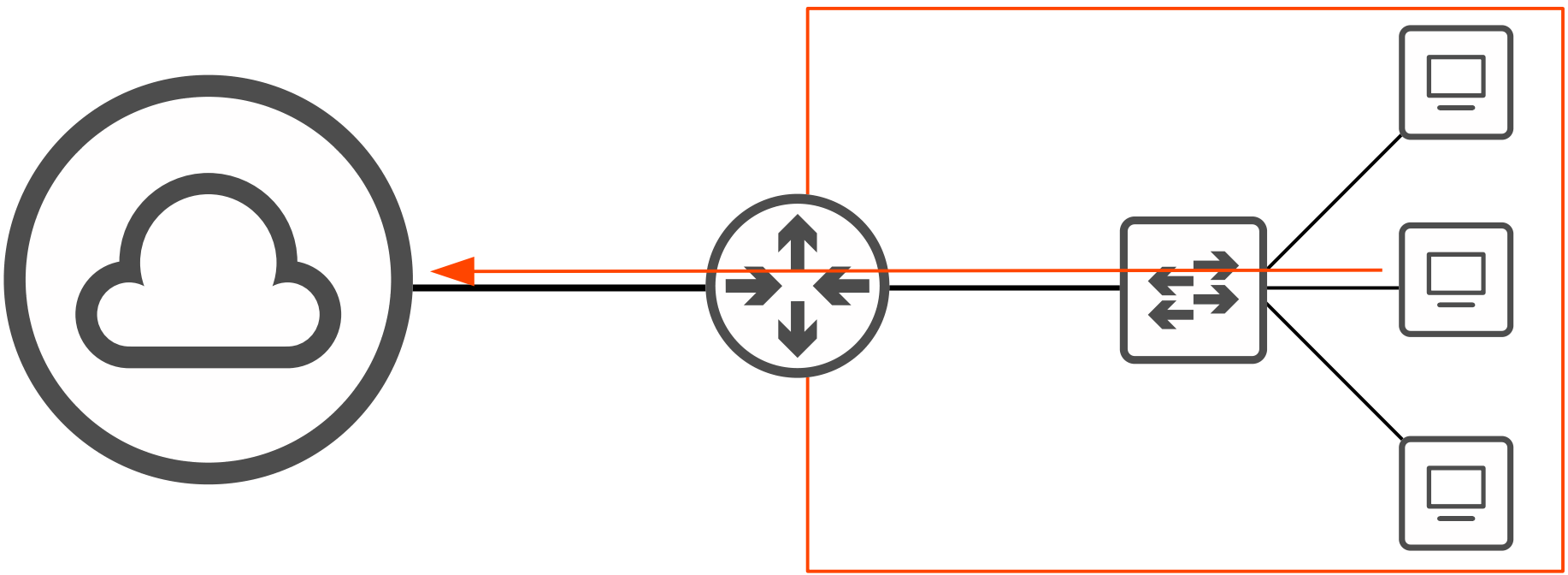
Jeremy's IT Lab

CCNA 200-301 Day 7

IPv4 Addressing



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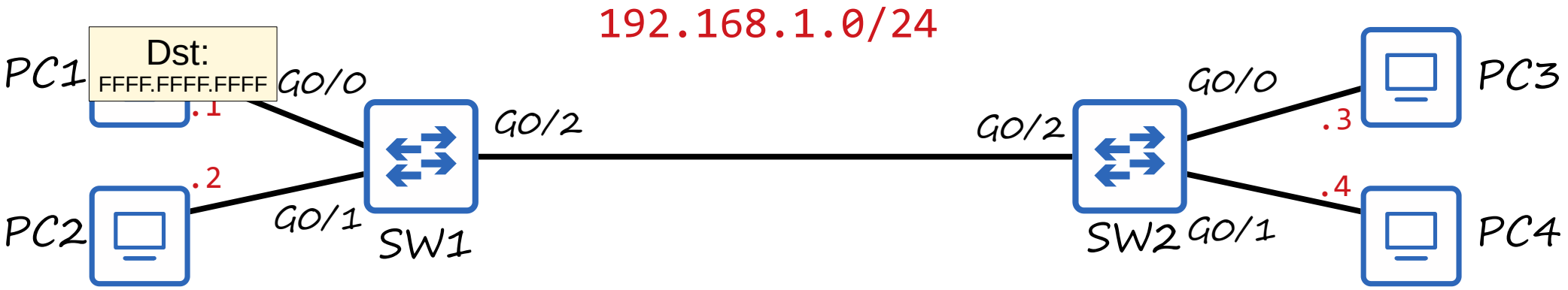
OSI Model – Network Layer

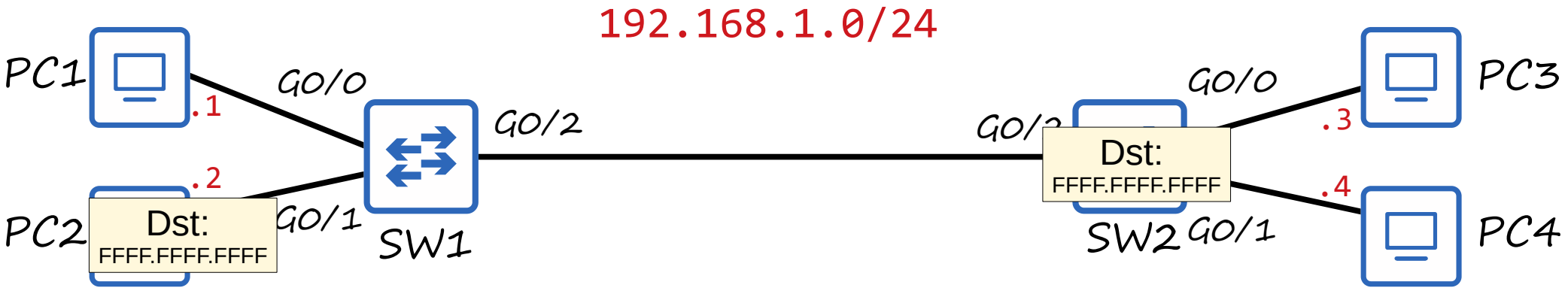
7	Application
6	Presentation
5	Session
4	Transport
3	**Network**
2	Data Link
1	Physical

- Provides connectivity between end hosts on *different* networks (ie. outside of the LAN).
- Provides logical addressing (IP addresses).
- Provides path selection between source and destination.
- Routers operate at Layer 3.

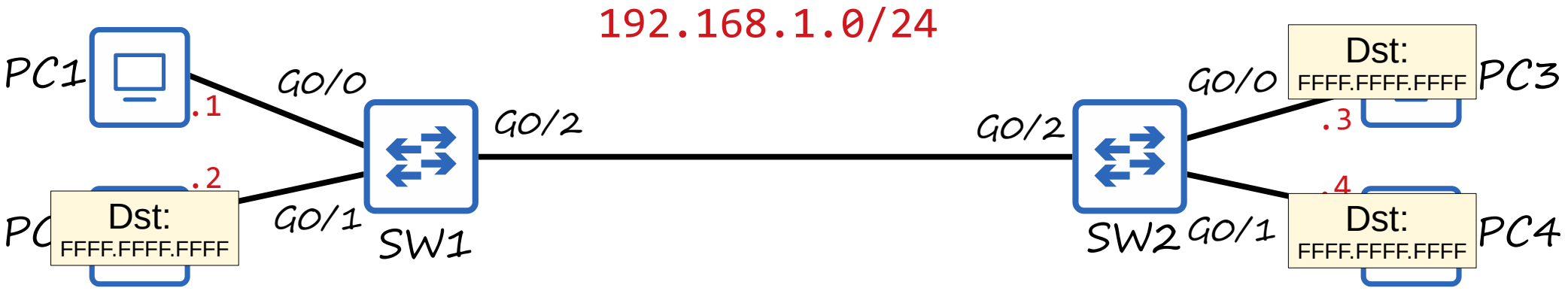
Routing


192.168.1.0/24
PC1
Dst:
FFFF.FFFF.FFFF
.1
Gi0/0
.2
PC2
Gi0/1
SW1
Gi0/2
Gi0/2
SW2
Gi0/0
.3
PC3
.4
Gi0/1
PC4

