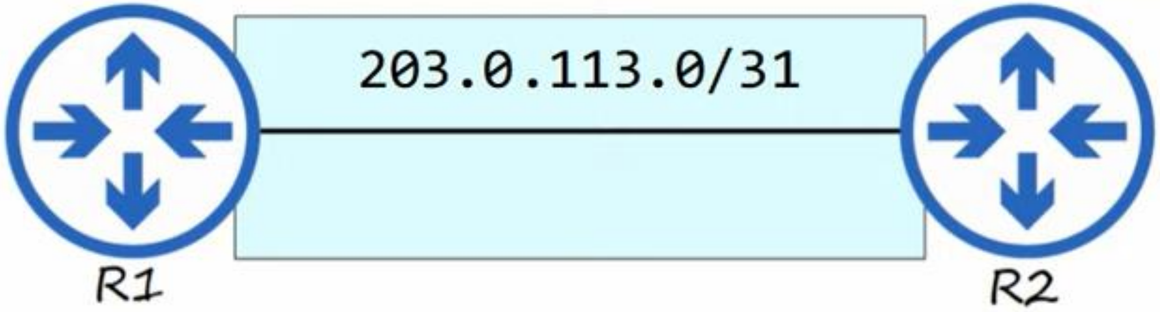
1 1 0 0 1 0 1 1 . 0 0 0 0 0 0 0 0 . 0 1 1 1 0 0 0 1 . 0 0 0 0 0 0 0 1

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 1 0

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 1 1

The remaining addresses in the 203.0.113.0/24 address block (203.0.113.4 – 203.0.113.255) are now available to be used in other subnets!

CIDR (/31)



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

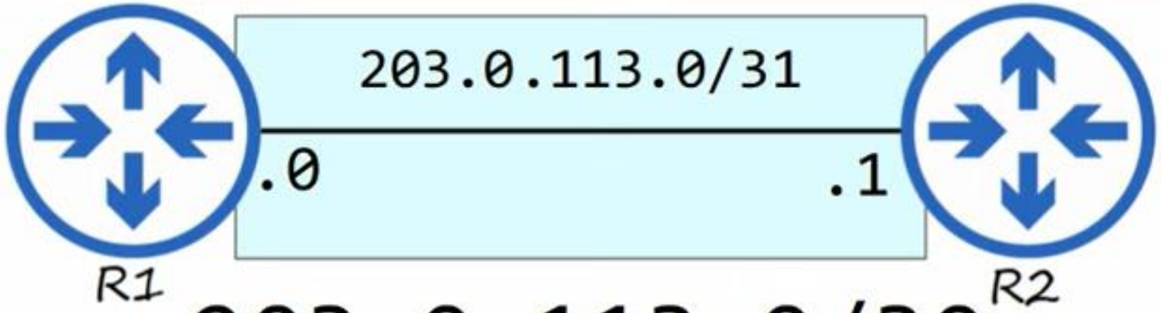
203 . 0 . 113 . 0

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 1 0

255 . 255 . 255 . 254

$2^1 - 2 = 0$ usable addresses.

CIDR (/31)



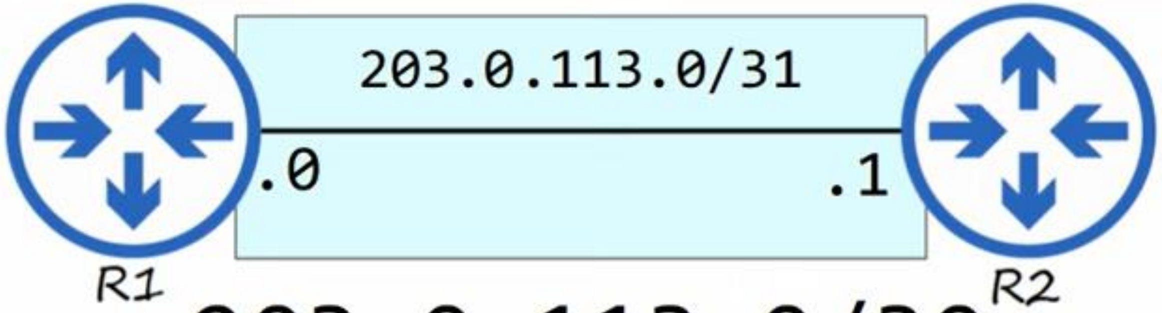
203.0.113.0/30

= 203.0.113.0 – 203.0.113.1

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
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 1

```
Router(config-if)#ip address 203.0.113.0 255.255.255.254
% Warning: use /31 mask on non point-to-point interface cautiously
Router(config-if)#
```

CIDR (/31)



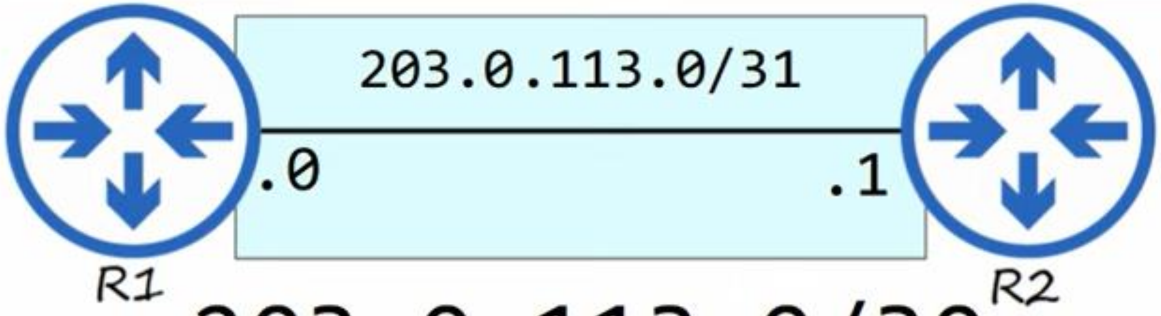
203.0.113.0/30

= 203.0.113.0 - 203.0.113.1

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
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 1

The remaining addresses in the 203.0.113.0/24 address block (203.0.113.2 - 203.0.113.255) are now available to be used in other networks!

CIDR (/31)



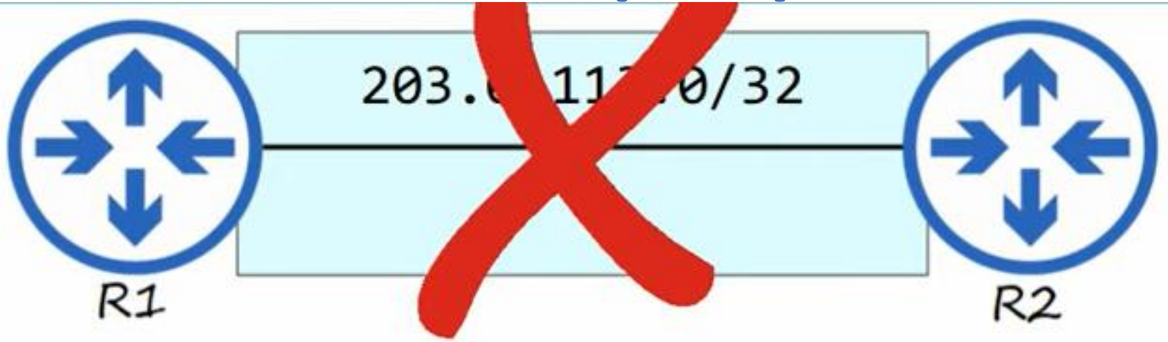
203.0.113.0/30

= 203.0.113.0 – 203.0.113.1

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
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 1

```
Router(config-if)#ip address 203.0.113.0 255.255.255.254
% Warning: use /31 mask on non point-to-point interface cautiously
Router(config-if)#
```

CIDR (/32)



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

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 1 1

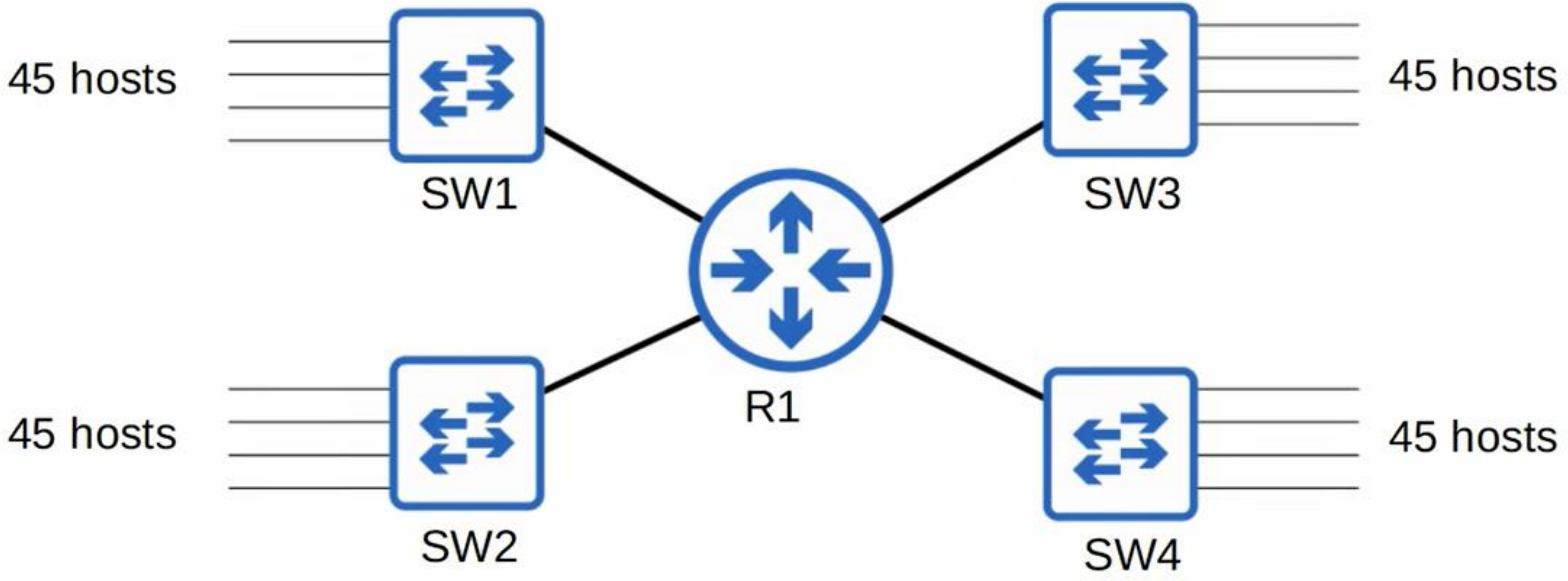
255 . 255 . 255 . 255

$2^0 - 2 = -1$ usable addresses?

