CISCO CCNA1

CCNA Routing and Switching: Introduction to Networks

HOOFDSTUK 4

Network Access

DE HOGESCHOOL
MET HET NETWERK

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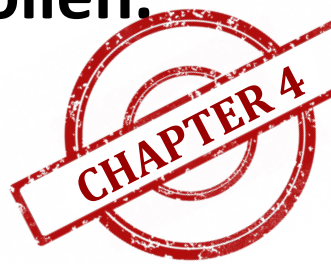
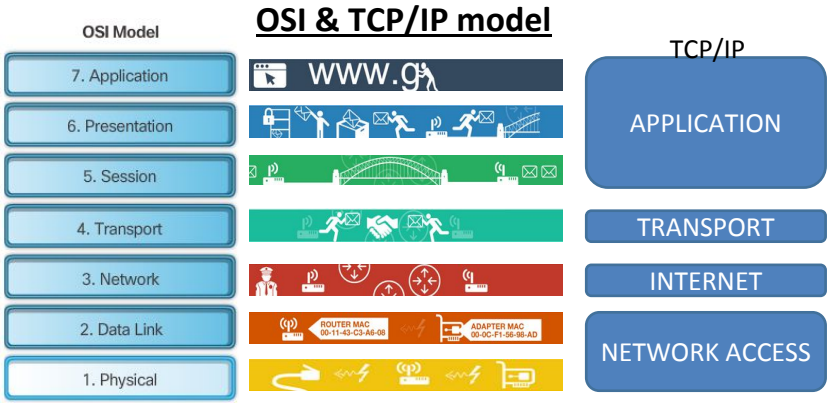
CCNA1 - Overzicht

- **OSI model en de belangrijkste (LAN) protocollen.**
- Data Flow in een LAN
  (verklaring volgens het OSI model).
- IP en subnetting.
- Het toepassen en onderzoeken van bovenstaande 3 in Packettrace oefeningen.

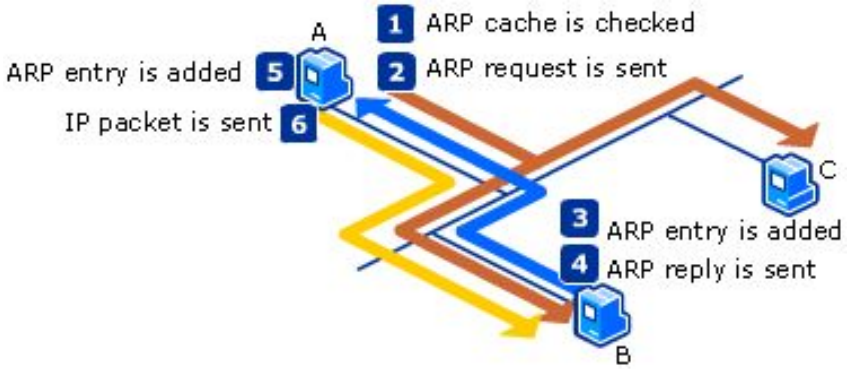


CCNA1 - Overzicht

1. OSI model en de belangrijkste (LAN) protocollen.



2. Data Flow in een LAN (verklaring volgens het OSI model)



3. IP en subnetting

Situering hoofdstuk 4

Dit hoofdstuk begint met de algemene functies van de **fysieke laag** en zijn standaarden en protocollen voor de overdracht van data, alsook de diverse bekabeling. Het introduceert ook de functies van de **data link laag** en de protocollen die ermee verbonden zijn.
Chapter 4 bespreekt de eerste layer van het TCP/IP model, 'Network access'. Deze layer komt overeen met de onderste 2 lagen van het OSI model nm Physical + data link.
Het eerste deel van het hoofdstuk (4.1 & 4.2) toont een overzicht van de verschillende soorten mediums en hun eigenschappen alsook standaarden en protocollen voor de overdracht van data.
Een tweede deel (4.3 & 4.4) gaat dieper in op de datalink layer. De gebruikte protocollen, media access, het data link frame en de LAN/WAN topologie.

Doelstellingen:

- UTP, STP, Coax, fiberoptics en wireless herkennen en vergelijken. (4.2)
- Doel van de pyhiscal + data link layer verklaren.
- Framefields van een frame interpreteren (4.2.1.7)
- Begrijp de adressering op de data link layer. (4.4.4.4)

Activity en PT:

- 4.2.1.7 Copper media characteristics
- 4.4.4.3 Generic Frame fields
- PT 4.2.4.4: Connecting a wired and wireless LAN

Zie leerpad op blackboard!

Cisco Networking Academy
Mind Wide Open

Chapter 4:

Network Access

Introduction to Networks v5.1

Chapter Outline

4.0 Introduction

4.1 Physical Layer Protocols

4.2 Network Media

4.3 Data Link Layer Protocols

4.4 Media Access Control

4.5 Summary

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Section 4.1: Physical Layer Protocols

- 4.1.1: Physical Layer Connection
- 4.1.2: Purpose of the Physical Layer
- 4.1.3: Physical Layer Characteristics

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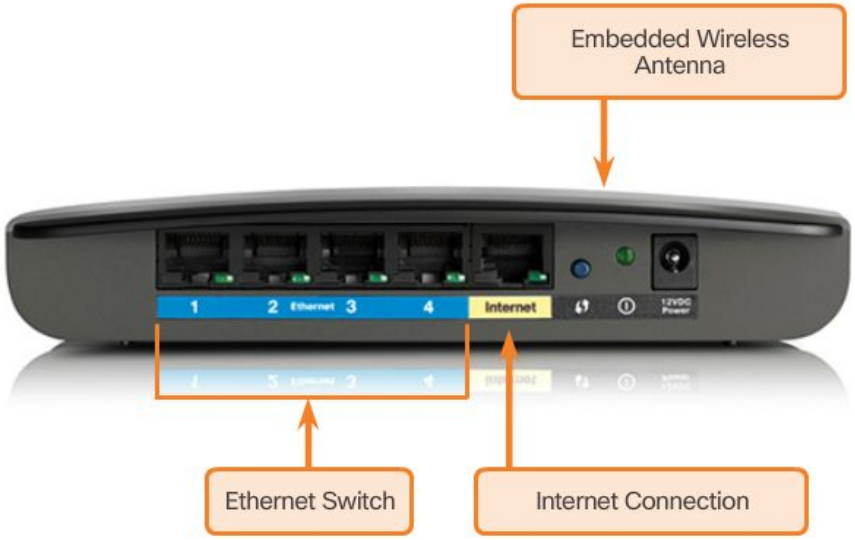
4.1.1: Physical Layer Connection
4.1.1.1 Types of Connections



Home Router

Connecting to the Wired LAN

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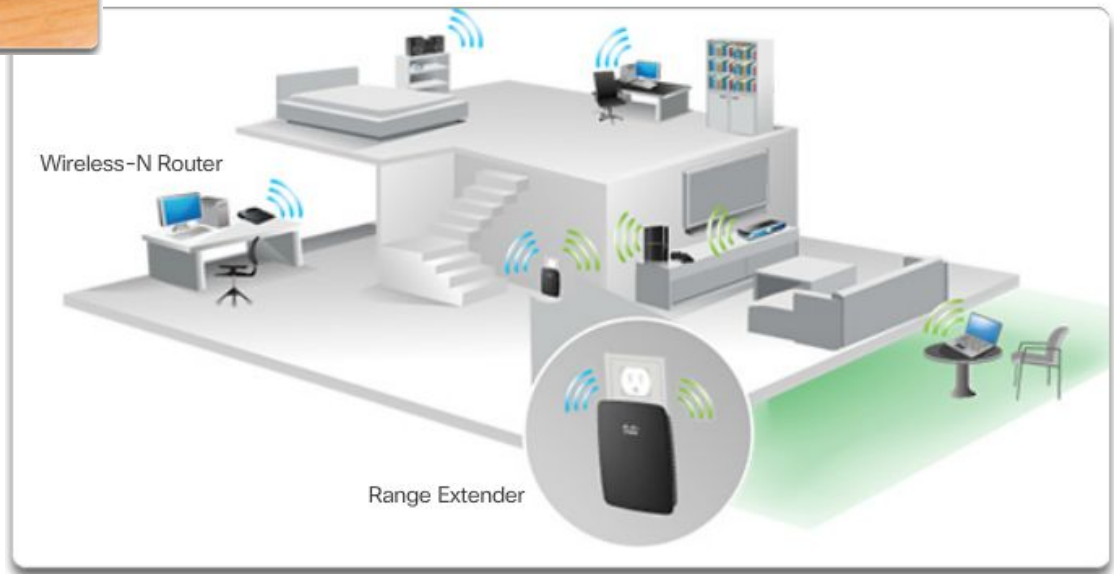
4.1.1: Physical Layer Connection
4.1.1.2 Network Interface Cards

