Chapter 7:
Explore the Network

Introduction to Networks v5.1

Chapter Outline

Section 7.1:
IPv4 Network Addresses

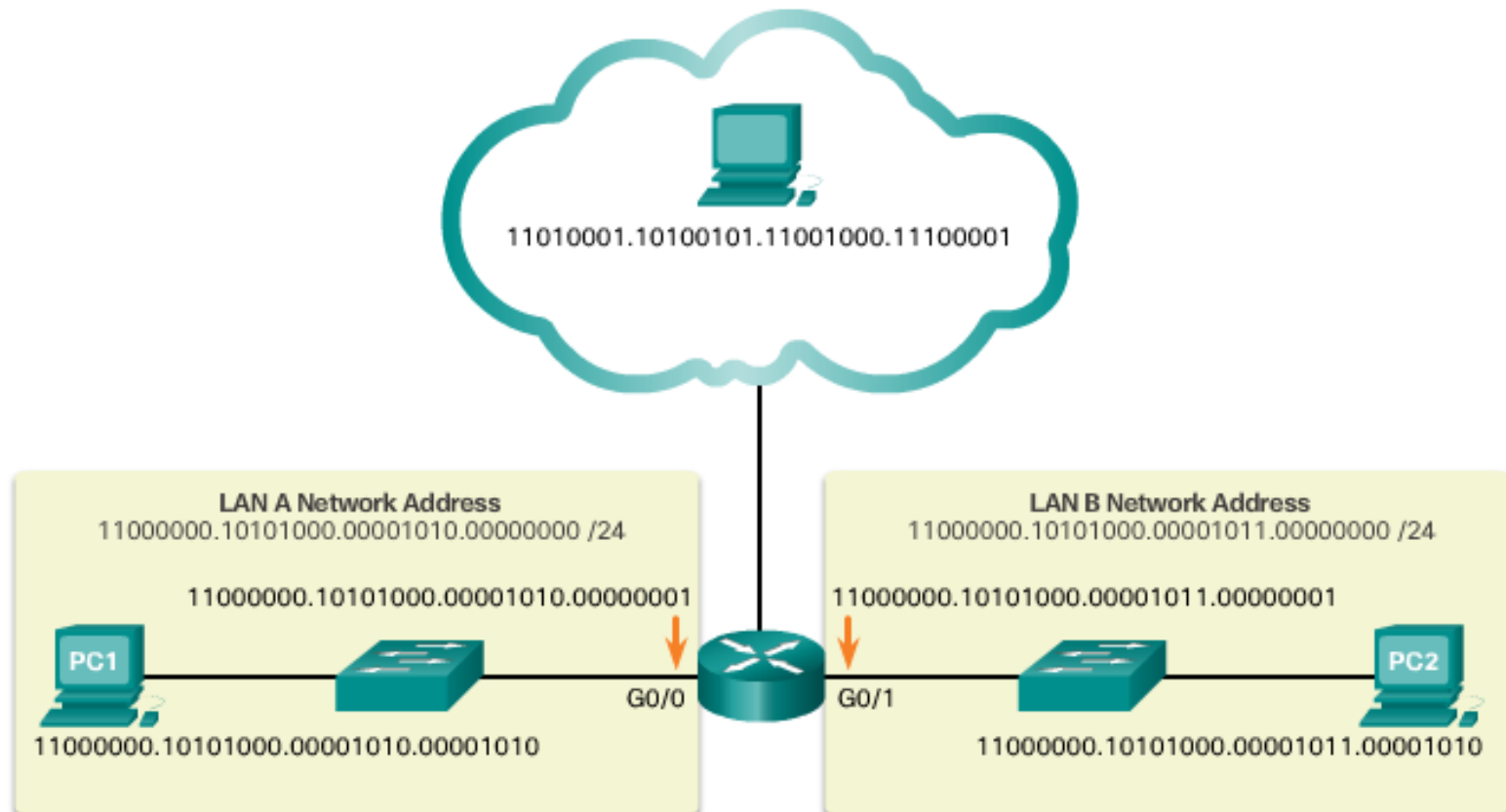Upon completion of this section, you should be able to:

- Convert between binary and decimal numbering systems.

- Describe the structure of an IPv4 address including the network portion, the host portion, and the subnet mask.

- Compare the characteristics and uses of the unicast, broadcast, and multicast IPv4 addresses.

- Explain public, private, and reserved IPv4 addresses.

