OSI Network Layer

Network Fundamentals – Chapter 5

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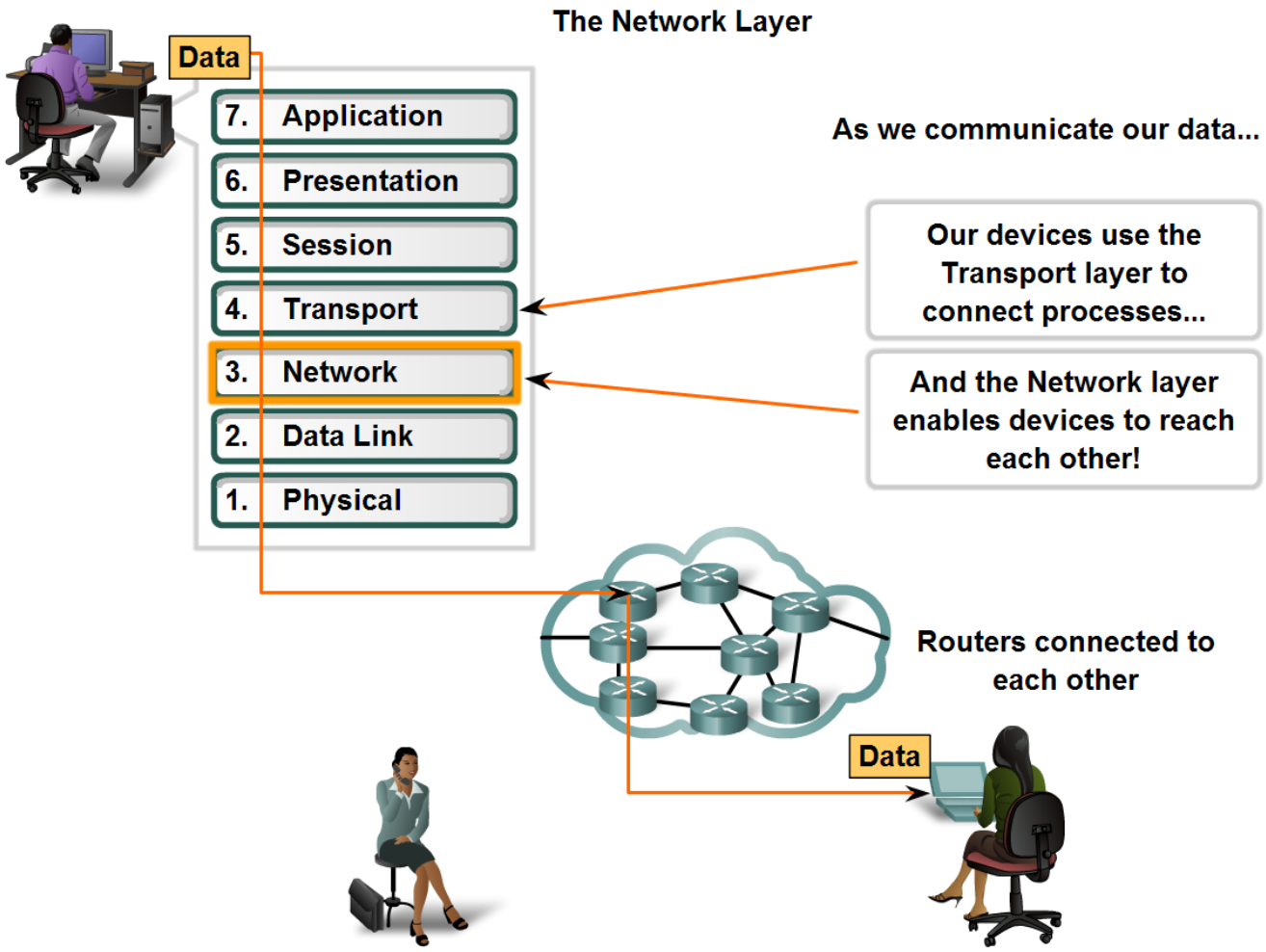
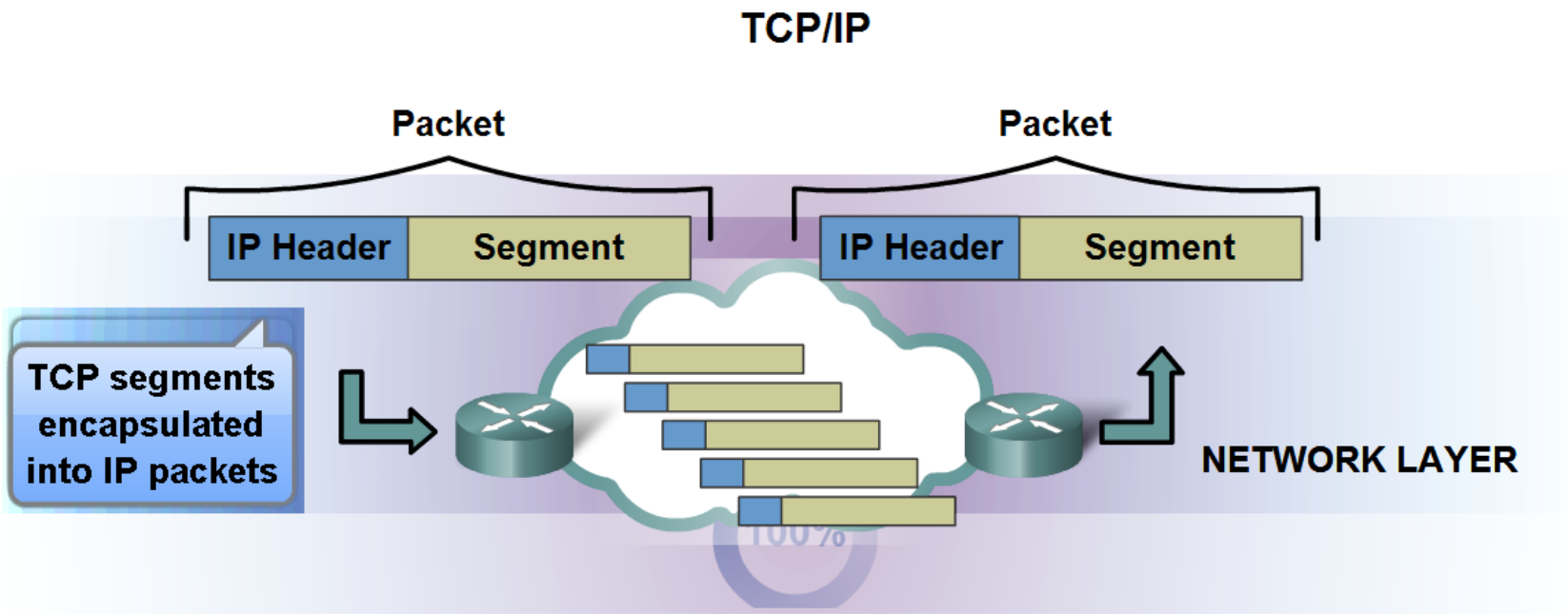
Version 4.0