Wired Connection Using an Ethernet NIC

Connecting to the Wireless LAN with Range Extender



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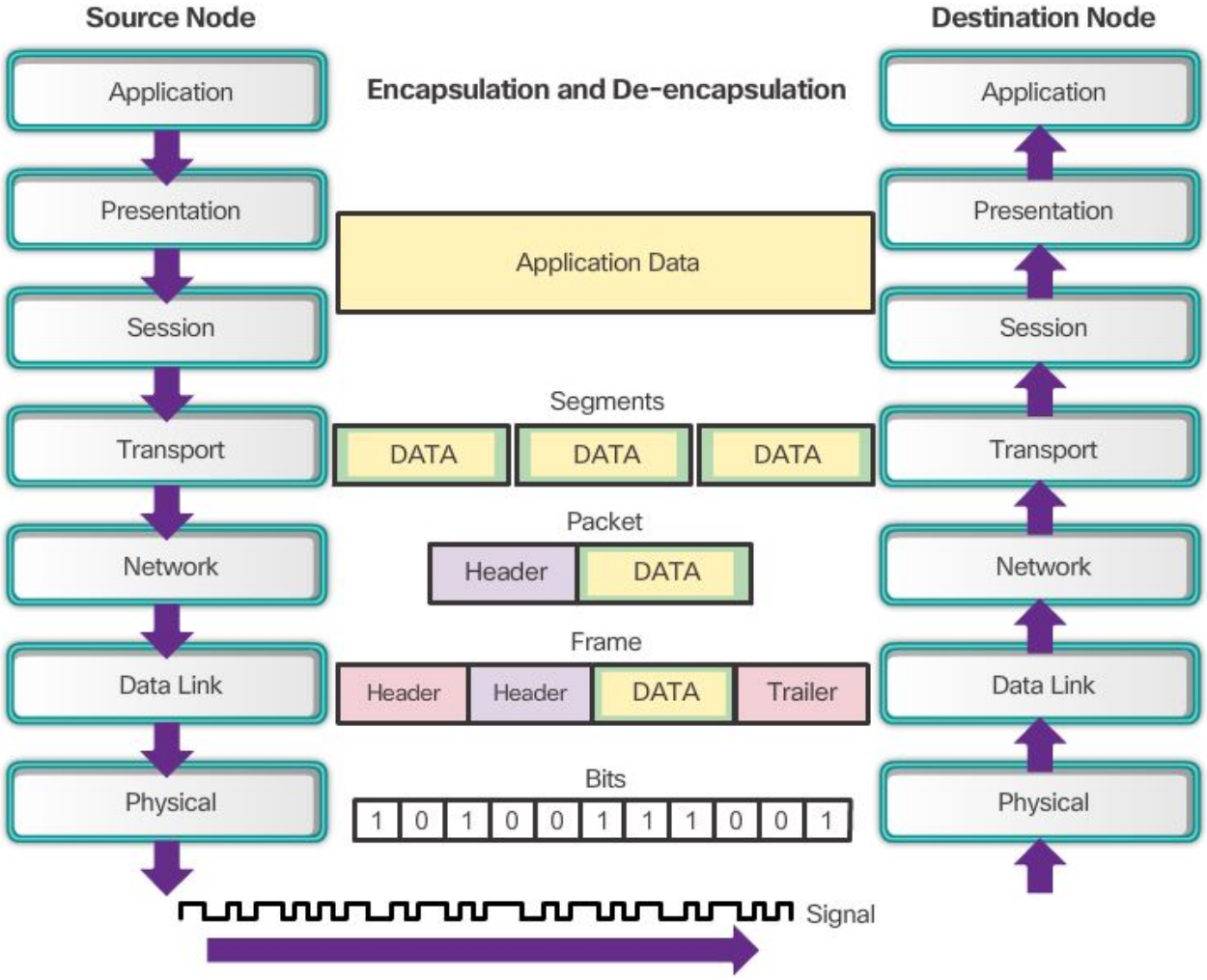
4.1.2: Purpose of the Physical Layer

4.1.2.1 The Physical Layer



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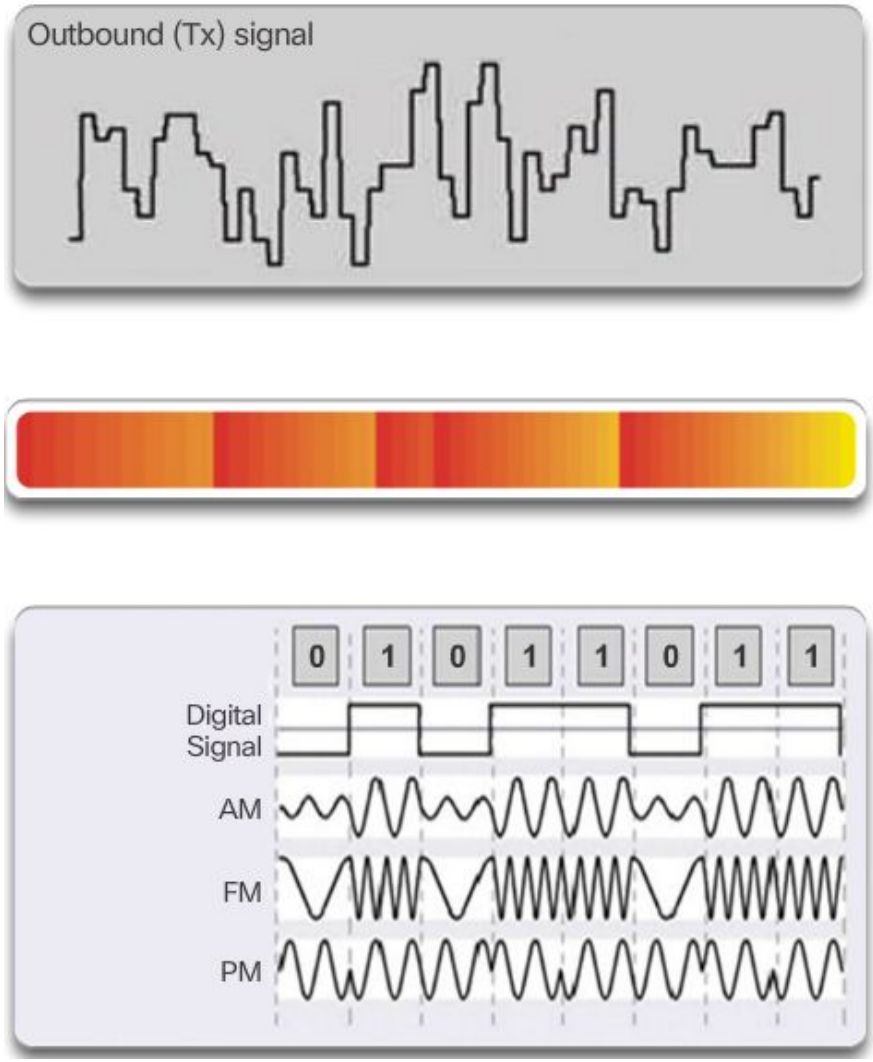
4.1.2: Purpose of the Physical Layer
4.1.2.2 Physical Layer Media



