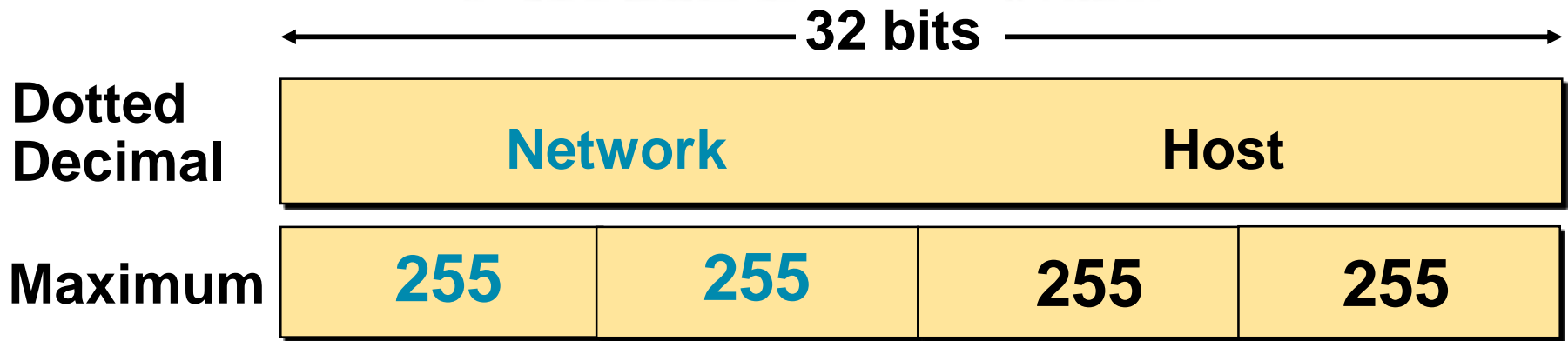
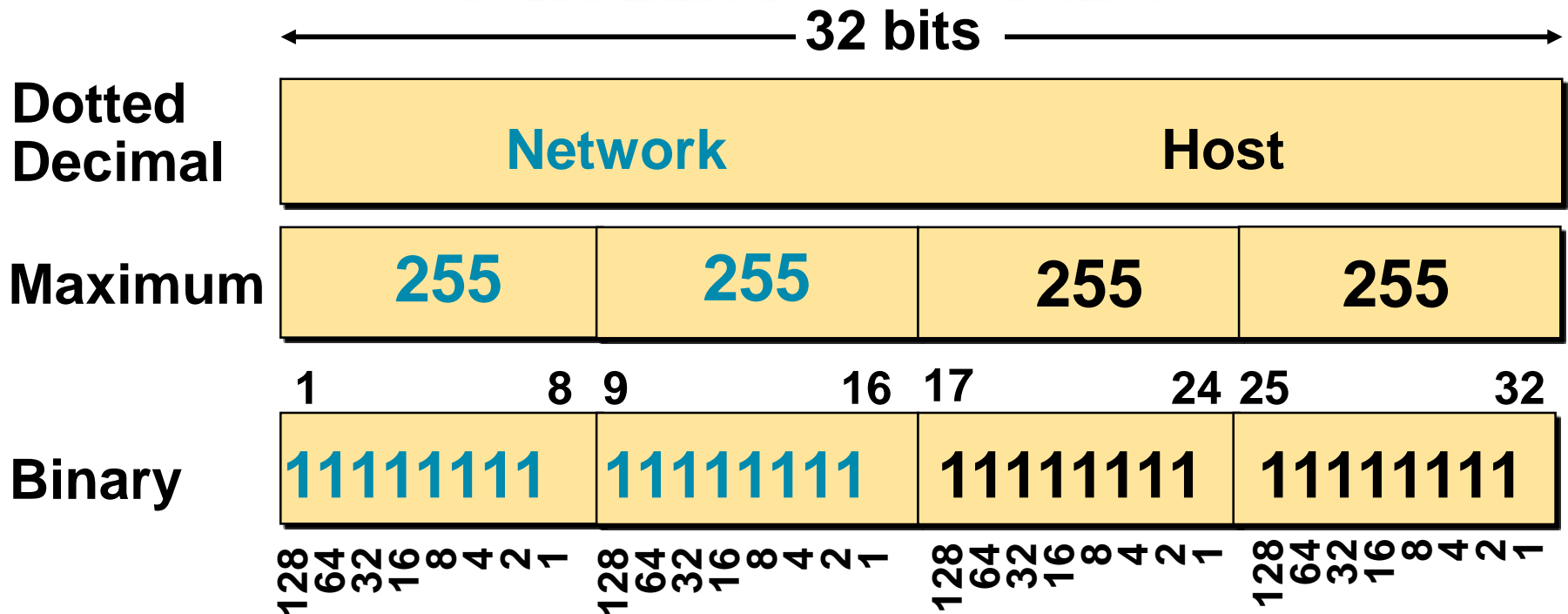