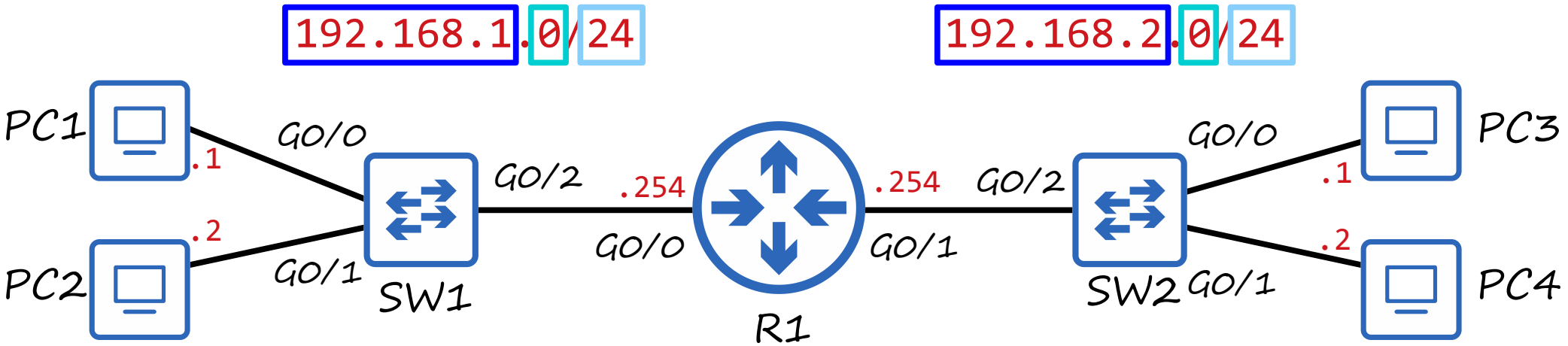
Routing


192.168.1.0/24
PC1
.1
G0/0
PC2
.2
Dst:
FFFF.FFFF.FFFF
G0/1
SW1
G0/2
G0/2
Dst:
FFFF.FFFF.FFFF
SW2
G0/0
G0/1
.3
.4
PC3
PC4

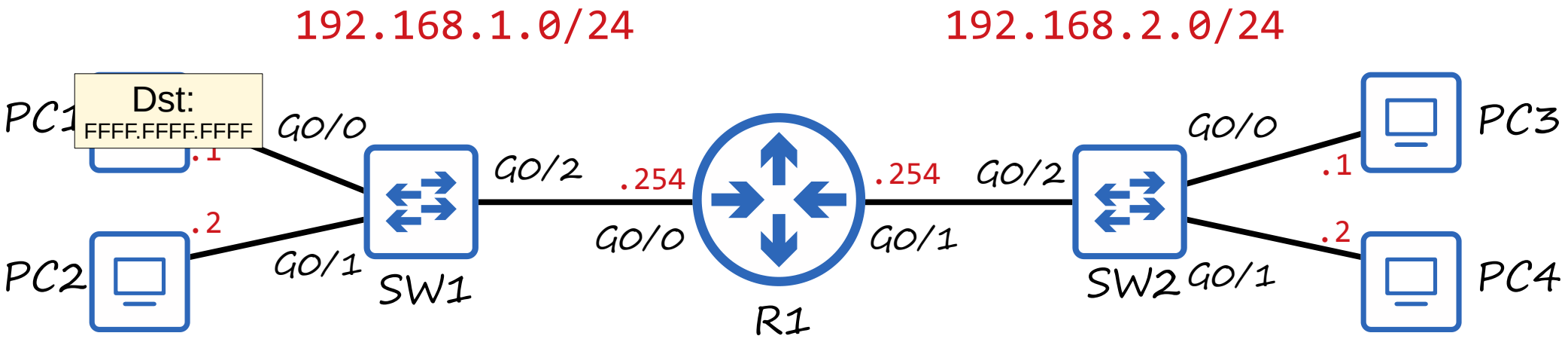
Routing


192.168.1.0/24
PC1
.1
G0/0
.2
Dst:
FFFF.FFFF.FFFF
G0/1
SW1
G0/2
G0/2
SW2
G0/0
Dst:
FFFF.FFFF.FFFF
PC3
.3
.4
G0/1
Dst:
FFFF.FFFF.FFFF
PC4

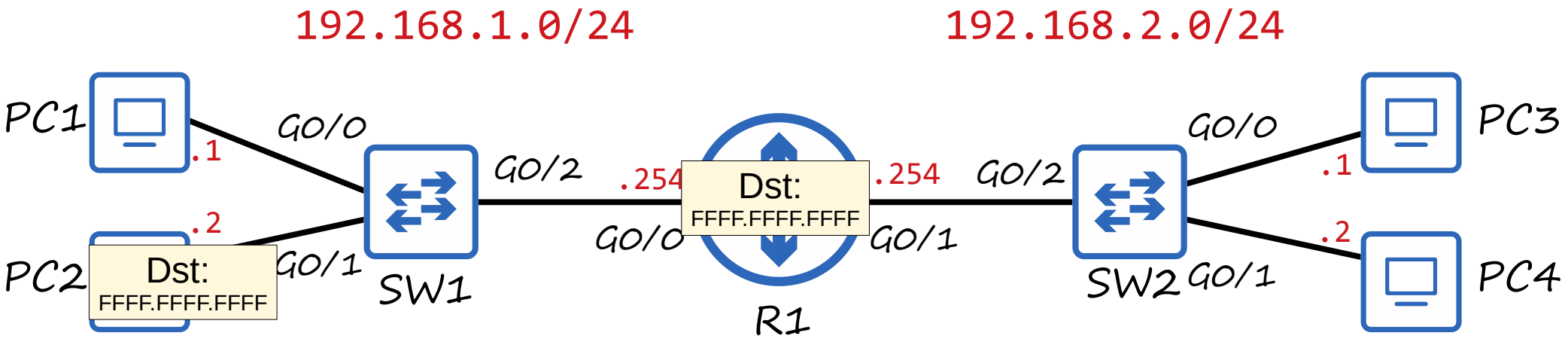
Routing


192.168.1.0/24
192.168.2.0/24
PC1
PC2
PC3
PC4
.1
.2
.1
.2
GO/0
GO/1
SW1
GO/2
.254
GO/0
R1
.254
GO/1
GO/2
SW2
GO/0
GO/1

Routing


192.168.1.0/24
192.168.2.0/24
PC1
Dst:
FFFF.FFFF.FFFF
.1
.2
PC2
Gi0/0
Gi0/1
SW1
Gi0/2
.254
Gi0/0
R1
.254
Gi0/1
Gi0/2
SW2
Gi0/0
Gi0/1
.1
.2
PC3
PC4

Routing


192.168.1.0/24
192.168.2.0/24
PC1
.1
PC2
.2
Dst:
FFFF.FFFF.FFFF
G0/0
G0/1
SW1
G0/2
.254
G0/0
Dst:
FFFF.FFFF.FFFF
.254
G0/1
R1
G0/2
G0/0
G0/1
SW2
.1
.2
PC3
PC4

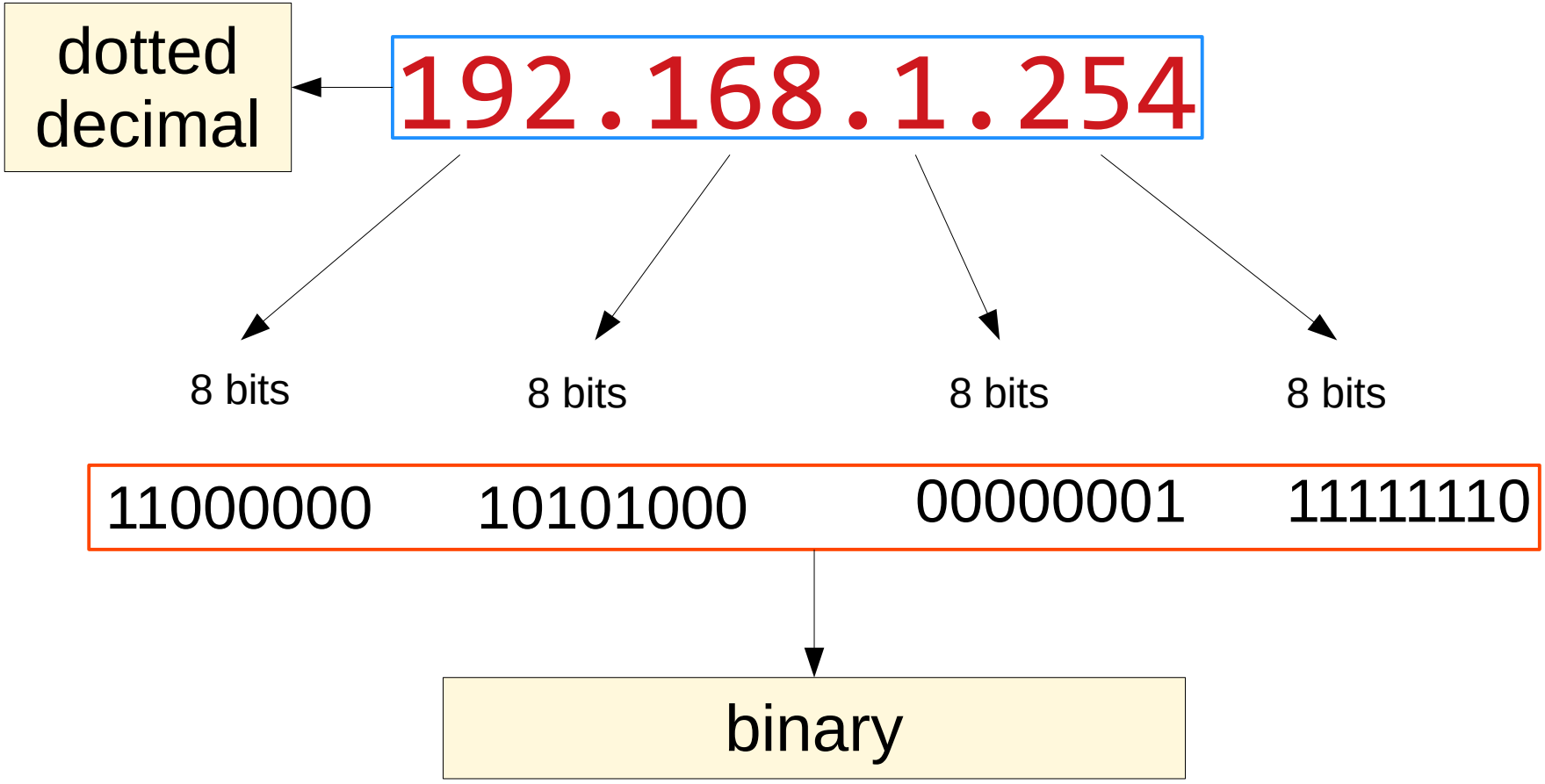
IPv4 Header

IPv4 Header Format

Offsets	Octet	0								1								2								3							
Octet	Bit	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
0	0	Version				IHL				DSCP						ECN		Total Length															
4	32	Identification																Flags			Fragment Offset											
8	64	Time To Live								Protocol								Header Checksum															
12	96	Source IP Address																															
16	128	Destination IP Address																															
20	160	Options (if I																															
24	192																																
28	224																																
32	256																																

IP address are 32 bits (4 bytes) in length.