Electrical Signals – Copper cable

Light Pulse – Fiber-optic cable

Microwave Signals – Wireless

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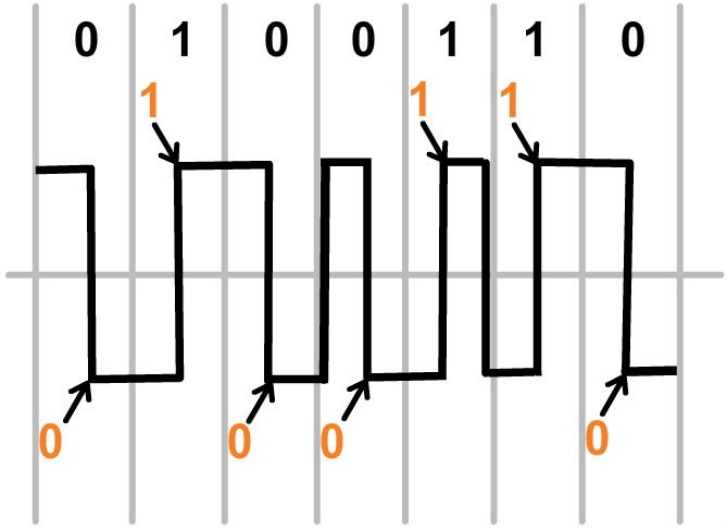
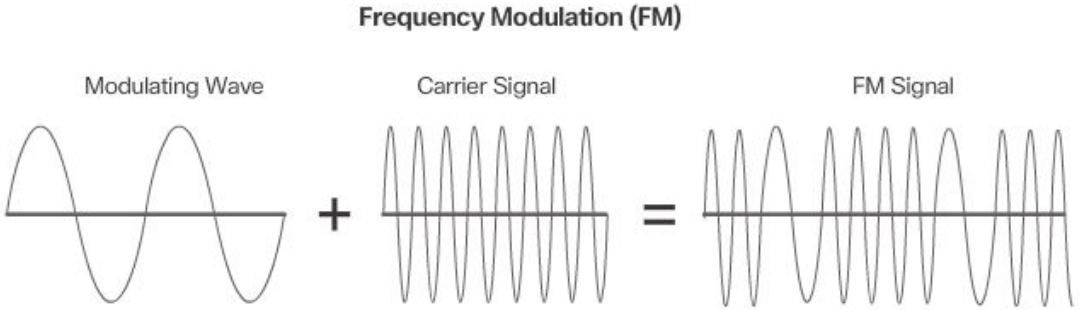
4.1.3: Physical Layer Characteristics

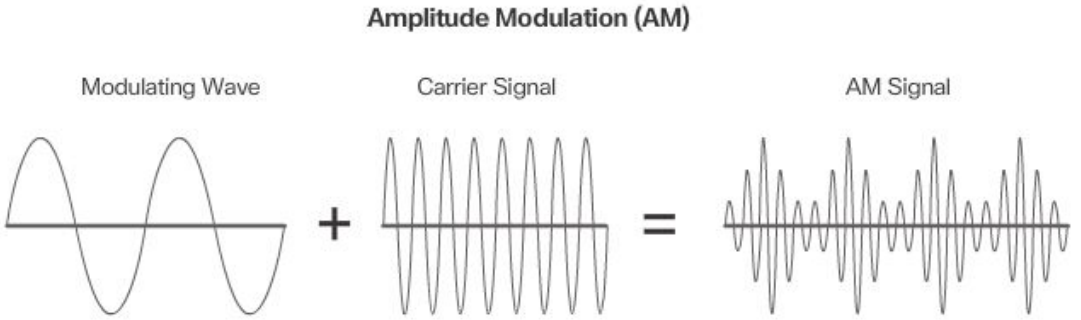
4.1.3.1 Functions



Manchester Encoding

Modulation





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4.1.3: Physical Layer Characteristics
4.1.3.2 Bandwidth

Unit of Bandwidth	Abbreviation	Equivalence
Bits per second	bps	1 bps = fundamental unit of bandwidth
Kilobits per second	kbps	1 kbps = 1,000 bps = 10^3 bps
Megabits per second	Mbps	1 Mbps = 1,000,000 bps = 10^6 bps
Gigabits per second	Gbps	1 Gbps = 1,000,000,000 bps = 10^9 bps
Terabits per second	Tbps	1 Tbps = 1,000,000,000,000 bps = 10^12 bps

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4.1.3: Physical Layer Characteristics
4.1.3.3 Throughput

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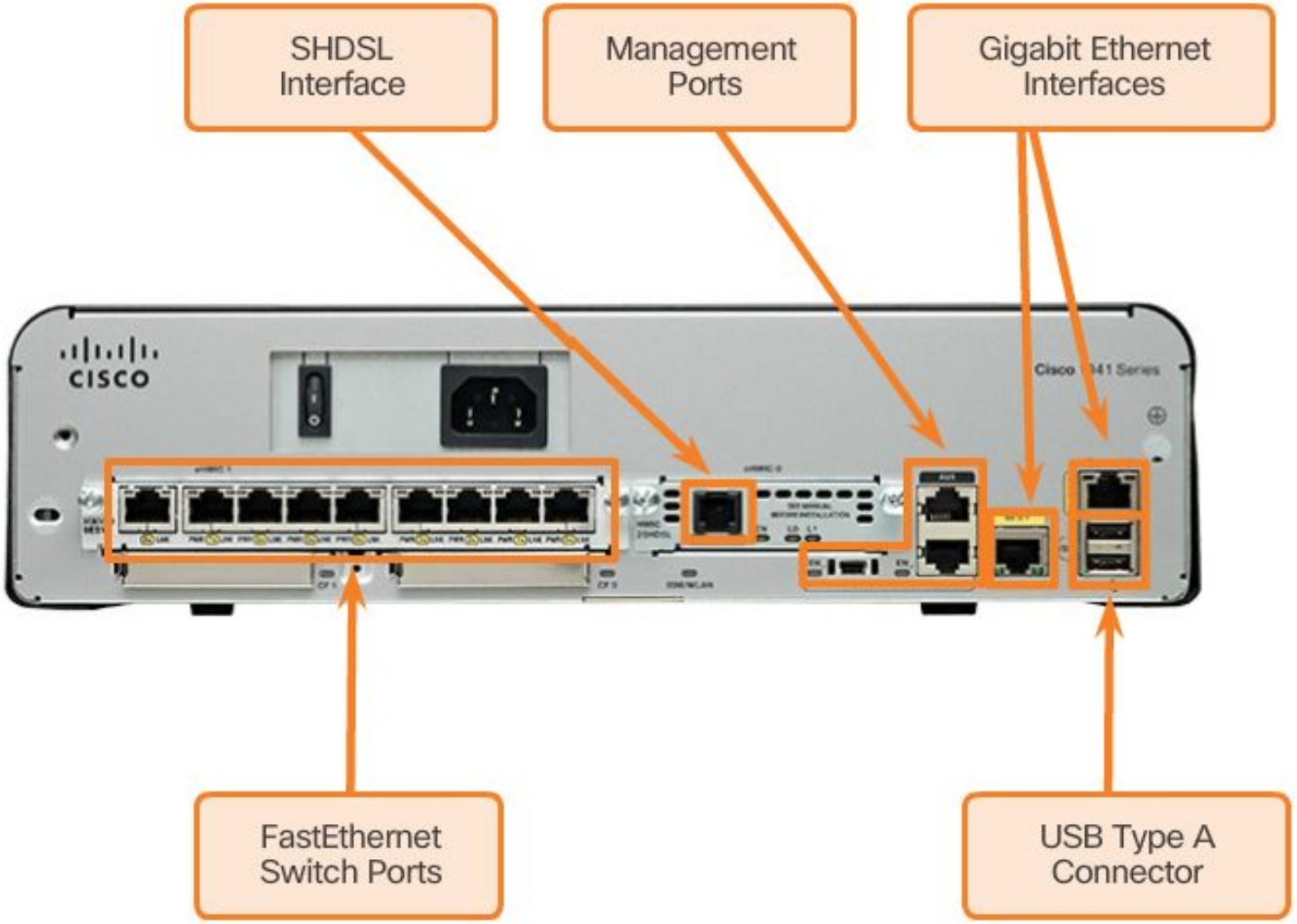
4.1.3: Physical Layer Characteristics
4.1.3.4 Types of Physical Media