CIDR Notation

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

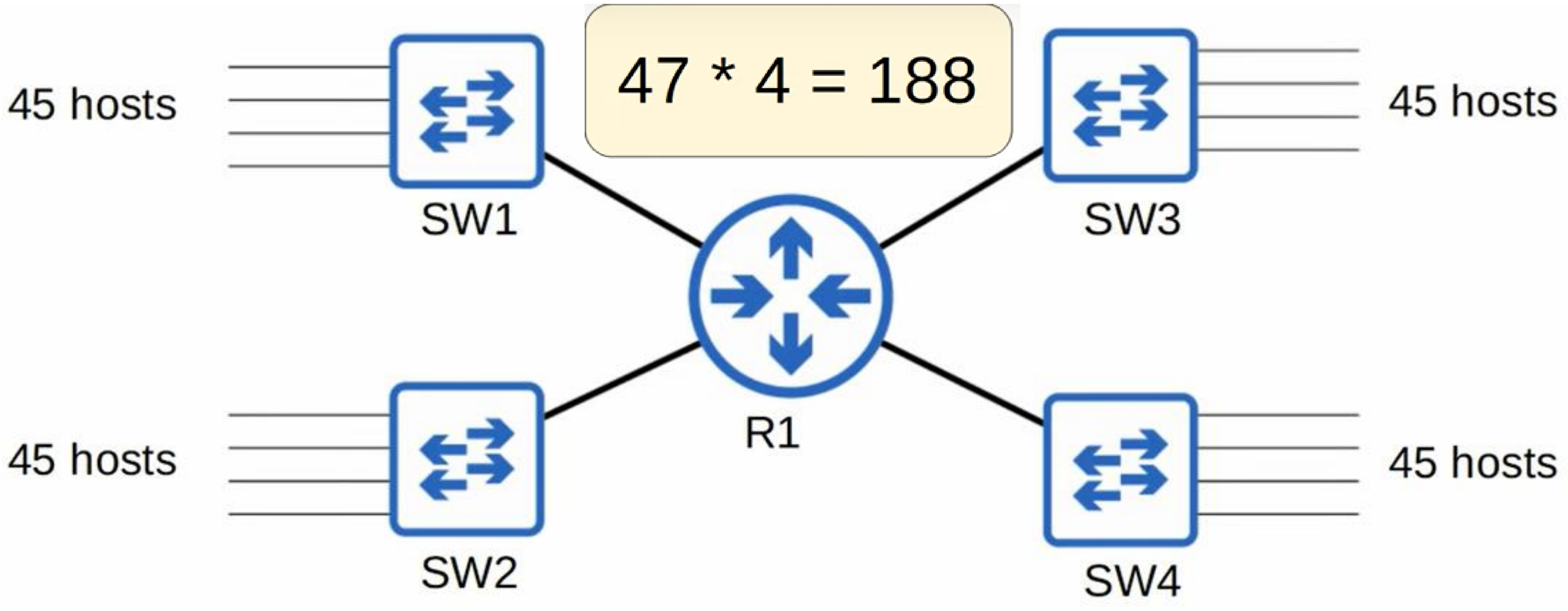
Subnetting



192.168.1.0/24

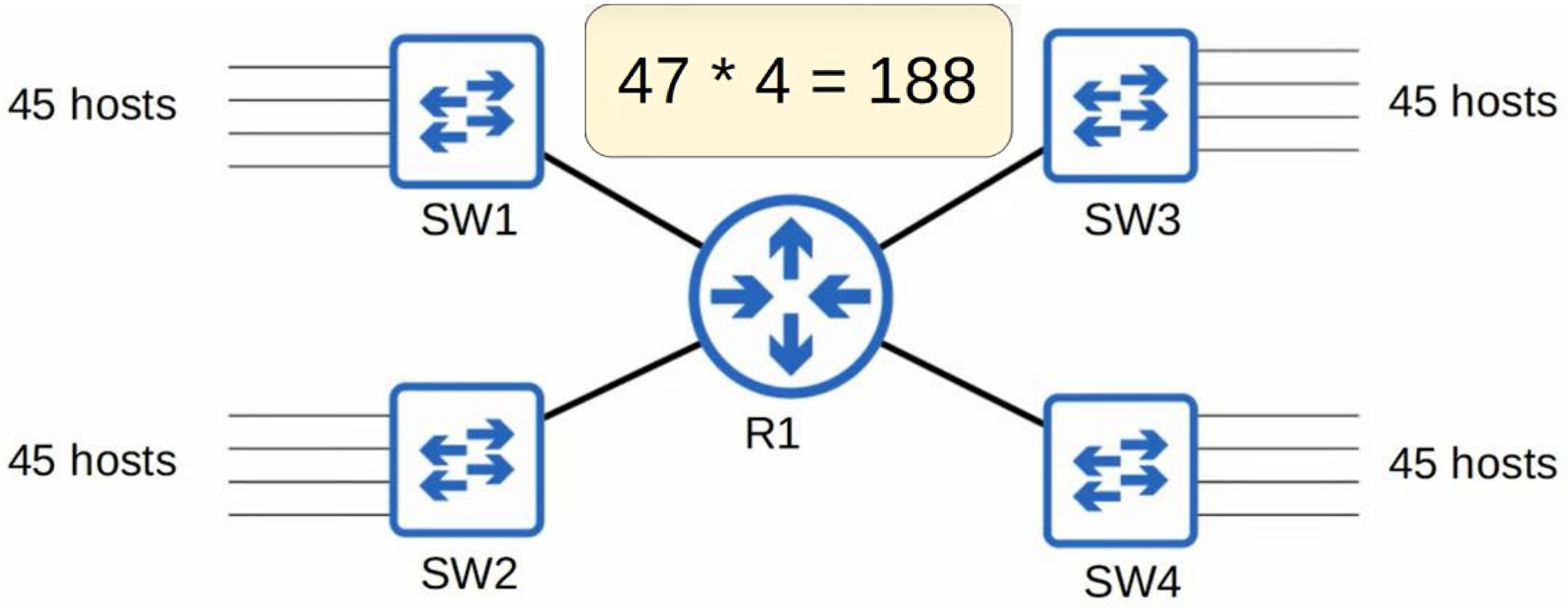
Divide the **192.168.1.0/24** network into four subnets that can accommodate the number of hosts required.

Subnetting



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

Subnetting



192.168.1.0/24

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

Subnetting

/30

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 1 1 1 1 0 0

255 . 255 . 255 . 252

$2^2 - 2 = 2$ usable addresses

↓

$2 * 2 = 4$

Subnetting

/29

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 1 1 1 0 0 0

255 . 255 . 255 . 248

$2^3 - 2 = 6$ usable addresses

$2 * 2 * 2 = 8$

Subnetting

/28

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 1 1 0 0 0 0

255 . 255 . 255 . 240

$2^4 - 2 = 14$ usable addresses

$2 * 2 * 2 * 2 = 16$

Subnetting

/27

```
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 1 0 0 0 0 0
      255       .       255       .       255       .       224
```

$2^5 - 2 = 30$ usable addresses

↓

$2 * 2 * 2 * 2 * 2 = 32$

Subnetting

/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 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

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

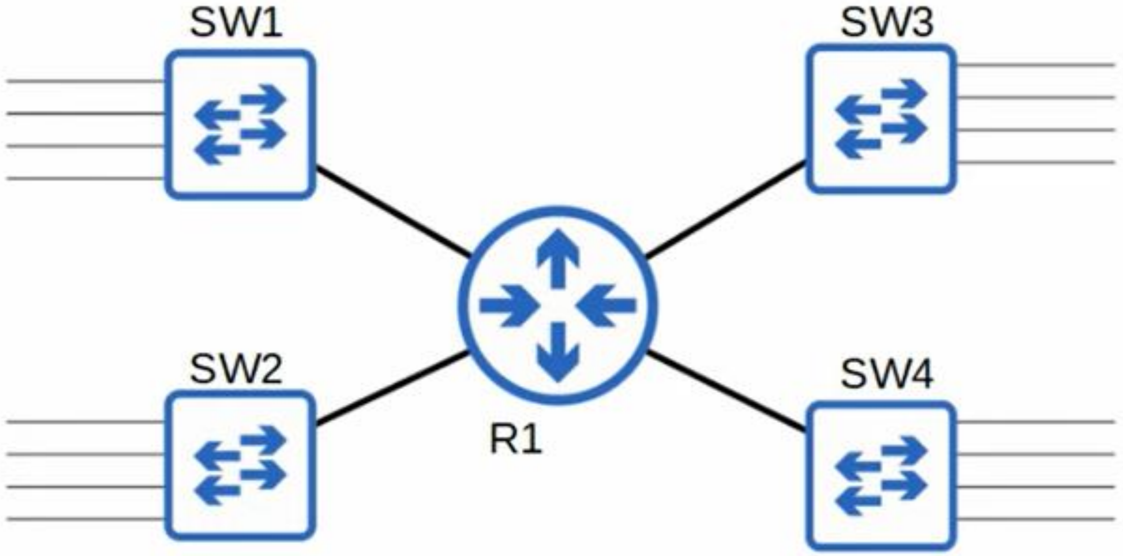
Quiz

The first subnet (Subnet 1) is 192.168.1.0/26. What are the remaining subnets?