Topic 7.1.1:
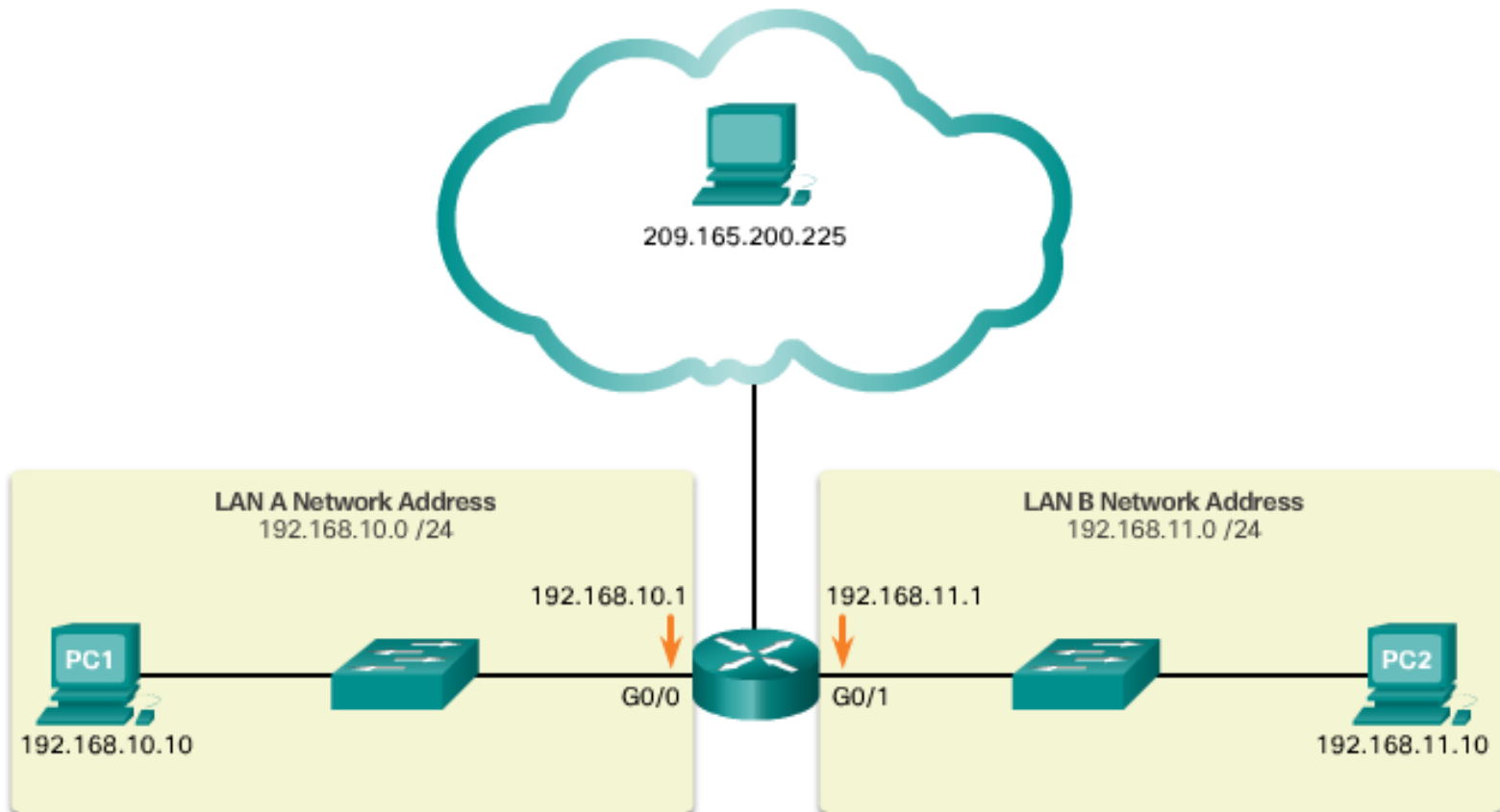# Binary and Decimal Conversion

IPv4 Addresses

IPv4 Addresses Expressed in Binary

11010001.10100101.11001000.11100001

LAN A Network Address
11000000.10101000.00001010.00000000 /24

11000000.10101000.00001010.00000001

PC1

G0/0

11000000.10101000.00001010.00001010

LAN B Network Address
11000000.10101000.00001011.00000000 /24

11000000.10101000.00001011.00000001

G0/1

PC2

11000000.10101000.00001011.00001010

IPv4 Addresses (cont.)

IPv4 Addresses Expressed in Dotted Decimal

IPv4 Addresses (cont.)

Dotted Decimal Address

192	.	168	.	10	.	10
11000000		10101000		00001010		00001010

192.168.10.10 is an IP address that is assigned to a computer.

Octets

192	.	168	.	10	.	10
11000000		10101000		00001010		00001010

This address is made up of four different octets.

32-Bit Address

192	.	168	.	10	.	10
11000000		10101000		00001010		00001010

The computer stores the address as the entire 32-bit data stream.