IPv4 Addresses



Decimal & Hexadecimal

Decimal (base 10)

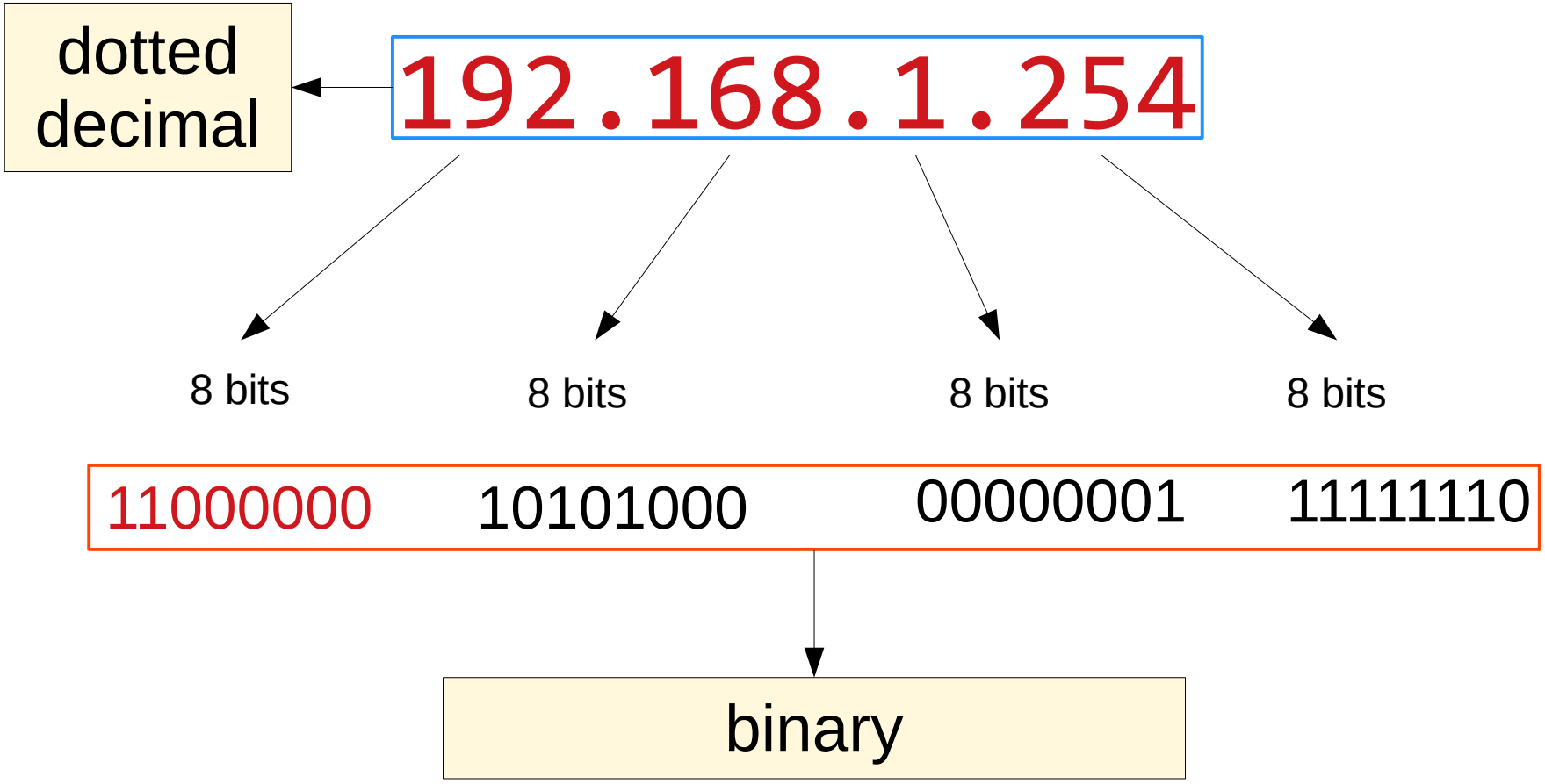
3	2	9	4
3 * 1000	2 * 100	9 * 10	4 * 1

Hexadecimal (base 16)

C	D	E
C * 256 (C = 12)	D * 16 (D = 13)	E * 1 (E = 14)

3072 + 208 + 14 = 3294

IPv4 Addresses



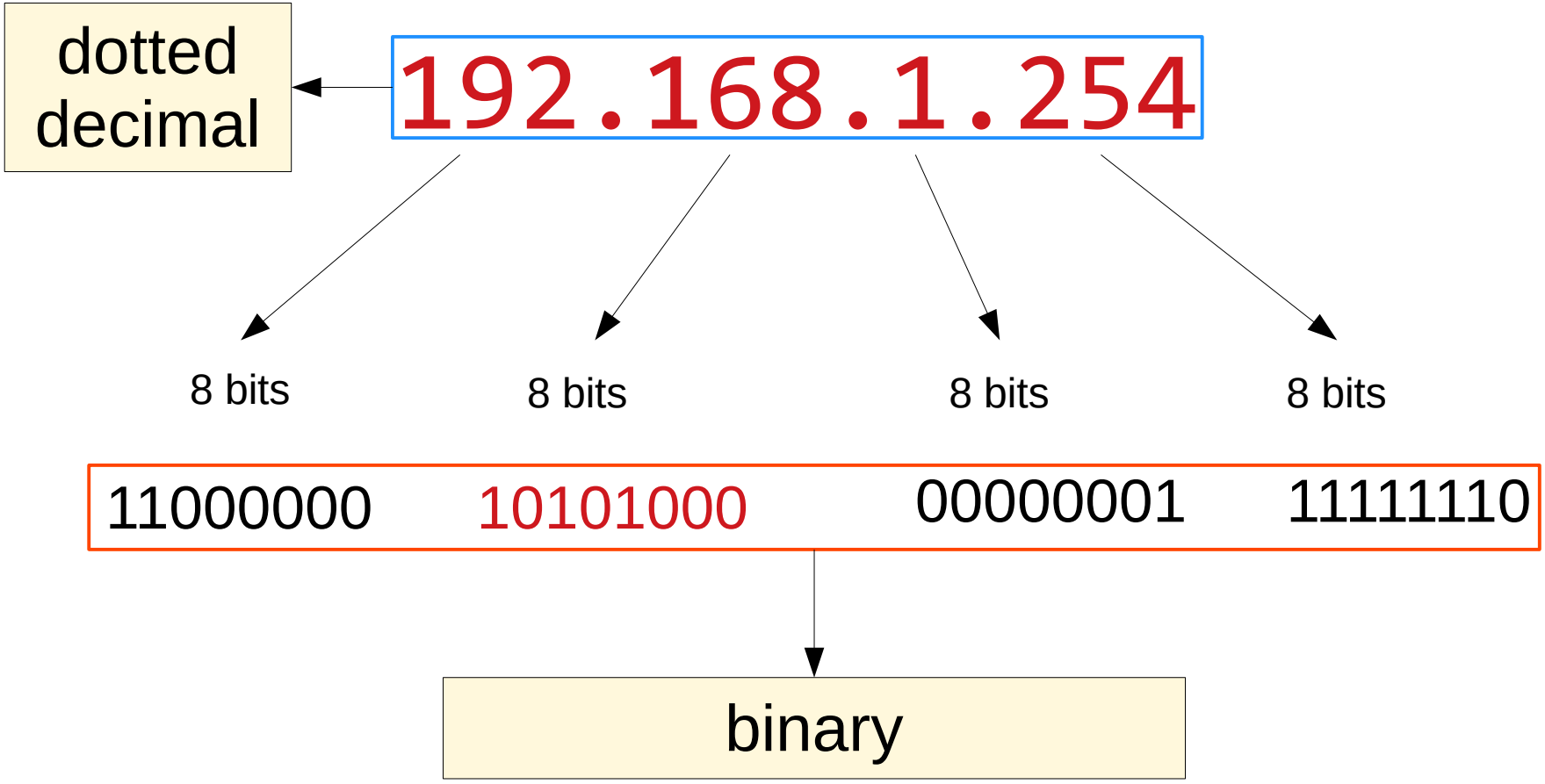
Binary (base 2)

