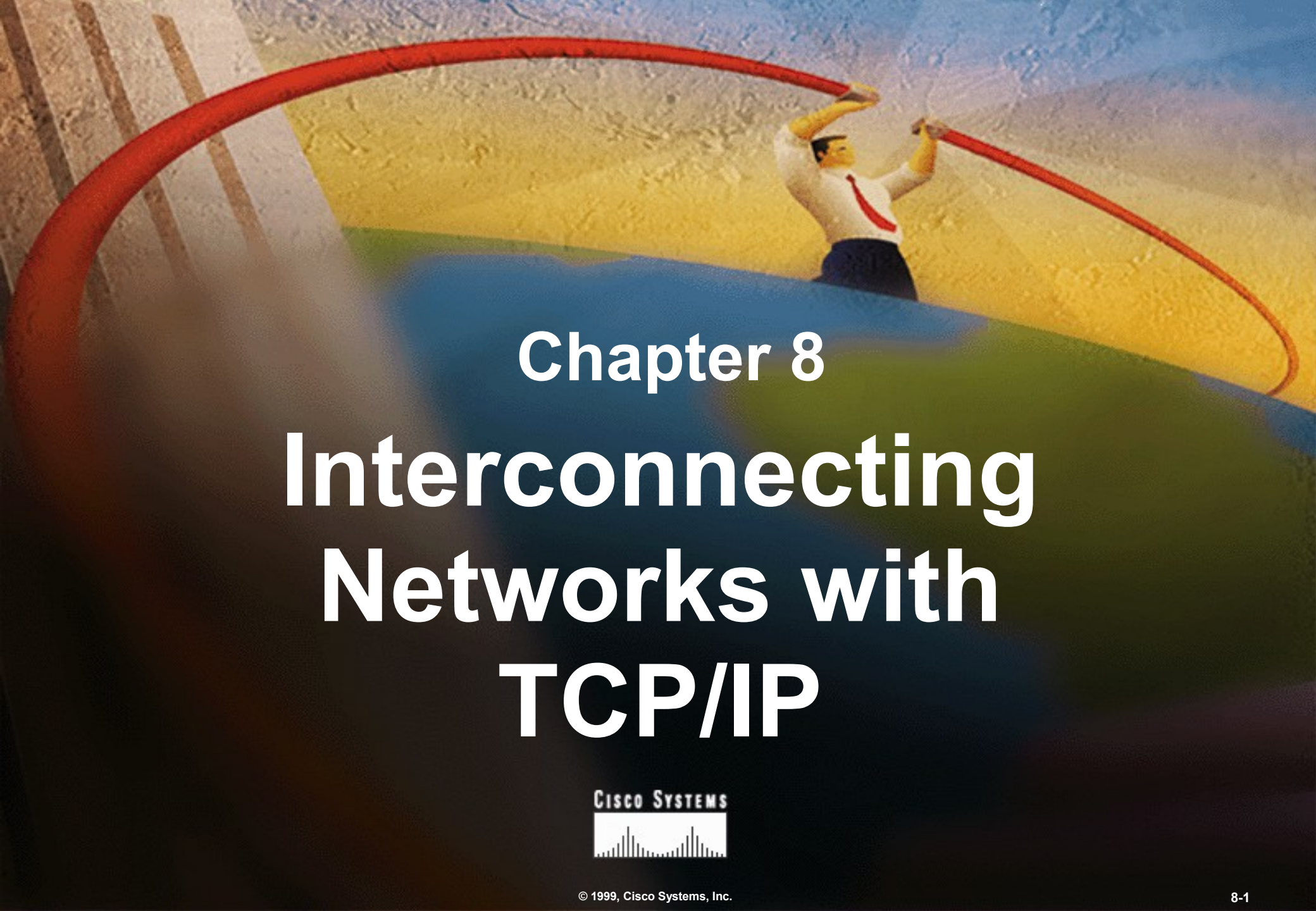
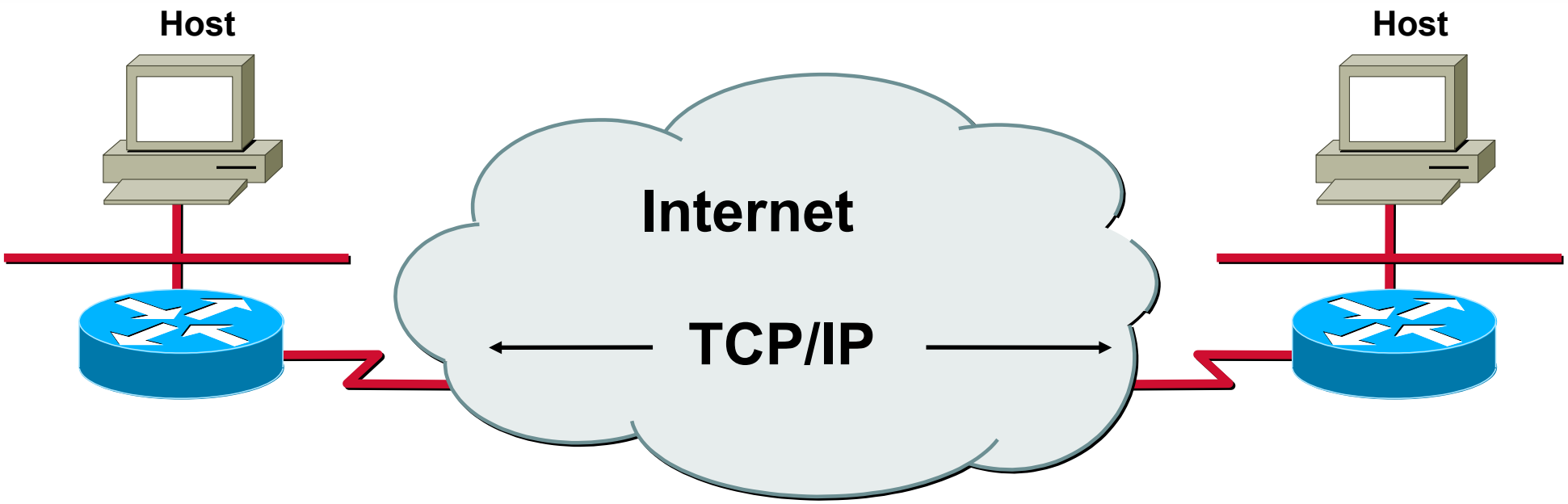