Network Layer Protocols and Internet Protocol (IP)



Network Layer Protocols & Internet Protocol (IP):

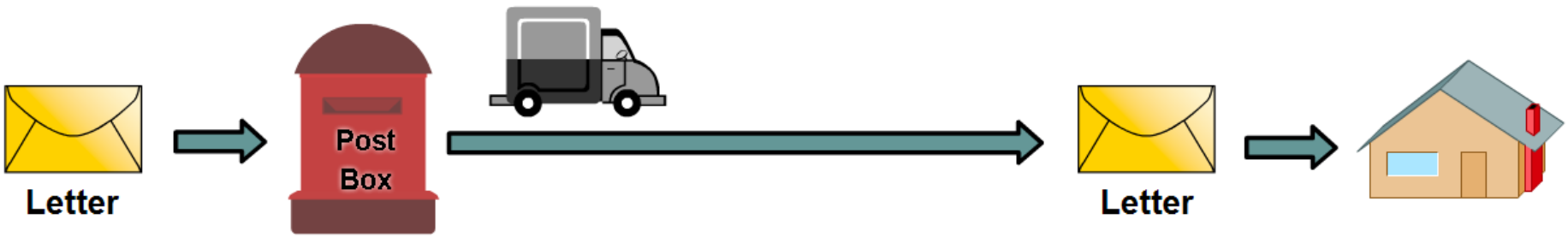


IP Packets flow through the internetwork.

- Connectionless - No connection is established before sending data packets.
- Best Effort (unreliable) - No overhead is used to guarantee packet delivery.
- Media Independent - Operates independently of the medium carrying the data.

Network Layer Protocols and Internet Protocol (IP)

Connectionless Communication



A letter is sent.

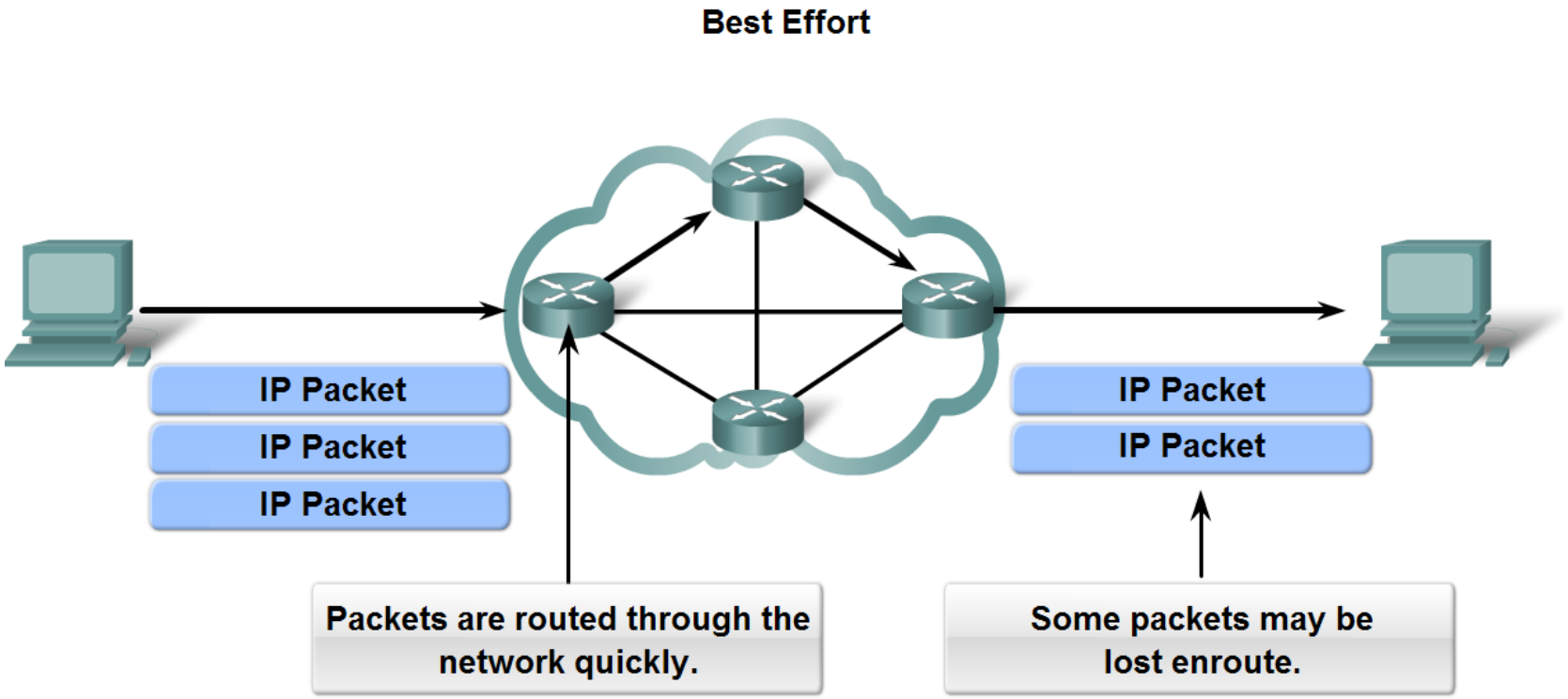
The sender doesn't know:

- if the receiver is present
- if the letter arrived
- if the receiver can read the letter

The receiver doesn't know:

- when it is coming

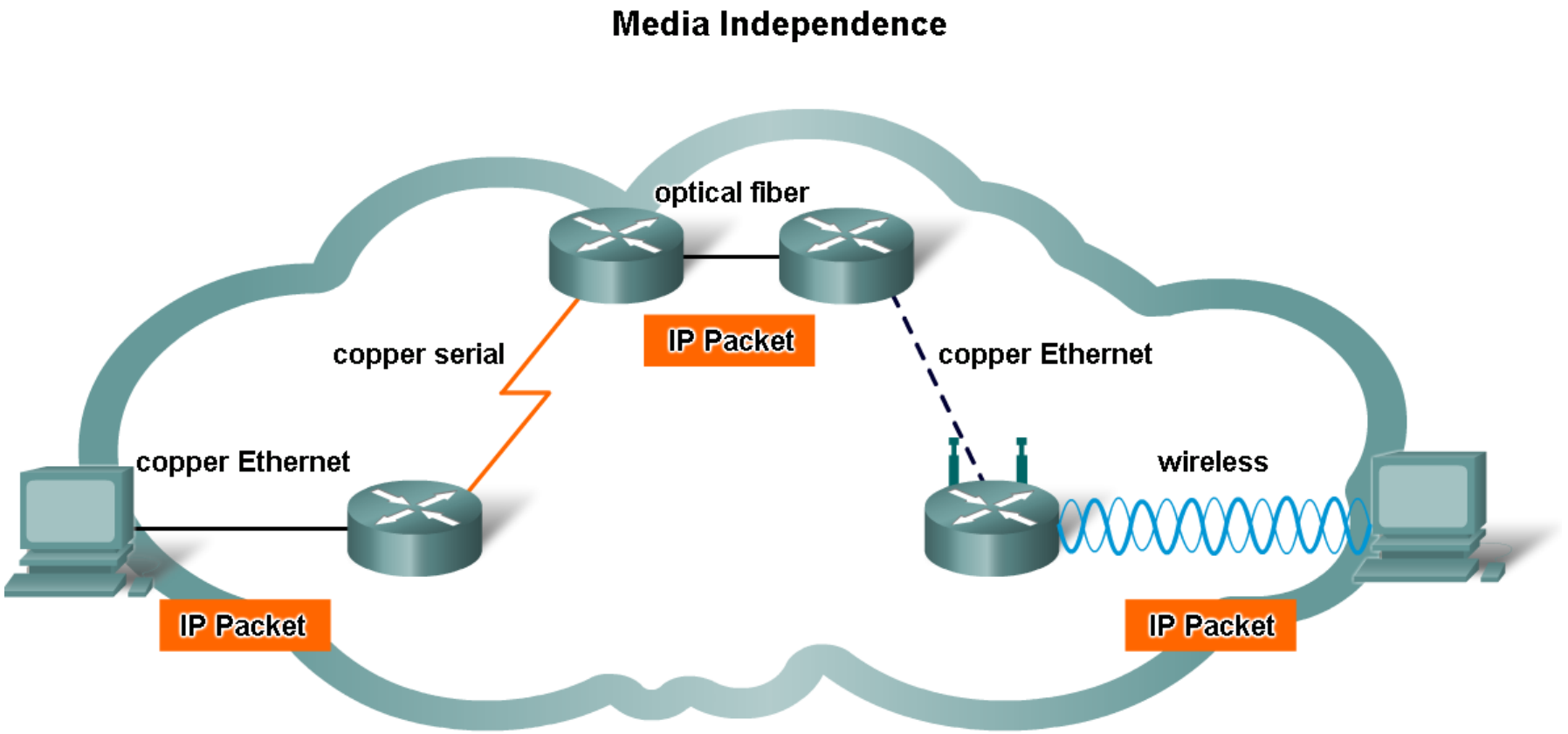
Network Layer Protocol Implications



As an unreliable Network layer protocol, IP does not guarantee that all sent packets will be received.

Other protocols manage the process of tracking packets and ensuring their delivery.

Network Layer Protocol is Media Independent



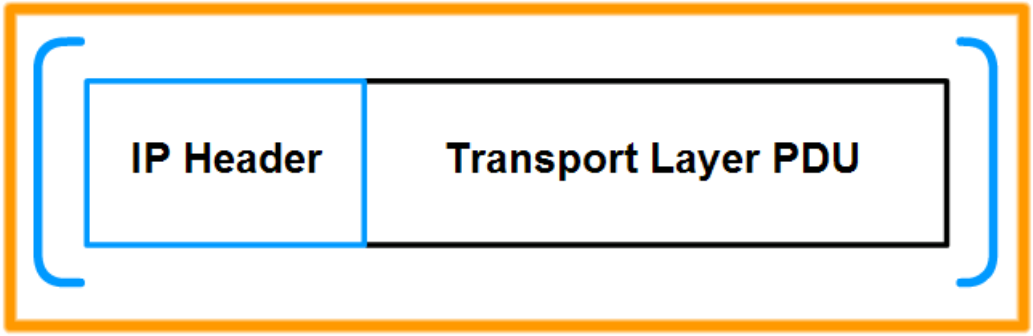
IP packets can travel over different media.