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

IPv4 Addresses



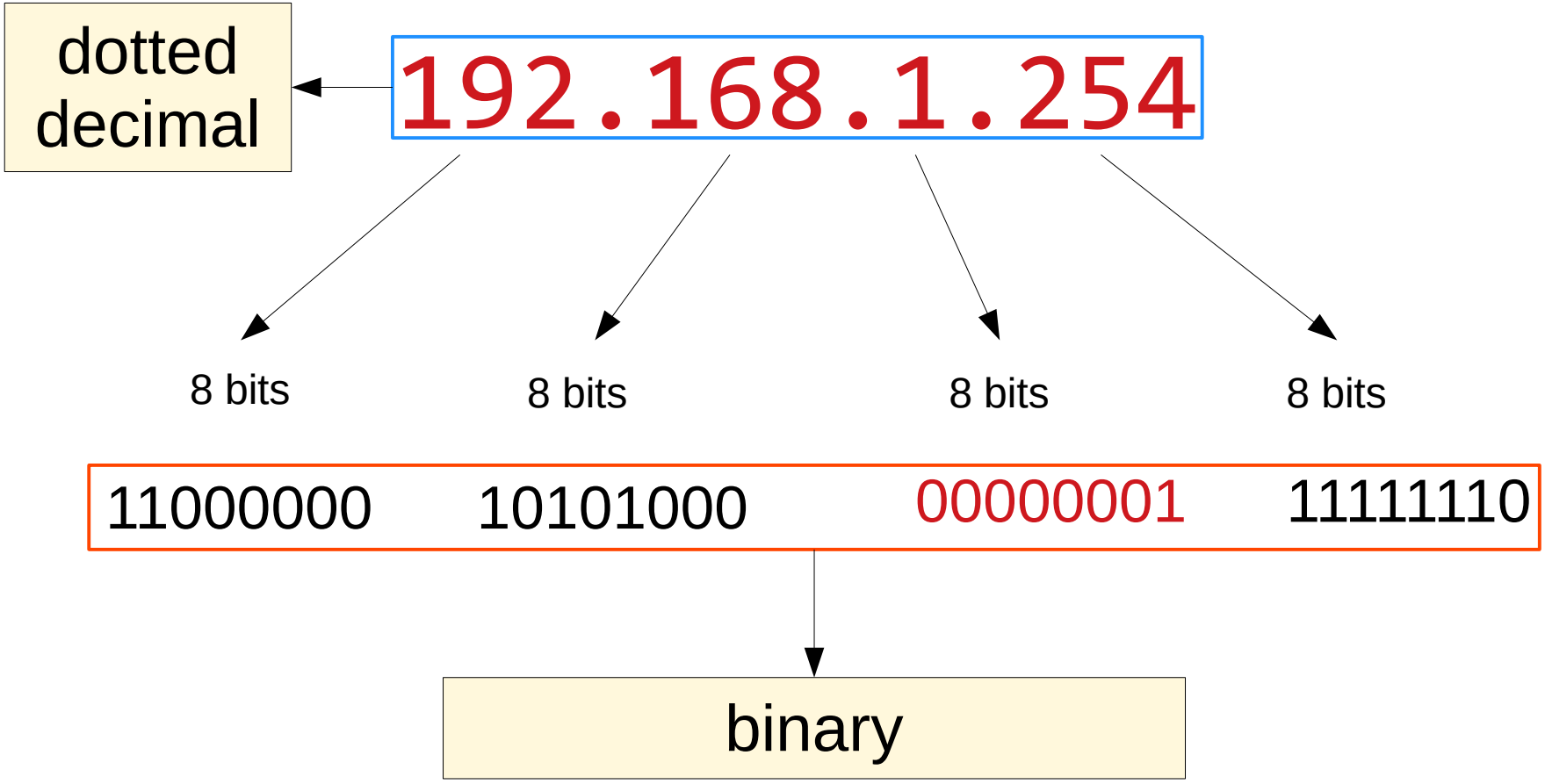
Binary (base 2)

168

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

128 + 32 + 8 = 168

IPv4 Addresses

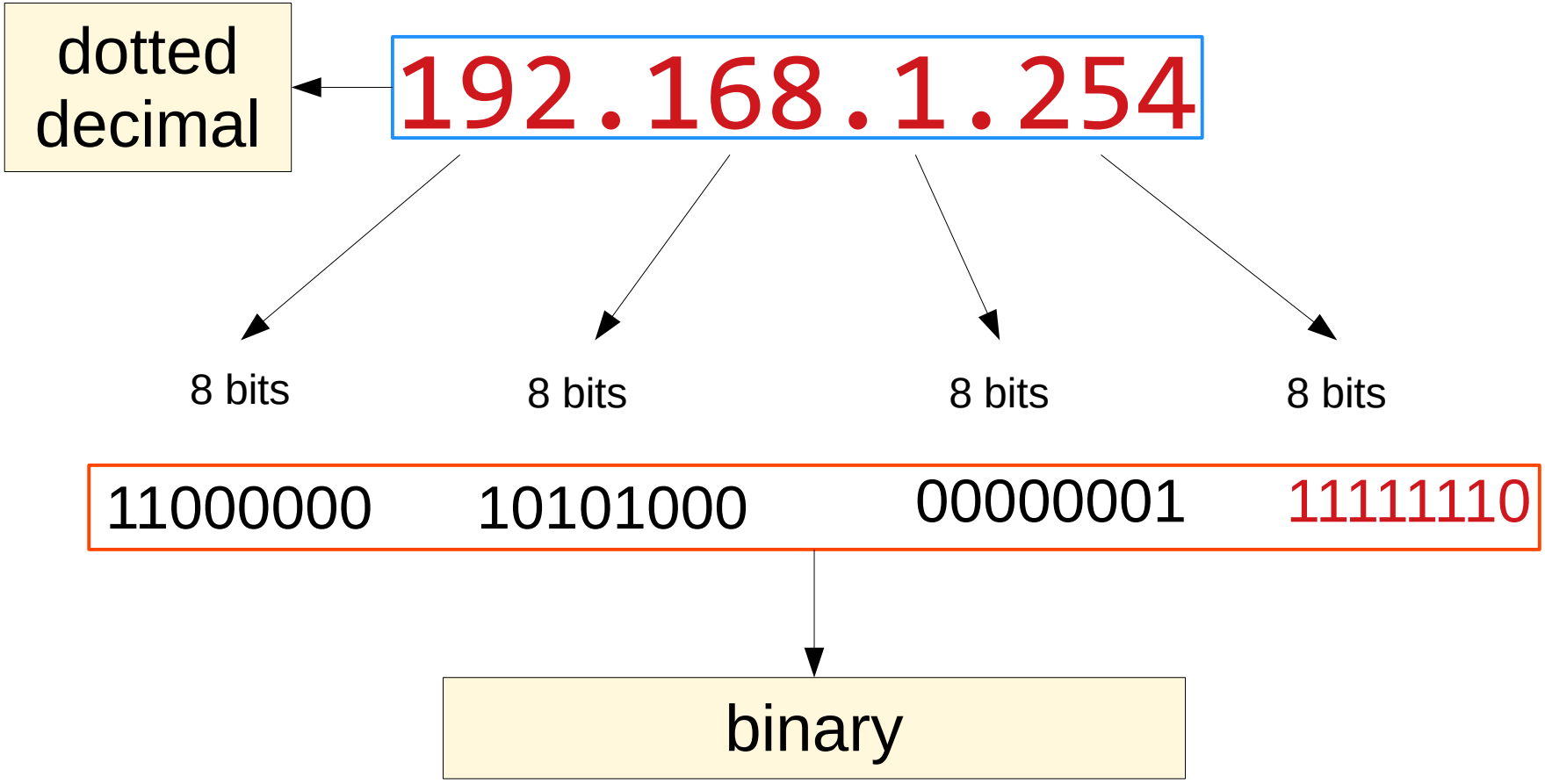


Binary (base 2)

1

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

IPv4 Addresses



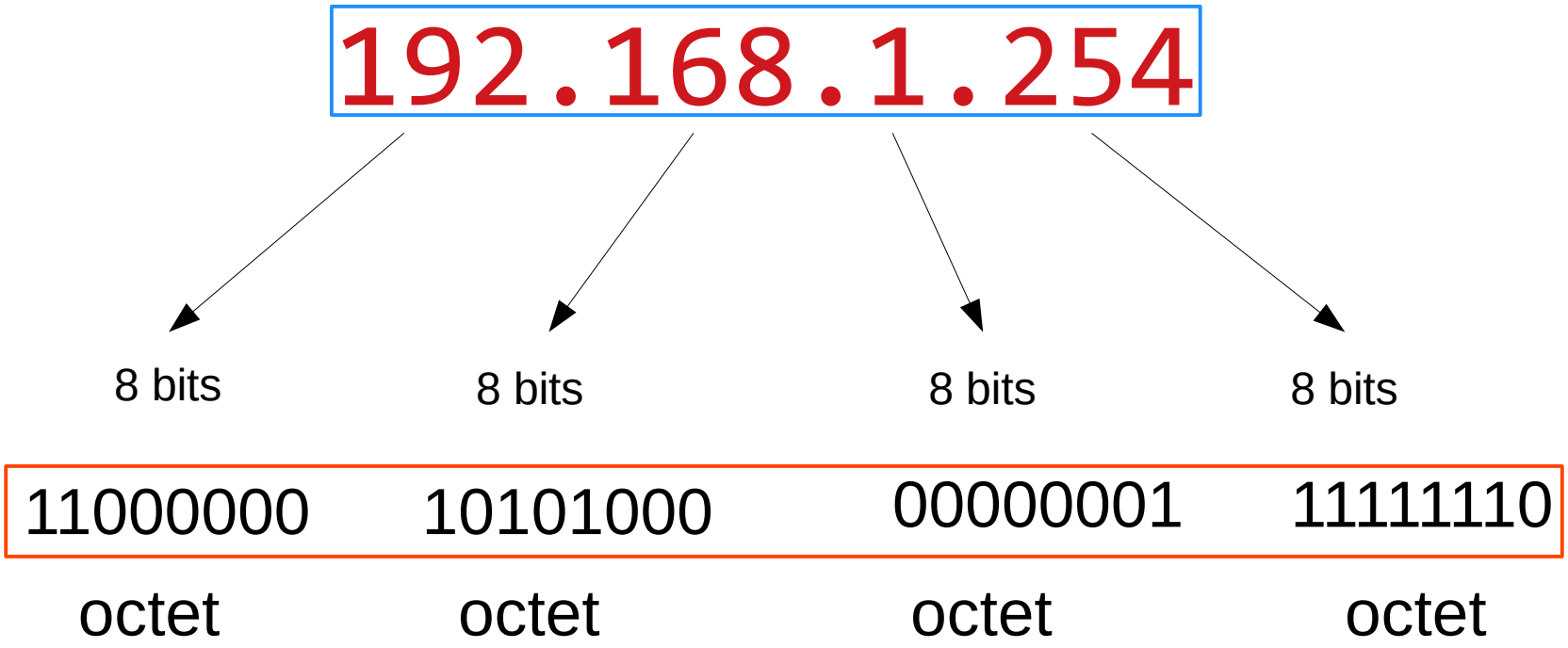
Binary (base 2)