Positional Notation

Decimal Positional Notation

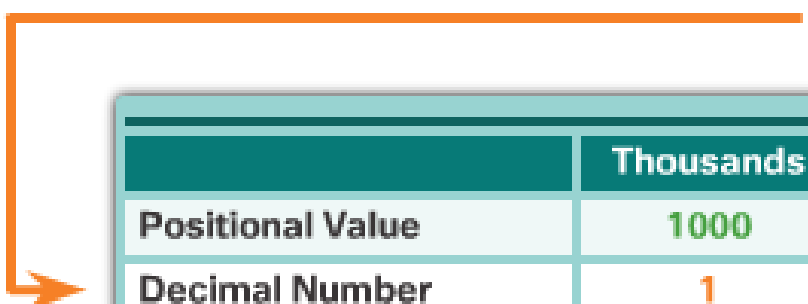| Radix	10	10	10	10
Position in #	3	2	1	0
Calculate	(10^3)	(10^2)	(10^1)	(10^0)
Positional Value	1000	100	10	1

Positional Value

The first row identifies the number base or radix. Therefore the value listed, from left to right, represents units of thousands, hundreds, tens, and ones.

Positional Notation (cont.)

Applying Decimal Positional Notation

1234

	Thousands	Hundreds	Tens	Ones
Positional Value	1000	100	10	1
Decimal Number	1	2	3	4
Calculate	1 x1000	2 x100	3 x10	4 x1
Add them up …	1000	+ 200	+ 30	+ 4
Result	1,234			

Positional Notation (cont.)

Binary Positional Notation

Radix	2	2	2	2	2	2	2	2
Position in #	7	6	5	4	3	2	1	0
Calculate	(2^7)	(2^6)	(2^5)	(2^4)	(2^3)	(2^2)	(2^1)	(2^0)
Positional Value	128	64	32	16	8	4	2	1

Radix

The binary notation system is based on 2, therefore the radix is 2.

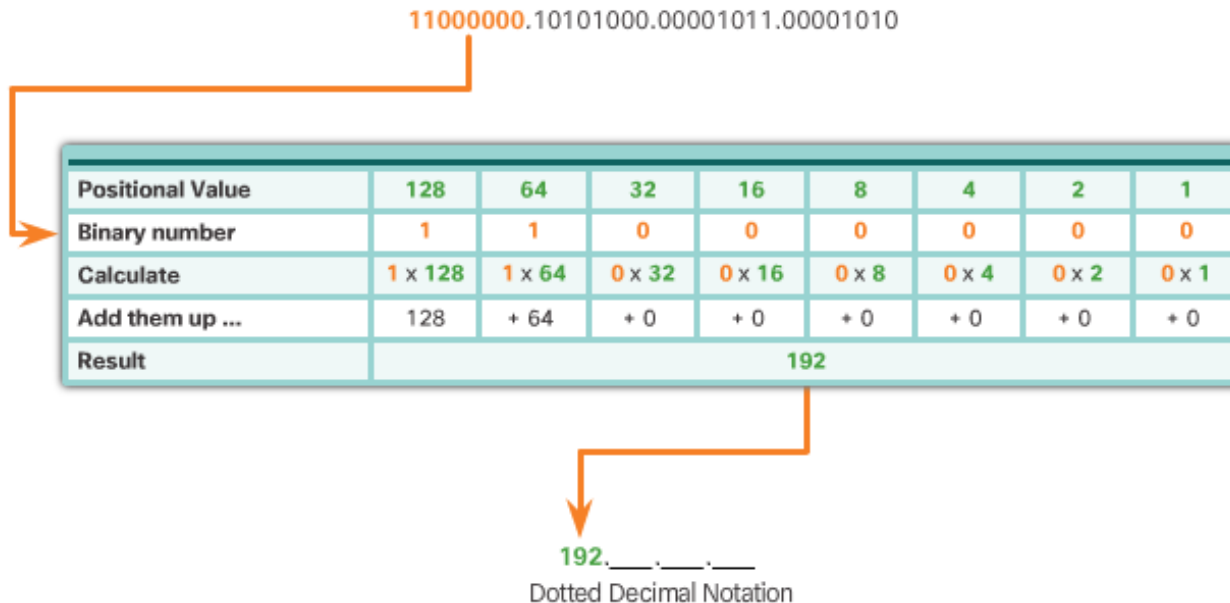# Positional Notation (cont.)