Chapter 8

Interconnecting Networks with TCP/IP

Cisco Systems

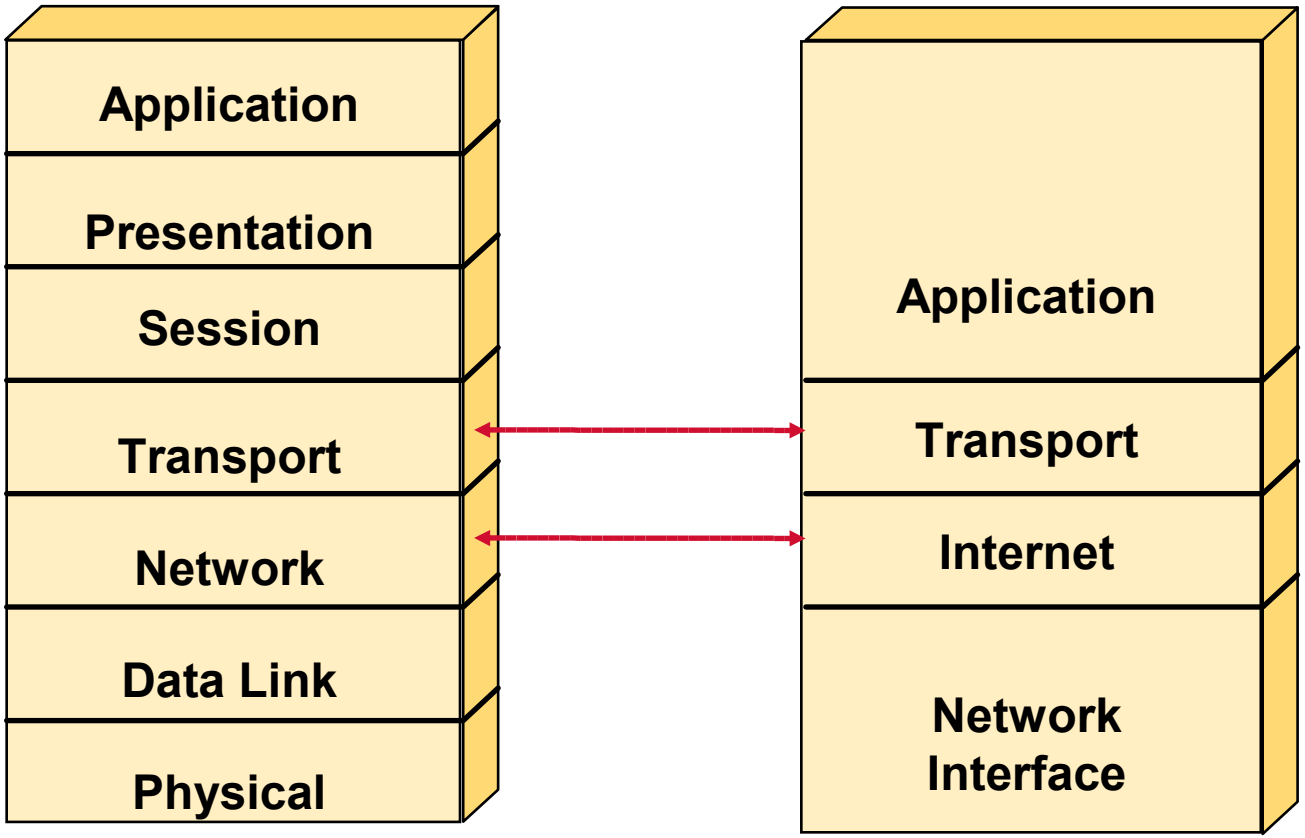
Introduction to TCP/IP



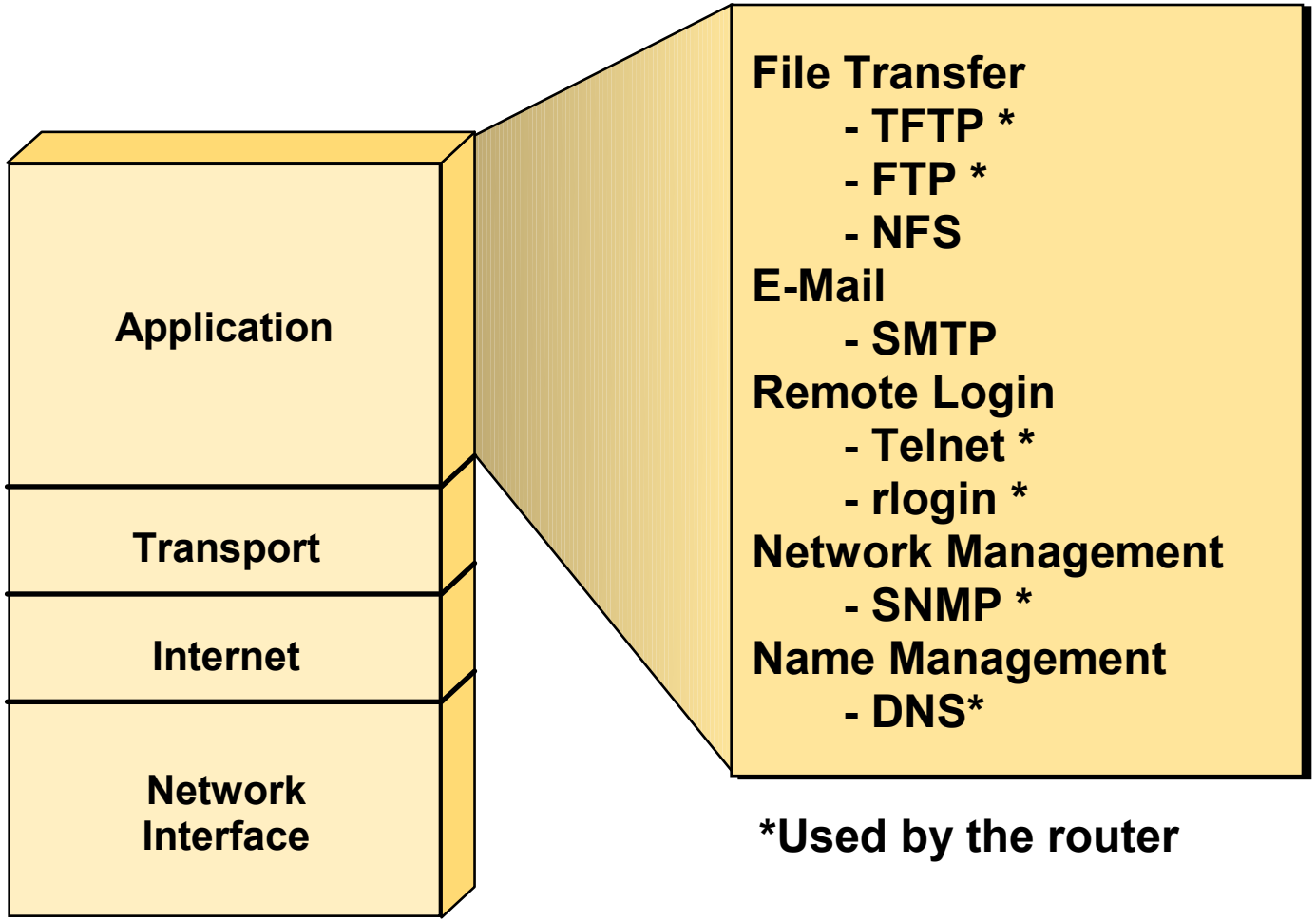
Early protocol suite

Universal

TCP/IP Protocol Stack

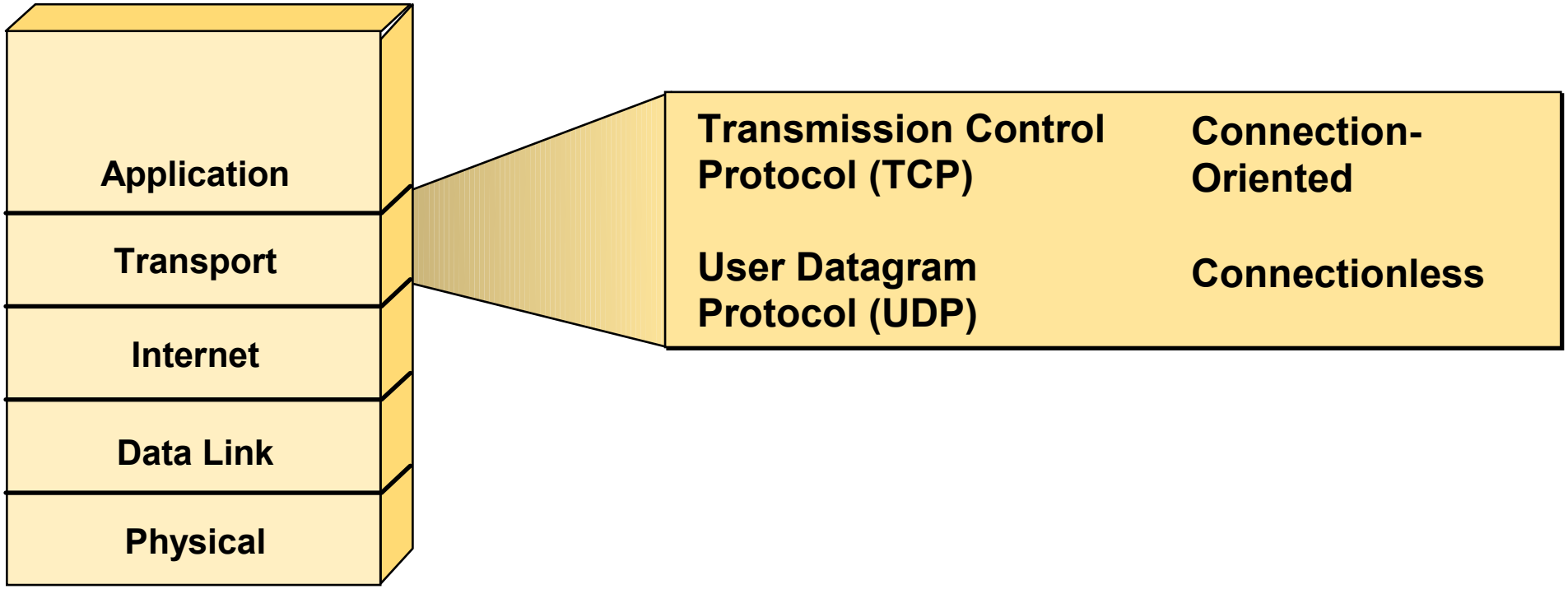


Application Layer Overview

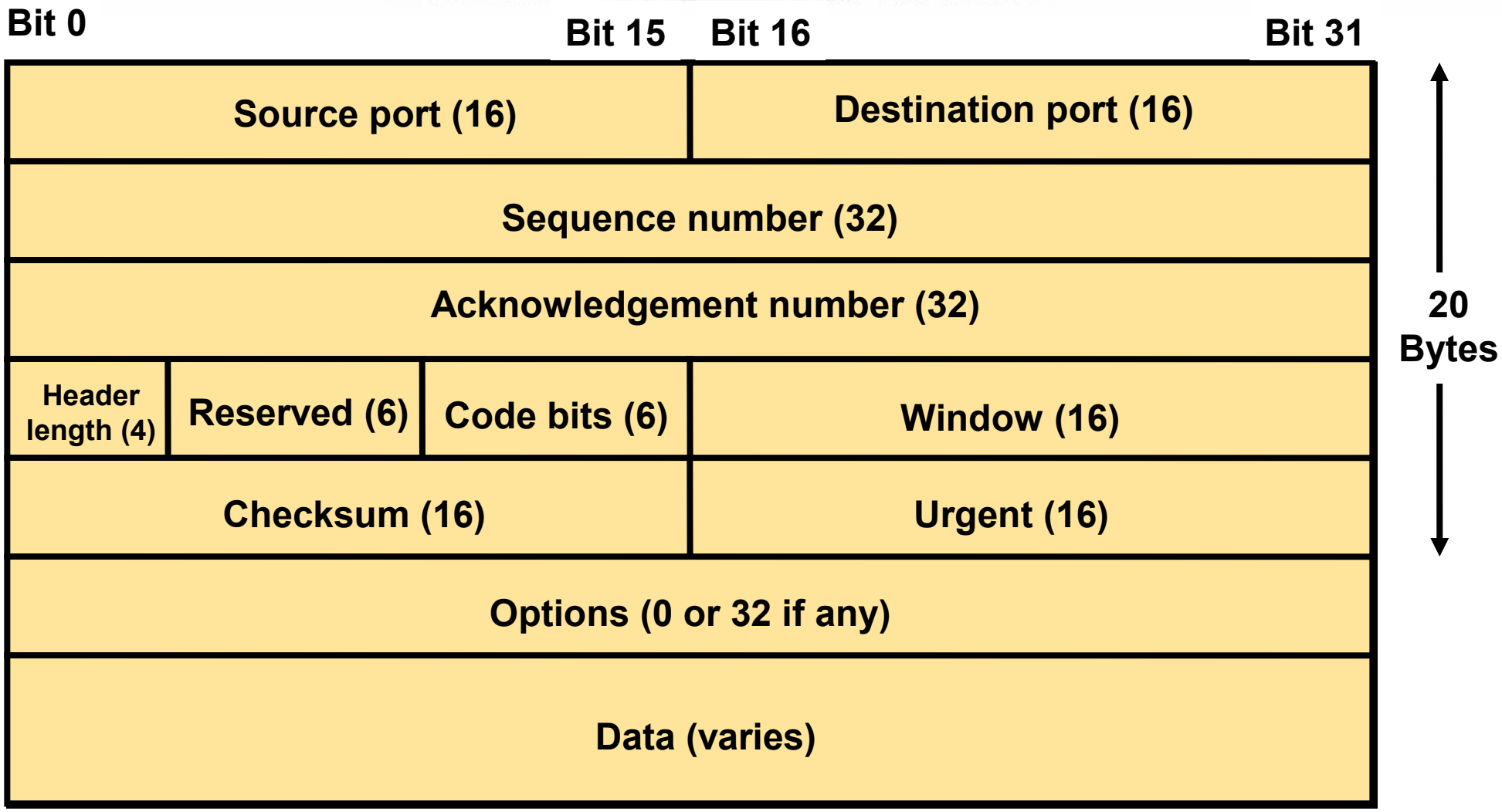


*Used by the router

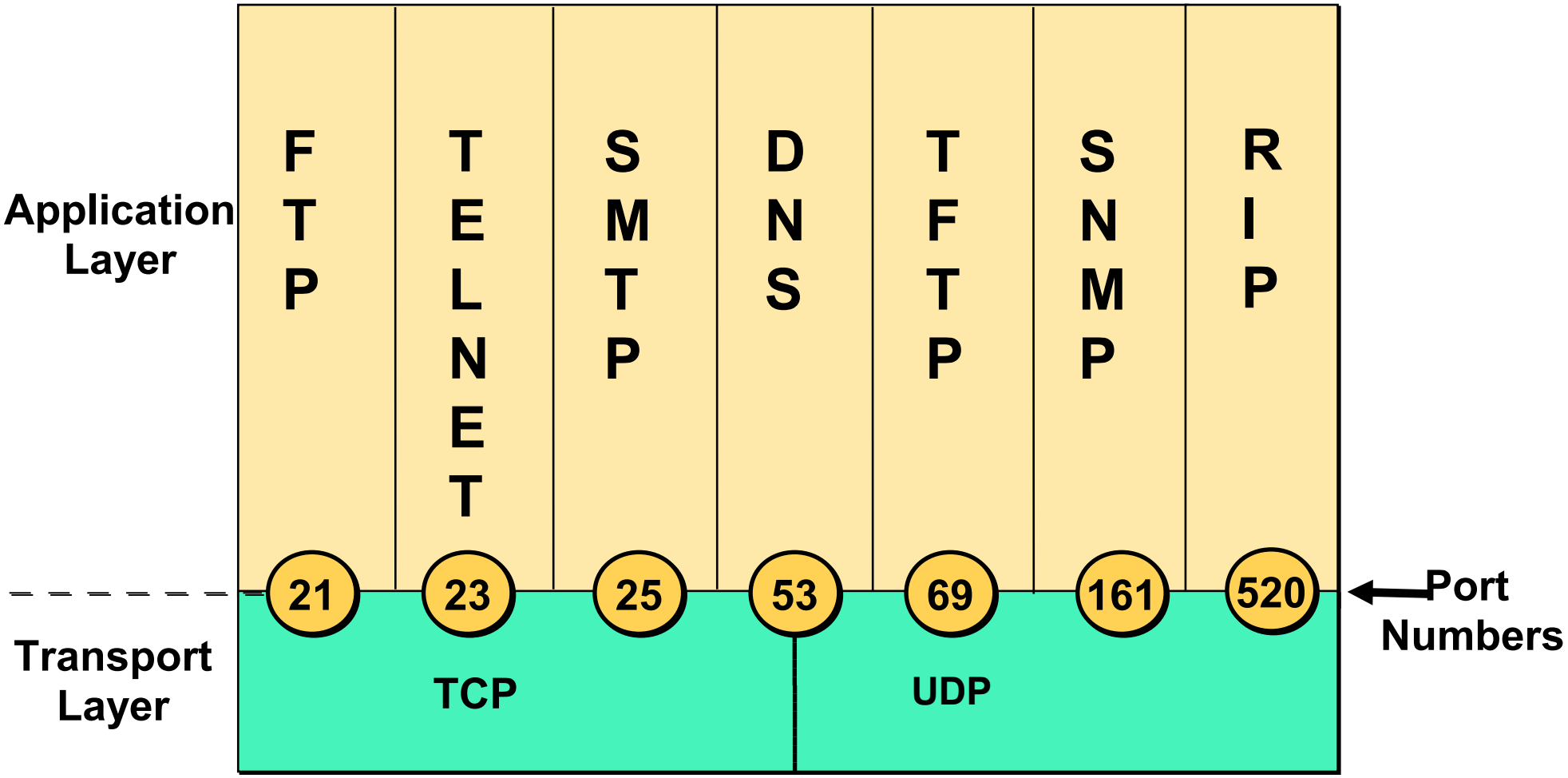
Transport Layer Overview



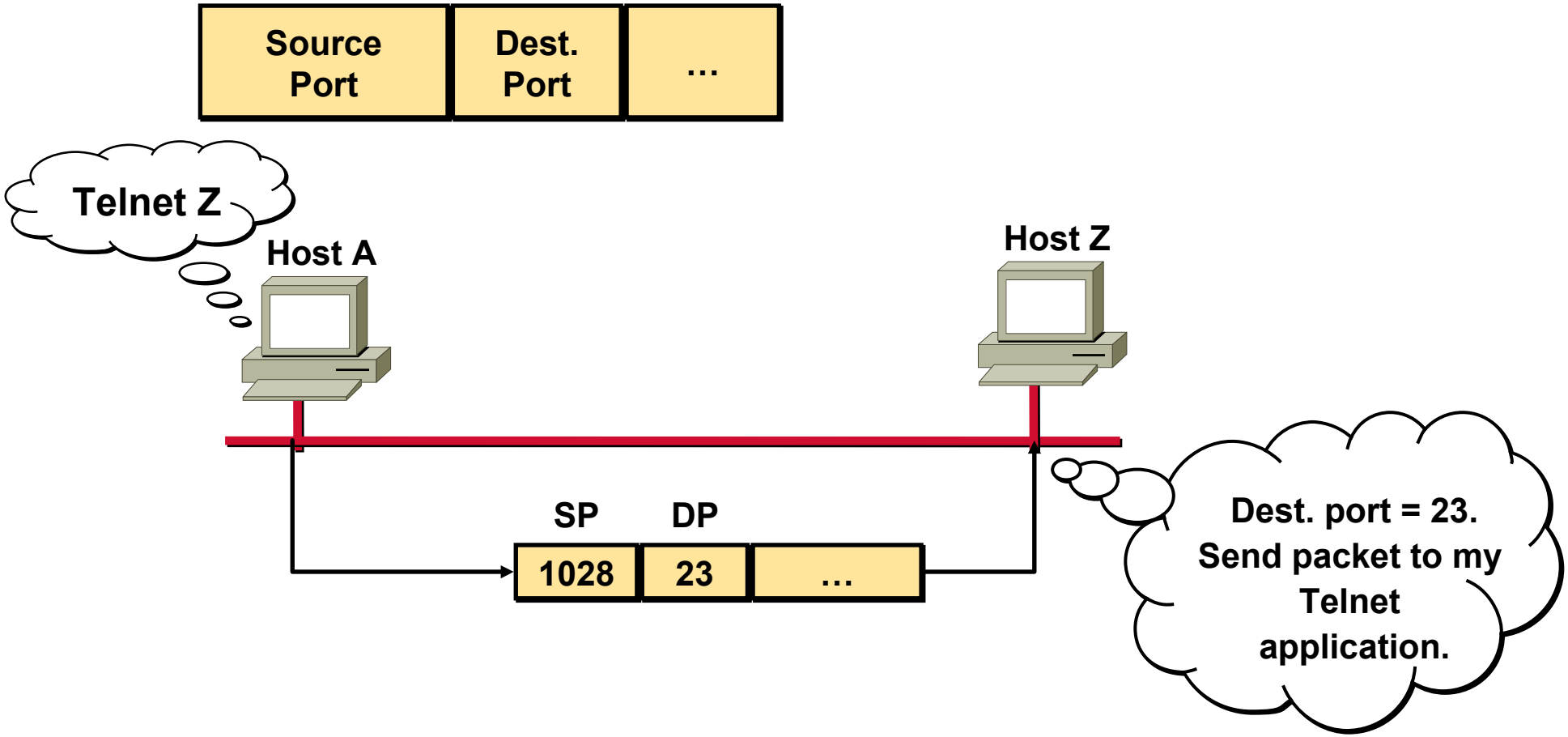
TCP Segment Format