# IP Addressing



# IP Addressing



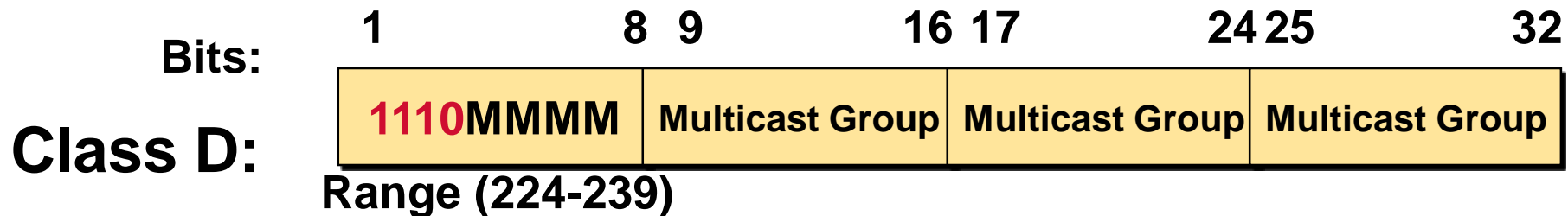
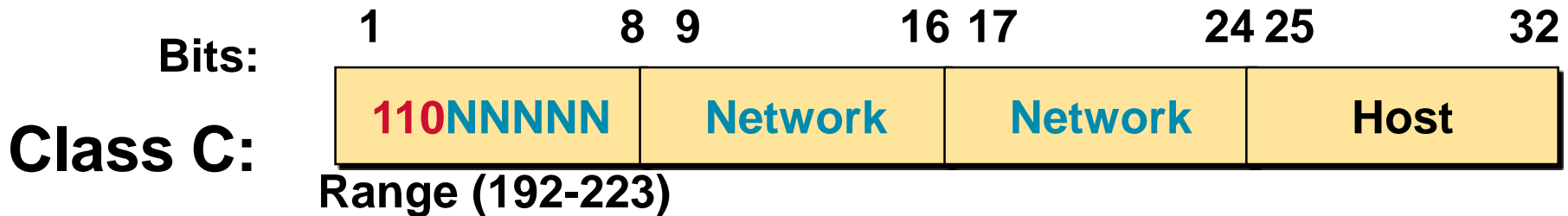
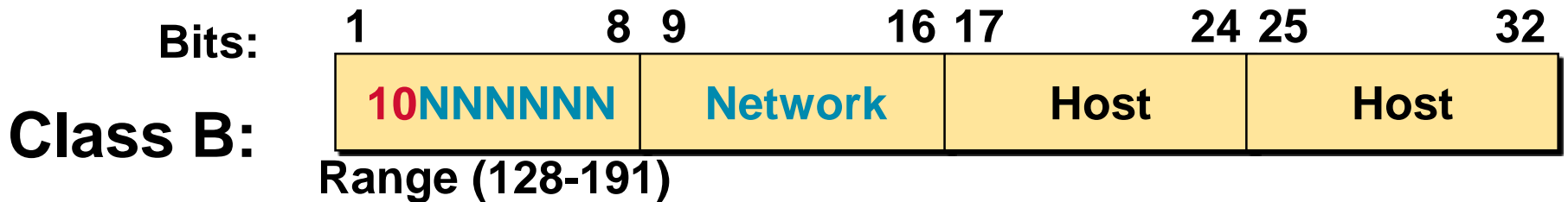
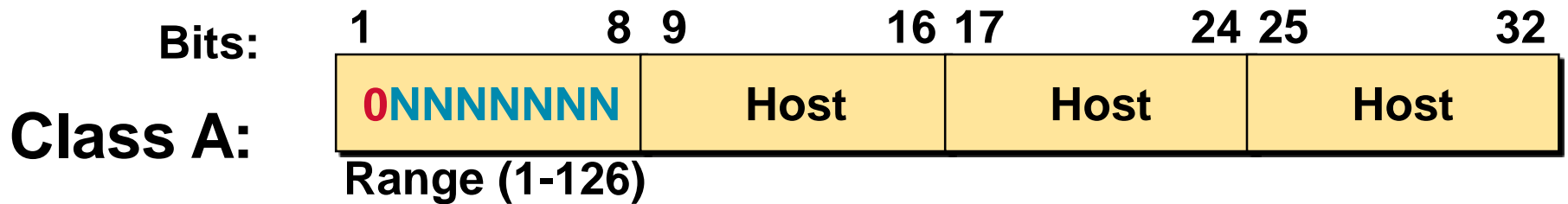
# IP Addressing

	← 32 bits →															
Dotted Decimal	Network								Host							
Maximum	255				255				255				255			
	1		8		9		16		17		24		25		32	
Binary	11111111				11111111				11111111				11111111			
	128	64	32	16	8	4	2	1	128	64	32	16	8	4	2	1
Example Decimal	172				16				122				204			
Example Binary	10101100				00010000				01111010				11001100			