HINT: Find the broadcast address of Subnet 1. The next address is the network address of Subnet 2. Repeat the process for Subnets 3 and 4.

Subnet 1:
192.168.1.0/26

Subnet 2:
(   )/26



Subnet 3:
(   )/26

Subnet 4:
(   )/26

192.168.1.0/24

Quiz

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

Quiz

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

192.168.1.63 – 192.168.1.127

Quiz

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

Quiz

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

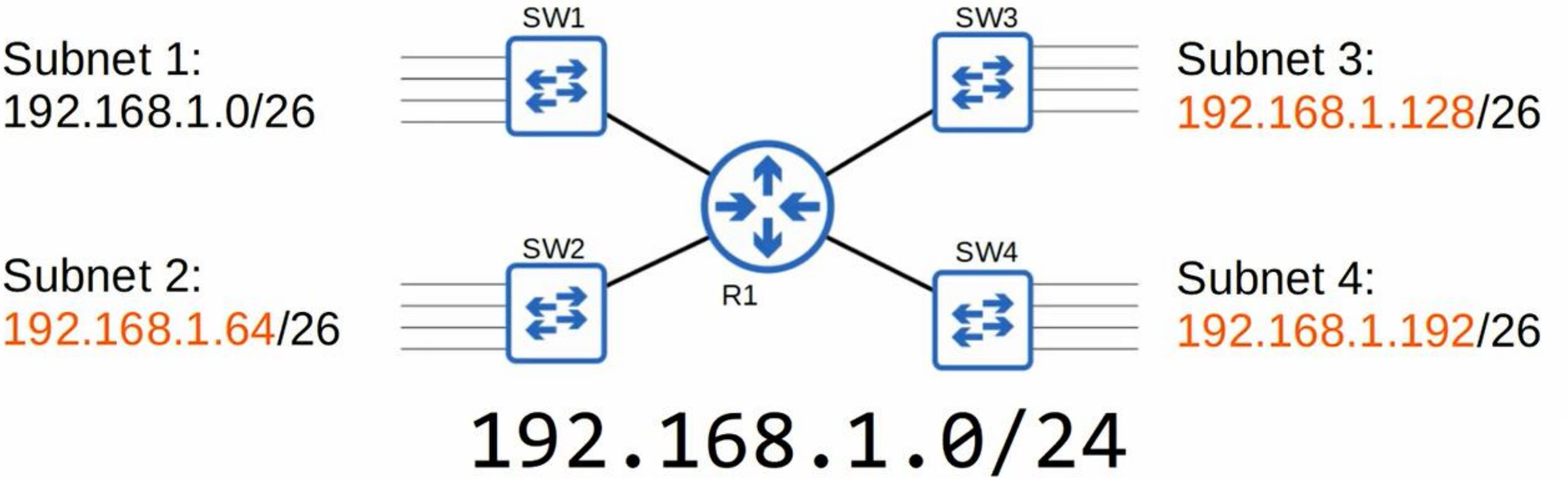
192 . 168 . 1 . 255

192.168.1.192 – 192.168.1.255

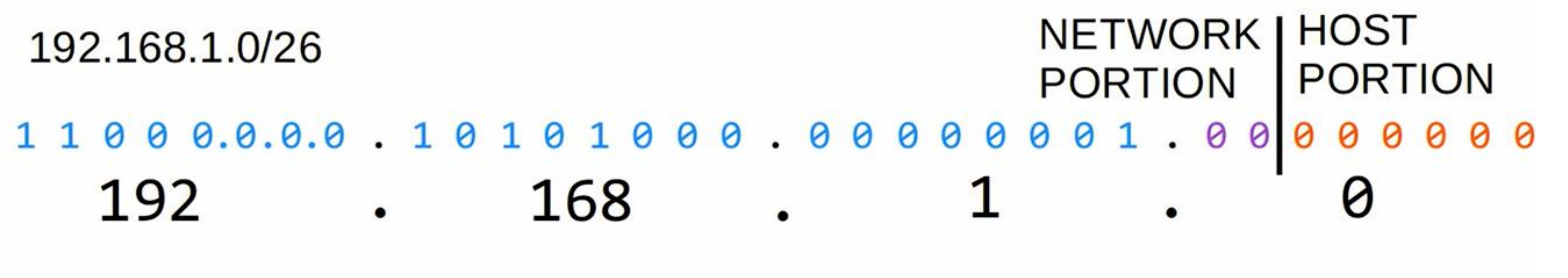
Quiz

The first subnet (Subnet 1) is 192.168.1.0/26. What are the remaining subnets?

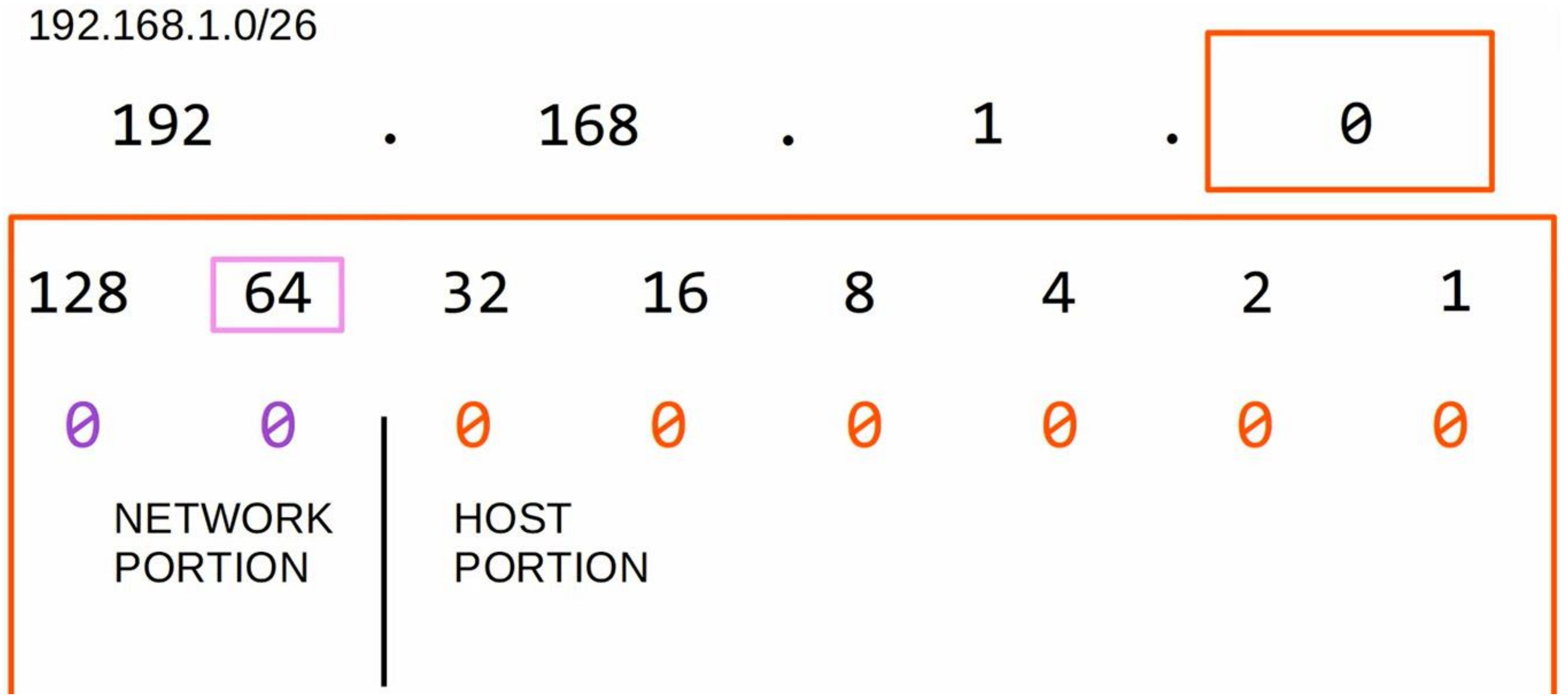
HINT: Find the broadcast address of Subnet 1. The next address is the network address of Subnet 2. Repeat the process for Subnets 3 and 4.