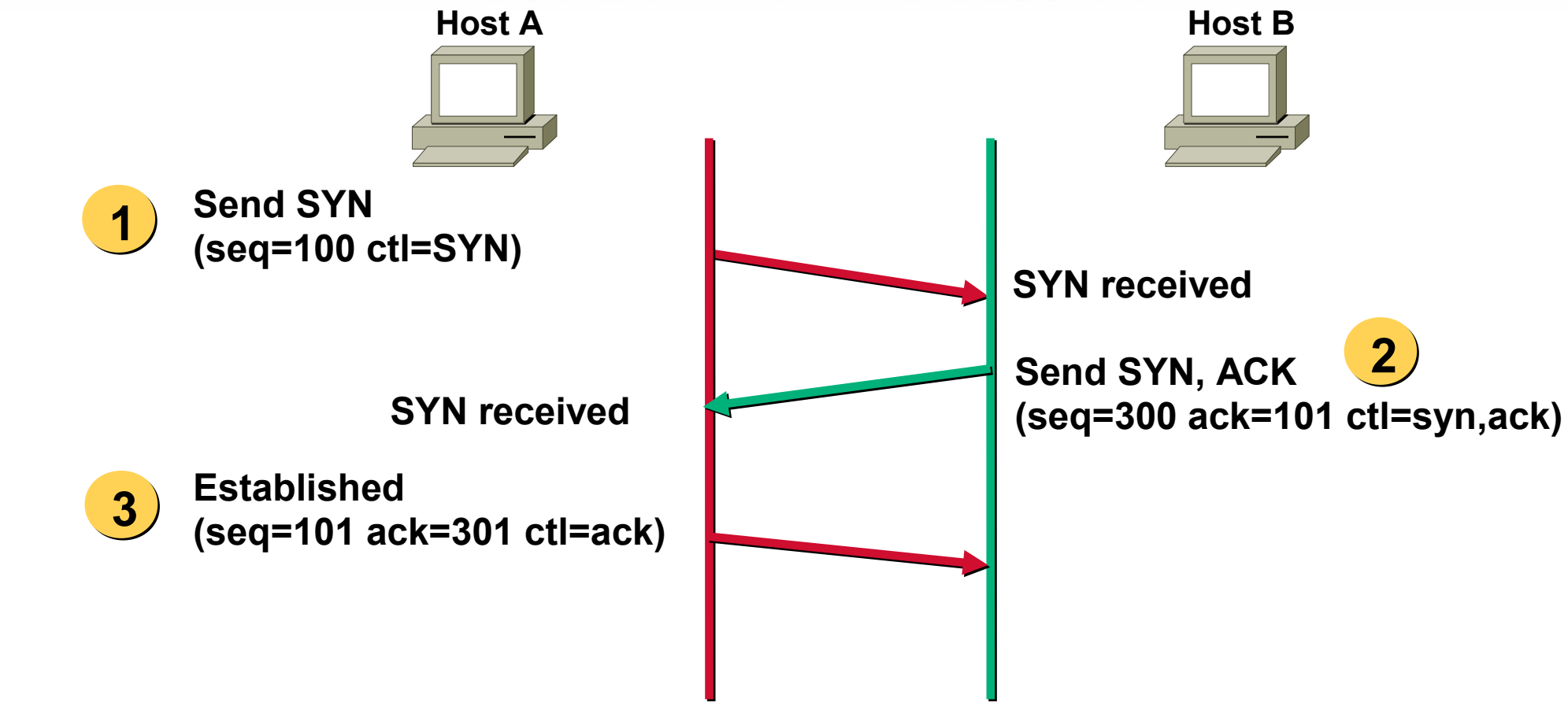
Port Numbers



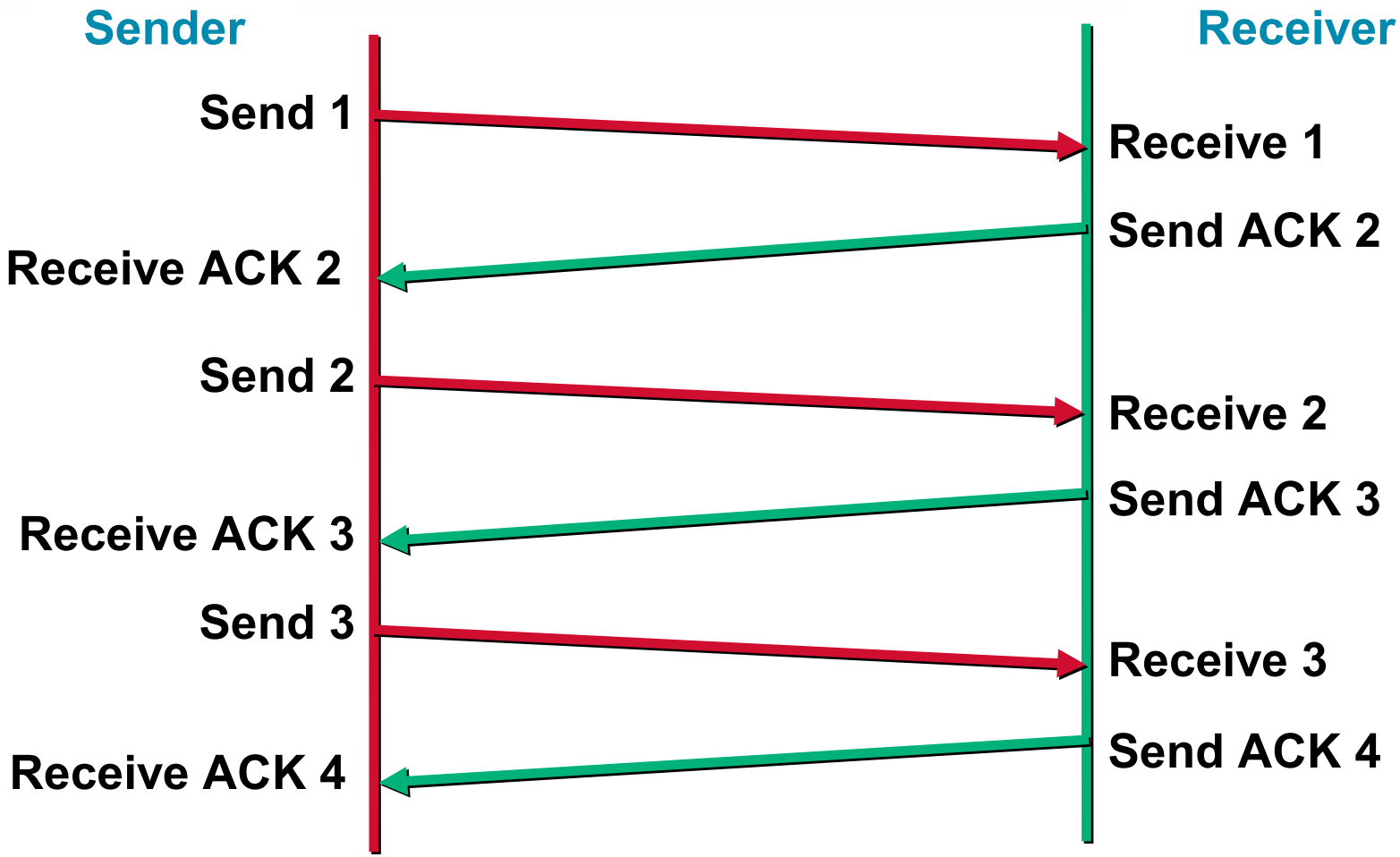
TCP Port Numbers



TCP Three Way Handshake/Open Connection



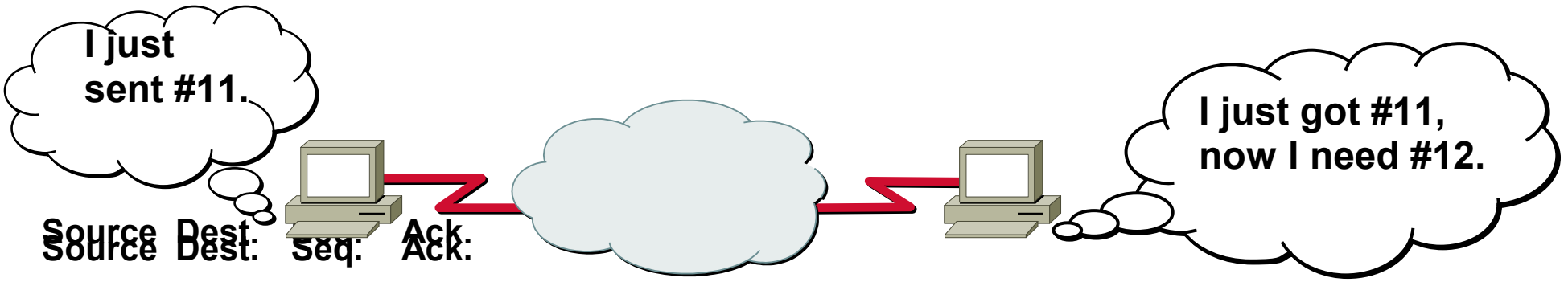
TCP Simple Acknowledgment



Window size = 1

TCP Sequence and Acknowledgment Numbers

Source Port	Dest. Port	Sequence #	Acknowledgement #	…



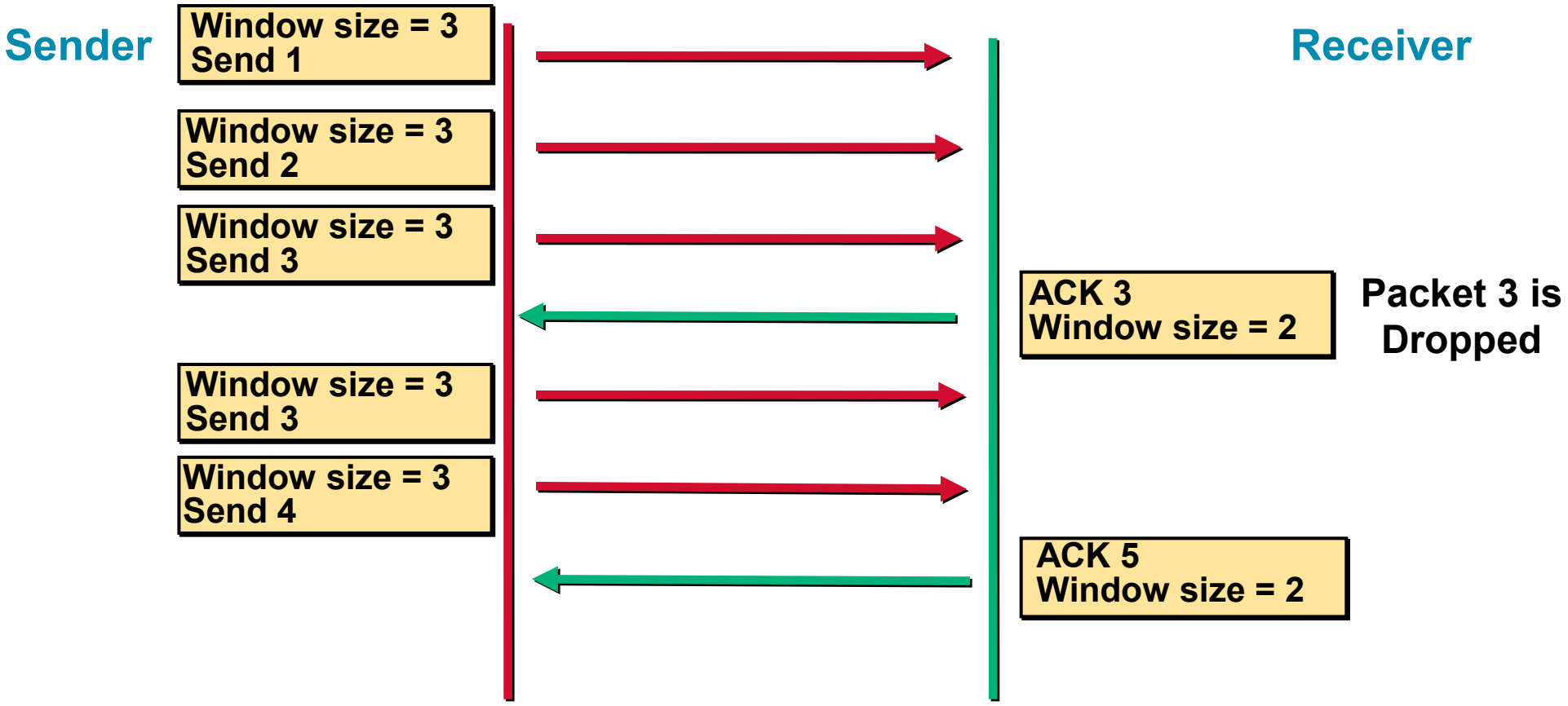
Source	Dest.	Seq.	Ack.
1028	23	10	1

Source	Dest.	Seq.	Ack.
23	1028	1	11