Applying Binary Positional Notation

11000000

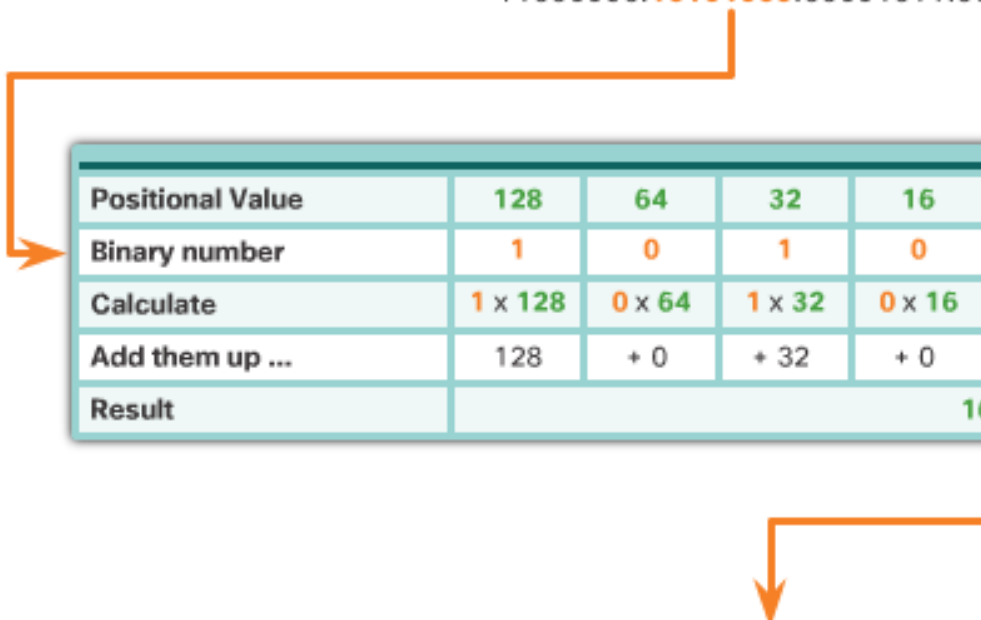| Positional Value	128	64	32	16	8	4	2	1
Binary number	1	1	0	0	0	0	0	0
Calculate	1 x 128	1 x 64	0 x 32	0 x 16	0 x 8	0 x 4	0 x 2	0 x 1
Add them up ...	128	+ 64	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Result	192							

Binary to Decimal Conversion

To convert a binary IPv4 address to its dotted decimal equivalent:

- Divide the IPv4 address into four 8-bit octets. Apply the binary positional value to the first octet binary number and calculate accordingly.

- Repeat for each octet.

11000000.10101000.00001011.00001010

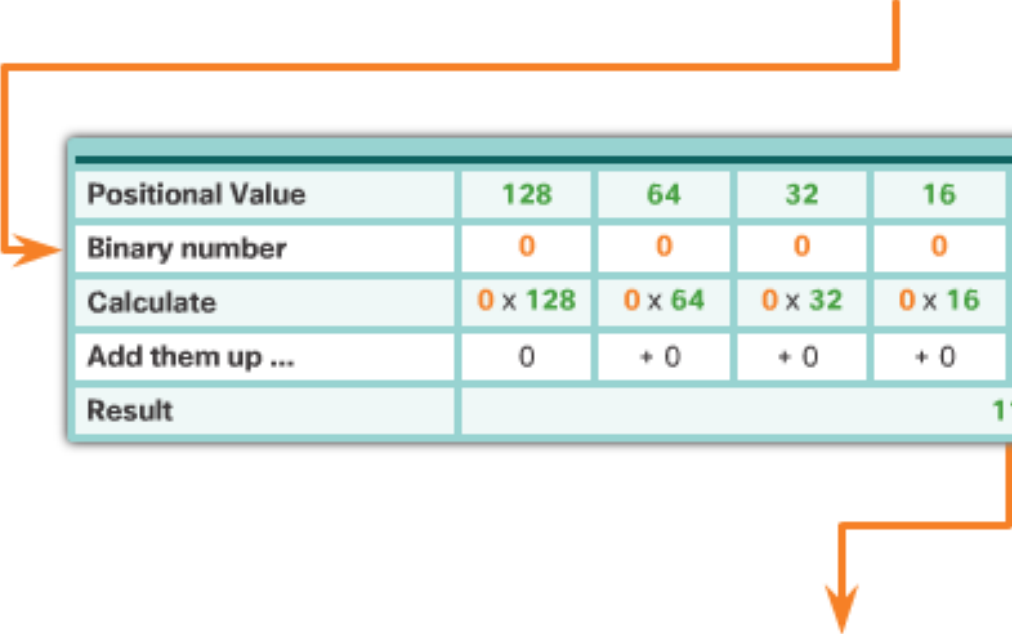| Positional Value	128	64	32	16	8	4	2	1
Binary number	1	1	0	0	0	0	0	0
Calculate	1 x 128	1 x 64	0 x 32	0 x 16	0 x 8	0 x 4	0 x 2	0 x 1
Add them up ...	128	+ 64	+ 0	+ 0	+ 0	+ 0	+ 0	+ 0
Result	192							

192.___.___.___
Dotted Decimal Notation

Binary to Decimal Conversion (cont.)

11000000.**10101000**.00001011.00001010

Positional Value	128	64	32	16	8	4	2	1
Binary number	1	0	1	0	1	0	0	0
Calculate	1 x 128	0 x 64	1 x 32	0 x 16	1 x 8	0 x 4	0 x 2	0 x 1
Add them up …	128	+ 0	+ 32	+ 0	+ 8	+ 0	+ 0	+ 0
Result	168							

192.**168**.___.___

Dotted Decimal Notation

Binary to Decimal Conversion (cont.)