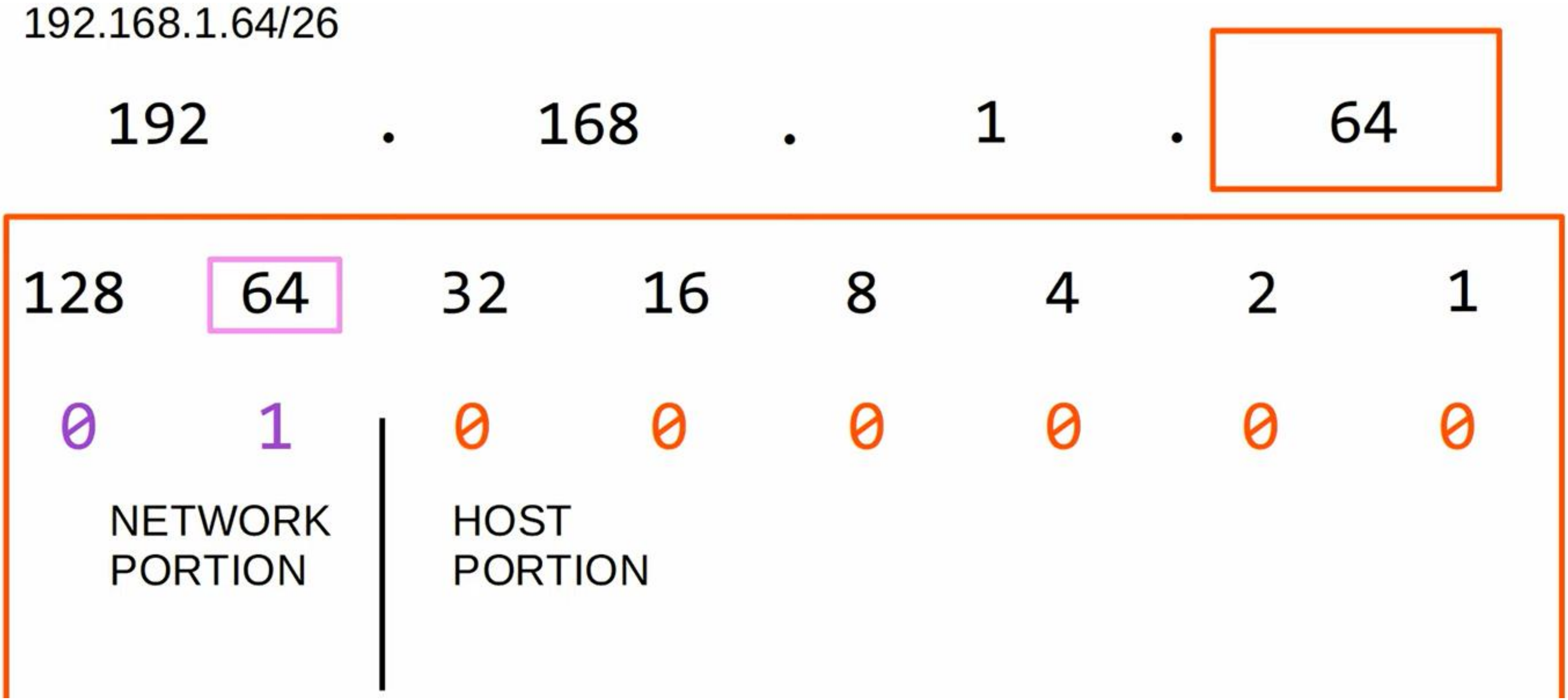
Subnetting Trick



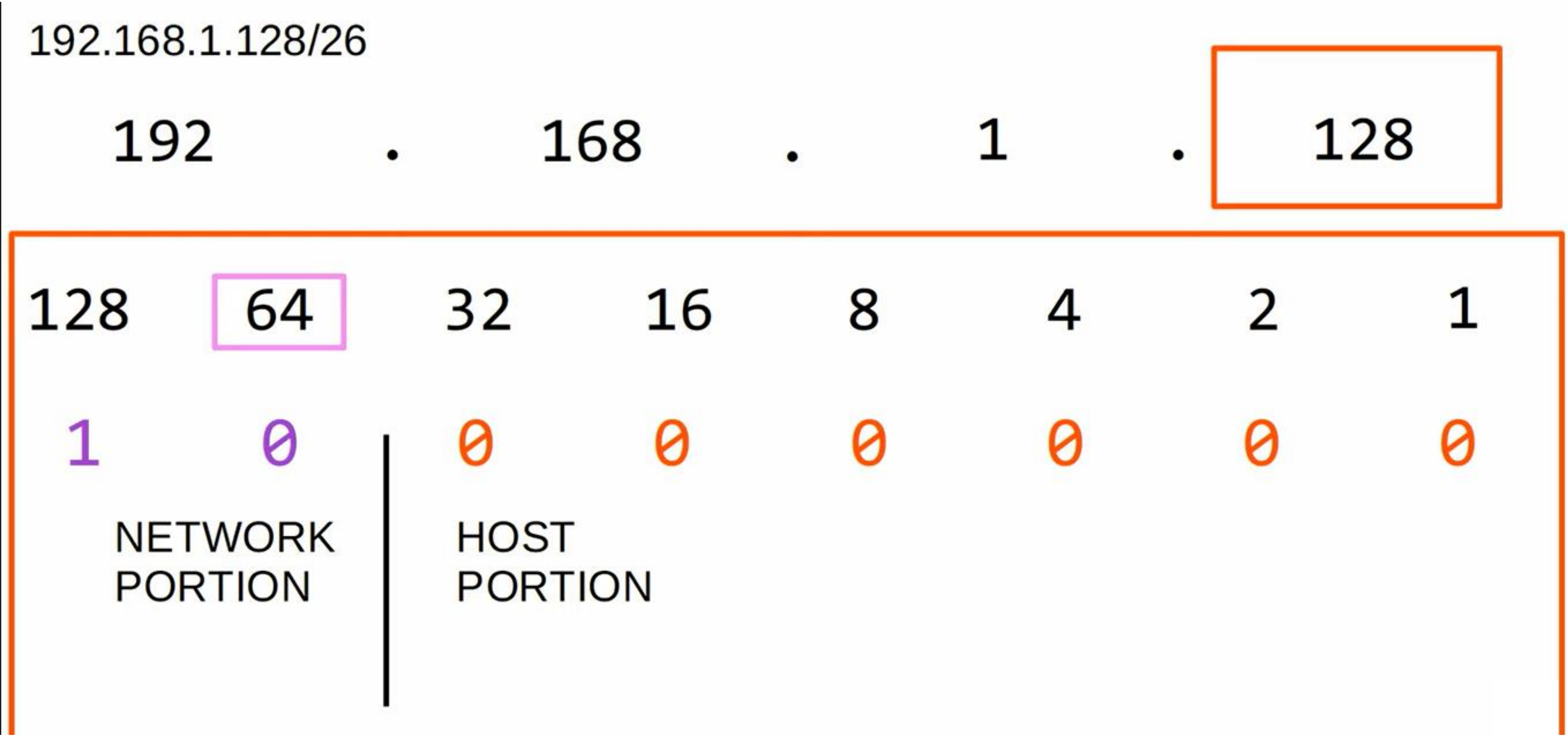
Subnetting Trick



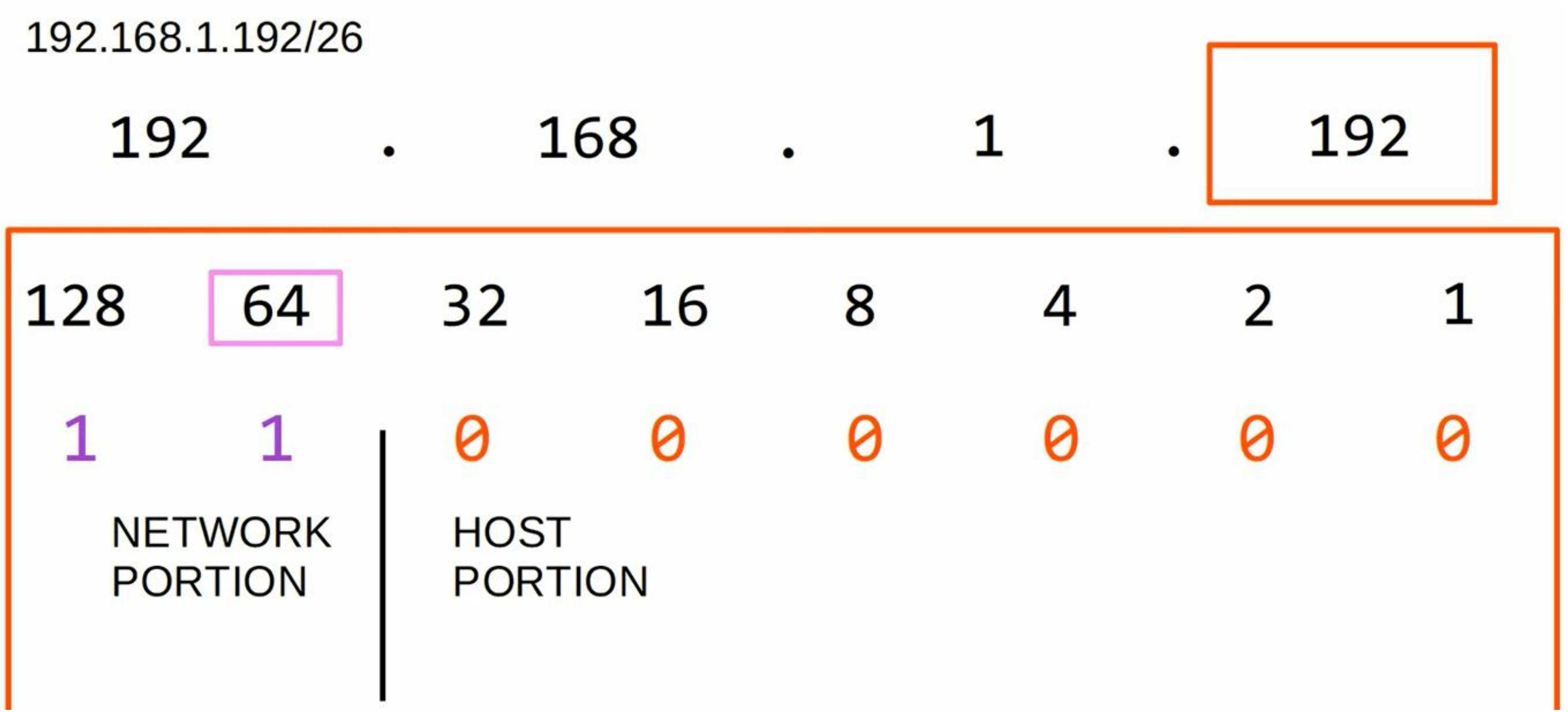
Subnetting Trick



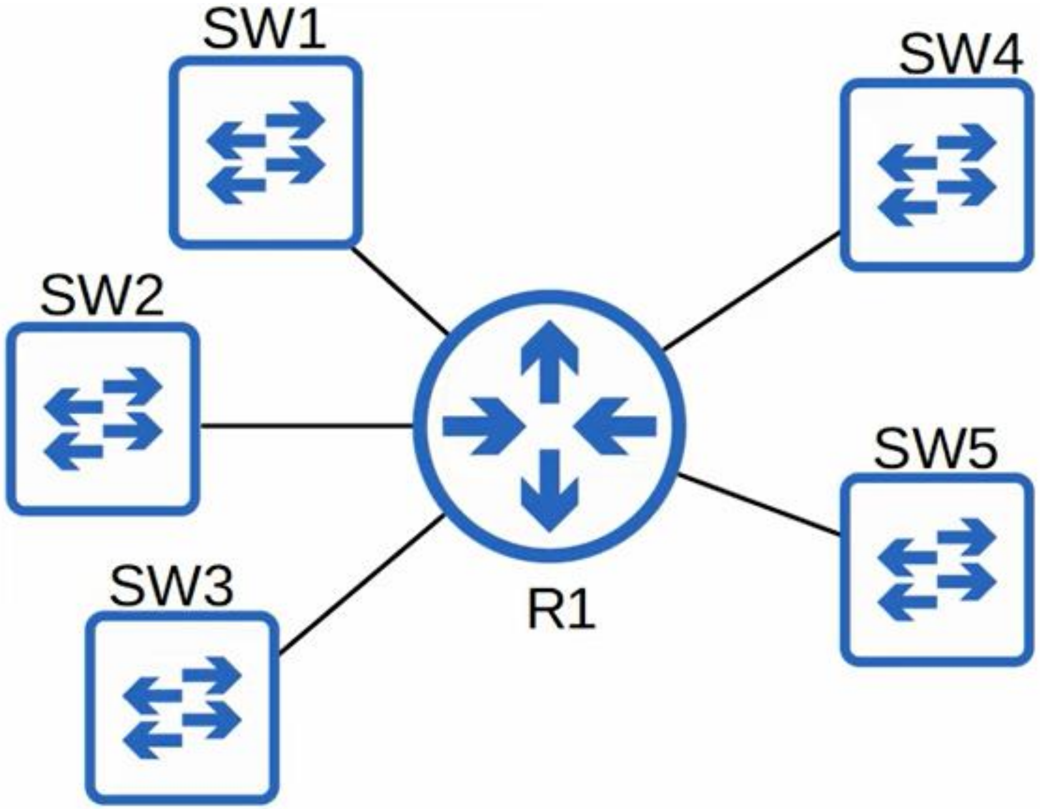
Subnetting Trick



Subnetting Trick



Subnetting



Subnet 1:

Subnet 2:

Subnet 3:

Subnet 4:

Subnet 5:

192.168.255.0/24

Divide the **192.168.255.0/24** network into five subnets of equal size. Identify the five subnets.

Subnetting

/24

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

192 . 168 . 255 . 0

Borrowing 0 bits = can’t make any subnets

Subnetting

/25

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

192 . 168 . 255 . 0

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