# IP Address Classes

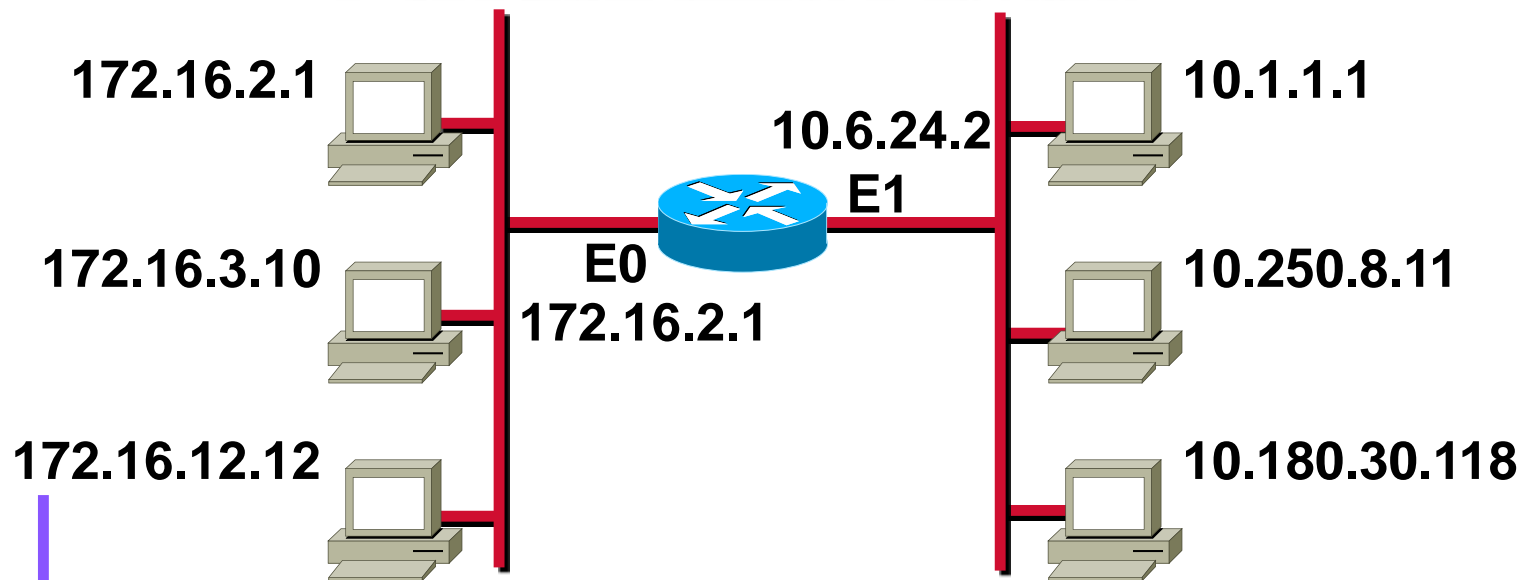
	8 bits	8 bits	8 bits	8 bits
<b>Class A:</b>	Network	Host	Host	Host
<b>Class B:</b>	Network	Network	Host	Host
<b>Class C:</b>	Network	Network	Network	Host
<b>Class D:</b>	Multicast			
<b>Class E:</b>	Research			

# IP Address Classes





# Host Addresses



172.16.12.12

↓

172.16 . 12 . 12

Network Host

Routing Table	
Network	Interface
172.16.0.0	E0
10.0.0.0	E1

# Determining Available Host Addresses

Network

Host

172

16

0

0

10101100 00010000

16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 N

00000000 00000000  
00000000 00000001  
00000000 00000011

⋮  
11111111 11111101  
11111111 11111110  
11111111 11111111

1  
2  
3  
⋮

65534

65535

65536

- 2

65534

$$2^N - 2 = 2^{16} - 2 = 65534$$

# IP Address Classes Exercise

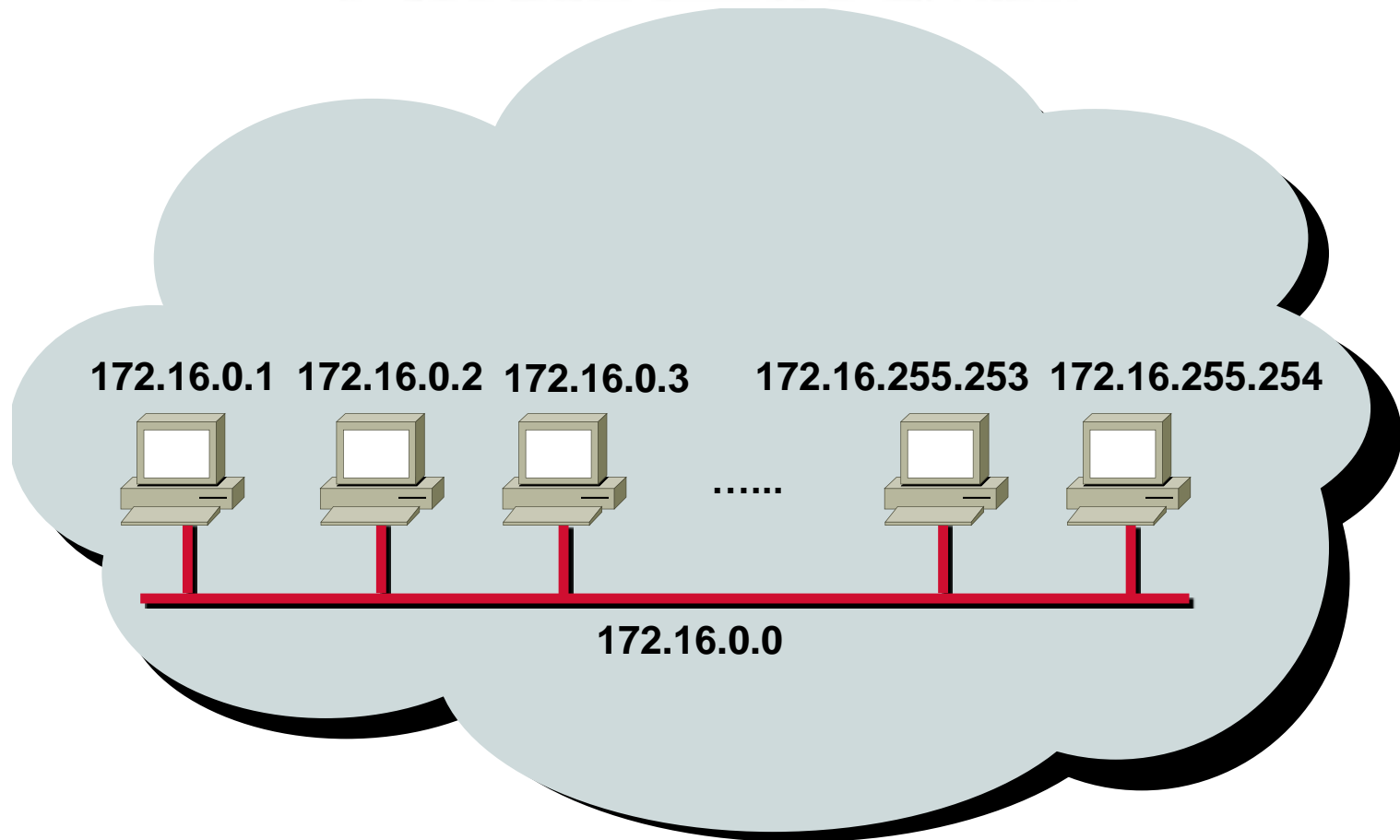
Address	Class	Network	Host
10.2.1.1			
128.63.2.100			
201.222.5.64			
192.6.141.2			
130.113.64.16			
256.241.201.10			