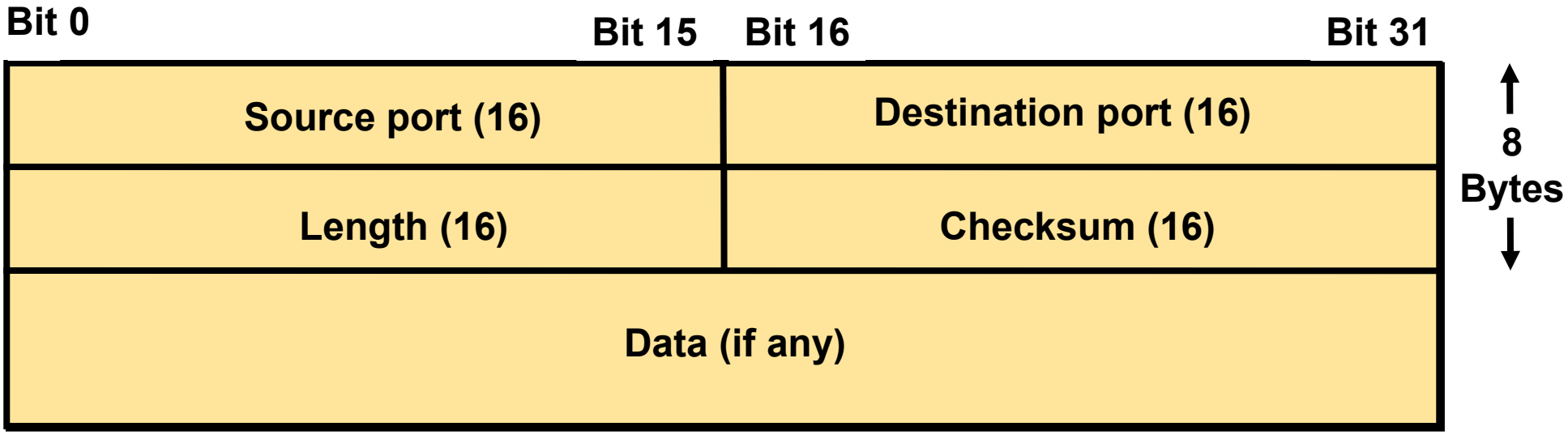
Source	Dest.	Seq.	Ack.
1028	23	11	2

Source	Dest.	Seq.	Ack.
23	1028	2	12

TCP Windowing

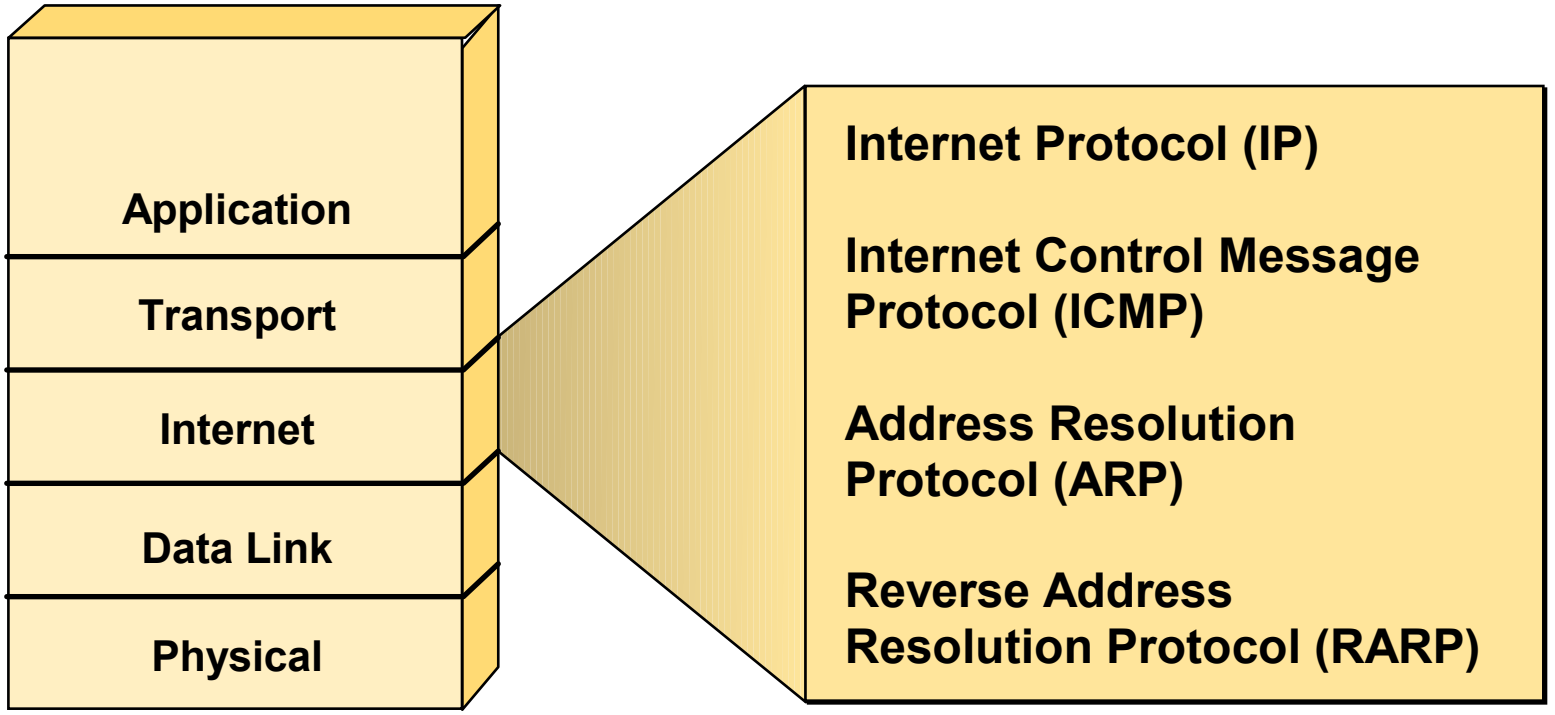


UDP Segment Format



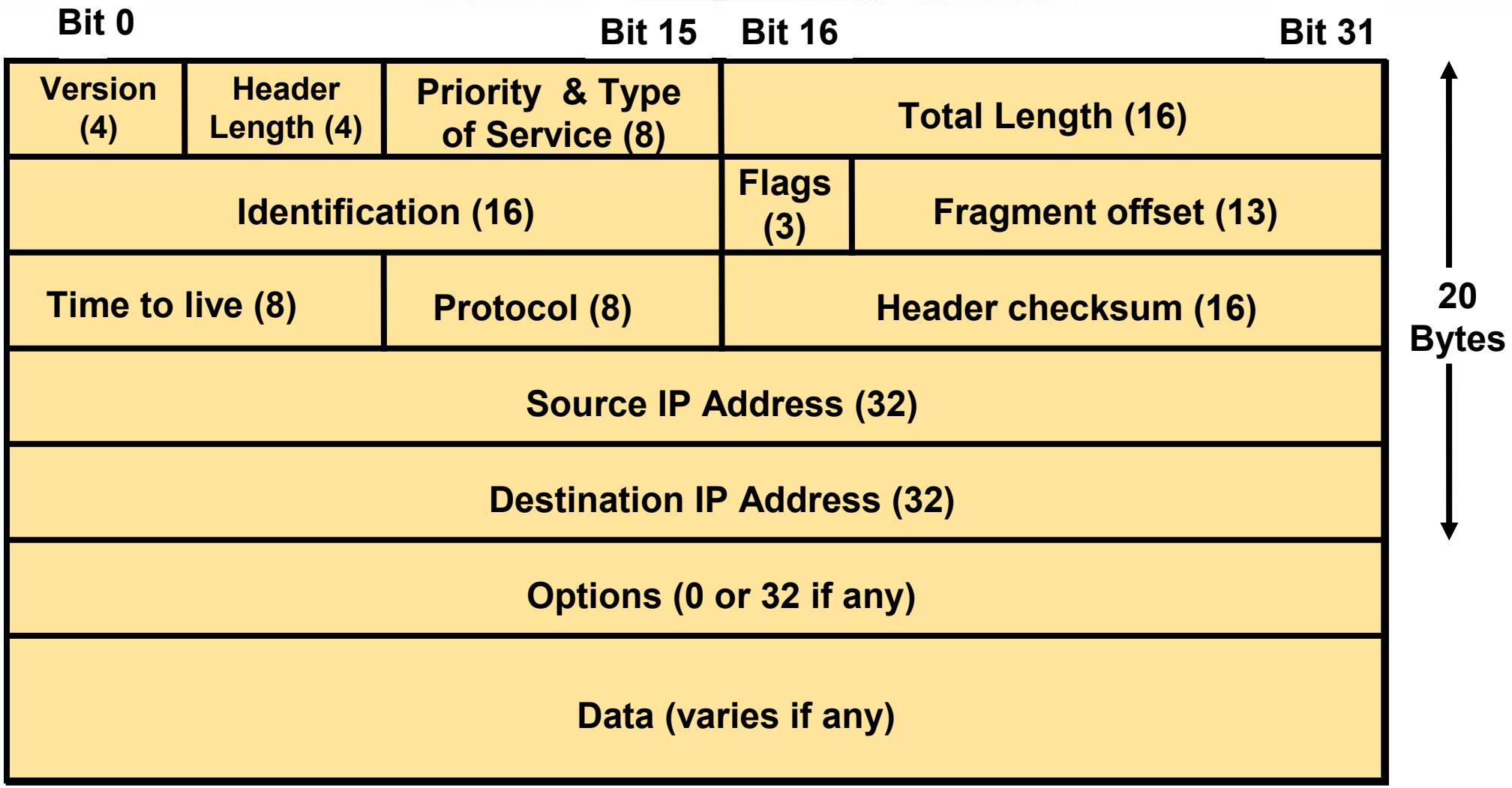
No sequence or acknowledgment fields

Internet Layer Overview

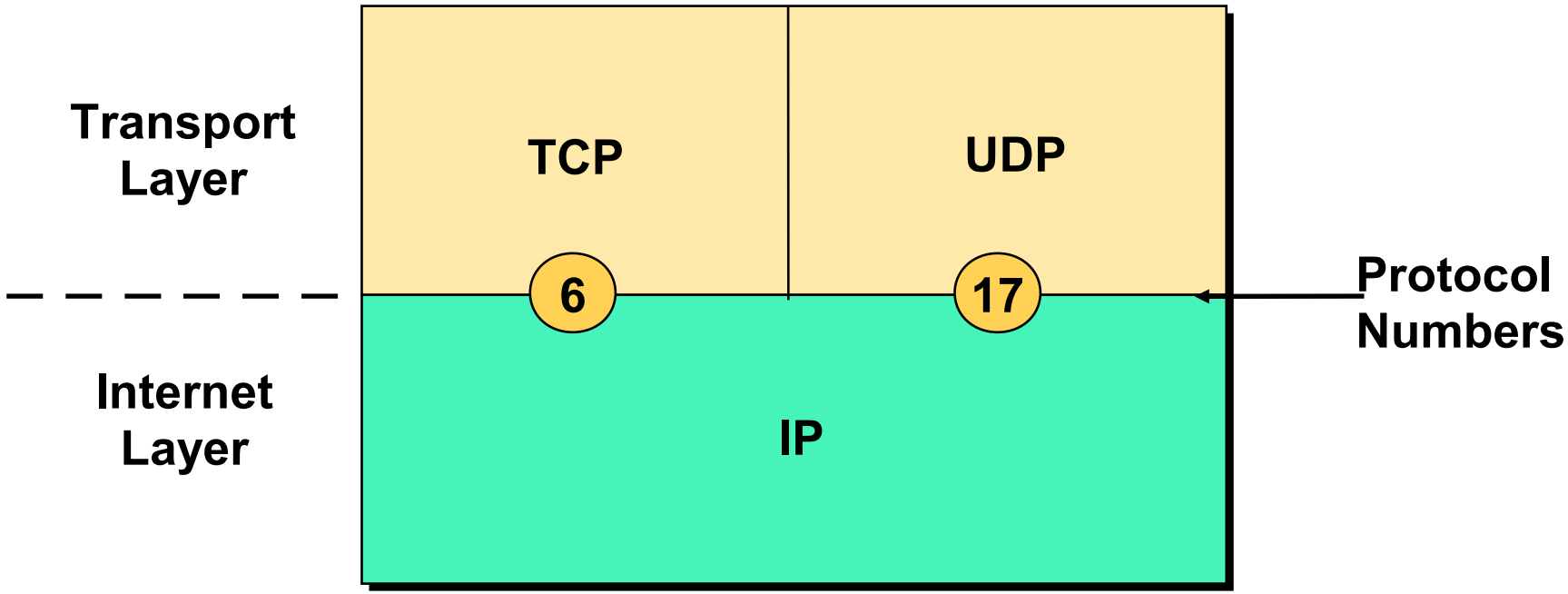


OSI network layer corresponds to the TCP/IP internet layer

IP Datagram

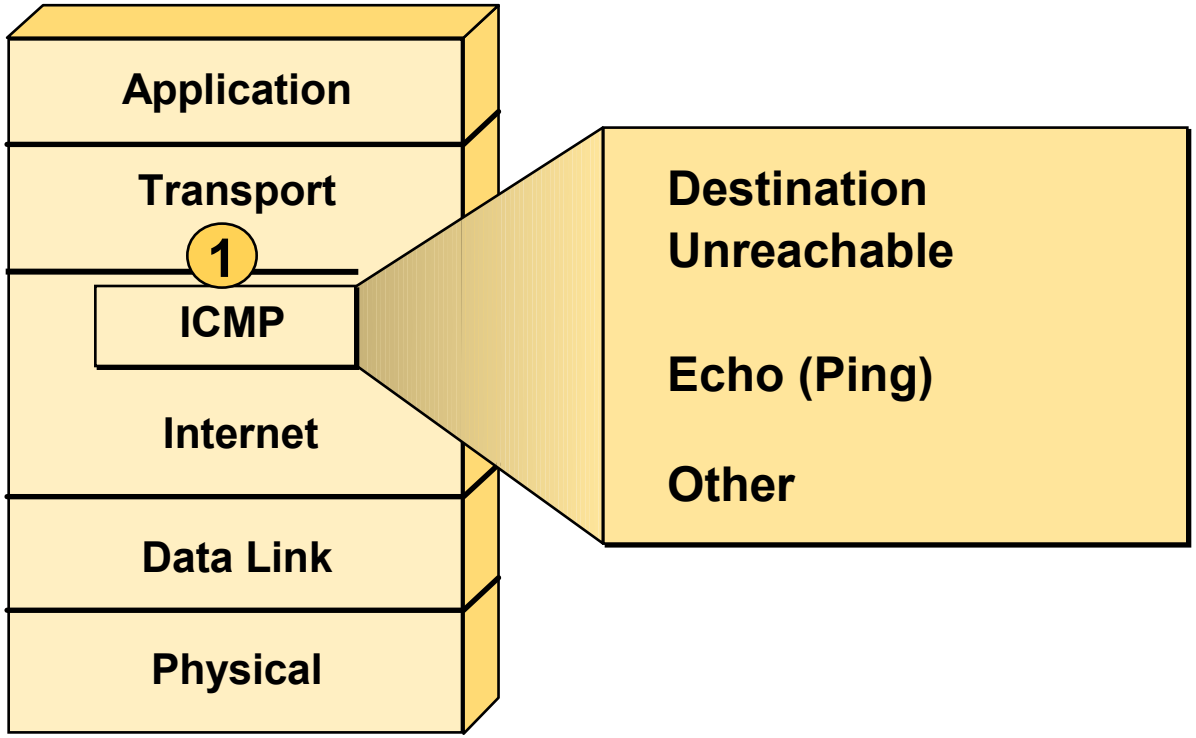


Protocol Field

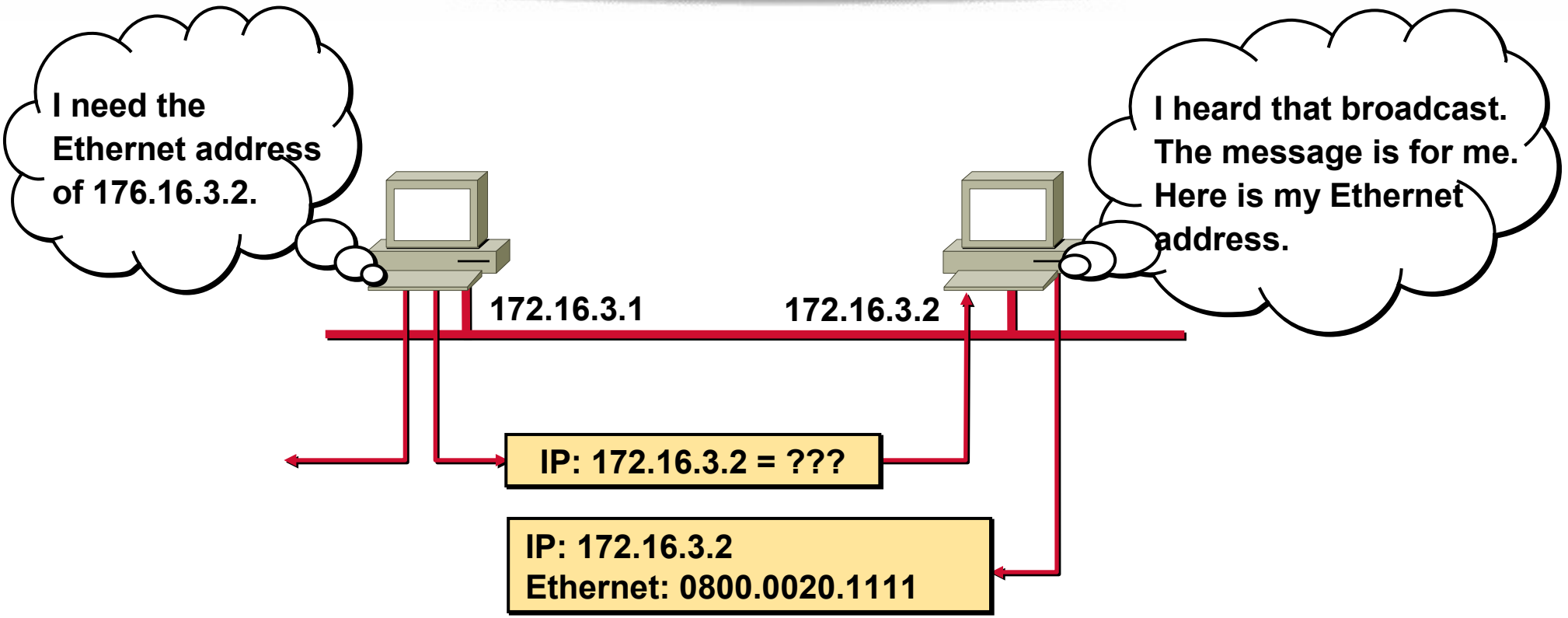