11000000.10101000.00001011.00001010

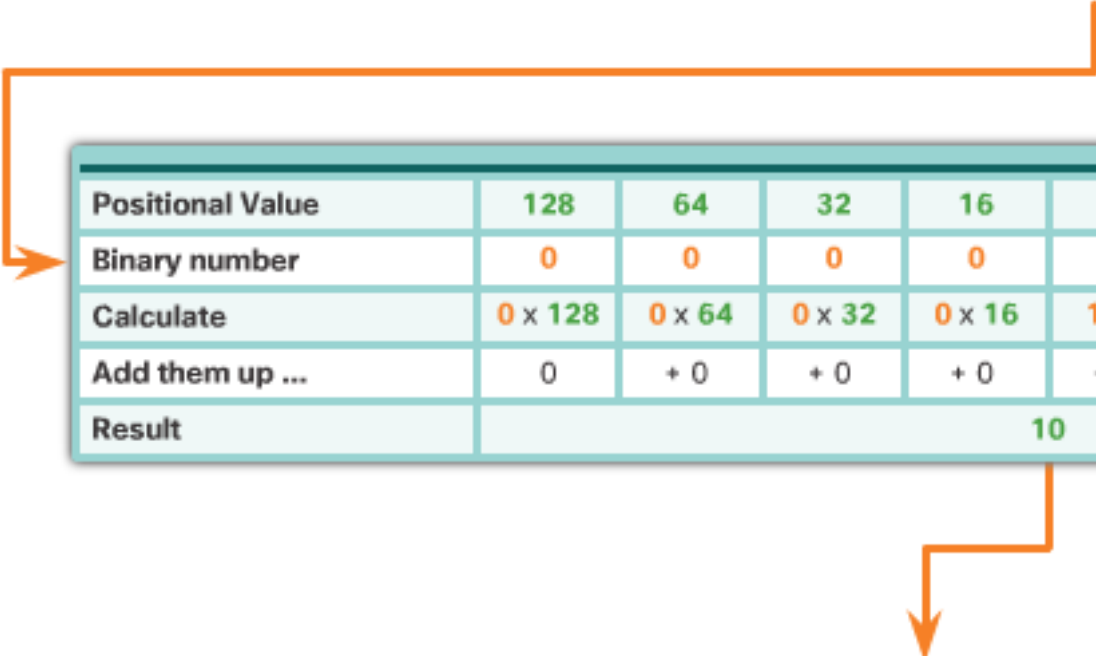| Positional Value	128	64	32	16	8	4	2	1
Binary number	0	0	0	0	1	0	1	1
Calculate	0 x 128	0 x 64	0 x 32	0 x 16	1 x 8	0 x 4	1 x 2	1 x 1
Add them up ...	0	+ 0	+ 0	+ 0	+ 8	+ 0	+ 2	+ 1
Result	11							