254

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

128 + 64 + 32 + 16 + 8 + 4 + 2 = 254

IPv4 Addresses



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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 (2)

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

64 + 32 + 16 + 4 + 2

= 118

Binary → Decimal (3)

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

= 236

Decimal → Binary (1)

221

128	64	32	16	8	4	2	1
1	1	0	1	1	1	0	1
221 -128 = 93	93 -64 = 29		29 -16 = 13	13 -8 = 5	5 -4 = 1		1 -1 = 0

11011101

Decimal → Binary (2)

127

128	64	32	16	8	4	2	1
0	1	1	1	1	1	1	1
	127 -64 = 63	63 -32 = 31	31 -16 = 15	15 -8 = 7	7 -4 = 3	3 -2 = 1	1 -1 = 0

01111111

Decimal → Binary (3)

207

128	64	32	16	8	4	2	1
1	1	0	0	1	1	1	1
207	79			15	7	3	1
-128	-64			-8	-4	-2	-1
= 79	= 15			= 7	= 3	= 1	= 0

11001111

Binary

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

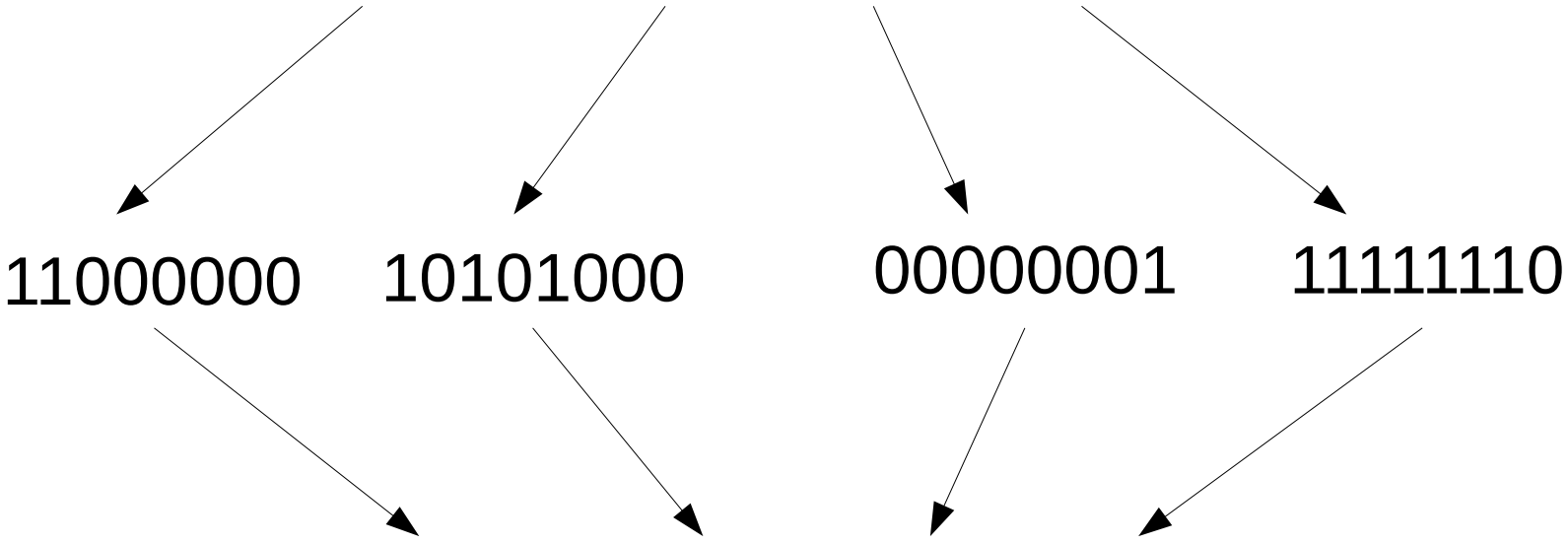
= 0

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

= 255

IPv4 Addresses

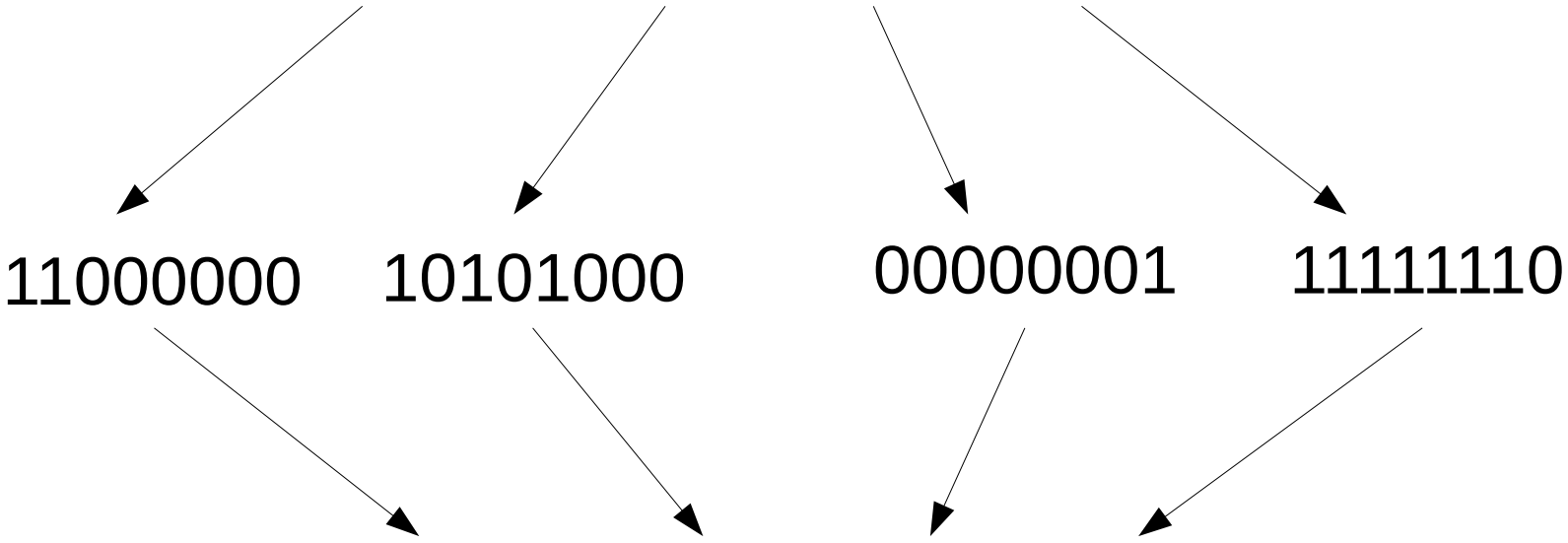
11000000101010000000000111111110



192.168.1.254/24

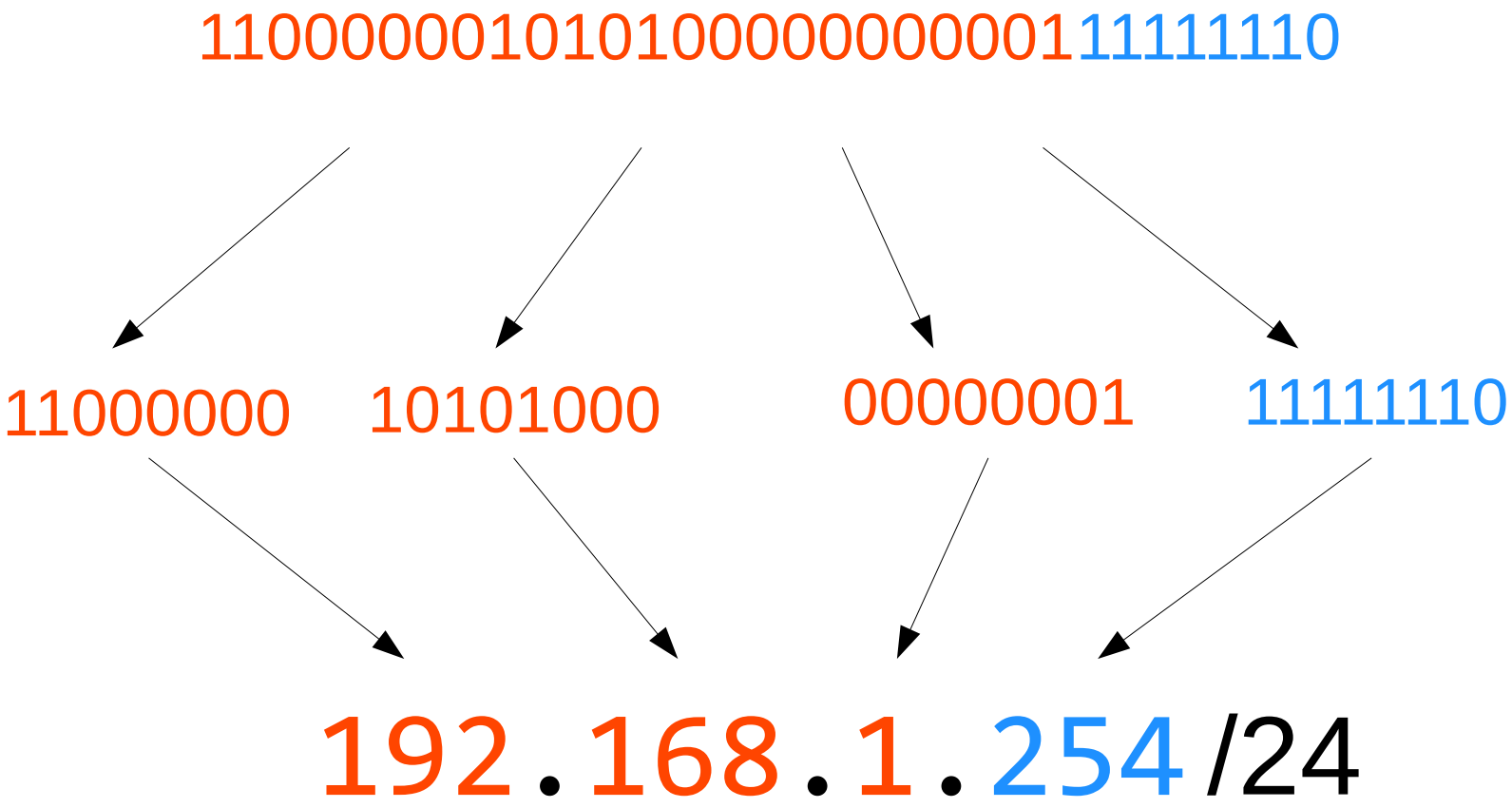
IPv4 Addresses