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4.1.3: Physical Layer Characteristics
4.1.3.5 Activity - Physical Layer Terminology

- Synchronous
- Signaling method
- Frame encoding
- Asynchronous
- Physical components

Term	Physical Layer Description
	Hardware devices, media, and connectors which transmit and carry bit signals
	How 1s and 0s are represented on the media – varies, depending on encoding scheme
	Evenly spaced time duration for signals
	A method for converting streams of data bits into groupings of bits – predefined
	Arbitrarily spaced time duration for signals

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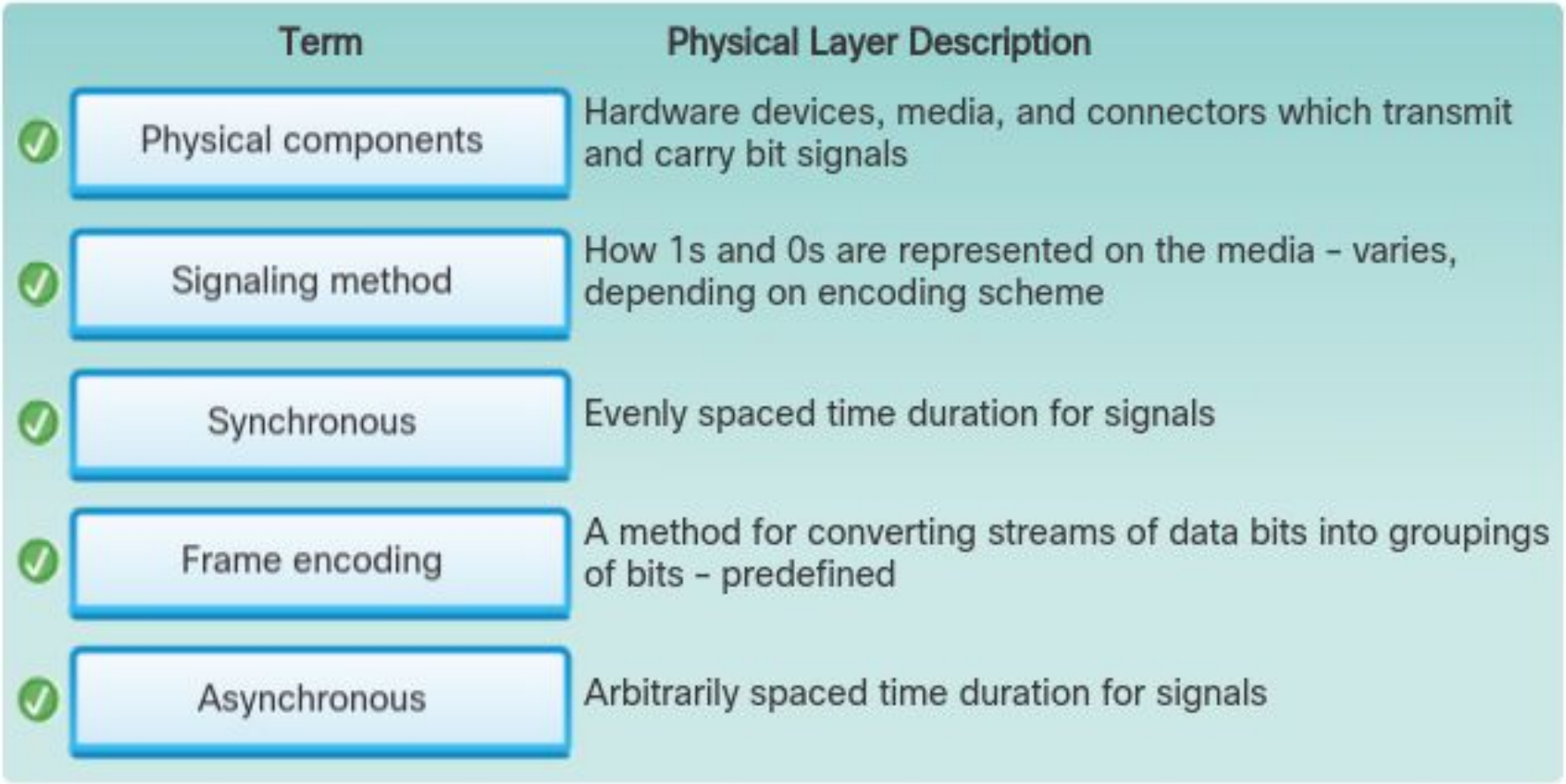
4.1.3: Physical Layer Characteristics
4.1.3.5 Activity - Physical Layer Terminology



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Section 4.2: Network Media

- 4.2.1: Copper Cabling
- 4.2.2: UTP Cabling
- 4.2.3: Fiber Optic Cabling
- 4.2.4: Wireless Media

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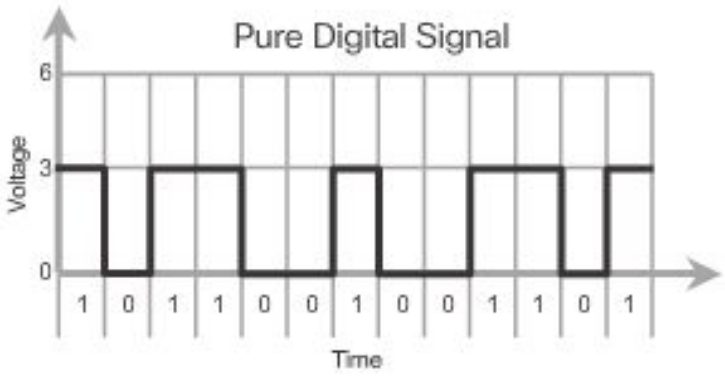
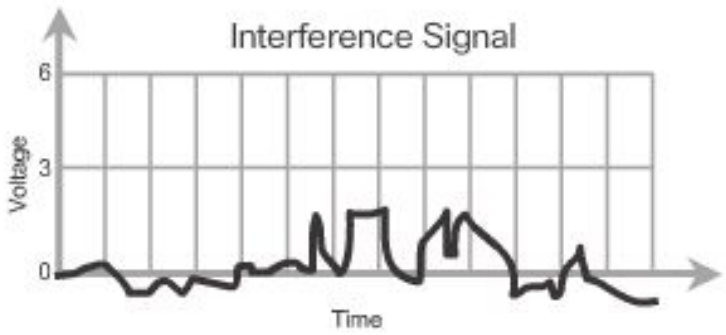
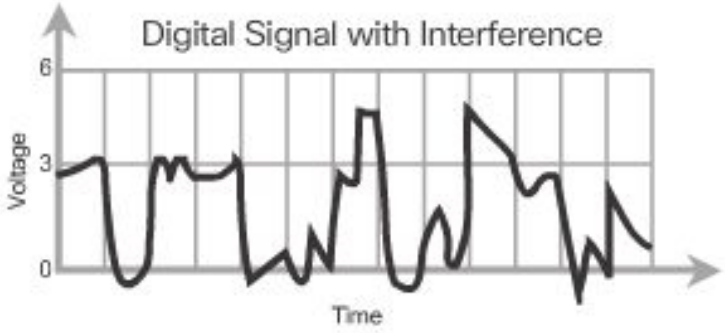
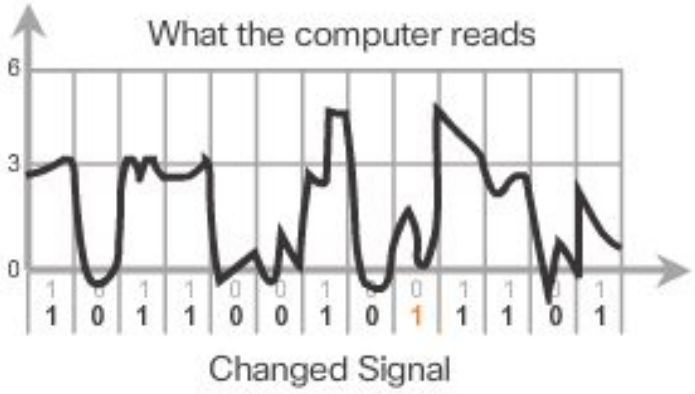
4.2.1: Copper Cabling
4.2.2.1 Characteristics of Copper Cabling