192.168.11.___
Dotted Decimal Notation

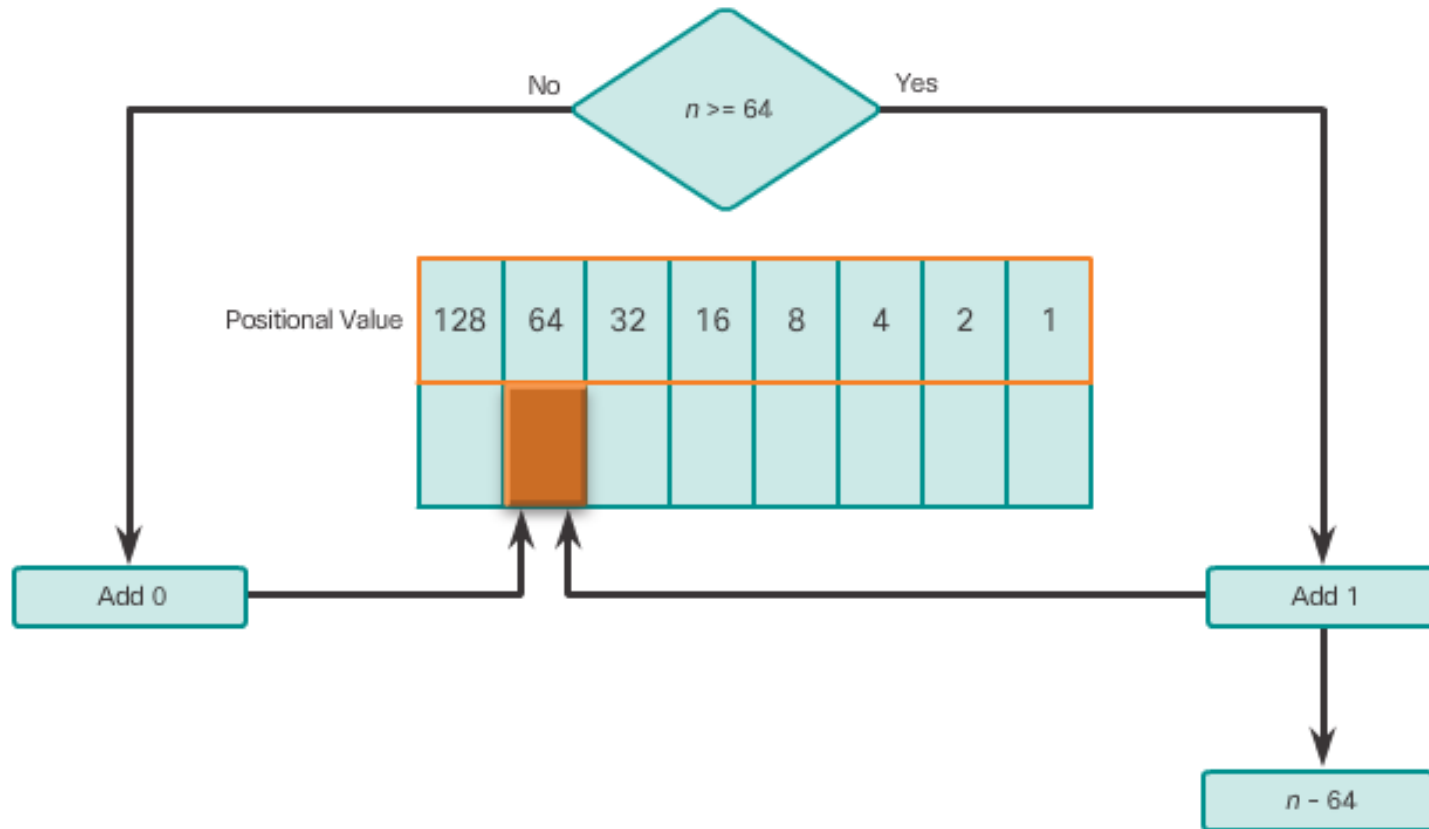# Binary to Decimal Conversion (cont.)

11000000.10101000.00001011.**00001010**

	128	64	32	16	8	4	2	1
Positional Value	128	64	32	16	8	4	2	1
Binary number	0	0	0	0	1	0	1	0
Calculate	0 x 128	0 x 64	0 x 32	0 x 16	1 x 8	0 x 4	1 x 2	0 x 1
Add them up ...	0	+ 0	+ 0	+ 0	+ 8	+ 0	+ 2	+ 0
Result	10							

192.168.11.**10**
Dotted Decimal Notation

Decimal to Binary Conversion

The following illustrates how to use the binary positional value table to convert decimal to binary.

Is the Decimal n Greater Than or Equal To 128?

No $n >= 128$ Yes

Positional Value	128	64	32	16	8	4	2	1

Add 0

Add 1

$n - 128$

Decimal to Binary Conversion (cont.)

Is the Decimal n Greater Than or Equal To 64?

Decimal to Binary Conversion (cont.)

Is the Decimal n Greater Than or Equal To 32?