Determines destination upper-layer protocol

Internet Control Message Protocol



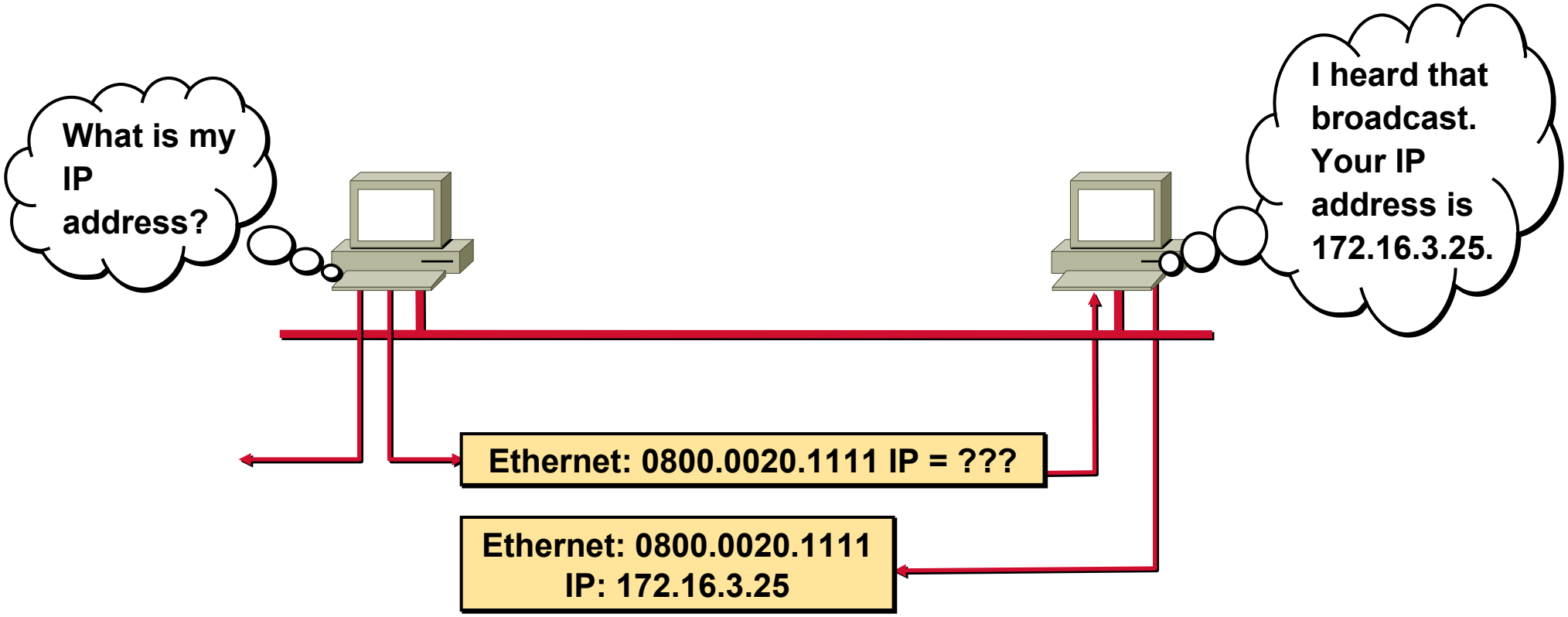
Address Resolution Protocol



Map IP → Ethernet

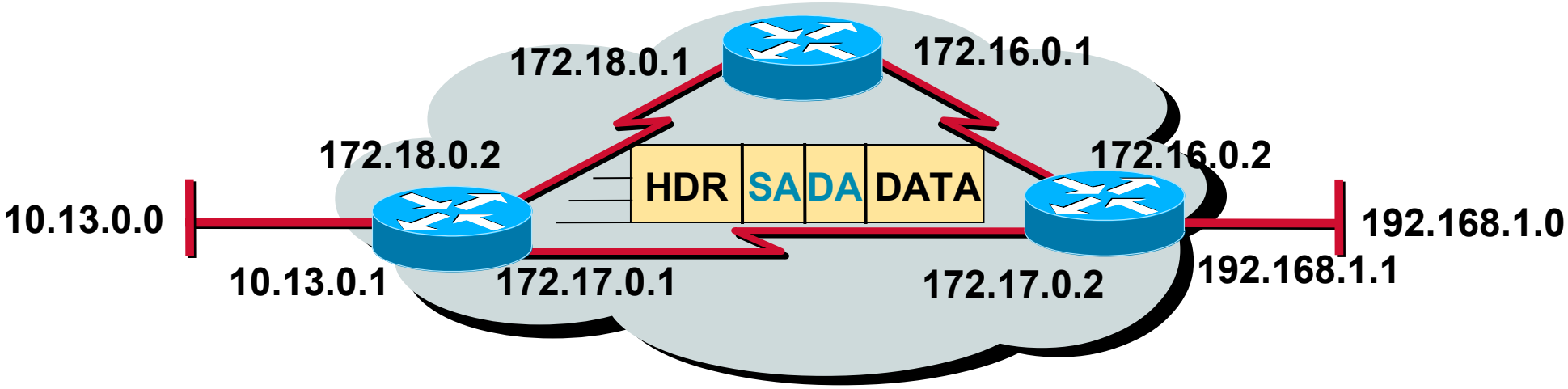
Local ARP

Reverse ARP



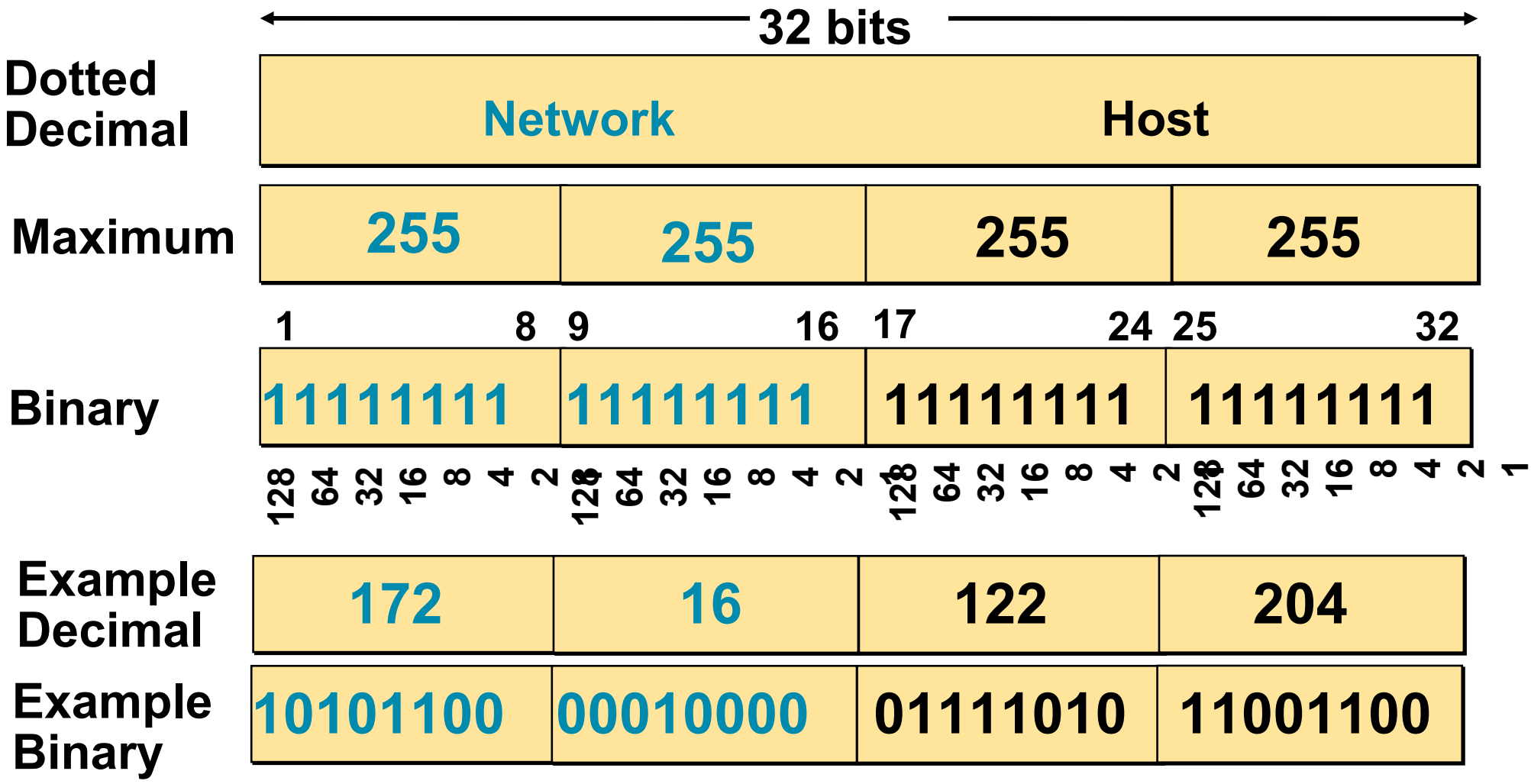
Map Ethernet → IP

Introduction to TCP/IP Addresses

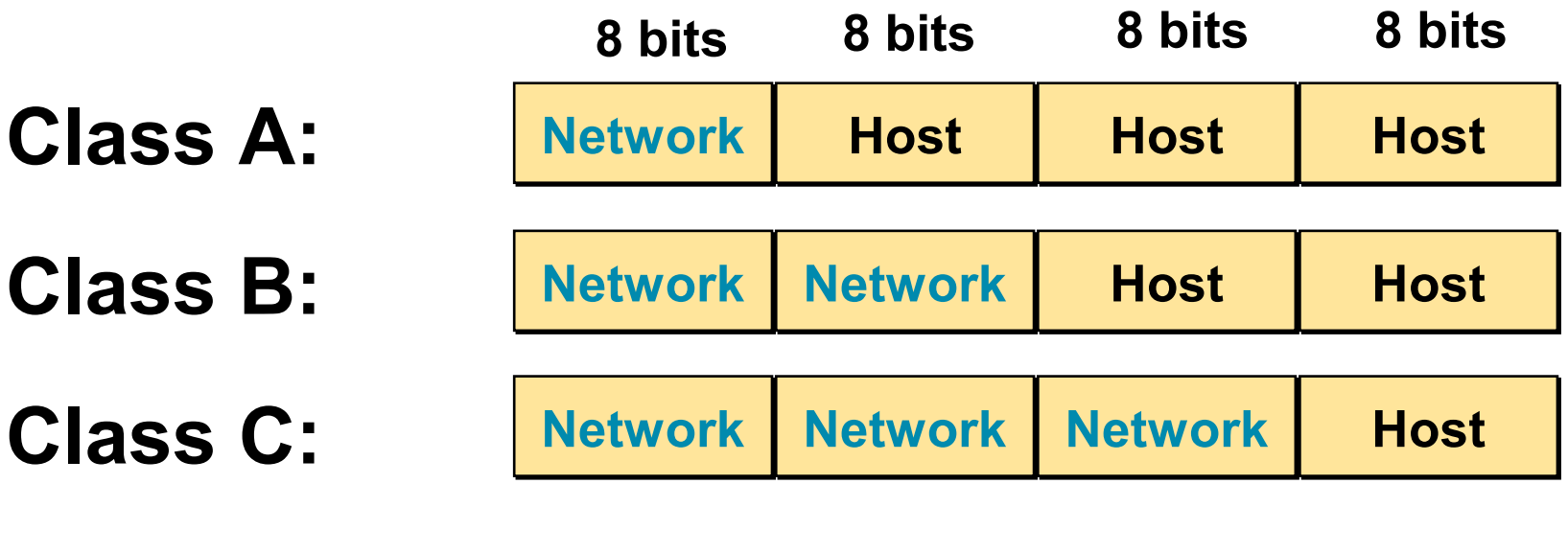


- Unique addressing allows communication between end stations
- Path choice is based on location