11000000101010000000000111111110

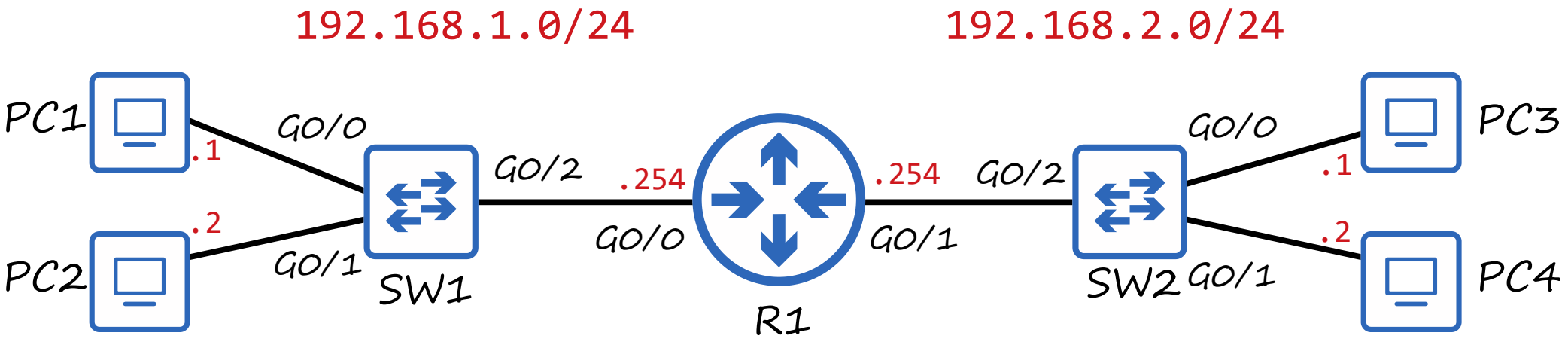


192.168.1.254/24

IPv4 Addresses



IPv4 Addresses

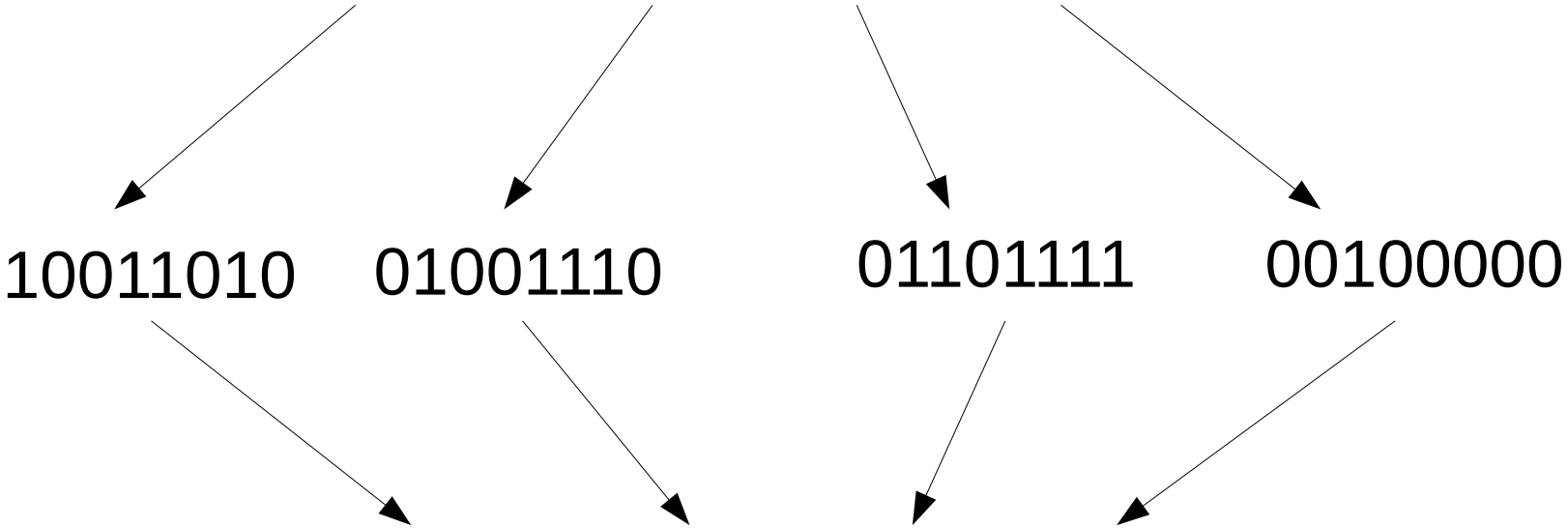


192.168.1.1/24
192.168.1.2/24
192.168.1.254/24

192.168.2.1/24
192.168.2.2/24
192.168.2.254/24

IPv4 Addresses

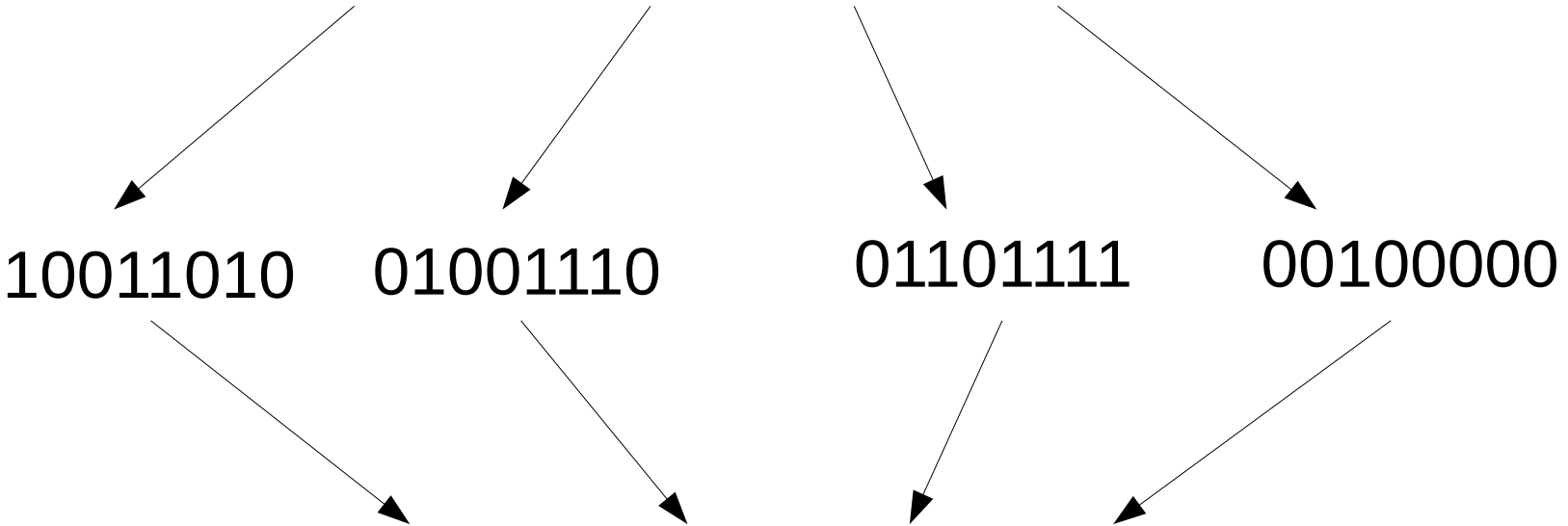
10011010010011100110111100100000



154.78.111.32/16

IPv4 Addresses

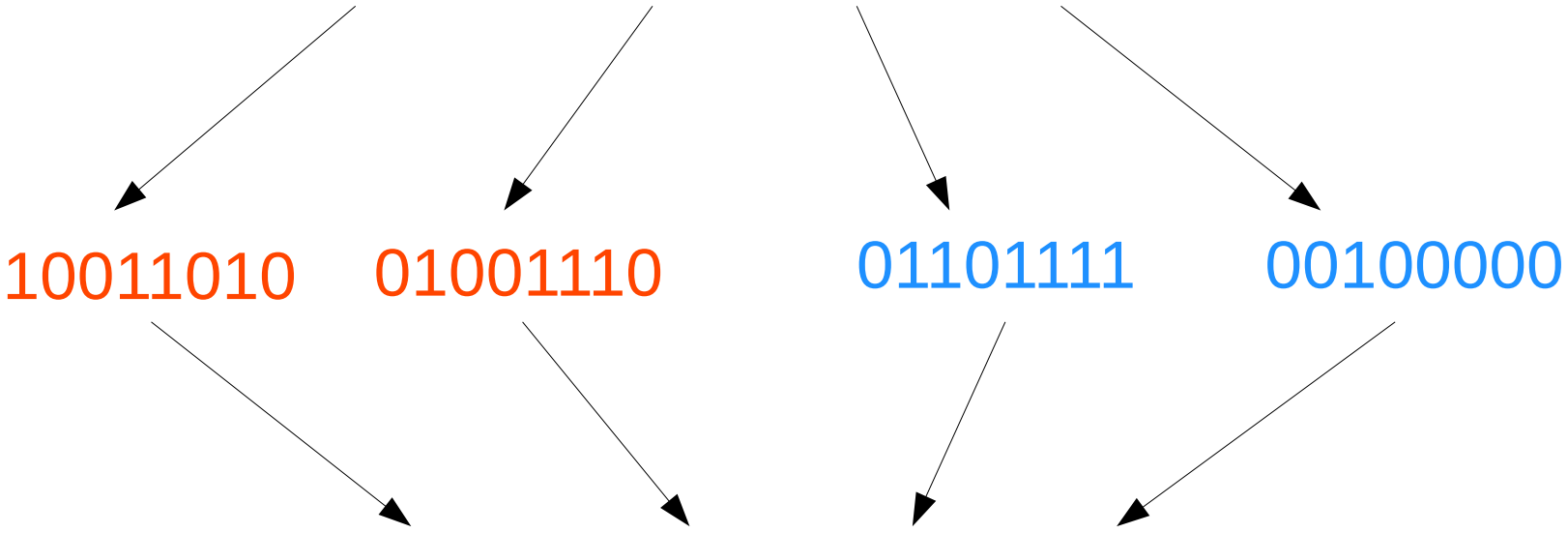
10011010010011100110111100100000



154.78.111.32/16

IPv4 Addresses

10011010010011100110111100100000

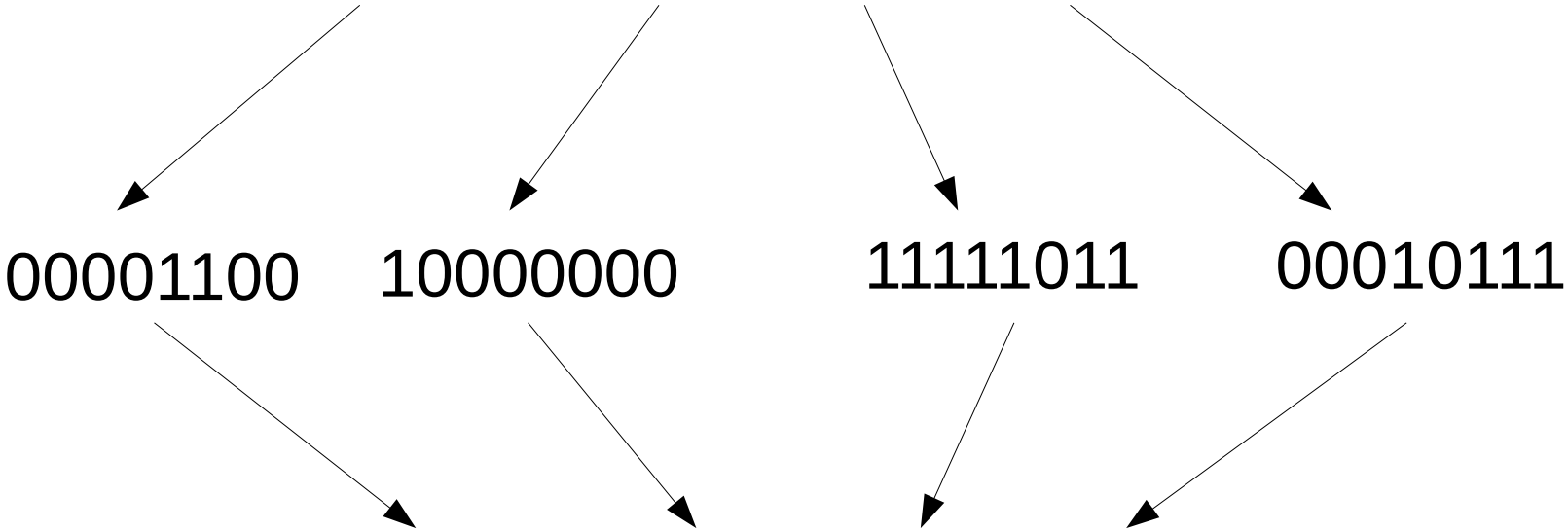


10011010 01001110 01101111 00100000

154.78.111.32/16

IPv4 Addresses

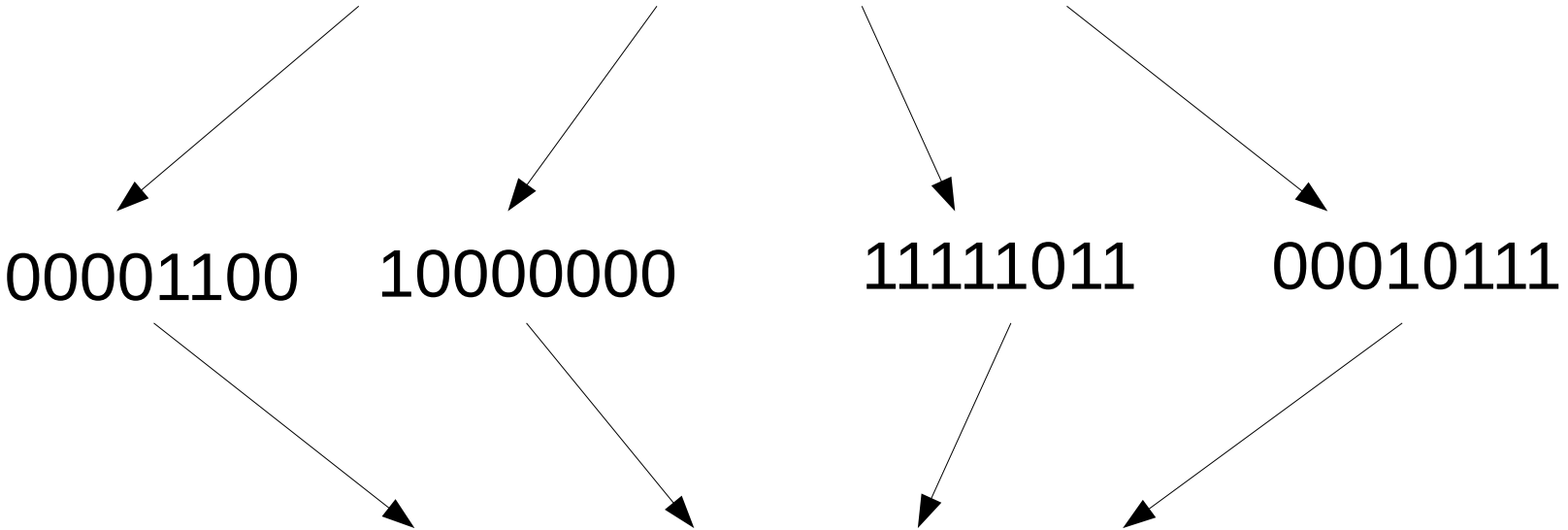
00001100100000001111101100010111



12.128.251.23 /8

IPv4 Addresses

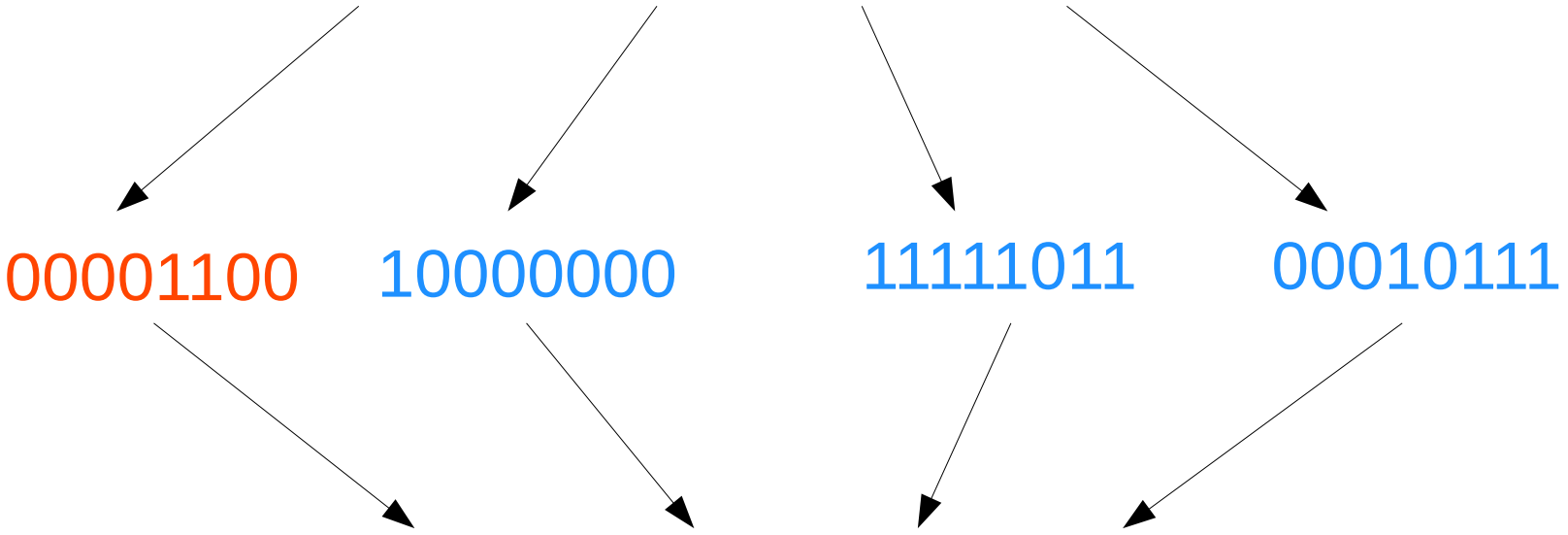
00001100100000001111101100010111



12.128.251.23 /8

IPv4 Addresses

00001100100000001111101100010111



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

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

Multicast addresses →

Reserved (experimental) →

Loopback Addresses

- 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
```

IPv4 Address Classes