Continue to evaluate the decimal until all positional values have been entered, which results in the equivalent binary value.
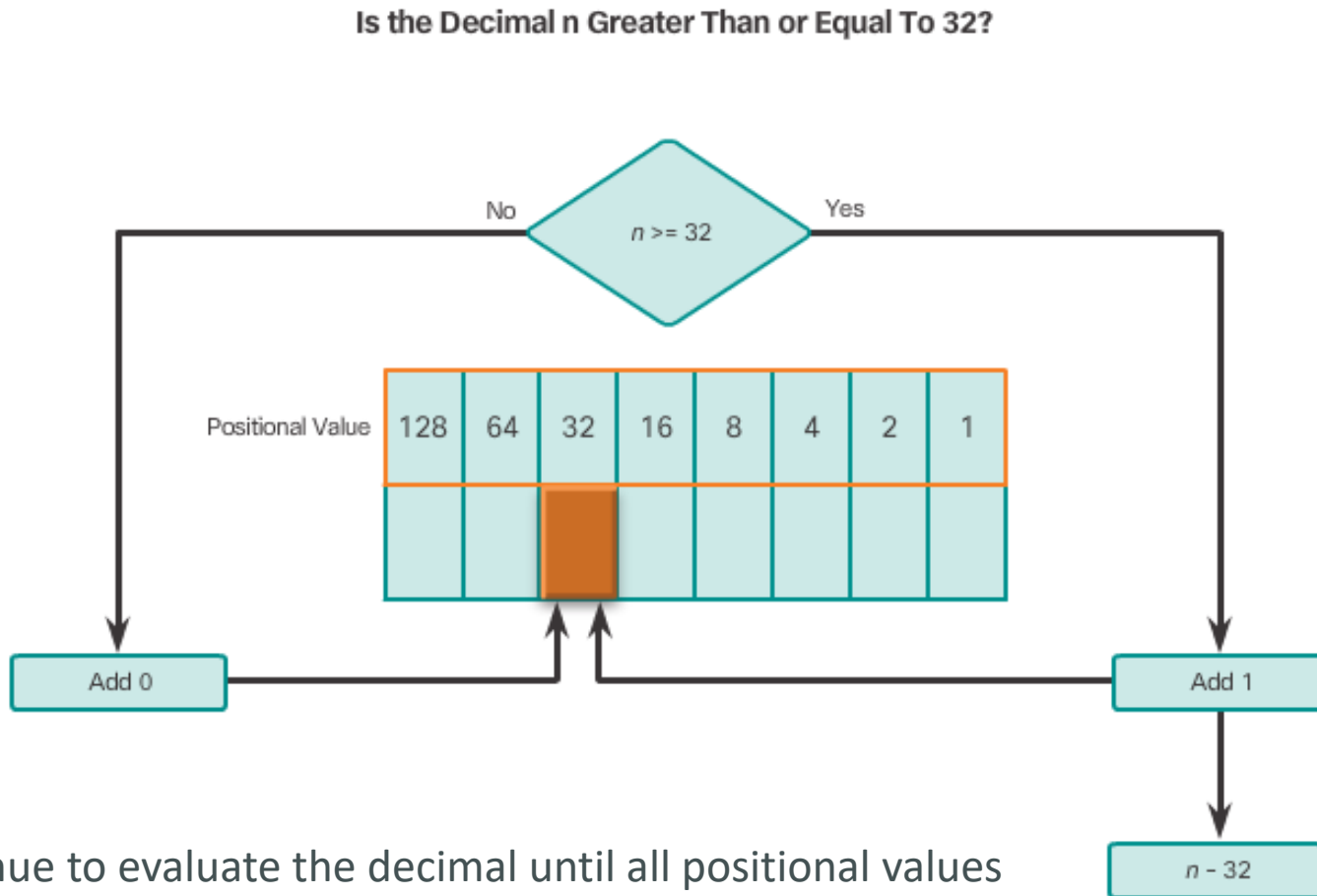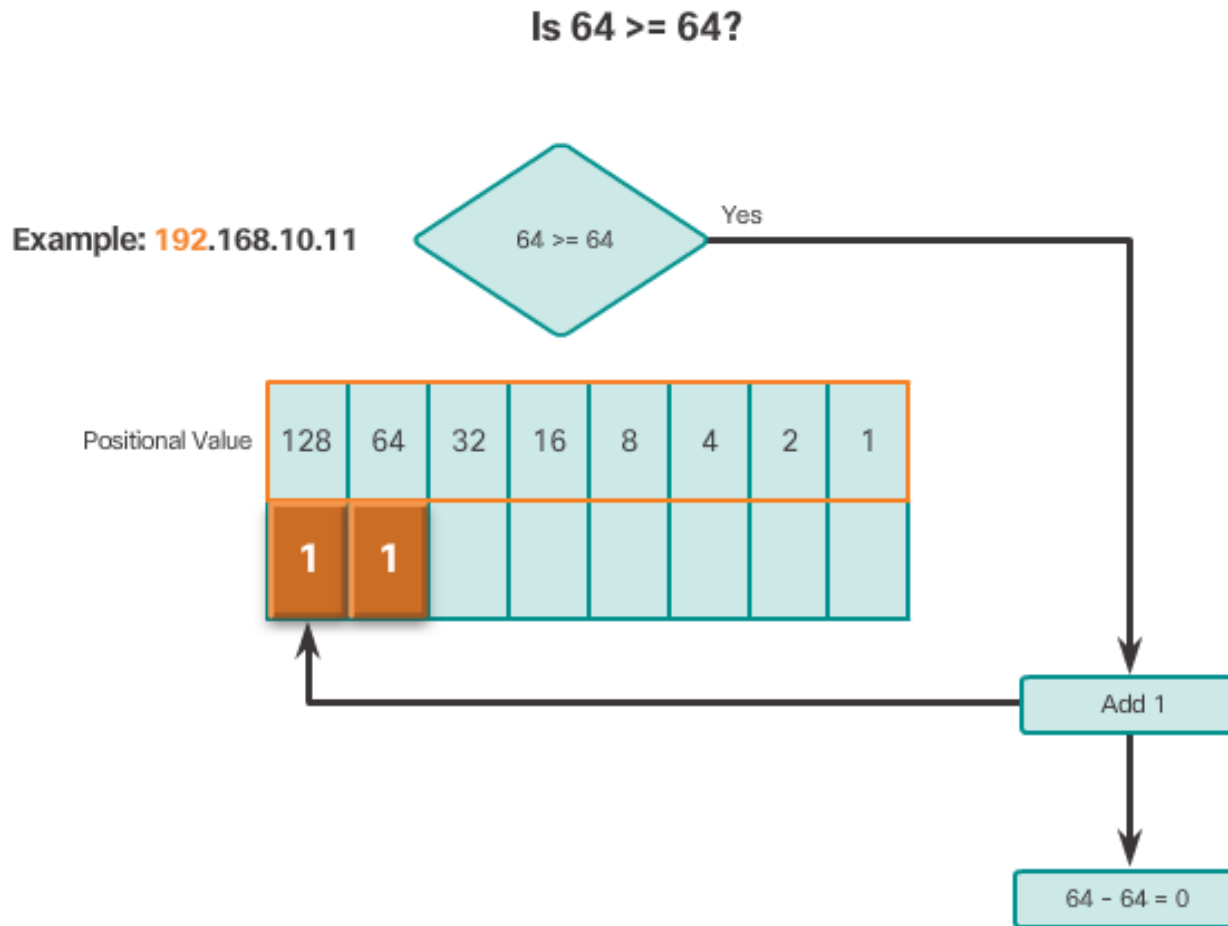
Decimal to Binary Conversion Example