# IP Address Classes Exercise Answers

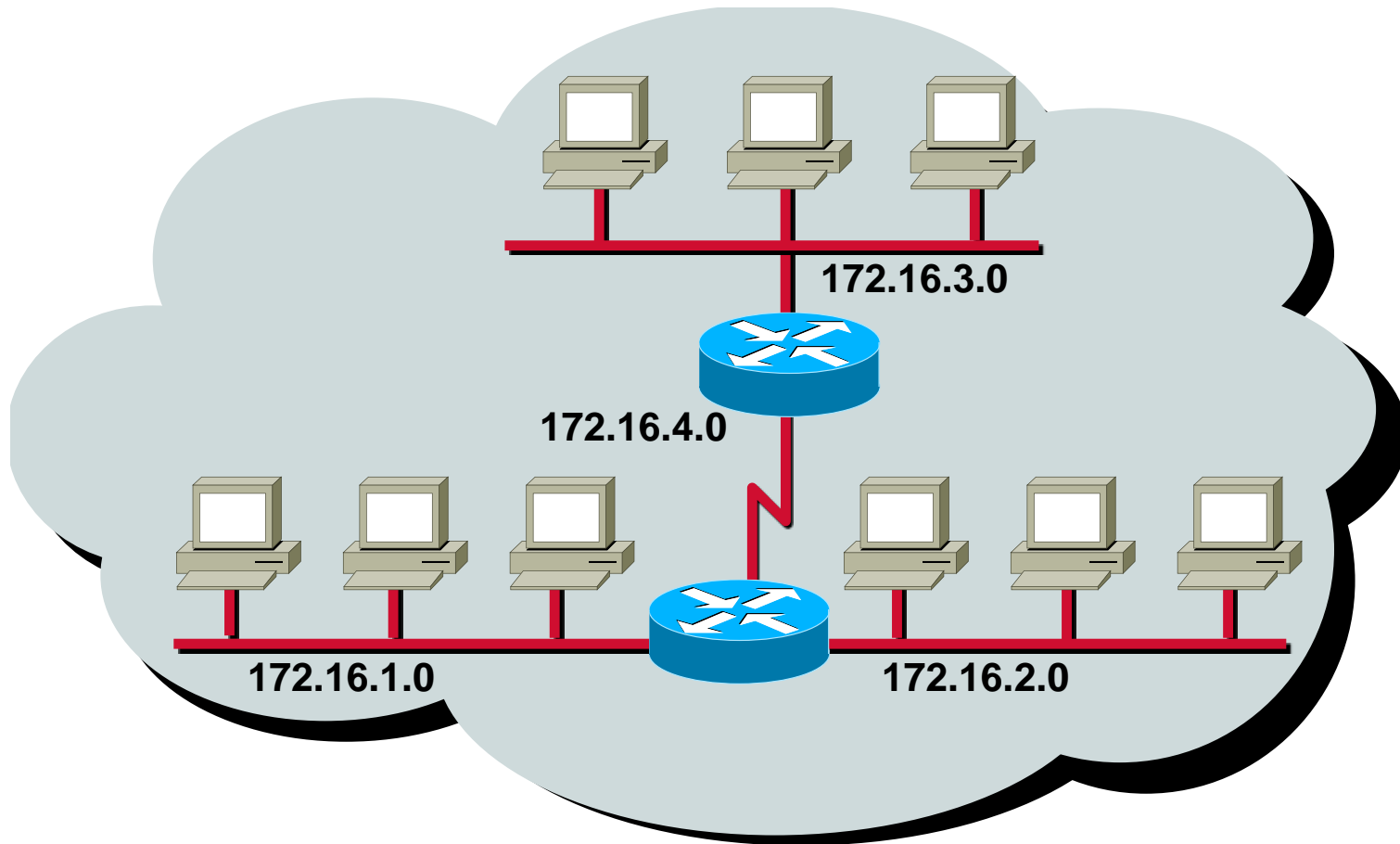
Address	Class	Network	Host
10.2.1.1	A	10.0.0.0	0.2.1.1
128.63.2.100	B	128.63.0.0	0.0.2.100
201.222.5.64	C	201.222.5.0	0.0.0.64
192.6.141.2	C	192.6.141.0	0.0.0.2
130.113.64.16	B	130.113.0.0	0.0.64.16
256.241.201.10	Nonexistent		