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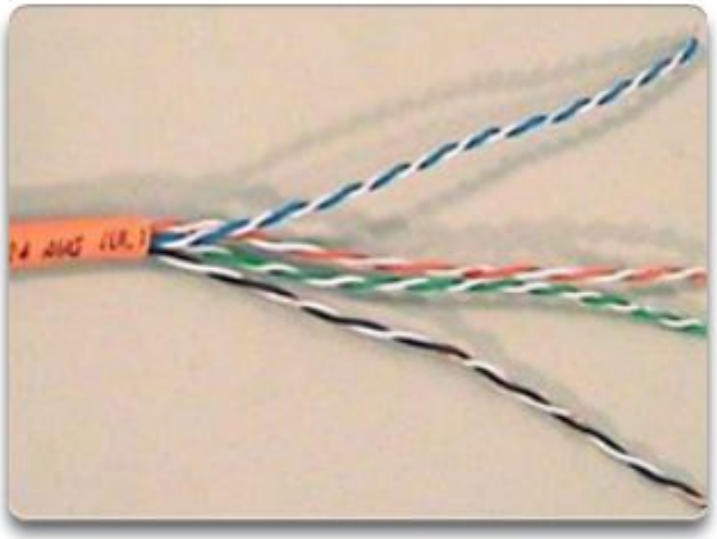
4.2.1: Copper Cabling
4.2.1.2 Copper Media



Unshielded Twisted-Pair (UTP) cable

Shielded Twisted-Pair (STP) cable

Coaxial cable

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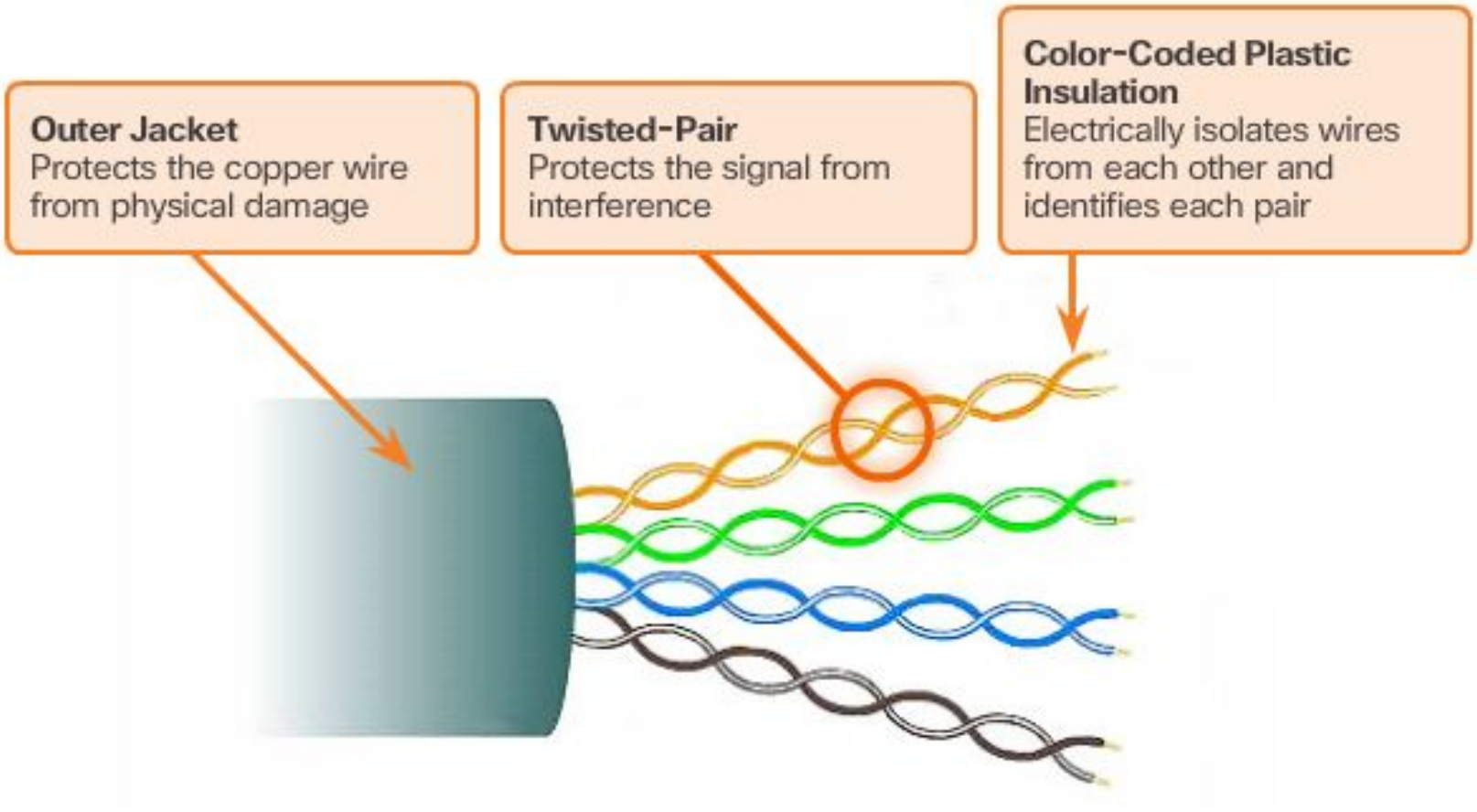
4.2.1: Copper Cabling
4.2.1.3 Unshielded Twisted-Pair Cable