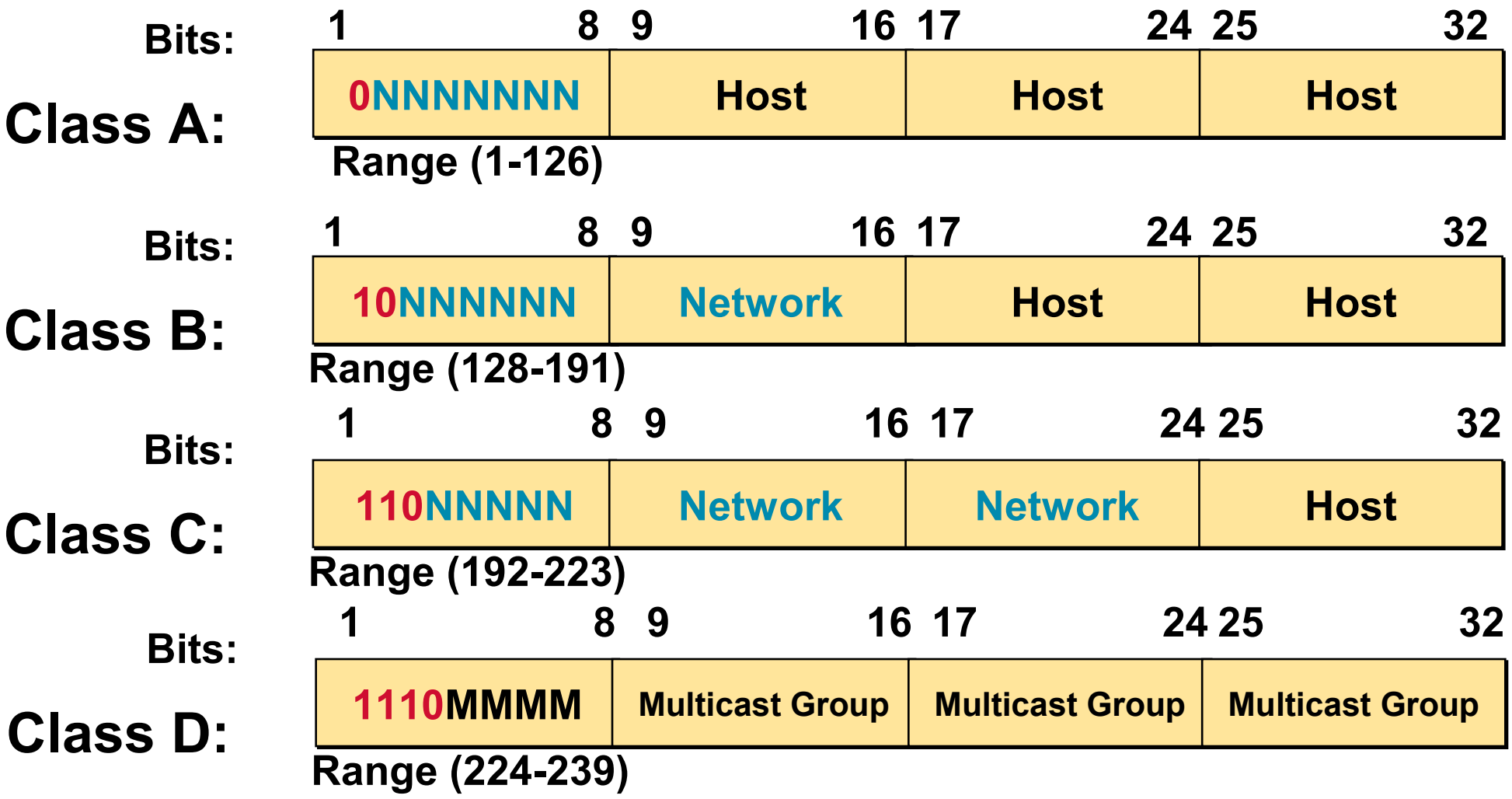
IP Addressing



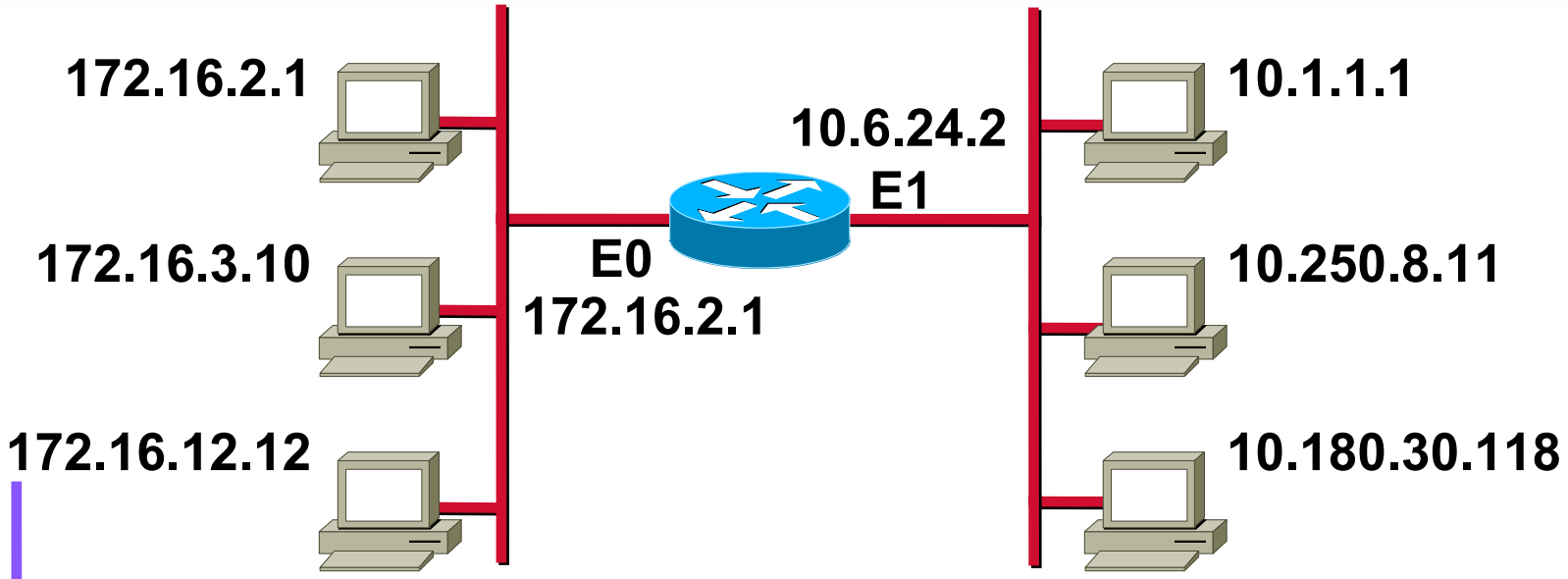
IP Address Classes



IP Address Classes



Host Addresses

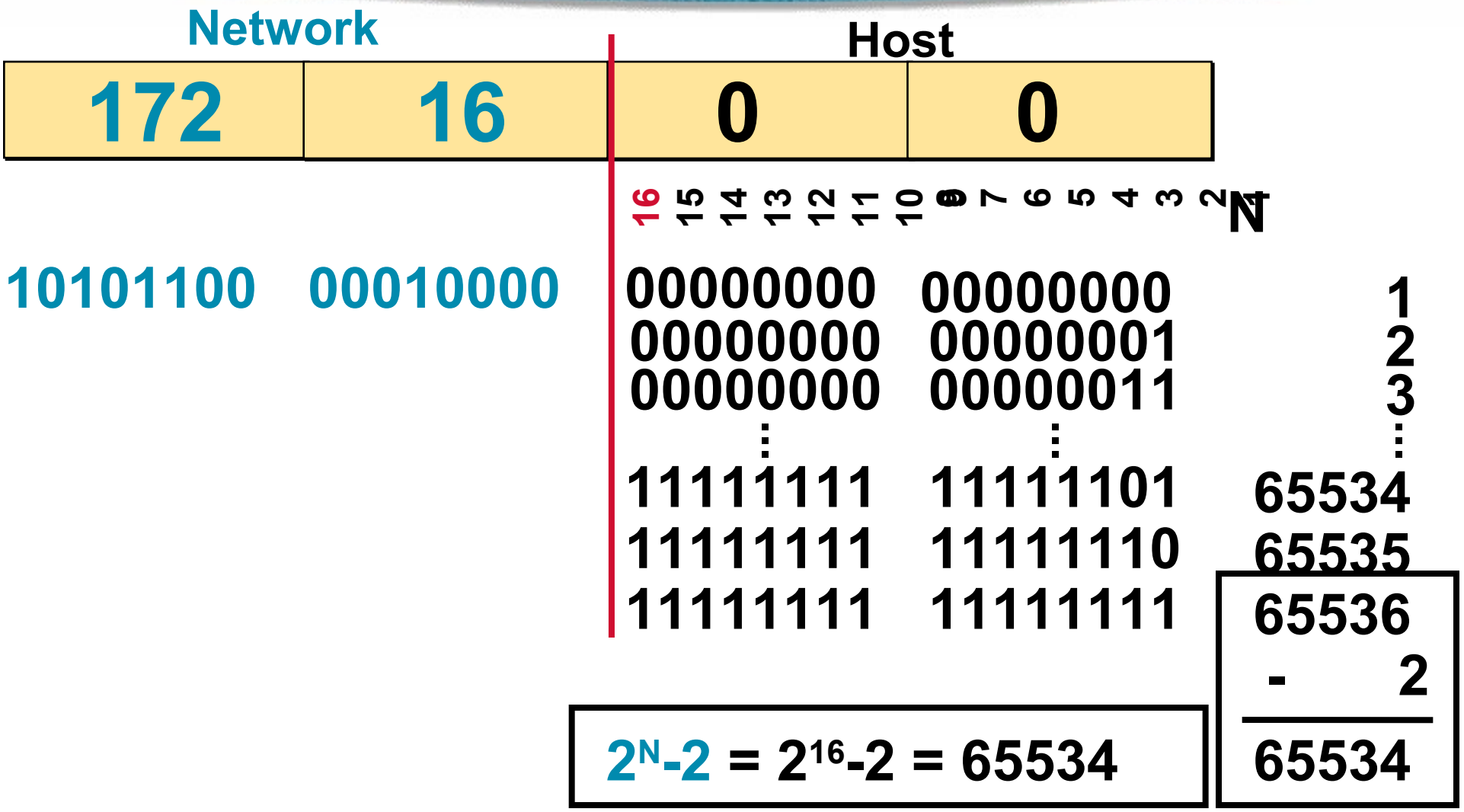


172.16 . 12 . 12

Network Host

Routing Table	
Network	Interface
172.16.0.0	E0
10.0.0.0	E1

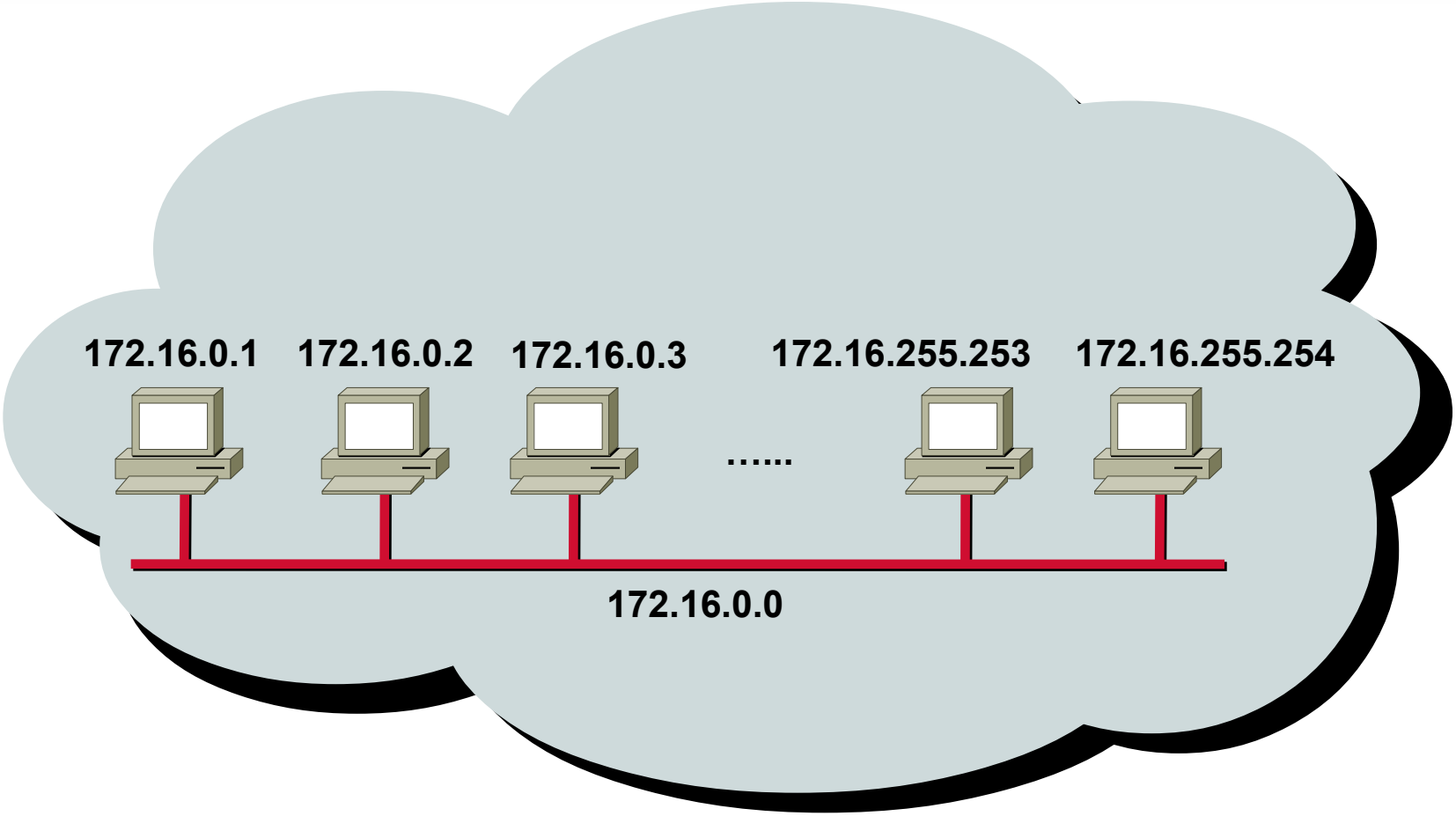
Determining Available Host Addresses



IP Address Classes Exercise Answers

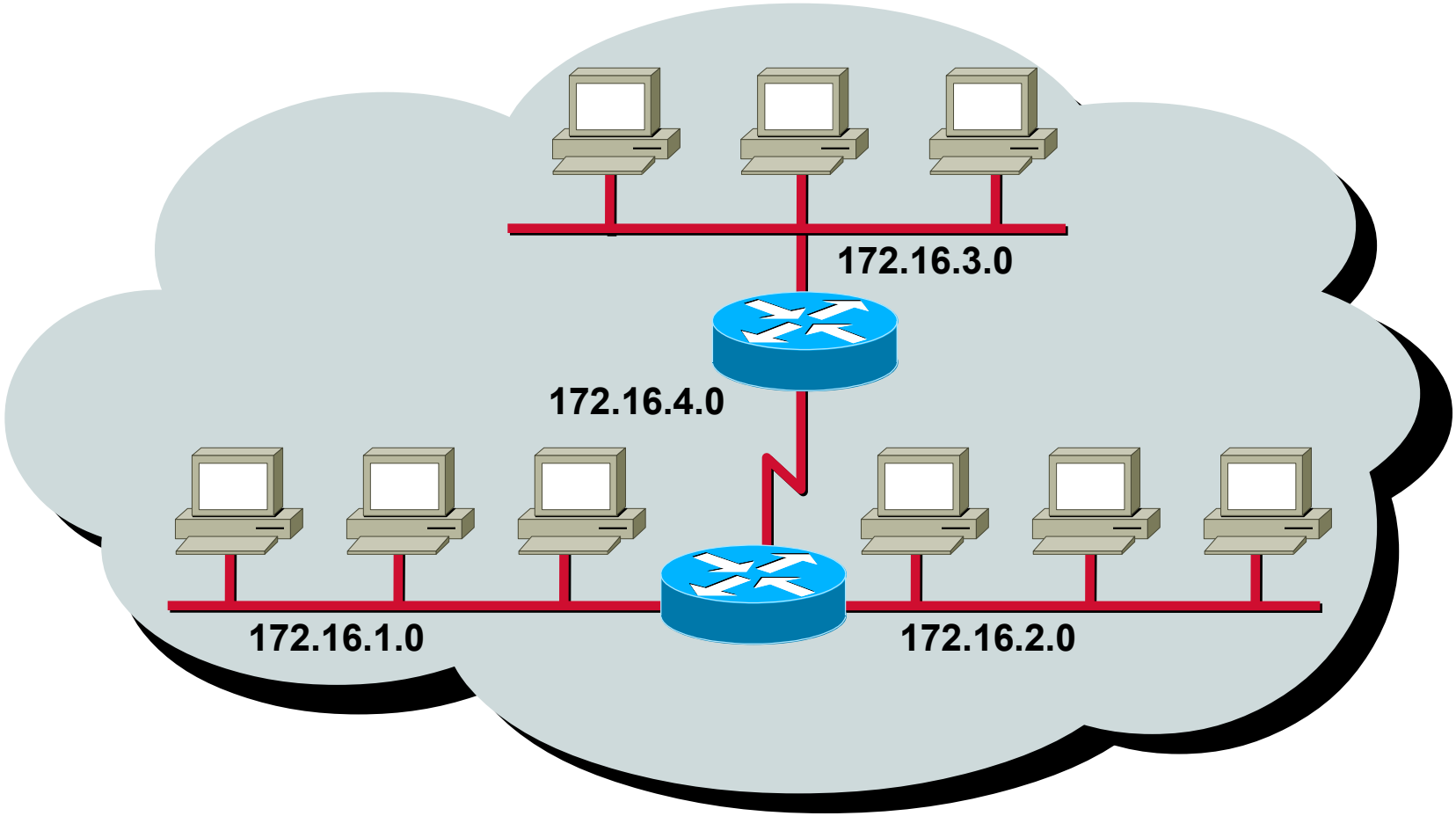
Address	Class	Network	Host
10.2.1.1	A	10.0.0.0	0.2.1.1
128.63.2.100	B	128.63.0.0	0.0.2.100
201.222.5.64	C	201.222.5.0	0.0.0.64
192.6.141.2	C	192.6.141.0	0.0.0.2
130.113.64.16	B	130.113.0.0	0.0.64.16
241.256.201.10	Non-existent		