192 . 168 . 255 . 128

Borrowing 1 bit = can make 2 subnets

2^x = number of subnets
(x = number of ‘borrowed’ bits)

$2^n - 2$ = number of hosts
(n = number of host bits)

Subnetting

/26

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

192 . 168 . 255 . 0

Borrowing 2 bits = can make 4 subnets

Subnetting

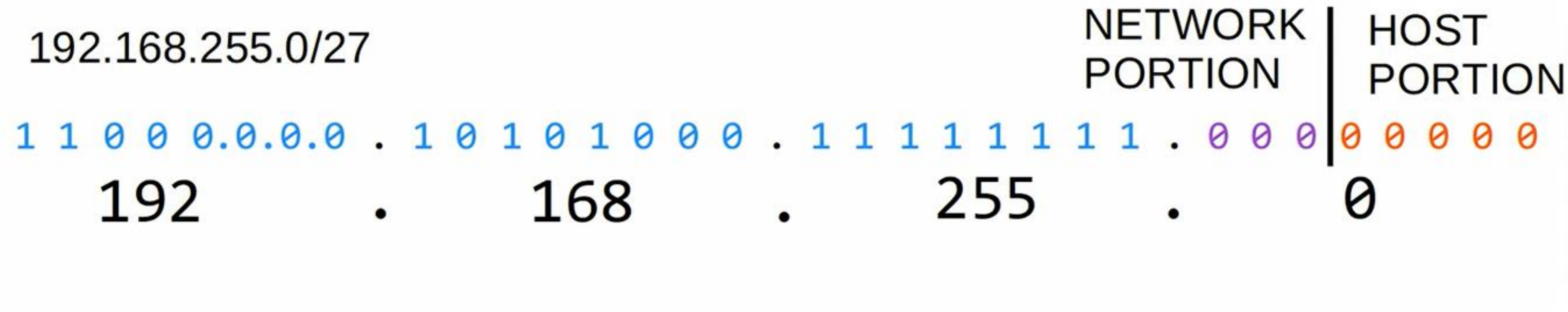
/27

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

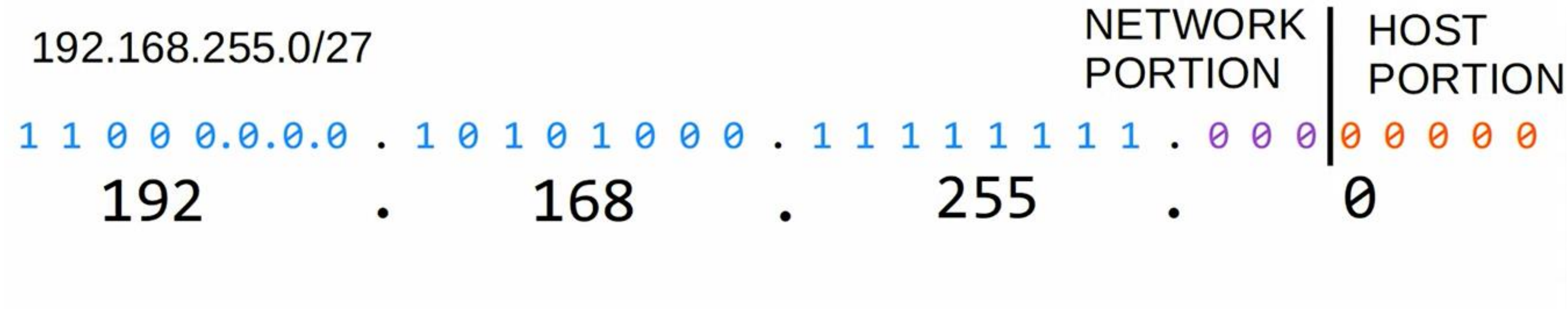
192 . 168 . 255 . 0

Borrowing 3 bits = can make 8 subnets

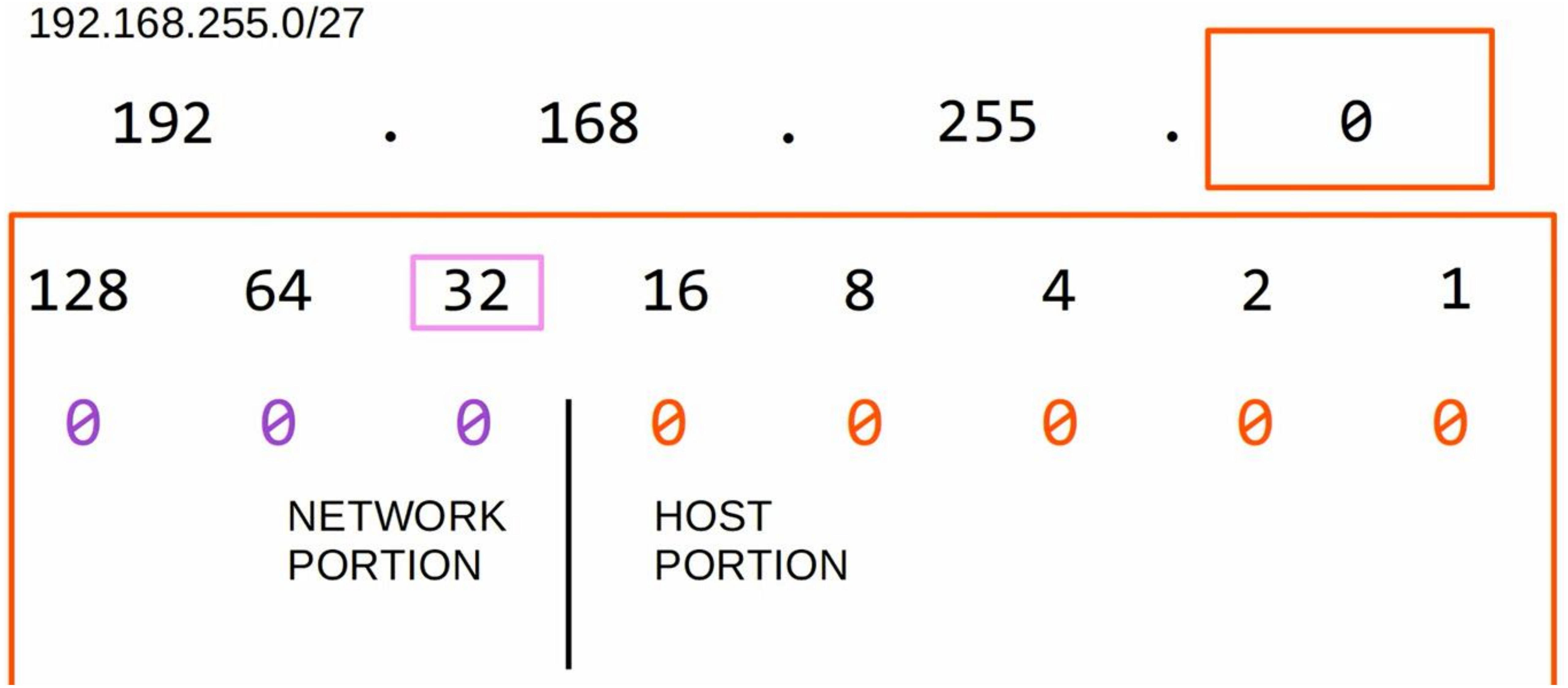
Subnetting


192.168.255.0/27
NETWORK PORTION
HOST PORTION
1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 1 1 1 1 1 1 1 1 . 0 0 0 0 0 0 0 0
192 . 168 . 255 . 0