Network Layer Protocol Encapsulation

Generating IP Packets

Transport Layer Encapsulation

Network Layer Encapsulation

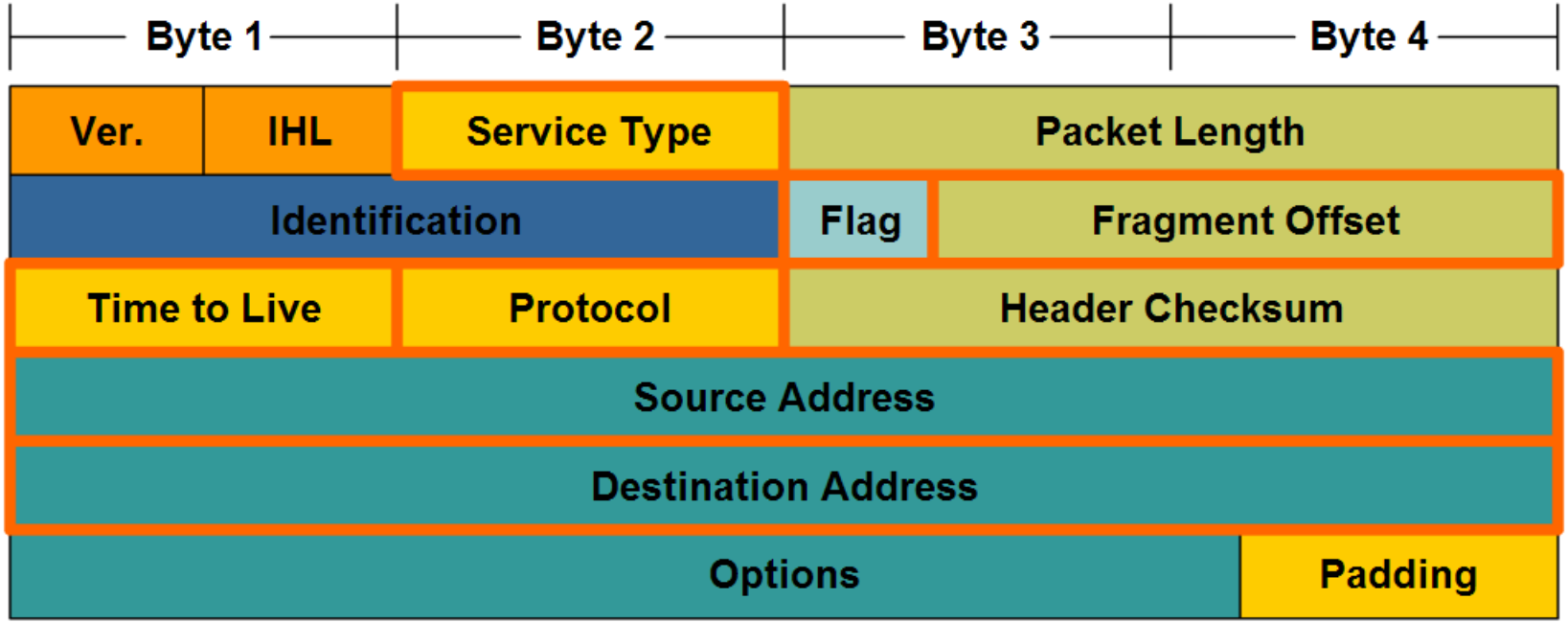


IP Packet

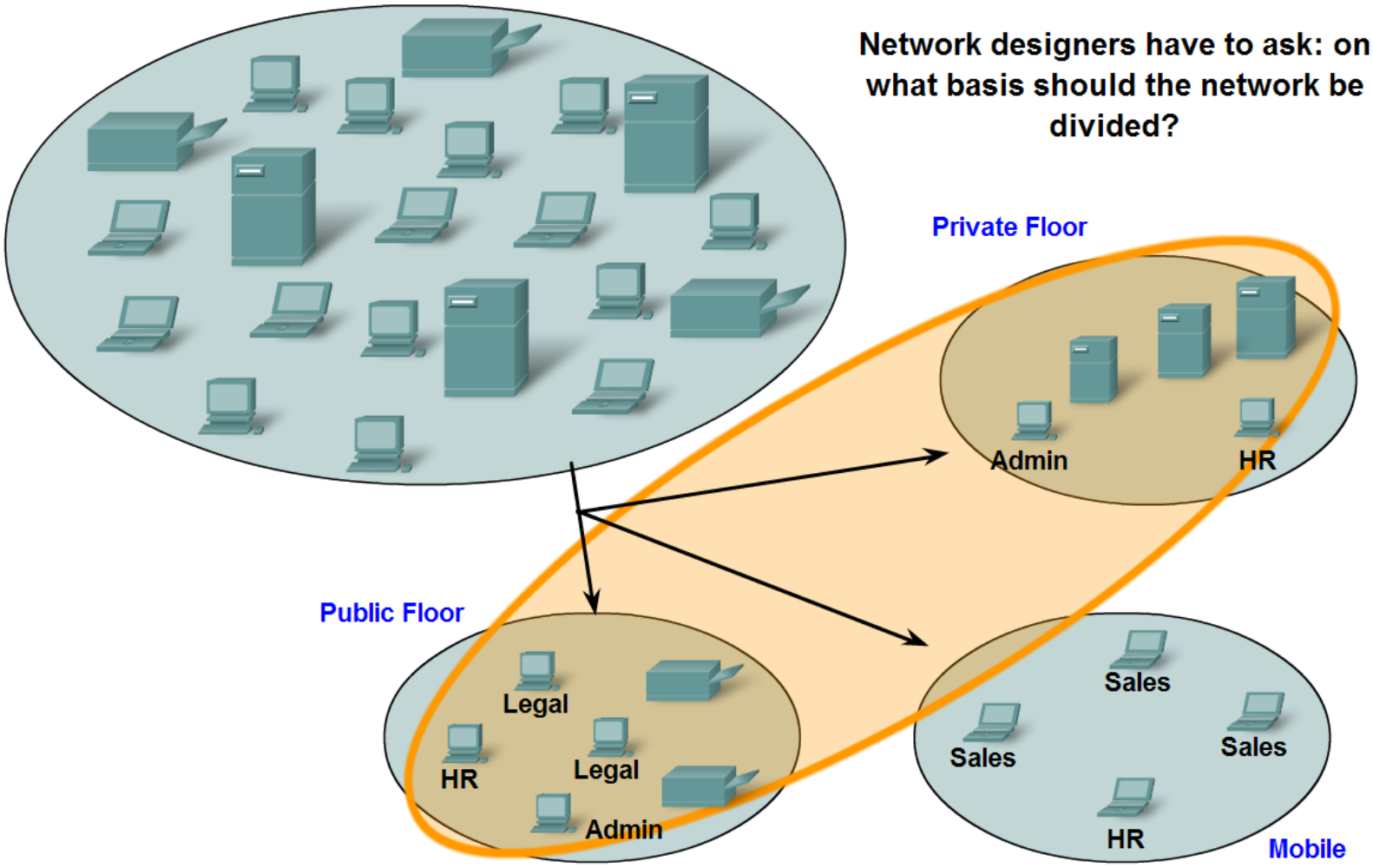
In TCP/IP based networks, the Network layer PDU is the IP packet.