Addressing without Subnets



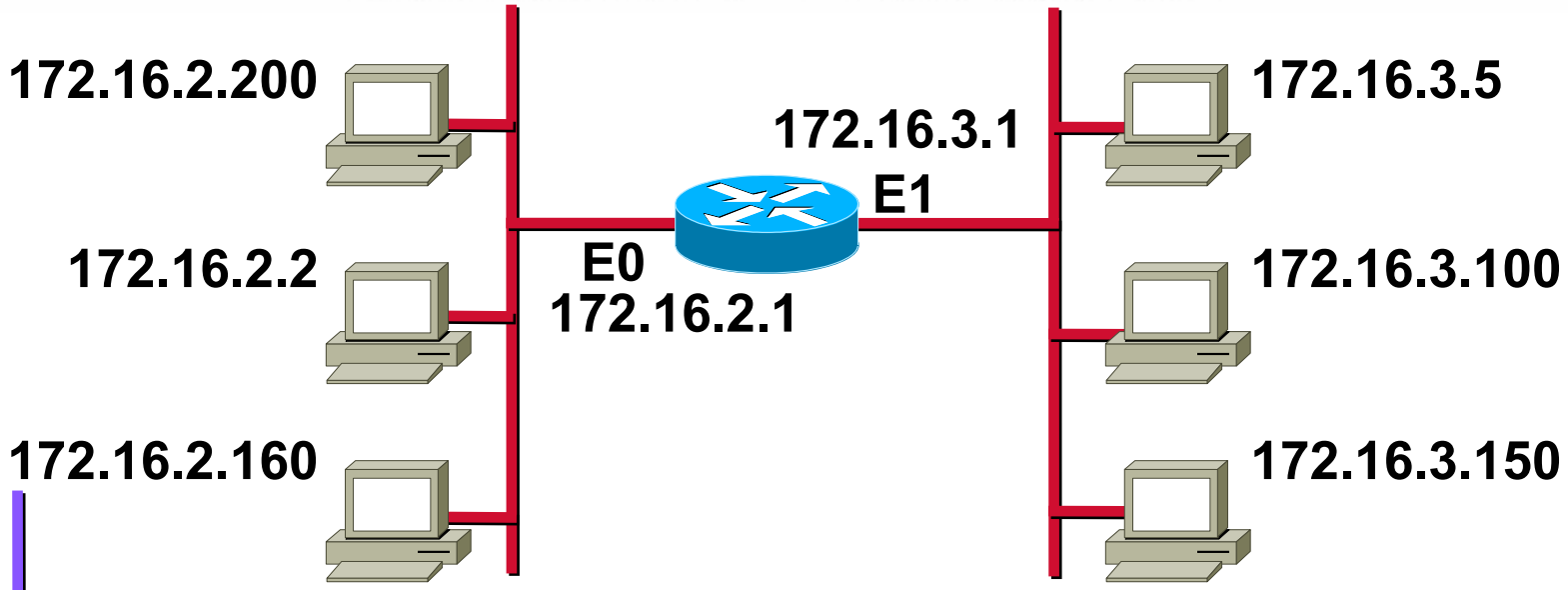
Network 172.16.0.0

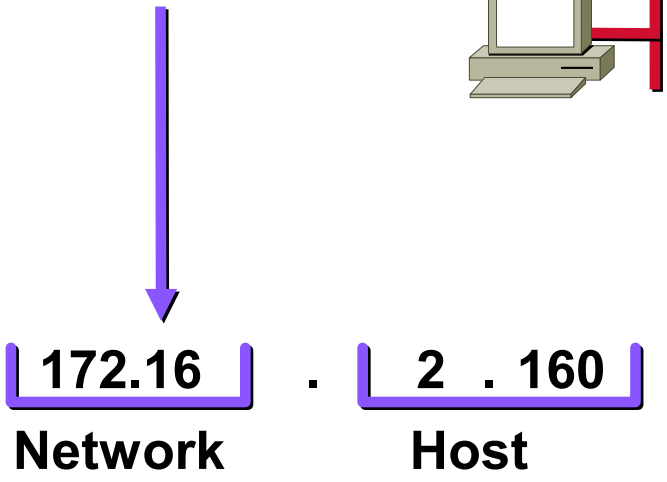
Addressing with Subnets



Network 172.16.0.0

Subnet Addressing

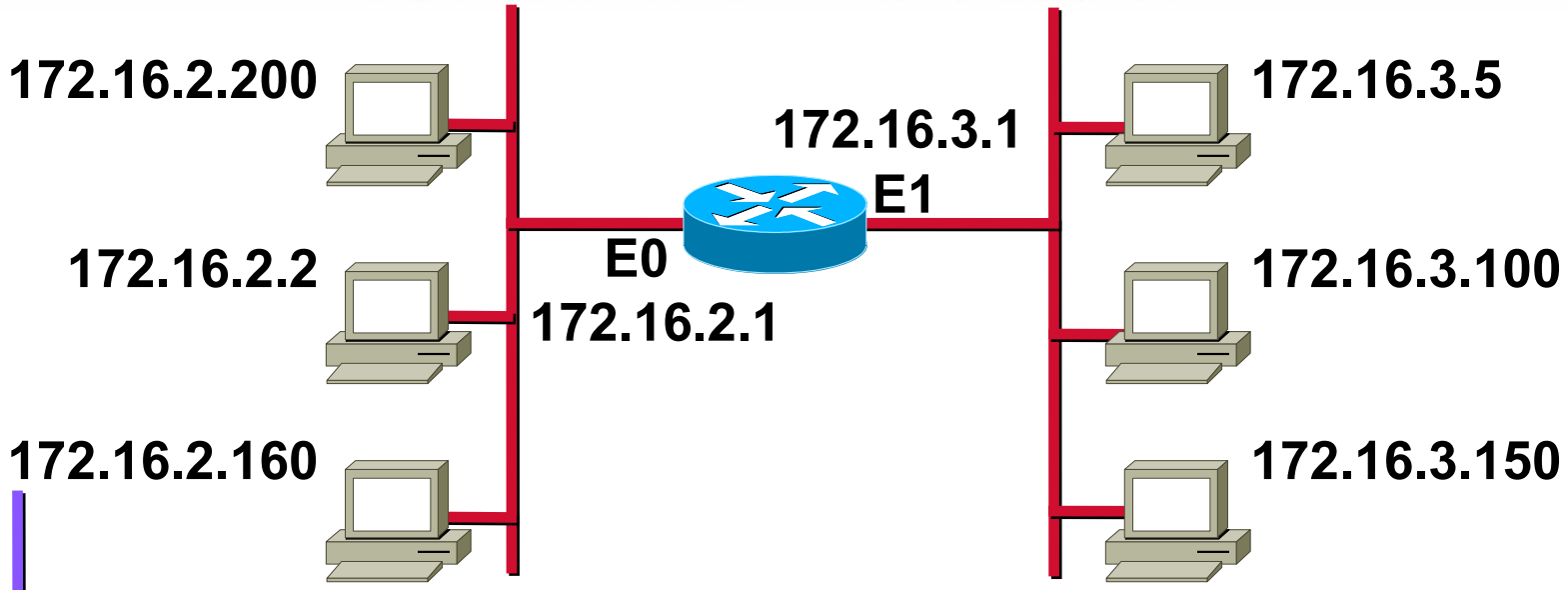




New Routing Table

Network	Interface
172.16.0.0	E0
172.16.0.0	E1

Subnet Addressing

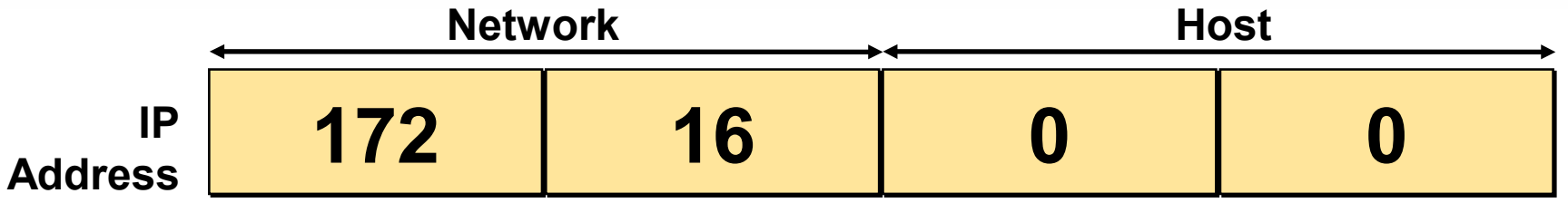


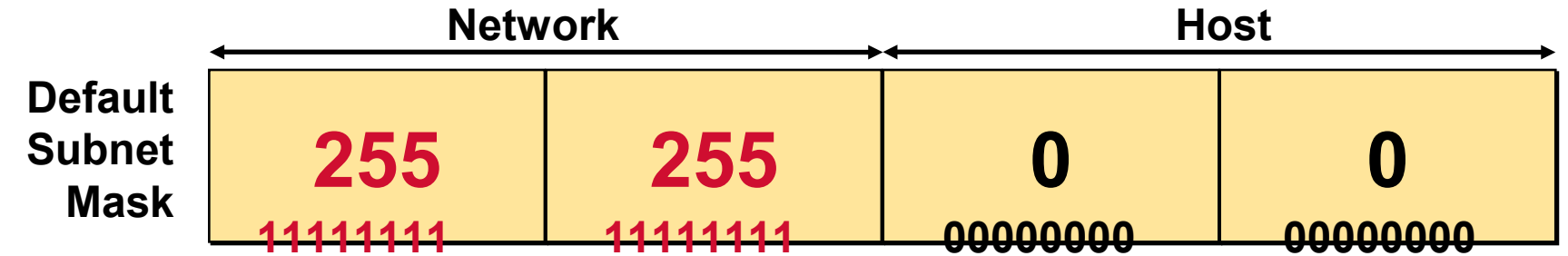
172.16 . 2 . 160

Network Subnet Host

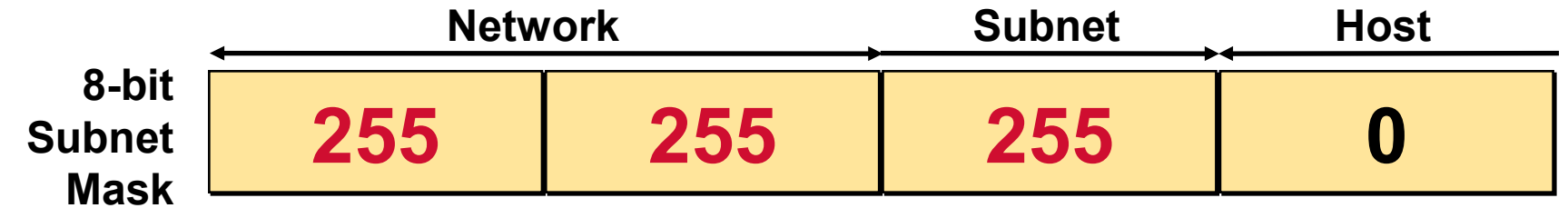
New Routing Table	
Network	Interface
172.16.2.0	E0
172.16.3.0	E1

Subnet Mask



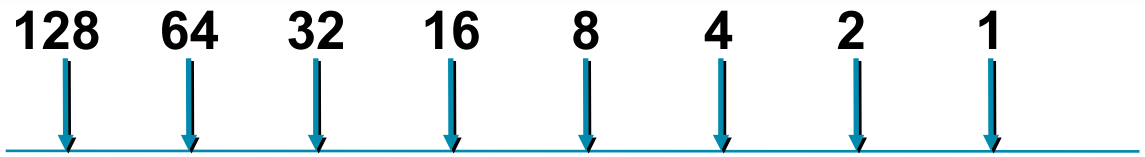


Also written as "/16" where 16 represents the number of 1s in the mask.



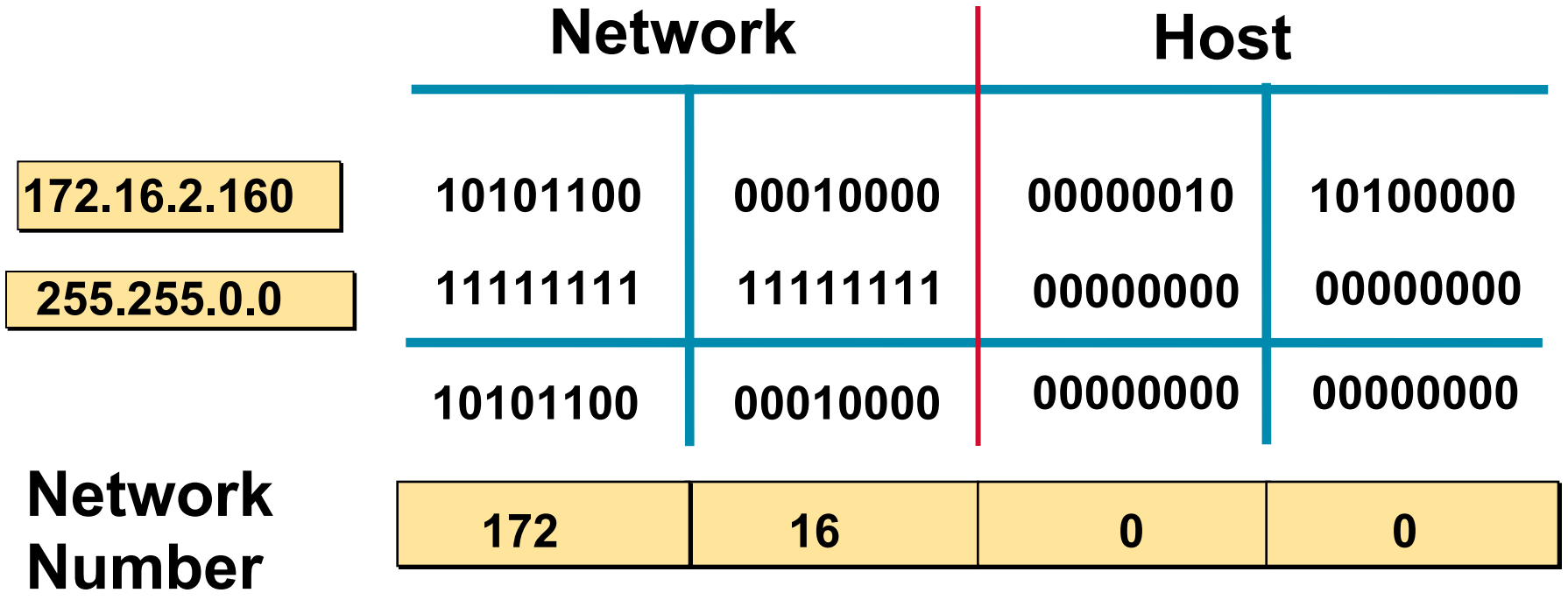
Also written as "/24" where 24 represents the number of 1s in the mask.