Subnetting


192.168.255.0/27
NETWORK PORTION
HOST PORTION
1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 1 1 1 1 1 1 1 1 . 0 0 0 | 0 0 0 0 0
192 . 168 . 255 . 0

Subnetting Trick

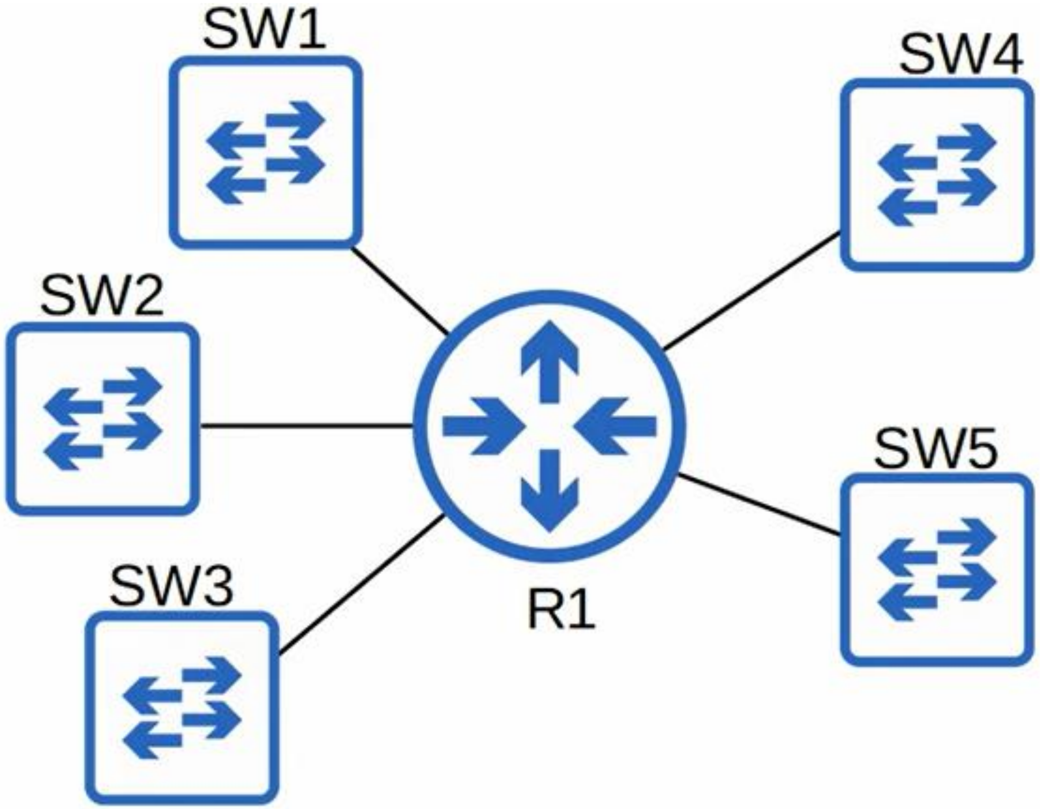


Subnetting

Subnet 1:
192.168.255.0/27

Subnet 2:
192.168.255.32/27

Subnet 3:
192.168.255.64/27



Subnet 4:
192.168.255.96/27

Subnet 5:
192.168.255.128/27

192.168.255.0/24

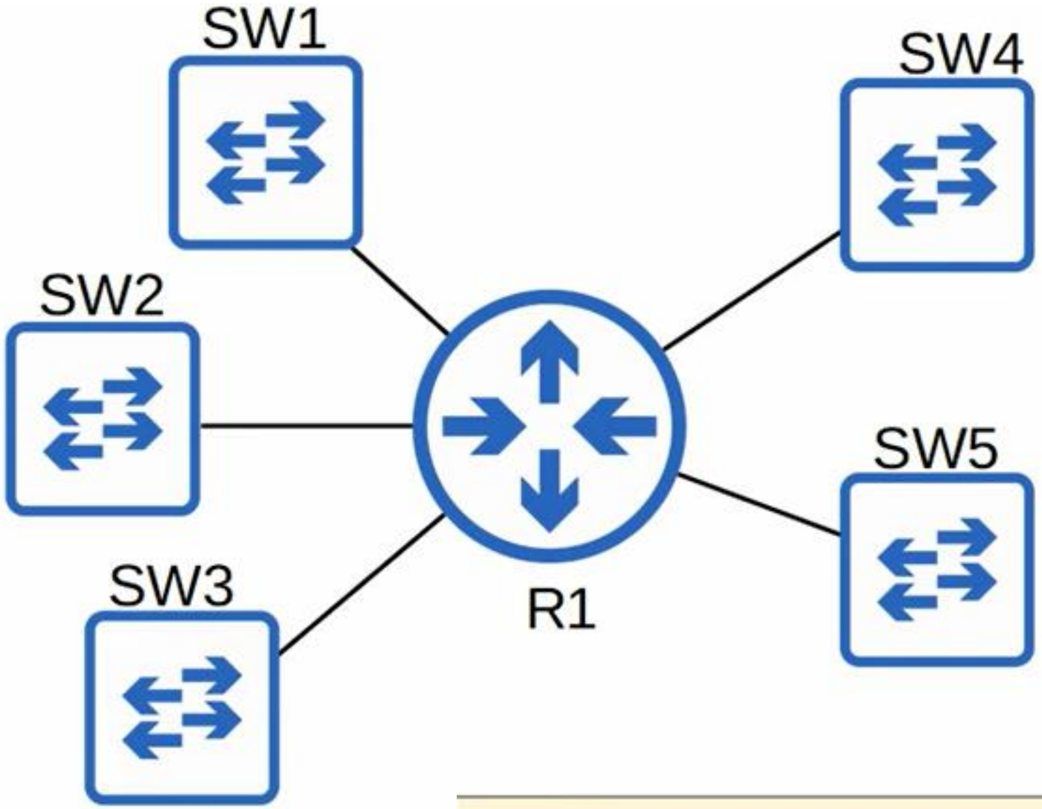
Divide the **192.168.255.0/24** network into five subnets of equal size. Identify the five subnets.

Subnetting

Subnet 1:
192.168.255.0/27

Subnet 2:
192.168.255.32/27

Subnet 3:
192.168.255.64/27



Subnet 4:
192.168.255.96/27

Subnet 5:
192.168.255.128/27

Subnet 6: 192.168.255.160/27
Subnet 7: 192.168.255.192/27
Subnet 8: 192.168.255.224/27

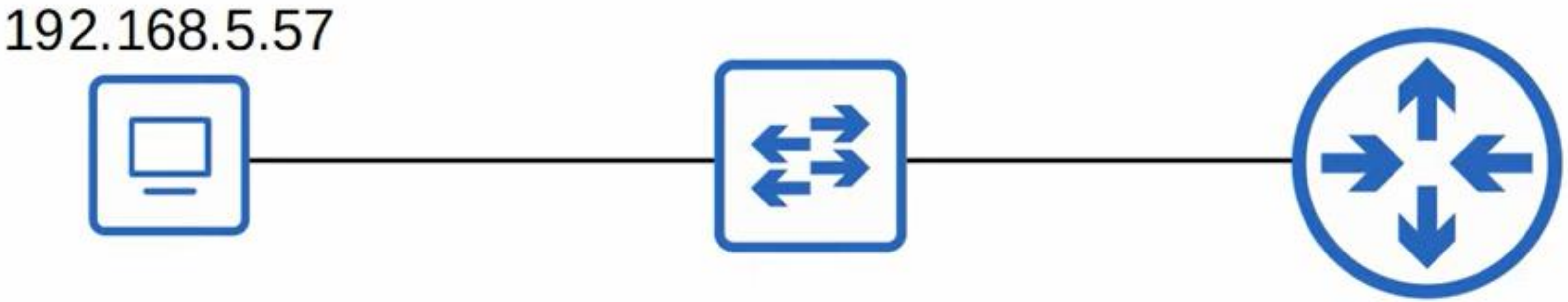
192.168

Divide the **192.168.255.0/** ... of equal size. Identify the five subnets.

Identify the Subnet

What subnet does host **192.168.5.57/27** belong to?