Internet Protocol (IP) Packet Header

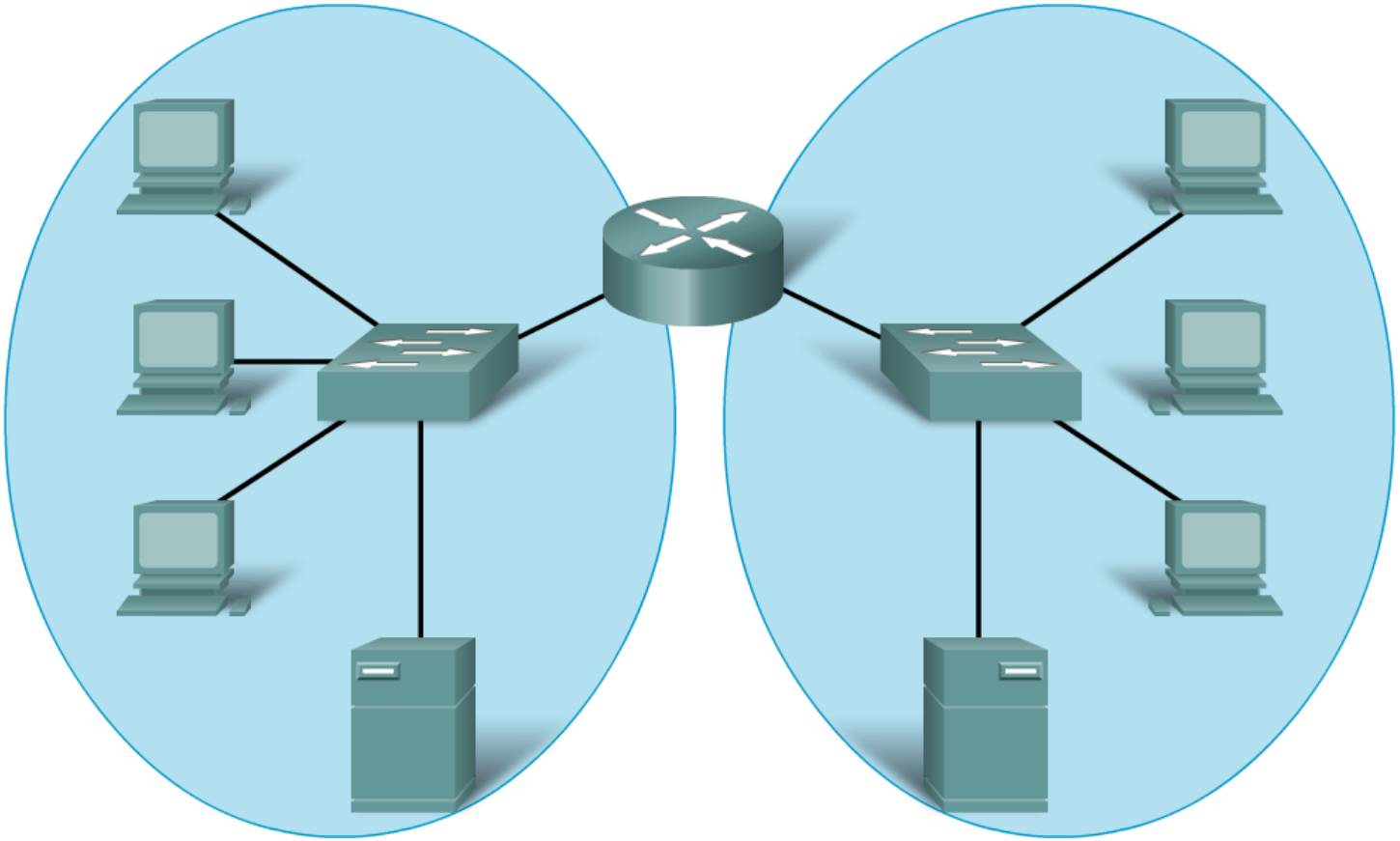
IPv4 Packet Header Fields



IP Addressing Groups Nodes into "Subnets"