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

IPv4 Address Classes

Class A: 12.128.251.23/8

Class B: 154.78.111.32/16

Class C: 192.168.1.254/24

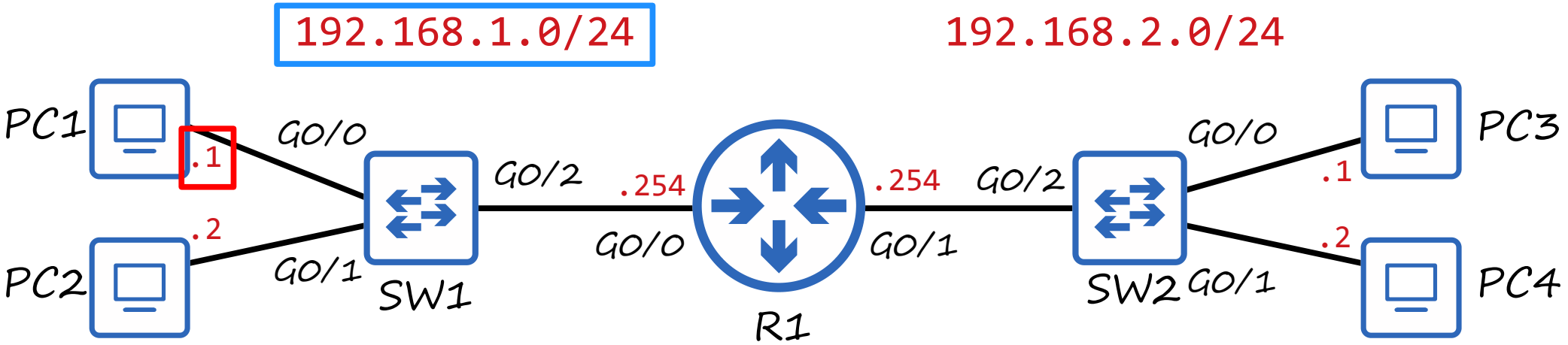
IPv4 Address Classes

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)

Netmask

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)

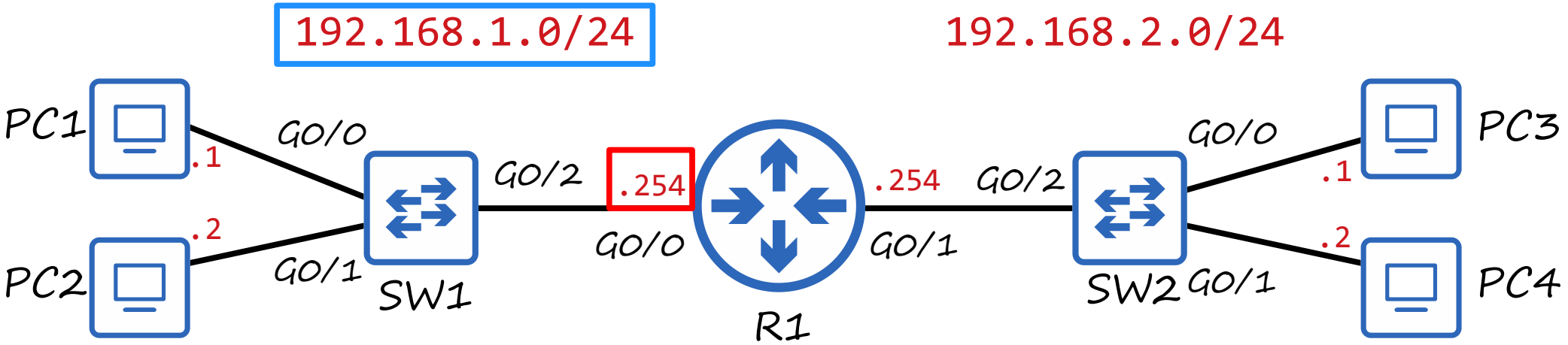
Network Address



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

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

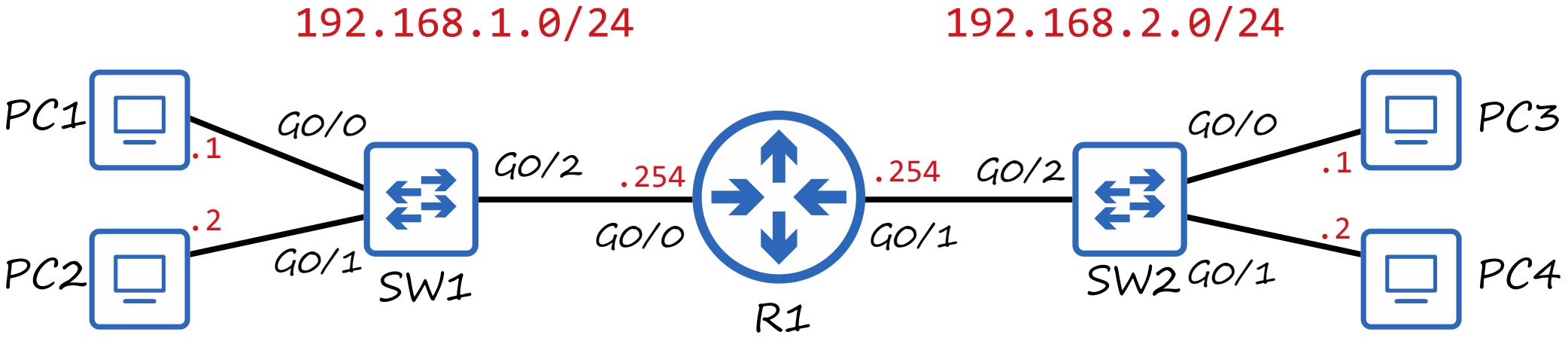
Broadcast Address



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

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

Broadcast Address



Dst. IP: 192.168.1.255

Dst. MAC: FF:FF:FF:FF:FF:FF

Review

- Dotted decimal & binary
- Network portion / host portion of IPv4 addresses
- IPv4 address classes
- Prefix lengths / netmasks
- Network addresses / broadcast addresses

QUIZ

Quiz Question 1

Convert the following IPv4 address to dotted decimal notation:

00111111 00111000 11100111 00010011

63.56.231.19

Quiz Question 2

Convert the following IPv4 address to dotted decimal notation:

11110011 01111111 01100010 00000001

243.127.98.1

Quiz Question 3

Convert the following IPv4 address to dotted decimal notation:

01101111 00000110 01011001 11000111

111.6.89.199

Quiz Question 4

Convert the following IPv4 address to dotted decimal notation:

11001111 11000110 00101111 01001100

207.198.47.76

Quiz Question 5

Convert the following IPv4 address to dotted decimal notation:

01100100 11001001 00100001 11111101

100.201.33.253

Quiz Question 6

Convert the following IPv4 address to binary notation:

88.46.90.91

01011000 00101110 01011010 01011011

Quiz Question 7

Convert the following IPv4 address to binary notation:

221.234.246.163

11011101 11101010 11110110 10100011

Quiz Question 8

Convert the following IPv4 address to binary notation:

3.41.143.222

00000011 00101001 10001111 11011110

Quiz Question 9

Convert the following IPv4 address to binary notation:

10.200.231.91

00001010 11001000 11100111 01011011

Quiz Question 10

Convert the following IPv4 address to binary notation:

248.87.255.152

11111000 01010111 11111111 10011000

Supplementary Materials

- Review flash cards (link in the description)
- Packet Tracer lab (after PART 2's video)