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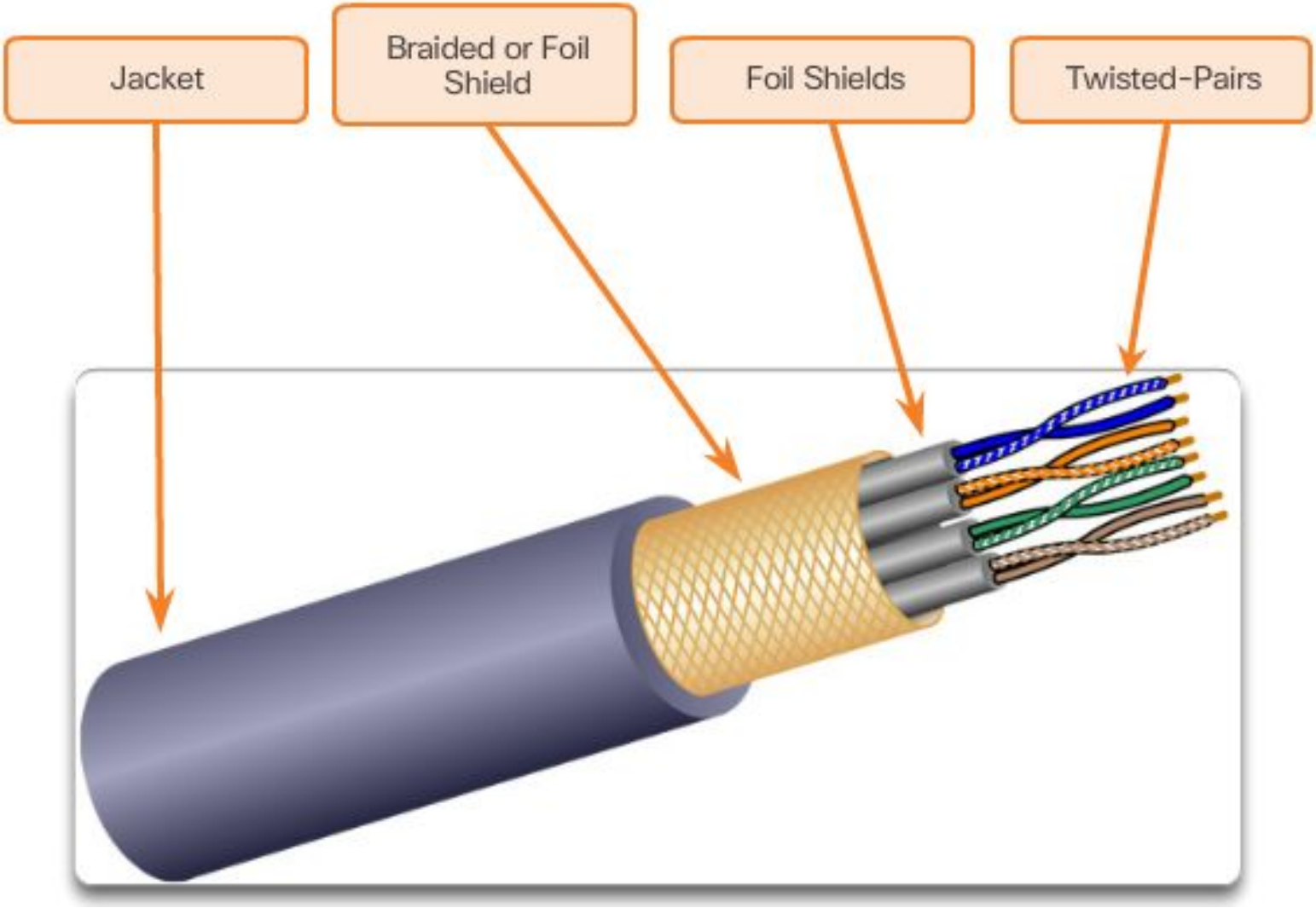
4.2.1: Copper Cabling
4.2.1.4 Shielded Twisted-Pair Cable



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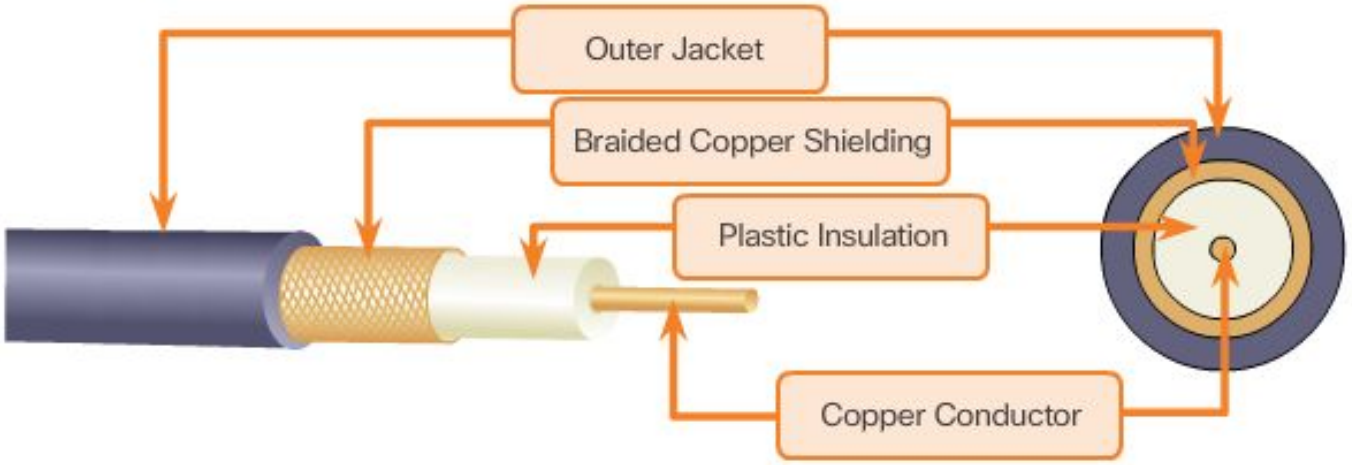
4.2.1: Copper Cabling
4.2.1.5 Coaxial Cable



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4.2.1: Copper Cabling
4.2.1.6 Copper Media Safety

The separation of data and electrical power cabling must comply with safety codes.

Cables must be connected correctly.

Installations must be inspected for damage.

Equipment must be grounded correctly.

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4.2.1: Copper Cabling
4.2.1.7 Activity - Copper Media Characteristics

	UTP	STP	Coaxial
1. The new Ethernet 10GB standard uses this form of copper media			
2. Attaches antennas to wireless devices - can be bundled with fiber-optic cabling for two-way data transmission			
3. Counters EMI and RFI by using shielding techniques and special connectors			
4. Most common network media			
5. Terminates with BNC, N type and F type connectors			

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4.2.1: Copper Cabling
4.2.1.7 Activity - Copper Media Characteristics

	UTP	STP	Coaxial
1. The new Ethernet 10GB standard uses this form of copper media		✓	
2. Attaches antennas to wireless devices – can be bundled with fiber-optic cabling for two-way data transmission			✓
3. Counters EMI and RFI by using shielding techniques and special connectors		✓	
4. Most common network media	✓		
5. Terminates with BNC, N type and F type connectors			✓

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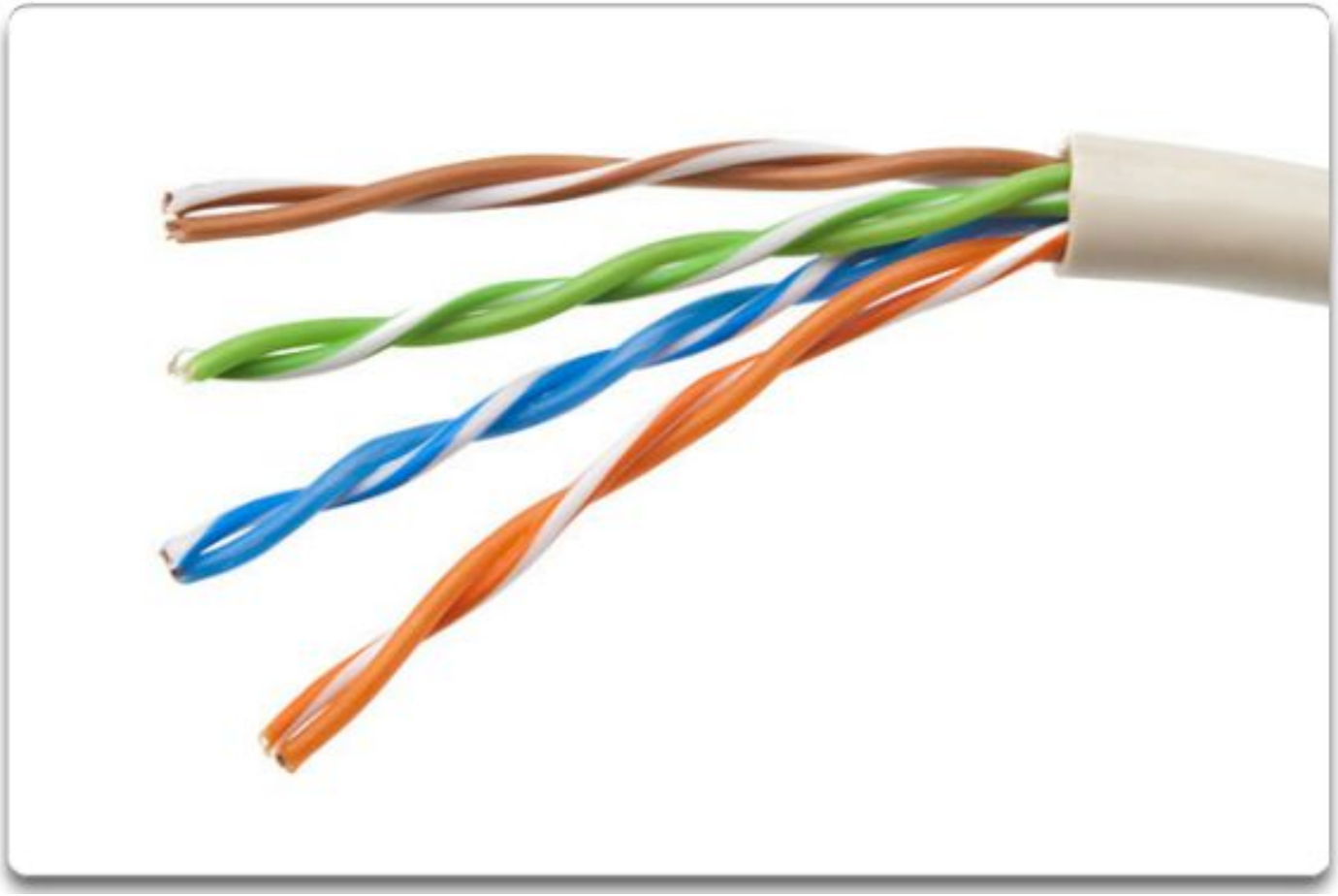
4.2.2: UTP Cabling
4.2.2.1 Properties of UTP Cabling