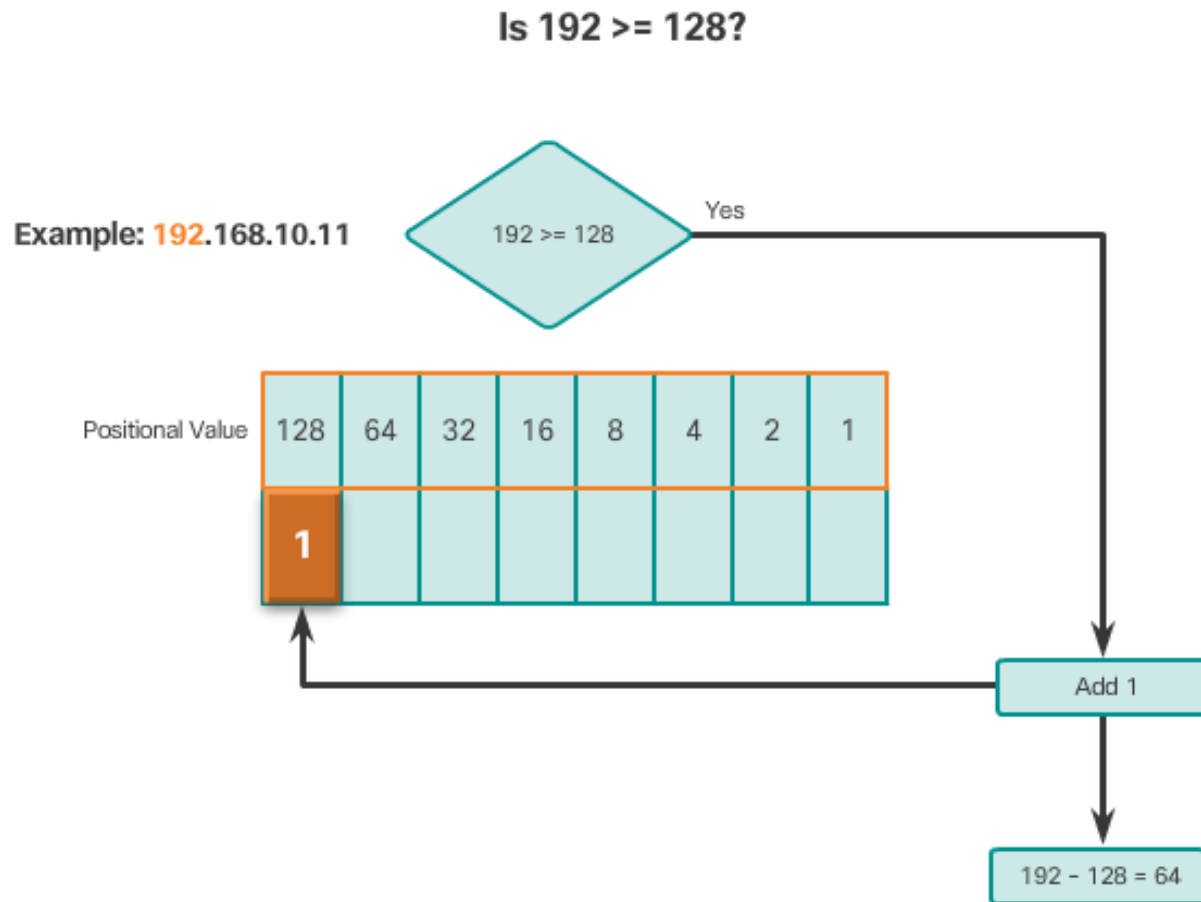
Decimal to Binary Conversion Example (cont.)

Decimal to Binary Conversion Example (cont.)

192 = 11000000

Example: 192.168.10.11

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

11000000 . _____ . _____ . _____

See VIDEO DEMONSTRATION