Subnet ID: ______________/27



Identify the Subnet

/27

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

192 . 168 . 5 . 57

↓

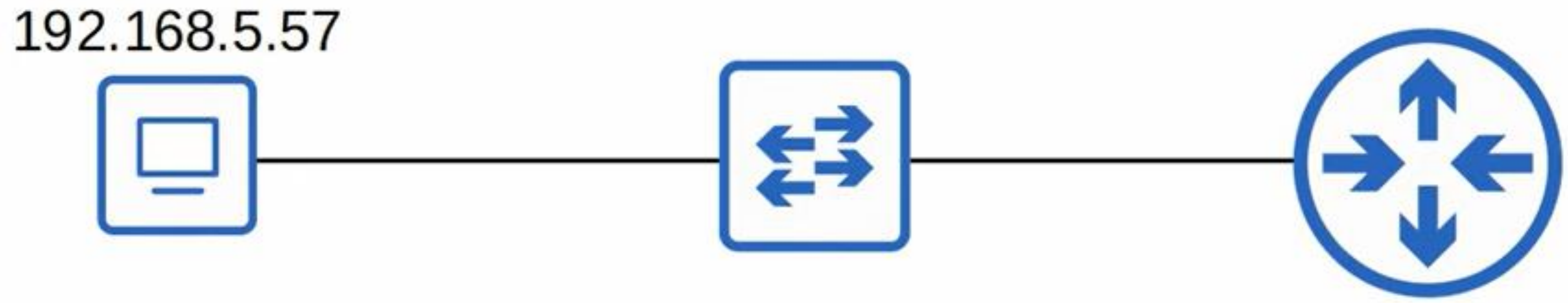
1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 0 0 1 0 1 . 0 0 1 0 0 0 0 0

192 . 168 . 5 . 32

Identify the Subnet

What subnet does host **192.168.5.57/27** belong to?

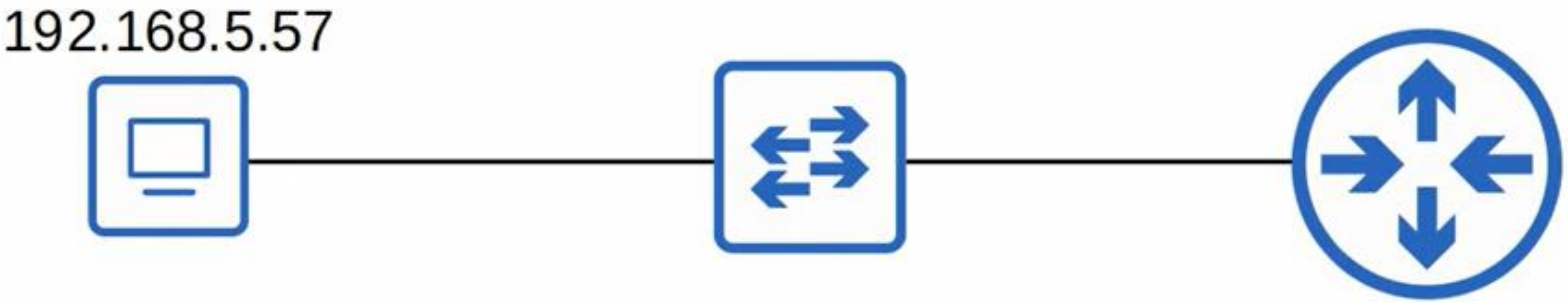
Subnet ID: 192.168.5.32 /27



Identify the Subnet

What subnet does host **192.168.5.57/27** belong to?

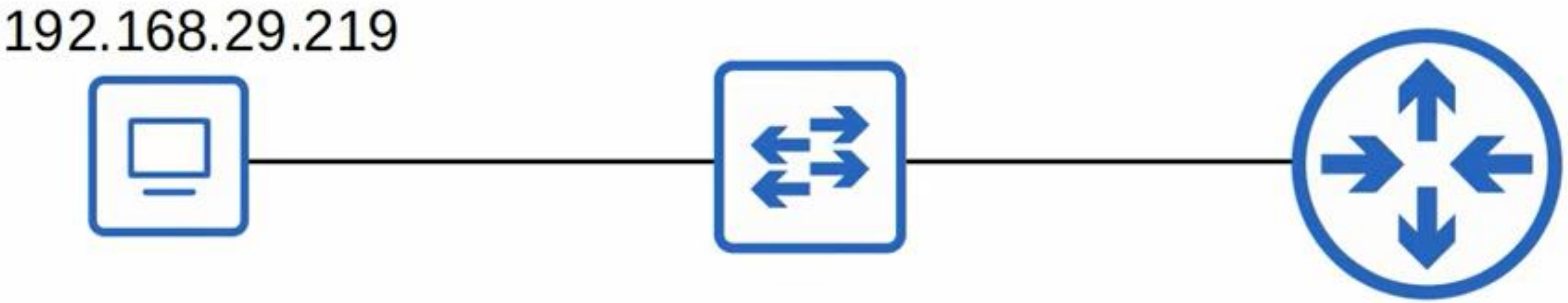
Subnet ID: 192.168.5.32 /27



Identify the Subnet

What subnet does host **192.168.29.219/29** belong to?

Subnet ID: ______________/29



Identify the Subnet

/29

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

192 . 168 . 29 . 219

↓

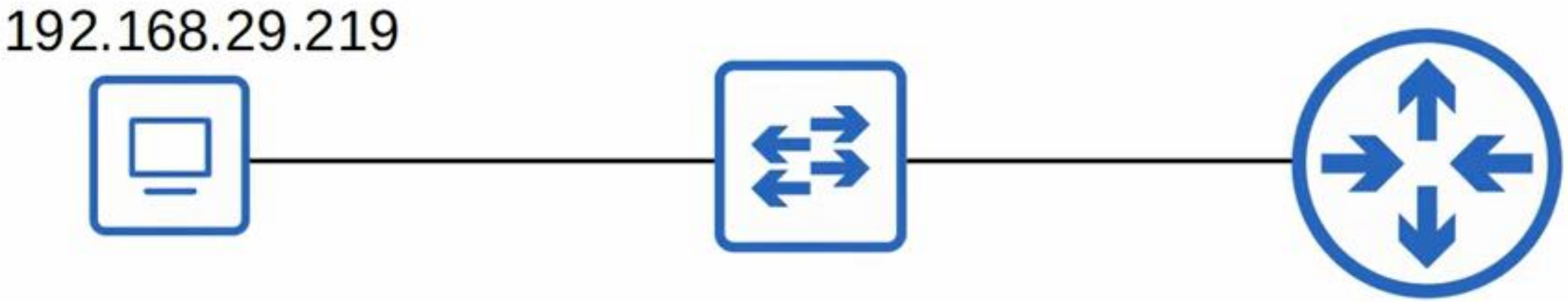
1 1 0 0 0.0.0.0 . 1 0 1 0 1 0 0 0 . 0 0 0 1 1 1 0 1 . 1 1 0 1 1 0 0 0

192 . 168 . 29 . 216

Identify the Subnet

What subnet does host **192.168.29.219/29** belong to?

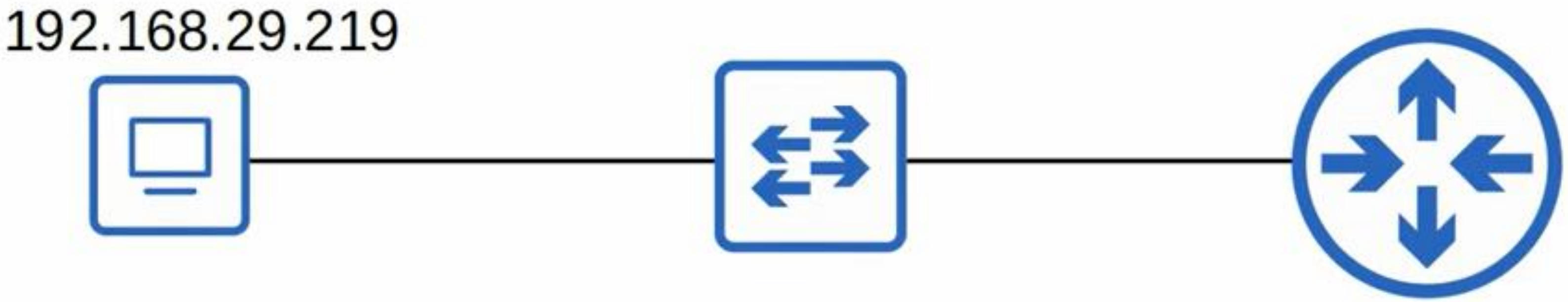
Subnet ID: 192.168.29.216/29



Identify the Subnet

What subnet does host **192.168.29.219/29** belong to?

Subnet ID: 192.168.29.216/29



Subnets/Hosts (Class C)

Prefix Length	Number of Subnets	Number of Hosts
/25	2	126
/26	4	62
/27	8	30
/28	16	14
/29	32	6
/30	64	2
/31	128	0 (2)
/32	256	0 (1)

Subnetting Class B networks

Class	Leading bits	Size of *network number* bit field	Size of *rest* bit field	Number of networks	Addresses per network
Class A	0	8	24	128 (2^7)	16,777,216 (2^{24})
Class B	10	16	16	16,384 (2^{14})	65,536 (2^{16})
Class C	110	24	8	2,097,152 (2^{21})	256 (2^8)

The process of subnetting Class A, Class B, and Class C networks is EXACTLY THE SAME!

Subnetting Class B networks

You have been given the 172.16.0.0/16 network. You are asked to create 80 subnets for your company's various LANs. What prefix length should you use?