# Addressing without Subnets



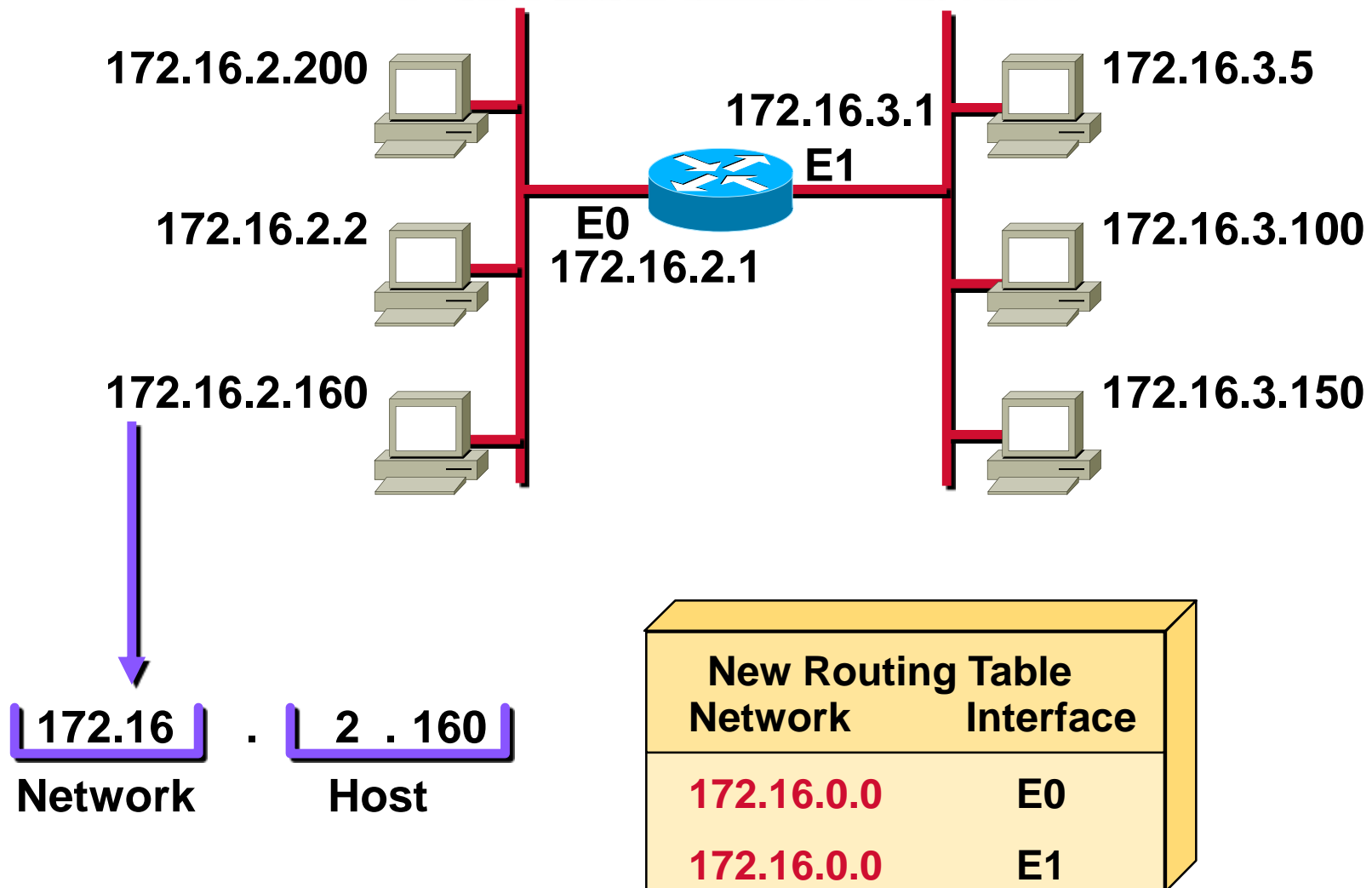
**Network 172.16.0.0**

# Addressing with Subnets

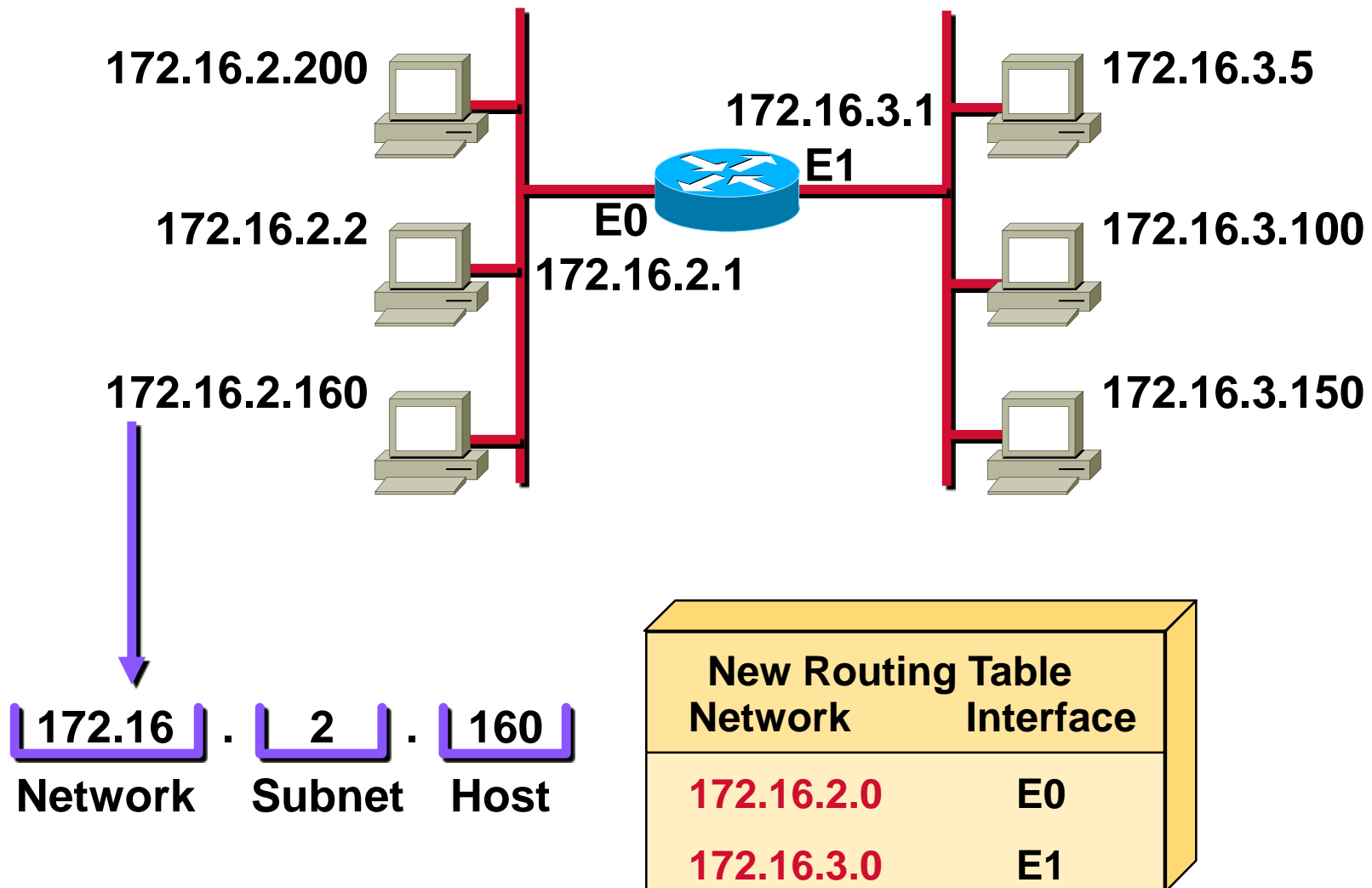


**Network 172.16.0.0**

# Subnet Addressing



# Subnet Addressing





# Subnet Mask

IP  
Address

Network		Host	
172	16	0	0

Default  
Subnet  
Mask

Network		Host	
255 11111111	255 11111111	0 00000000	0 00000000

Also written as “/16” where 16 represents the number of 1s in the mask.

8-bit  
Subnet  
Mask

Network		Subnet	Host
255	255	255	0

Also written as “/24” where 24 represents the number of 1s in the mask.

# Decimal Equivalents of Bit Patterns

128	64	32	16	8	4	2	1	
↓	↓	↓	↓	↓	↓	↓	↓	
1	0	0	0	0	0	0	0	= 128
1	1	0	0	0	0	0	0	= 192
1	1	1	0	0	0	0	0	= 224
1	1	1	1	0	0	0	0	= 240
1	1	1	1	1	0	0	0	= 248
1	1	1	1	1	1	0	0	= 252
1	1	1	1	1	1	1	0	= 254
1	1	1	1	1	1	1	1	= 255

# Subnet Mask without Subnets

Network		Host	
172.16.2.160	10101100 00010000	00000010 10100000	
255.255.0.0	11111111 11111111	00000000 00000000	
	10101100 00010000	00000000 00000000	
Network Number	172	16	0

**Subnets not in use—the default**

# Subnet Mask with Subnets

	Network		Subnet	Host
172.16.2.160	10101100	00010000	00000010	10100000
255.255.255.0	11111111	11111111	11111111	00000000
	10101100	00010000	00000010	00000000

128  
192  
224  
240  
248  
252  
254  
255

Network  
Number

172	16	2	0
-----	----	---	---

Network number extended by eight bits

# Subnet Mask with Subnets (cont.)

	Network		Subnet	Host
172.16.2.160	10101100	00010000	00000010	10100000
255.255.255.192	11111111	11111111	11111111	11000000
	10101100	00010000	00000010	10000000
			128 192 224 240 248 252 254 255	128 192 224 240 248 252 254 255
Network Number	172	16	2	128