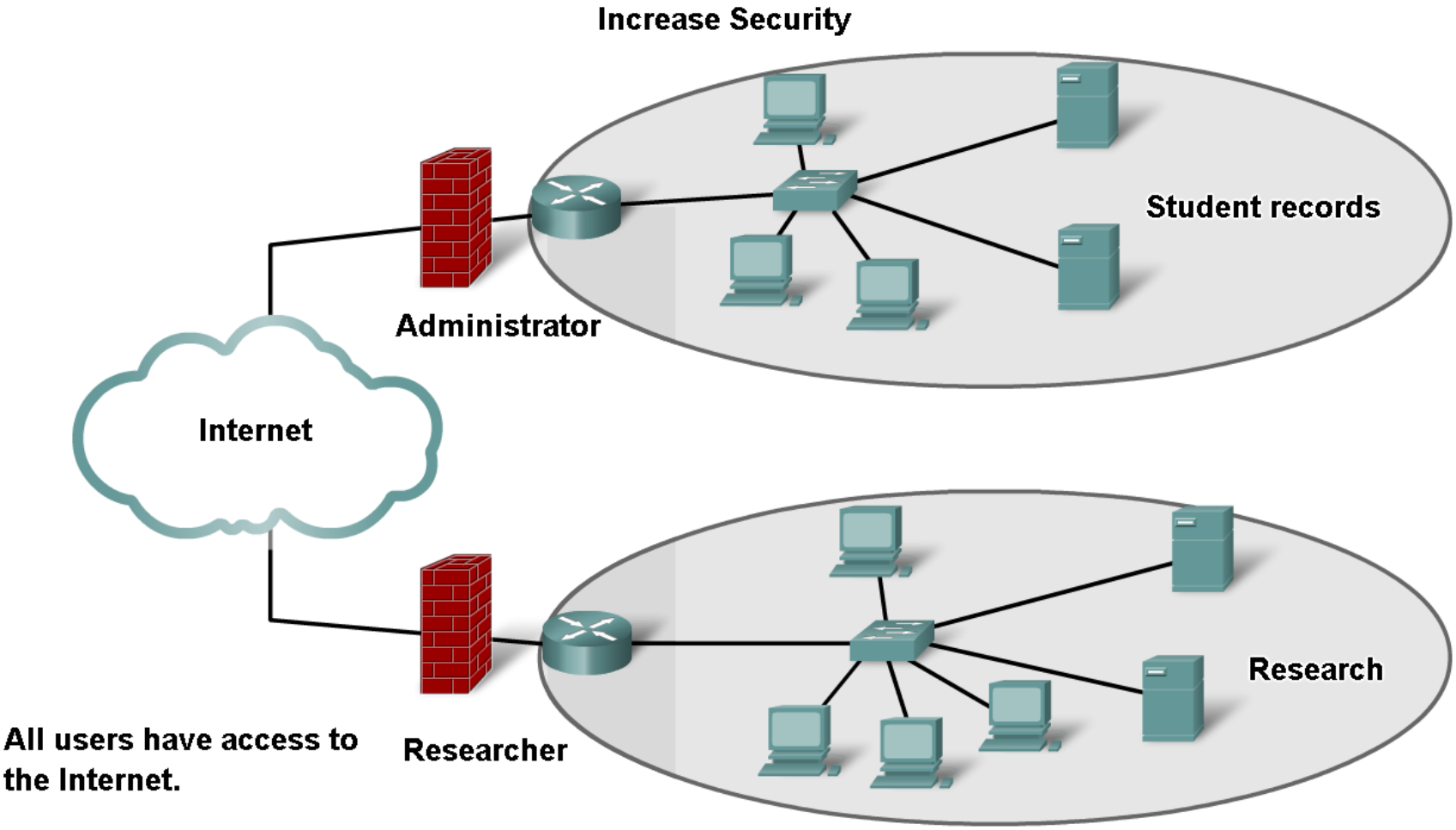


Grouping Devices into Networks with Hierarchical Addressing

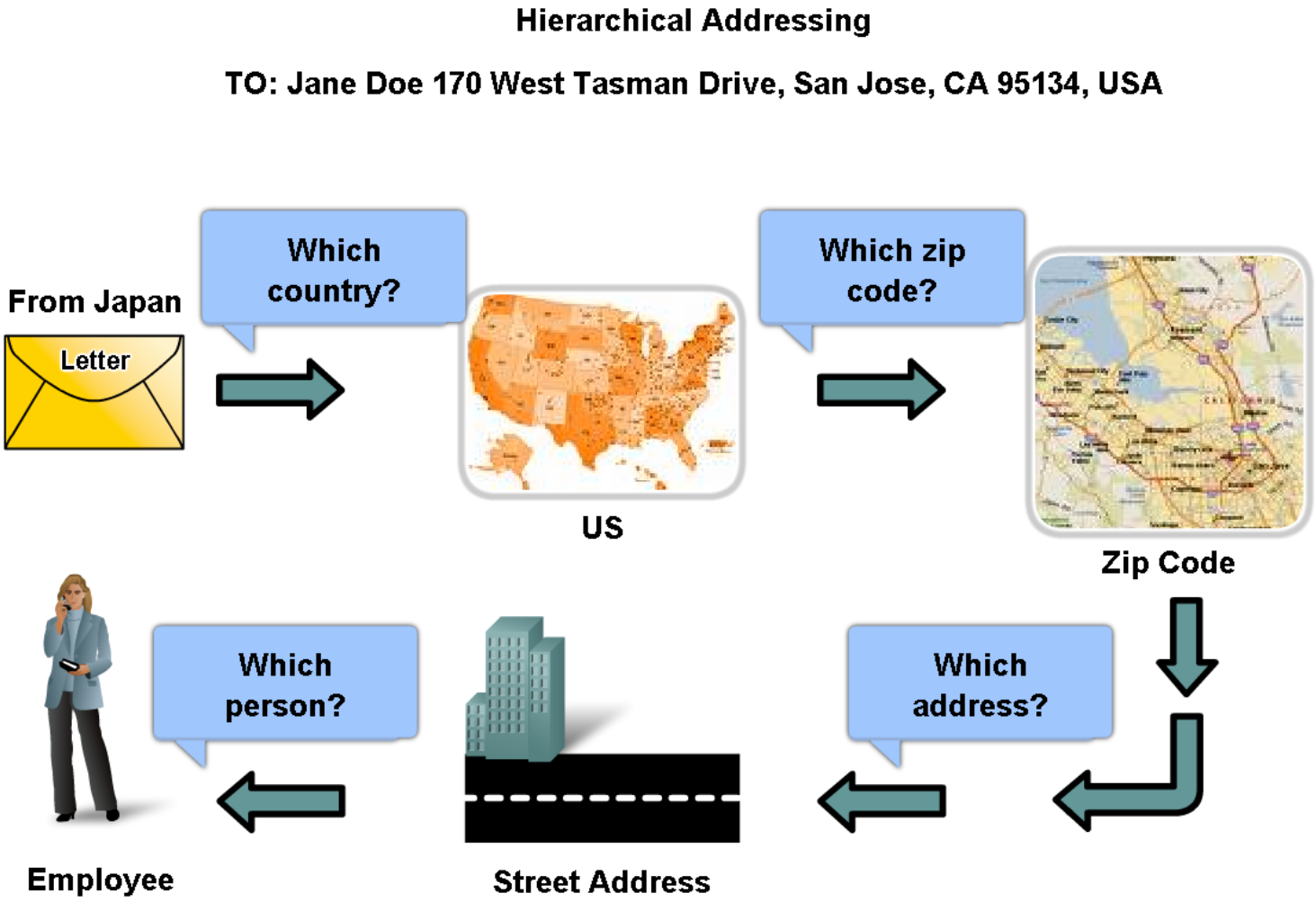


Replacing the middle switch with a router creates 2 IP subnets, hence, 2 distinct broadcast domains. All devices are connected but local broadcasts are contained.

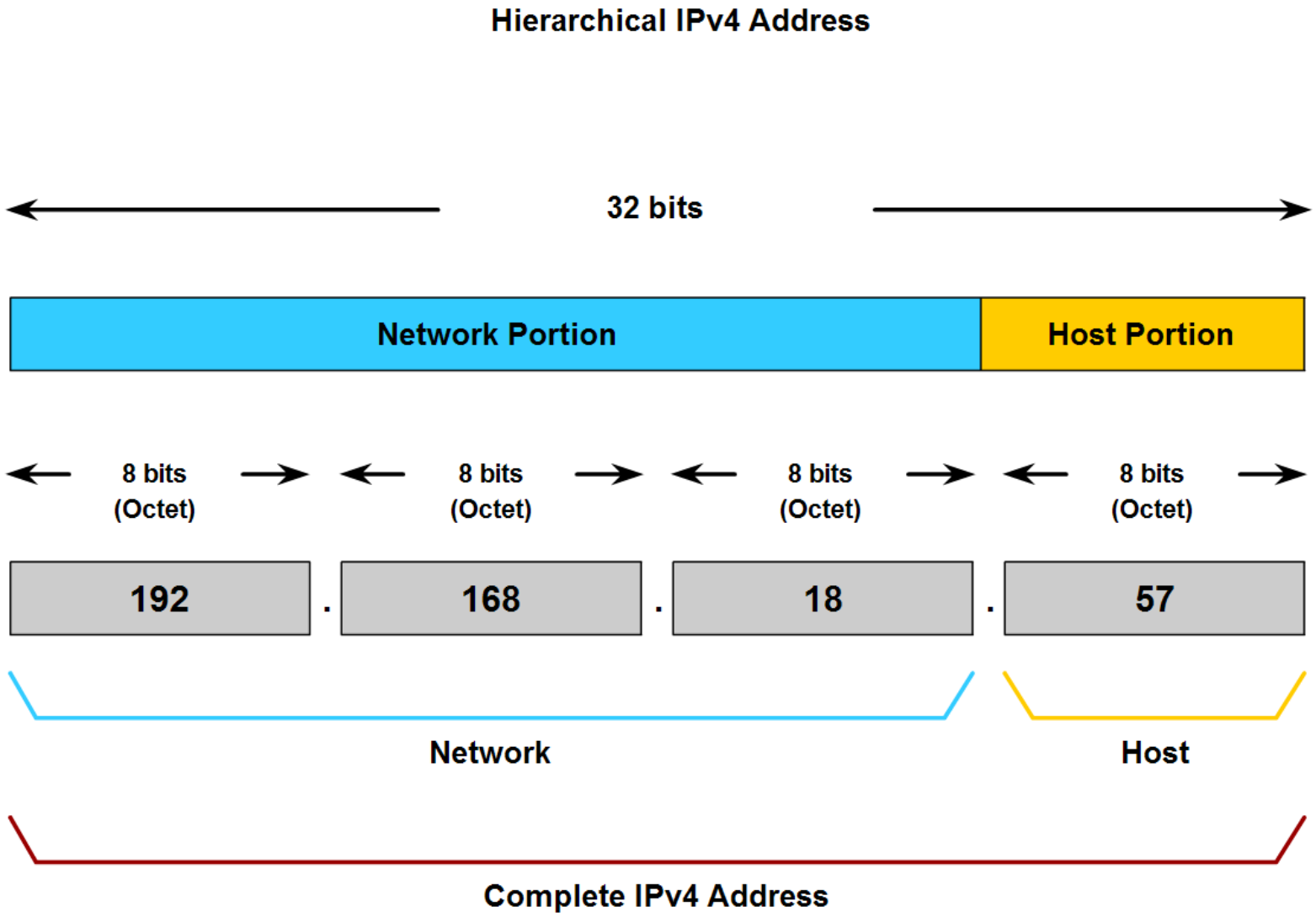
Dividing Large Networks is a Security Strategy