172.16.0.0/16

Subnetting Class B networks

/16

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

172 . 16 . 0 . 0

Borrowing 0 bits = can't make any subnets

2^x = number of subnets
(x = number of 'borrowed' bits)

Subnetting Class B networks

/17

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

172 . 16 . 0 . 0

Borrowing 1 bit = 2 subnets

Subnet mask:

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 0 0 0 0 0 0 0

255 . 255 . 128 . 0

Subnetting Class B networks

/23

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

172 . 16 . 0 . 0

Borrowing 7 bits = 128 subnets

Subnet mask:

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 0

255 . 255 . 254 . 0

Subnetting Class B networks

/23

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 0 0 0 0 . 0 0 0 0 0 0 0 0
172 . 16 . 0 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 0 0 1 0 . 0 0 0 0 0 0 0 0
172 . 16 . 2 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 0 1 0 0 . 0 0 0 0 0 0 0 0
172 . 16 . 4 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 0 1 1 0 . 0 0 0 0 0 0 0 0
172 . 16 . 6 . 0

1 0 1 0 1 1 0 0 . 0 0 0 1 0 0 0 0 . 0 0 0 0 1 0 0 0 . 0 0 0 0 0 0 0 0
172 . 16 . 8 . 0

Subnetting Class B networks

/23

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

172 . 16 . 0 . 0

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

172 . 16 . 2 . 0

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

172 . 16 . 4 . 0

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

172 . 16 . 6 . 0

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

172 . 16 . 8 . 0

Subnetting Class B networks

You have been given the 172.22.0.0/16 network. You are required to divide the network into 500 separate subnets. What prefix length should you use?

172.22.0.0/16

Subnetting Class B networks

/25

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

172 . 22 . 0 . 0

Borrowing 9 bits = 512 subnets

Subnetting Class B networks

You have been given the 172.18.0.0/16 network. Your company requires 250 subnets with the same number of hosts per subnet. What prefix length should you use?

172.18.0.0/16

Subnetting Class B networks

/24

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

172 . 18 . 0 . 0

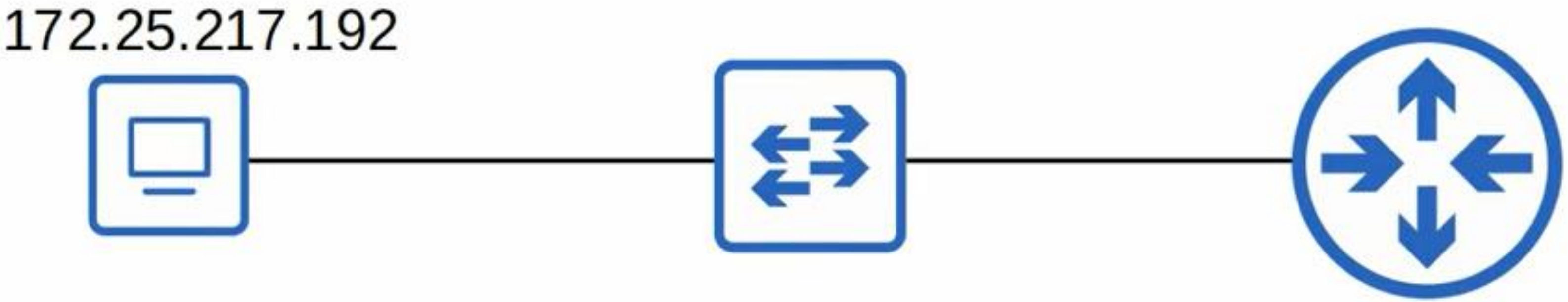
Borrowing 8 bits = 256 subnets

8 host bits = 254 hosts per subnet

Identify the Subnet

What subnet does host **172.25.217.192/21** belong to?

Subnet ID: _______________/21



Identify the Subnet

/21

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

172 . 25 . 217 . 192

↓

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

172 . 25 . 216 . 0

Identify the Subnet

/21

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

172 . 25 . 217 . 192

↓

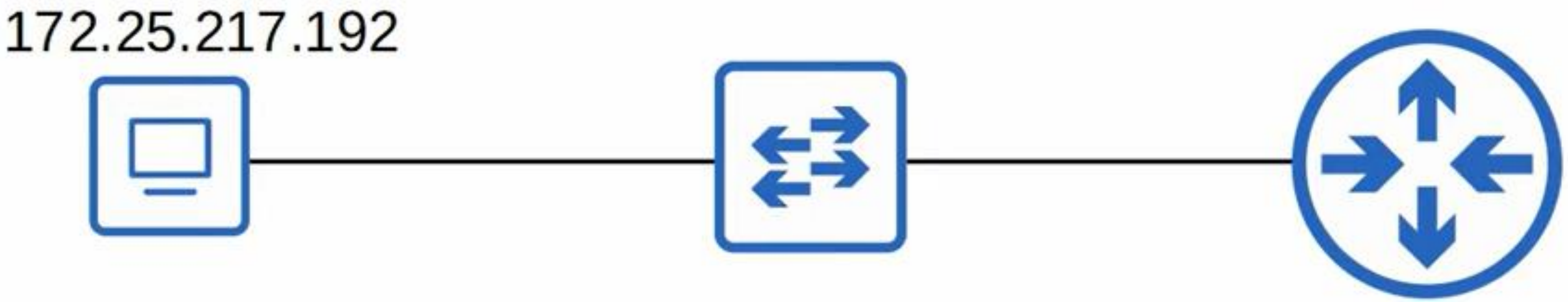
1 0 1 0 1 1 0 0 . 0 0 0 1 1 0 0 1 . 1 1 0 1 1 0 0 0 . 0 0 0 0 0 0 0 0

172 . 25 . 216 . 0

Identify the Subnet

What subnet does host **172.25.217.192/21** belong to?

Subnet ID: ___172.25.216.0___/21



Subnets/Hosts (Class B)

Prefix Length	Number of Subnets	Number of Hosts
/17	2	32766
/18	4	16382
/19	8	8190
/20	16	4094
/21	32	2044
/22	64	1022
/23	128	510
/24	256	254

Prefix Length	Number of Subnets	Number of Hosts
/25	512	126
/26	1024	62
/27	2048	30
/28	4096	14
/29	8192	6
/30	16384	2
/31	32768	0 (2)
/32	65536	0 (1)

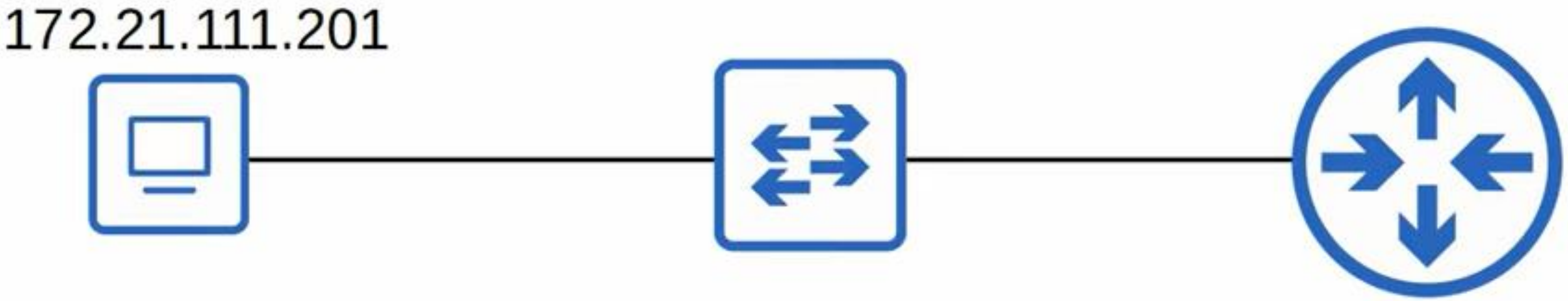
Quiz, Question 1

You have been given the 172.30.0.0/16 network. Your company requires 100 subnets with at least 500 hosts per subnet. What prefix length should you use?

Quiz, Question 2

What subnet does host **172.21.111.201/20** belong to?

Subnet ID: ______________/20

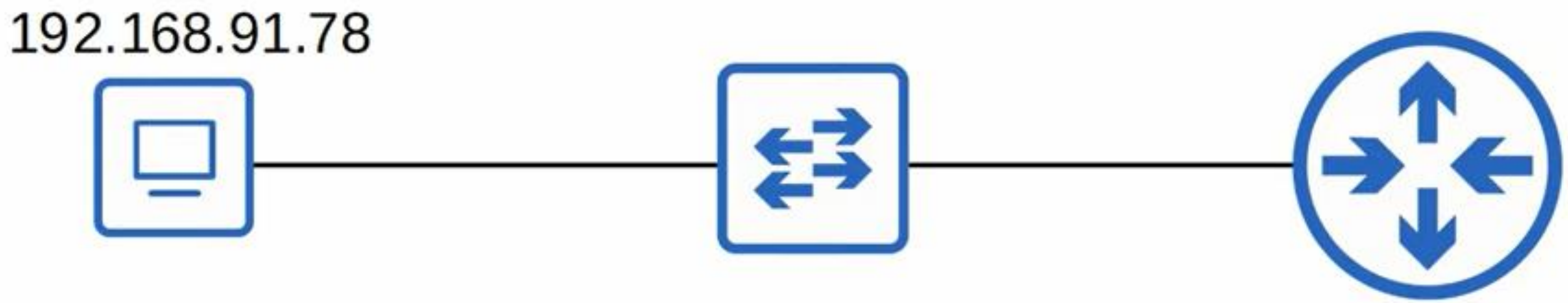


Quiz, Question 3

What is the **broadcast address** of the network

192.168.91.78/26 belongs to?

Broadcast address: ______________/26



Quiz, Question 4

You divide the 172.16.0.0/16 network into 4 subnets of equal size. Identify the **network** and **broadcast** addresses of the second subnet.

Quiz, Question 5

You divide the 172.30.0.0/16 network into subnets of 1000 hosts each. How many subnets are you able to make?