Network number extended by ten bits



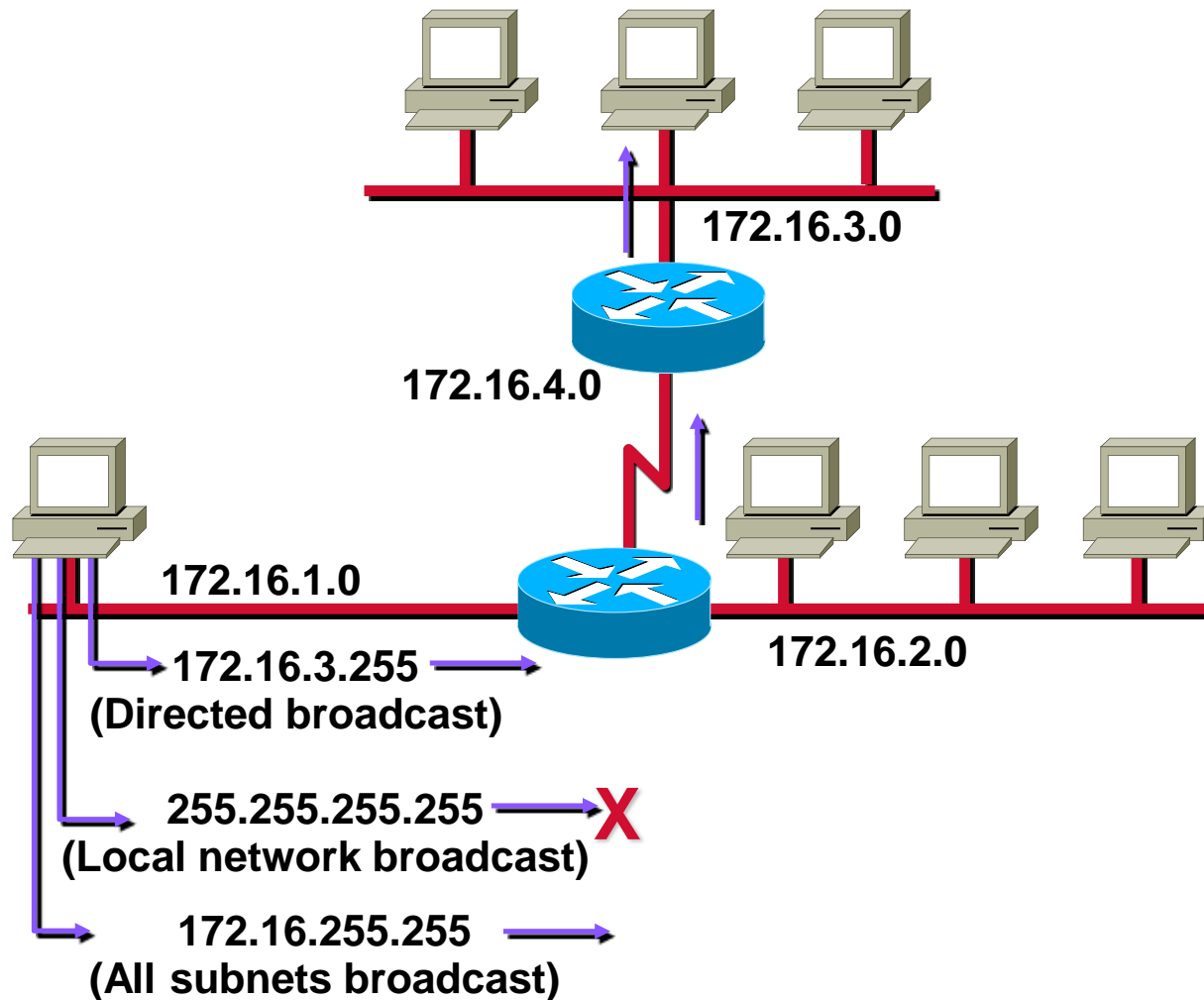
# Subnet Mask Exercise

Address	Subnet Mask	Class	Subnet
172.16.2.10	255.255.255.0		
10.6.24.20	255.255.240.0		
10.30.36.12	255.255.255.0		

# Subnet Mask Exercise Answers

Address	Subnet Mask	Class	Subnet
172.16.2.10	255.255.255.0	B	172.16.2.0
10.6.24.20	255.255.240.0	A	10.6.16.0
10.30.36.12	255.255.255.0	A	10.30.36.0

# Broadcast Addresses



# Addressing Summary Example

172	16	2	160
-----	----	---	-----

172.16.2.160

10101100 00010000 00000010 10100000 Host **1**

255.255.255.192

Mask

Subnet

Broadcast

First

Last

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

172.16.2.160	10101100	00010000	00000010	10100000	Host	1
255.255.255.192	11111111	11111111	11111111	11000000	Mask	2
					Subnet	
					Broadcast	
					First	
					Last	



# Addressing Summary Example

172	16	2	160
-----	----	---	-----

						3	
172.16.2.160	10101100	00010000	00000010	10100000	Host	1	
255.255.255.192	11111111	11111111	11111111	11000000	Mask	2	
					Subnet		
					Broadcast		
					First		
					Last		

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

				3	
172.16.2.160	10101100	00010000	00000010	10100000	Host 1
255.255.255.192	11111111	11111111	11111111	11000000	Mask 2
				10000000	Subnet 4
					Broadcast
					First
					Last

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

				3	
172.16.2.160	10101100	00010000	00000010	10100000	Host 1
255.255.255.192	11111111	11111111	11111111	11000000	Mask 2
				10000000	Subnet 4
				10111111	Broadcast
					5 First
					Last

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

				3	
172.16.2.160	10101100	00010000	00000010	10100000	Host 1
255.255.255.192	11111111	11111111	11111111	11000000	Mask 2
				10000000	Subnet 4
				10111111	Broadcast
				5	
				10000001	First 6
					Last

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

				3	
172.16.2.160	10101100	00010000	00000010	10100000	Host 1
255.255.255.192	11111111	11111111	11111111	11000000	Mask 2
				10000000	Subnet 4
				10111111	Broadcast
				5	
				10000001	First 6
				10111110	Last 7



# Addressing Summary Example

172	16	2	160
-----	----	---	-----

						3	
172.16.2.160	10101100	00010000	00000010	10100000	Host	1	
255.255.255.192	11111111	11111111	11111111	11000000	Mask	2	
8							
	10101100	00010000	00000010	10000000	Subnet	4	
	10101100	00010000	00000010	10111111	Broadcast		
						5	
	10101100	00010000	00000010	10000001	First	6	
	10101100	00010000	00000010	10111110	Last	7	

# Addressing Summary Example

172	16	2	160
-----	----	---	-----

						3	
172.16.2.160	10101100	00010000	00000010	10100000	Host	1	
255.255.255.192	11111111	11111111	11111111	11000000	Mask	2	
9	8						
172.16.2.128	10101100	00010000	00000010	10000000	Subnet	4	
172.16.2.191	10101100	00010000	00000010	10111111	Broadcast		
						5	
172.16.2.129	10101100	00010000	00000010	10000001	First	6	
172.16.2.190	10101100	00010000	00000010	10111110	Last	7	

# Class B Subnet Example

IP Host Address: 172.16.2.121

Subnet Mask: 255.255.255.0

	Network	Network	Subnet	Host
172.16.2.121:	10101100	00010000	00000010	01111001
255.255.255.0:	11111111	11111111	11111111	00000000
Subnet:	10101100	00010000	00000010	00000000
Broadcast:	10101100	00010000	00000010	11111111