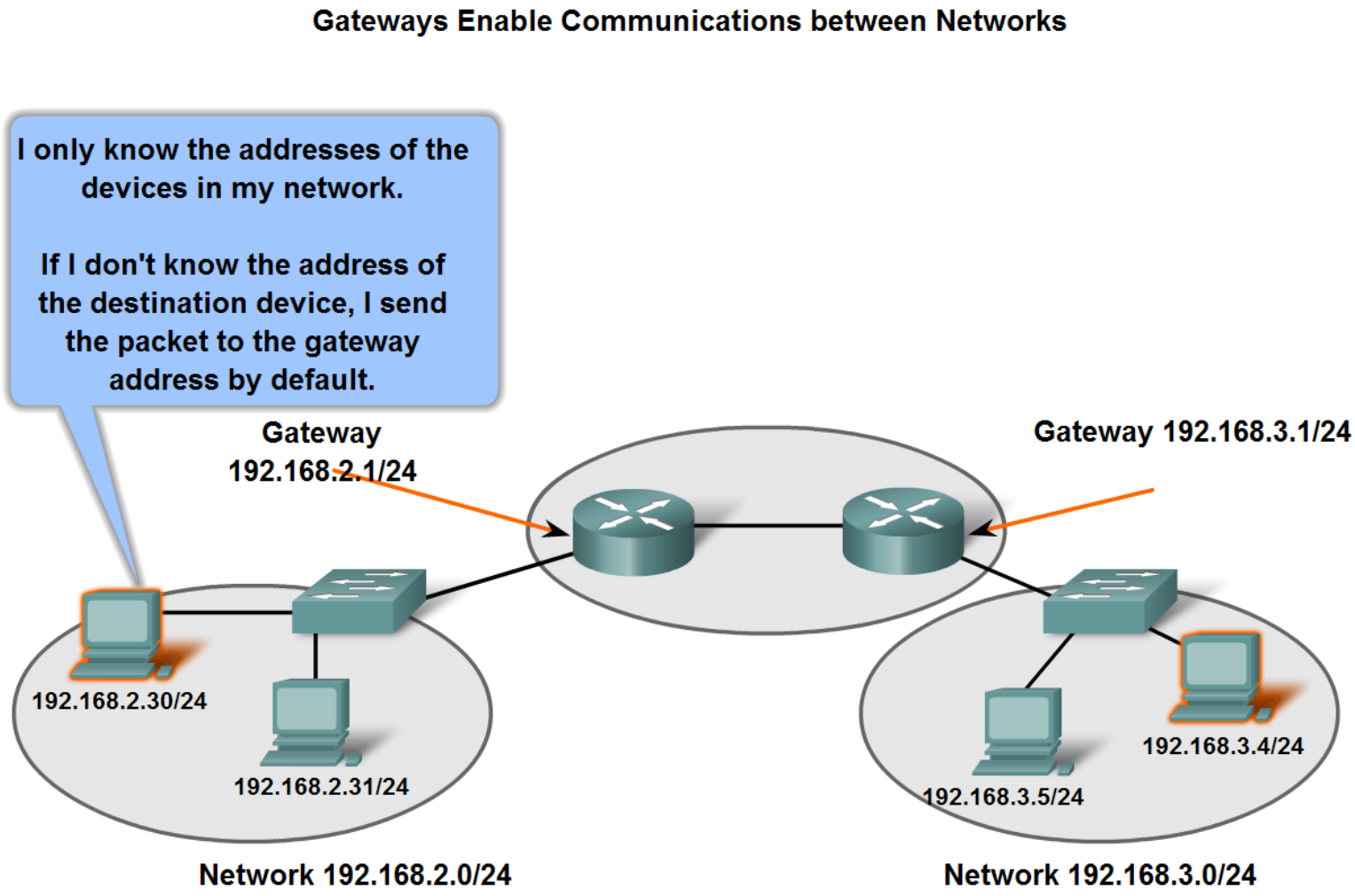
Hierarchical Addressing



Subnet Address Structure:

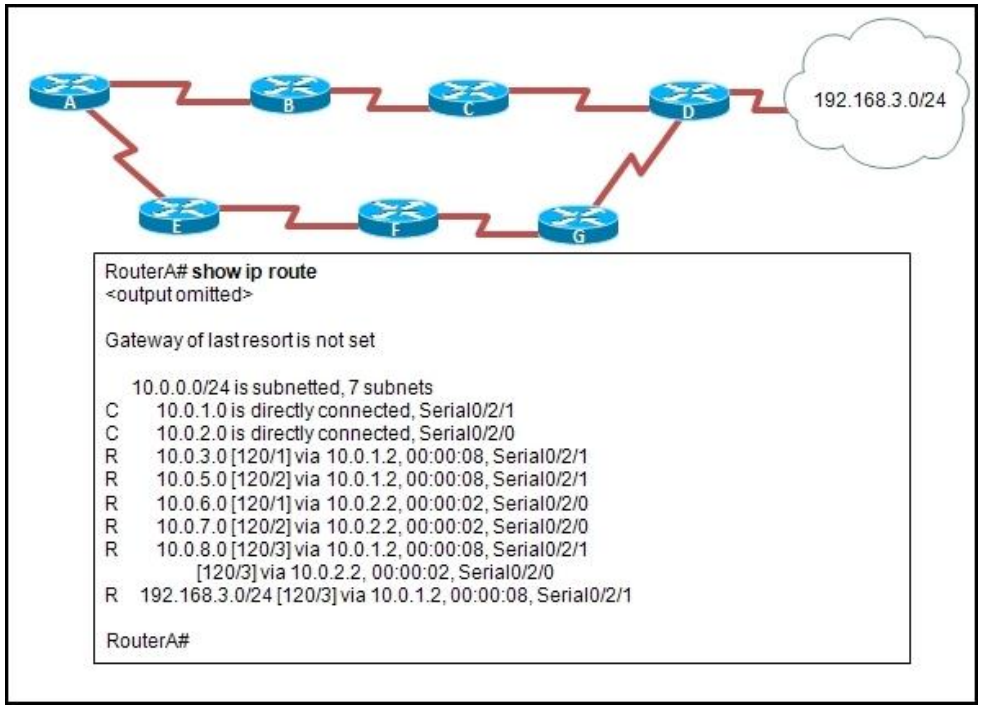


Routers "route" based on Next Hop Addresses



Route Tables:

1. Directly Connected Networks
2. Static Routes
3. Routes Learned via Routing Protocol



Let's Review Binary Math!