Decimal Equivalents of Bit Patterns



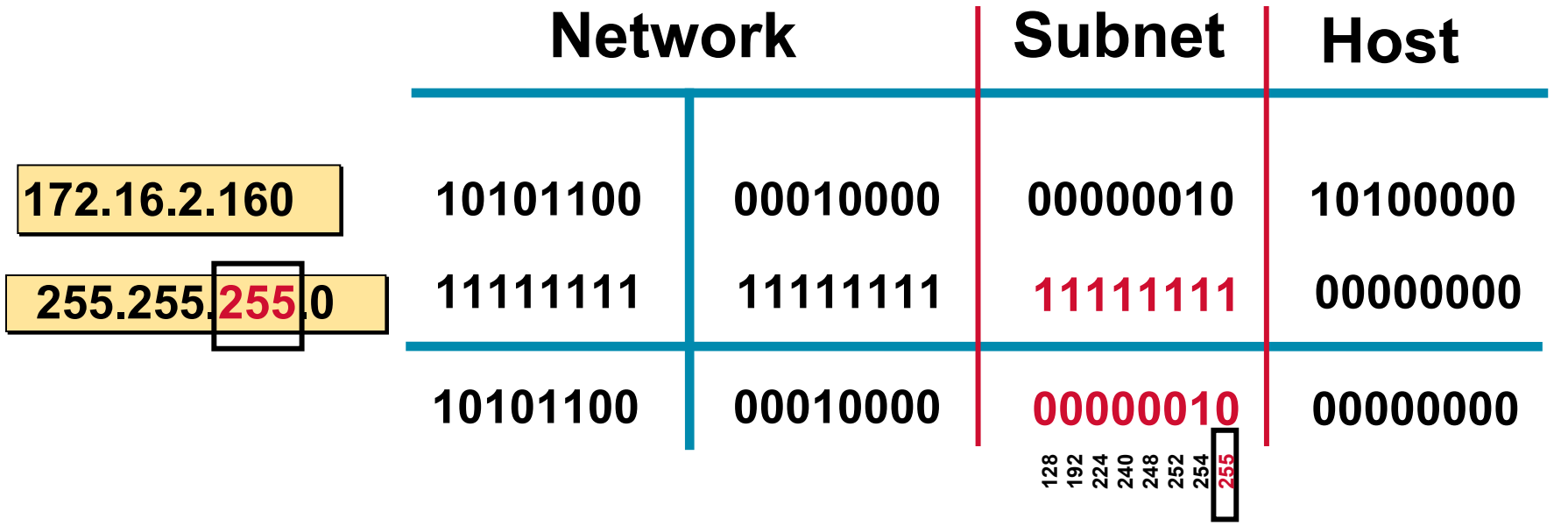
1	0	0	0	0	0	0	0	=	128
1	1	0	0	0	0	0	0	=	192
1	1	1	0	0	0	0	0	=	224
1	1	1	1	0	0	0	0	=	240
1	1	1	1	1	0	0	0	=	248
1	1	1	1	1	1	0	0	=	252
1	1	1	1	1	1	1	0	=	254
1	1	1	1	1	1	1	1	=	255

Subnet Mask without Subnets



Subnets not in use—the default

Subnet Mask with Subnets

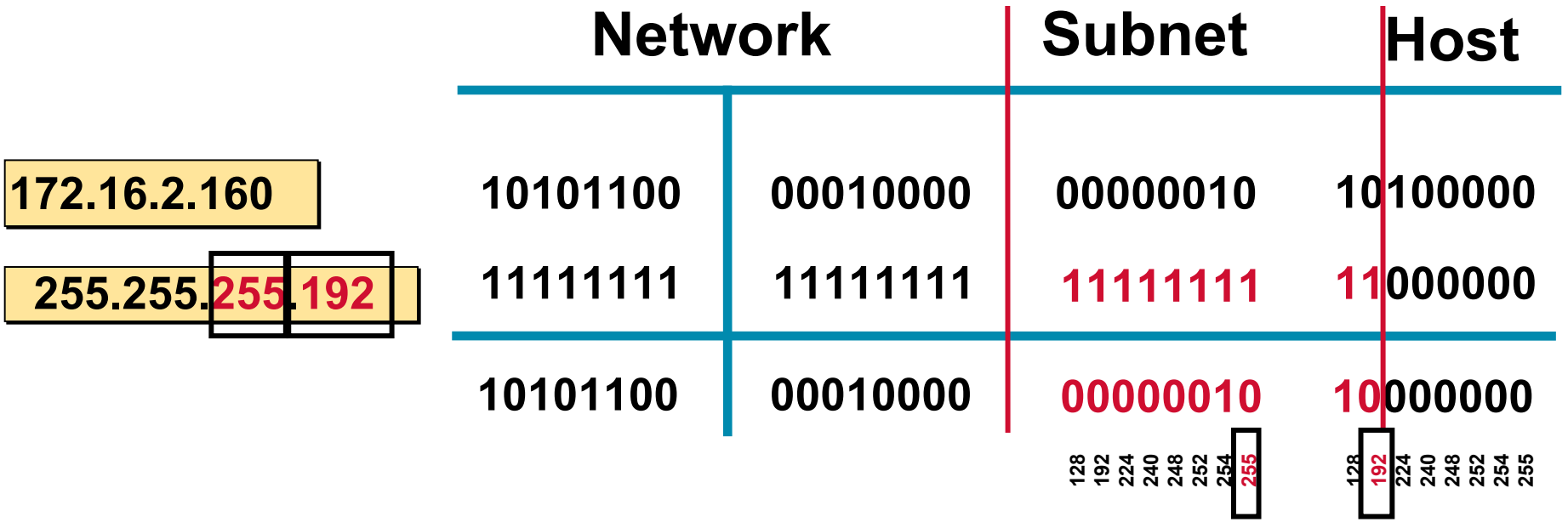


Network Number

172	16	2	0

Network number extended by eight bits

Subnet Mask with Subnets (cont.)



Network Number

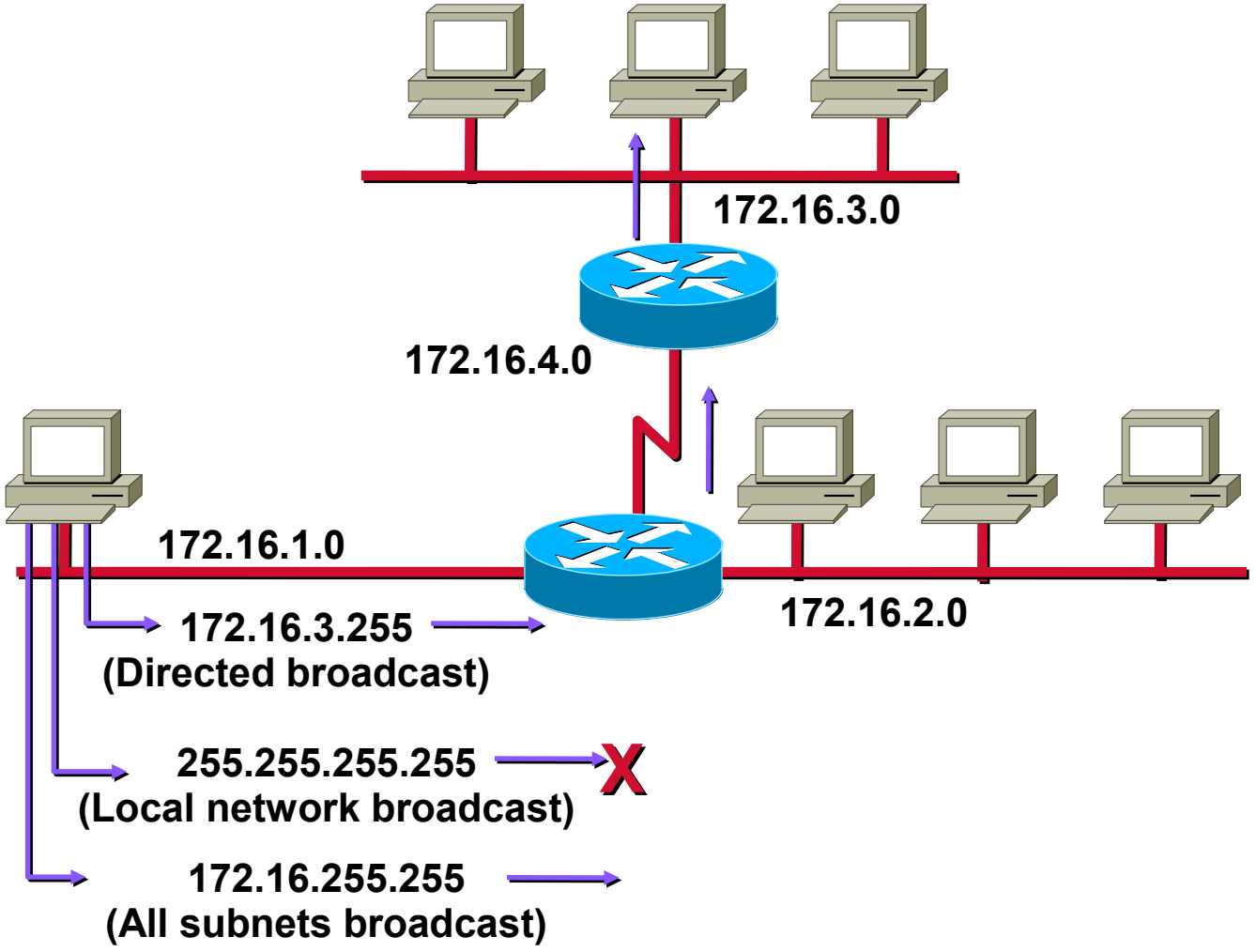
172	16	2	128

Network number extended by ten bits

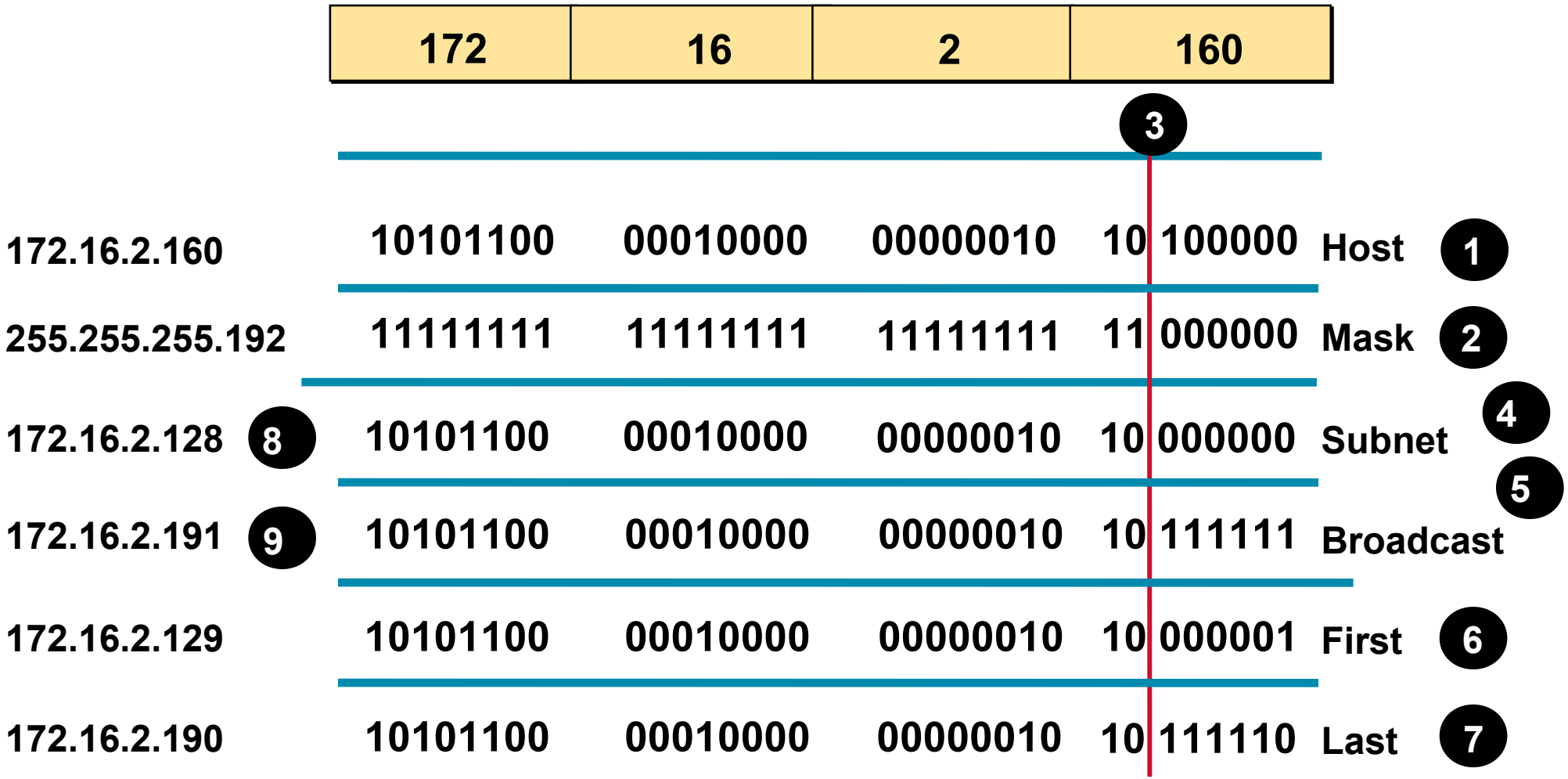
Subnet Mask Exercise Answers

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



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

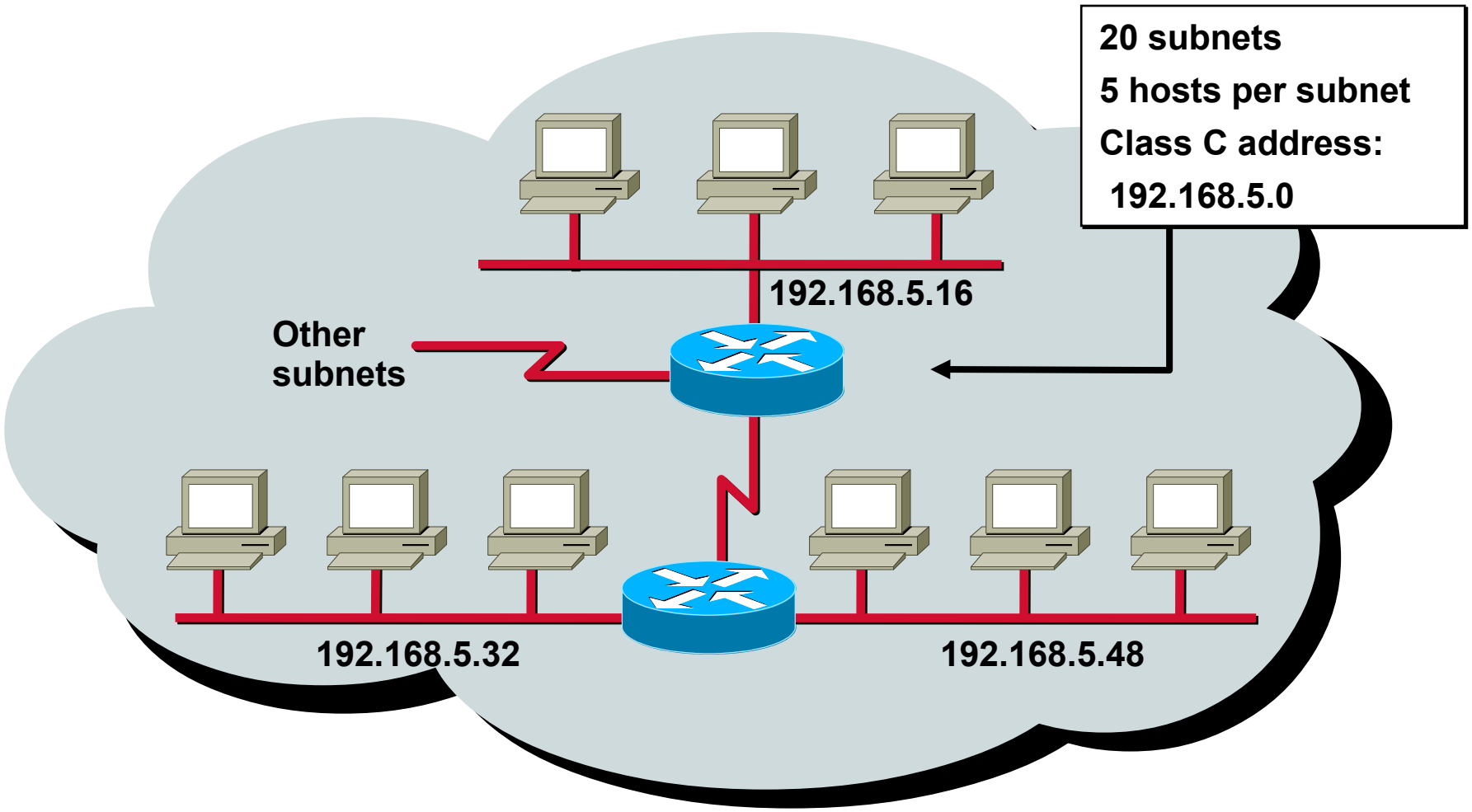
Subnet Address = 172.16.2.0

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	01111	001
255.255.255.248:	11111111	11111111	11111111	11111	000
Subnet:	11000000	10101000	00000101	01111	000
Broadcast:	11000000	10101000	00000101	01111	111

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 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