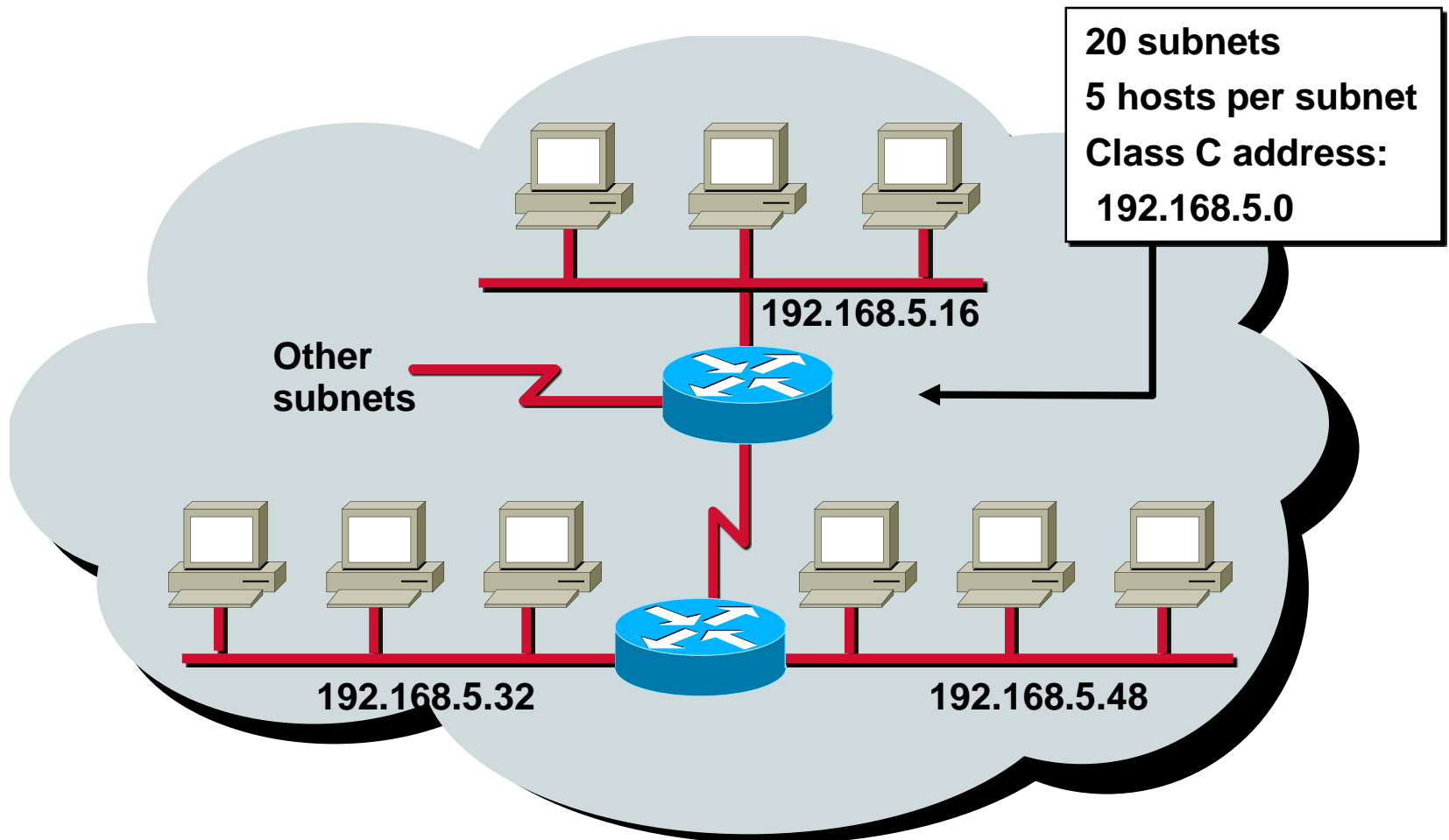
**Subnet Address = 172.16.2.0**

**Host Addresses = 172.16.2.1–172.16.2.254**

**Broadcast Address = 172.16.2.255**

**Eight bits of subnetting**

# Subnet Planning



# Class C Subnet Planning Example

**IP Host Address: 192.168.5.121**

**Subnet Mask: 255.255.255.248**

	Network	Network	Network	Subnet	Host
192.168.5.121:	11000000	10101000	00000101	01111001	
255.255.255.248:	11111111	11111111	11111111	11111000	
Subnet:	11000000	10101000	00000101	01111000	
Broadcast:	11000000	10101000	00000101	01111111	

**Subnet Address = 192.168.5.120**

**Host Addresses = 192.168.5.121–192.168.5.126**

**Broadcast Address = 192.168.5.127**

**Five Bits of Subnetting**



# Broadcast Addresses Exercise

Address	Subnet Mask	Class	Subnet	Broadcast
201.222.10.60	255.255.255.248			
15.16.193.6	255.255.248.0			
128.16.32.13	255.255.255.252			
153.50.6.27	255.255.255.128			

# Broadcast Addresses Exercise Answers

Address	Subnet Mask	Class	Subnet	Broadcast
201.222.10.60	255.255.255.248	C	201.222.10.56	201.222.10.63
15.16.193.6	255.255.248.0	A	15.16.192.0	15.16.199.255
128.16.32.13	255.255.255.252	B	128.16.32.12	128.16.32.15
153.50.6.27	255.255.255.128	B	153.50.6.0	153.50.6.127