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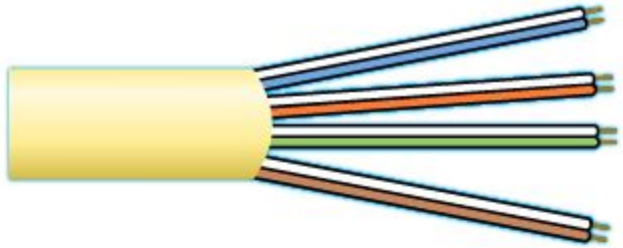
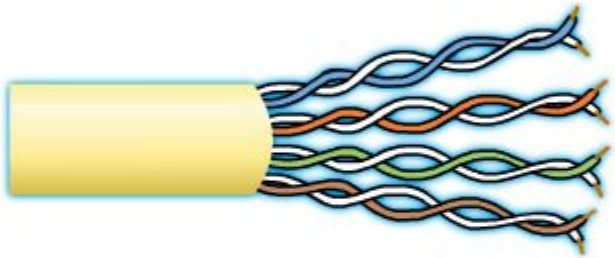
4.2.2: UTP Cabling

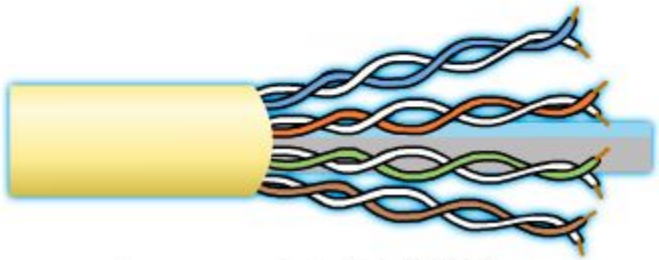
4.2.2.2 UTP Cabling Standards



Category 3 Cable (UTP)



Category 5 and 5e Cable (UTP)



Category 6 Cable (UTP)

Category 3 Cable (UTP)

- Used for voice communication
- Most often used for phone lines

Category 5 and 5e Cable (UTP)

- Used for data transmission
- Cat5 supports 100 Mb/s and can support 1000 Mb/s, but it is not recommended
- Cat5e supports 1000 Mb/s

Category 6 Cable (UTP)

- Used for data transmission
- An added separator is between each pair of wires allowing it to function at higher speeds
- Supports 1000 Mb/s – 10 Gb/s, though 10 Gb/s is not recommended

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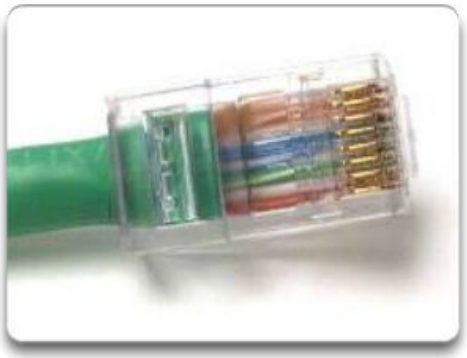
4.2.2: UTP Cabling

4.2.2.3 UTP Connectors

RJ-45 UTP Plugs

RJ-45 UTP Socket

Bad connector – Wires are exposed, untwisted, and not entirely covered by the sheath.



Good connector – Wires are untwisted to the extent necessary to attach the connector.

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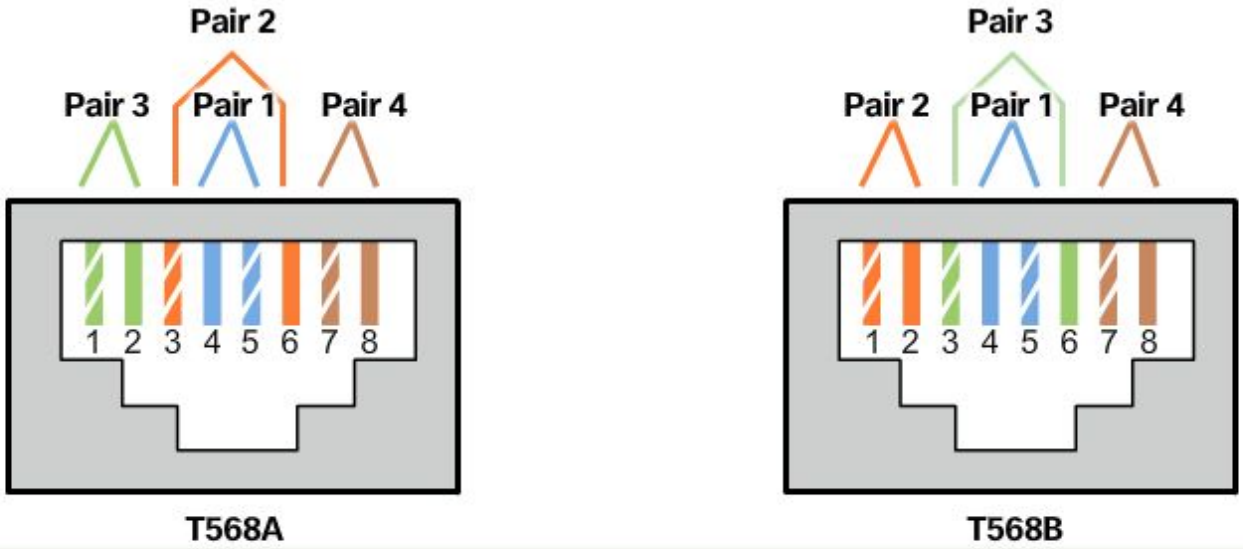
4.2.2: UTP Cabling
4.2.2.4 Types of UTP Cable



Cable Type	Standard	Application
Ethernet Straight-through	Both ends T568A or both ends T568B	Connects a network host to a network device such as a switch or hub.
Ethernet Crossover	One end T568A, other end T568B	• Connects two network hosts • Connects two network intermediary devices (switch to switch, or router to router)
Rollover	Cisco proprietary	Connects a workstation serial port to a router console port, using an adapter.