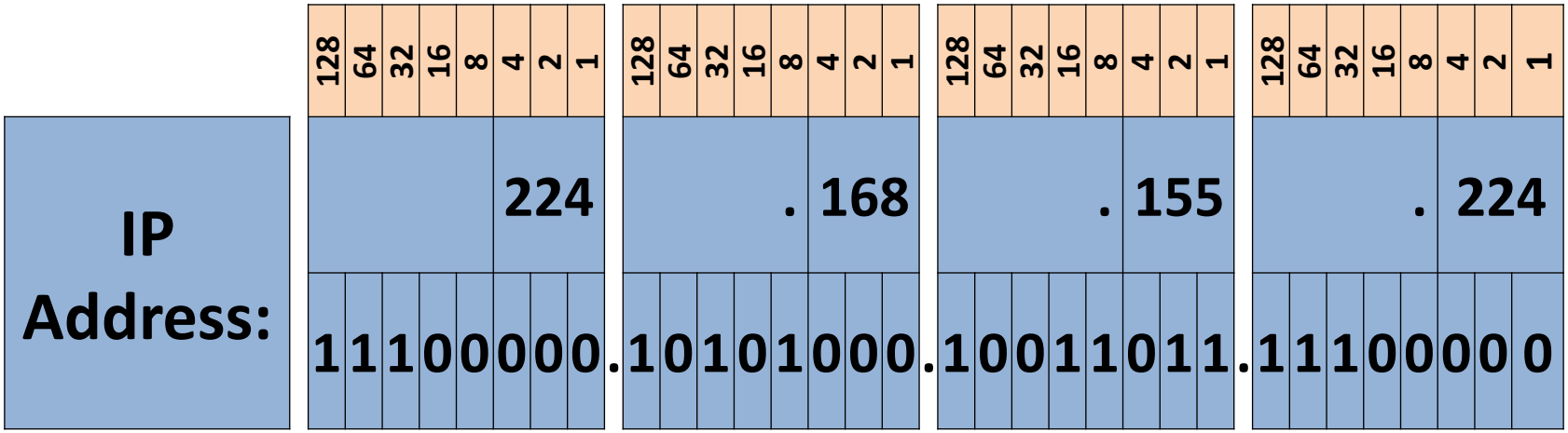
Bit Value by Position:

128	64	32	16	8	4	2	1
				.	255		
1	1	1	1	1	1	1	1

8 Bits = 1 Byte or "octet"

Lets' Review v4 IP Addresses:

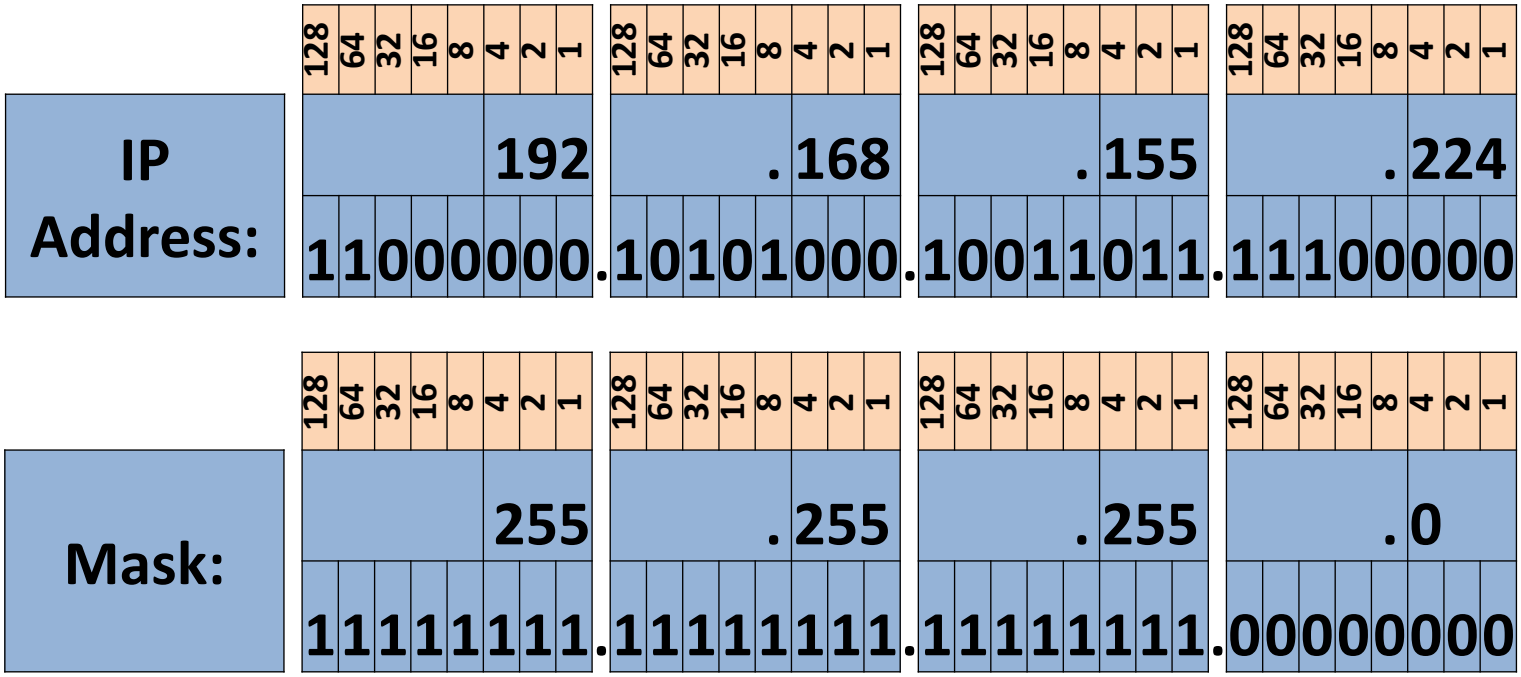
- 32 bit address
- 4 octets (or bytes)
- "dotted decimal" format



IP Address is part of a “Class”:

	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
Class A								0									126
	0	0	0	0	0	0	0	0	.	0	1	1	1	1	1	1	0
Class B								128									191
	1	0	0	0	0	0	0	0	.	1	0	1	1	1	1	1	1
Class C								192									223
	1	1	0	0	0	0	0	0	.	1	1	0	1	1	1	1	1
The Rest								224									254
	1	1	1	0	0	0	0	0	.	1	1	1	1	1	1	1	0

- All IP Addresses have two components:
  - ✓The Network Address (to the left)
  - ✓The Host ID (to the right)
- Combination is a unique address



Default Subnet Mask

	128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
Class A						255									0										0								0		
	1	1	1	1	1	1	1	1	.	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0	.	0	0	0	0	0	0	0	0
Class B						255									255										0								0		
	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	0
Class C						255									255										255								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

- A = 126 Networks, 16,777,214 hosts
- B = > 16,000 Networks, 65,534 hosts
- C = > 2,000,000 Networks, 254 hosts

A “Network” is a range of addresses:

- Example: **192.168.101.0** to **192.168.101.255**
  - ✓The first number in the range (host = all zero) is the Network Number = 192.168.101.0
  - ✓The last number in the range (host = all ones) is the broadcast address = 192.168.101.255
  - ✓The middle of the range can be used for identifying individual hosts.

Subnet Mask:

A subnet mask is used to identify the Network ID portion of the address range:

- ✓ A = 255.0.0.0
- ✓ B = 255.255.0.0
- ✓ C = 255.255.255.0

Three methods of identifying the Subnet Mask:

- ✓ Default Subnet Mask
- ✓ Subnet Mask for the Enterprise
- ✓ CIDR /number notation

We extract the Network ID using a binary logical “trick” … the “and logic”.