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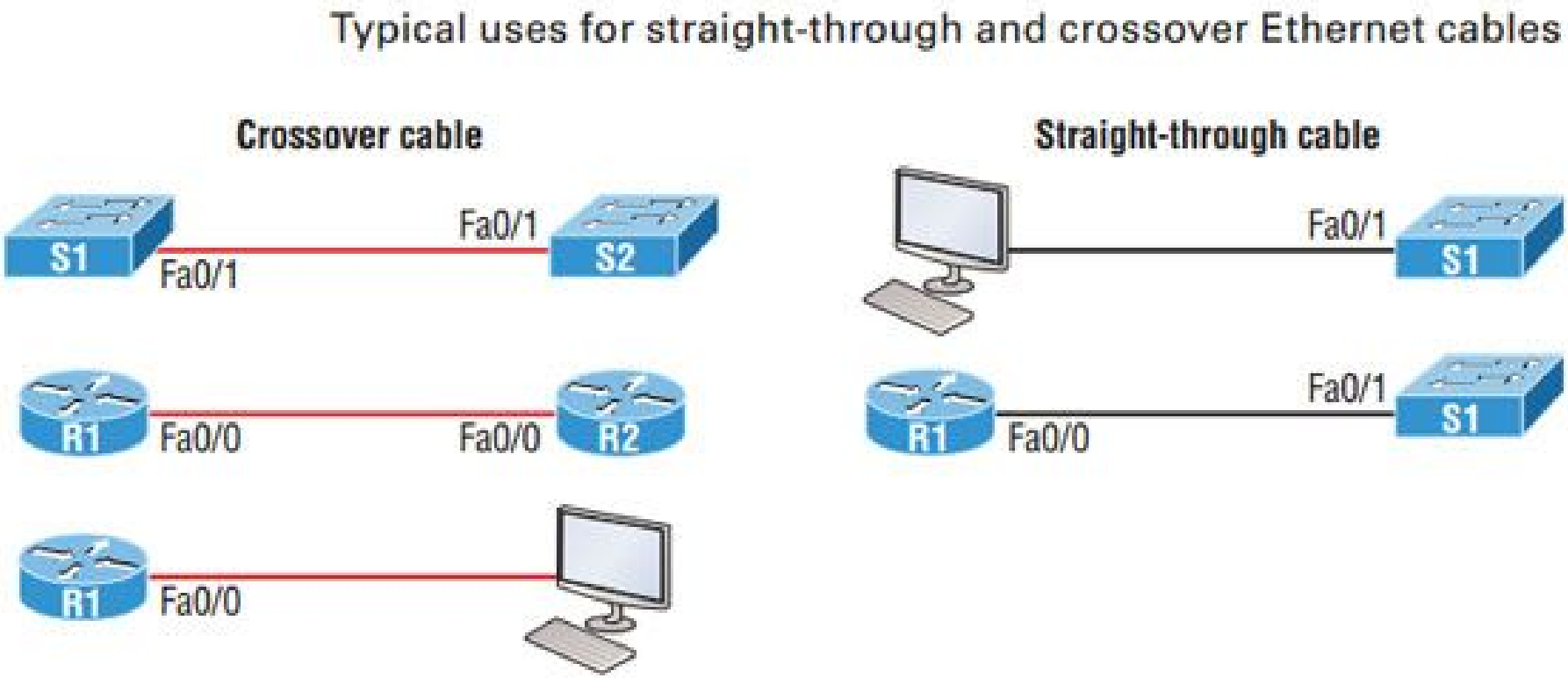
4.2.2: UTP Cabling
4.2.2.4 Types of UTP Cable



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4.2.2: UTP Cabling
4.2.2.5 Testing UTP Cables

UTP Testing Parameters:

- Wire map
- Cable length
- Signal loss due to attenuation
- Crosstalk

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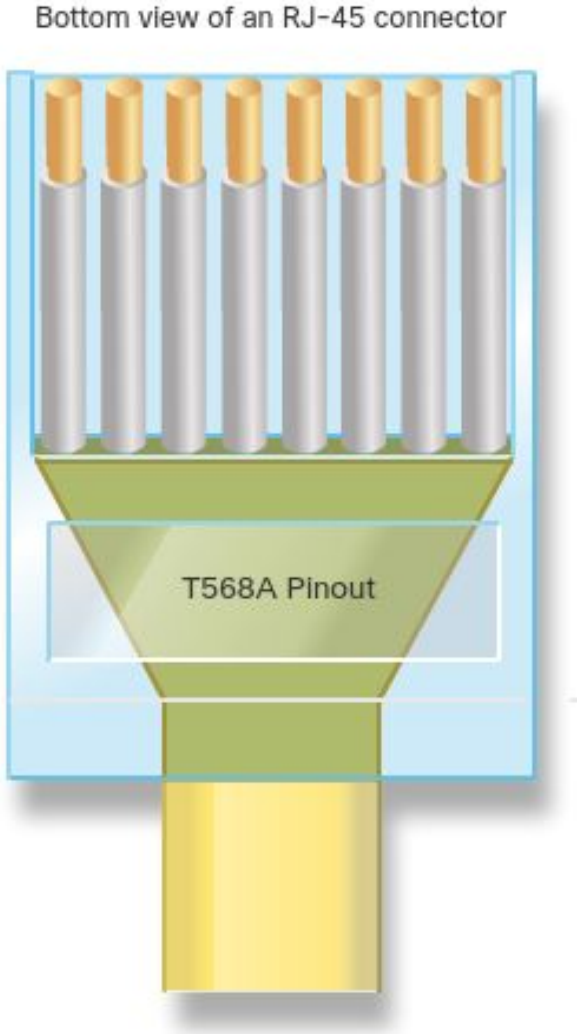
4.2.2: UTP Cabling
4.2.2.6 Activity - Cable Pinouts



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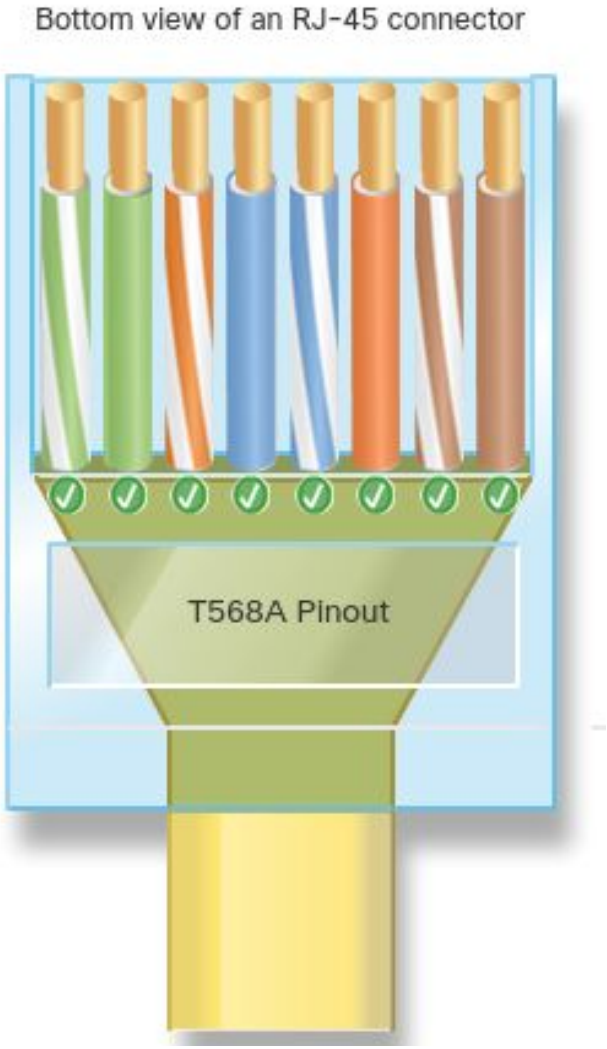
4.2.2: UTP Cabling
4.2.2.6 Activity - Cable Pinouts



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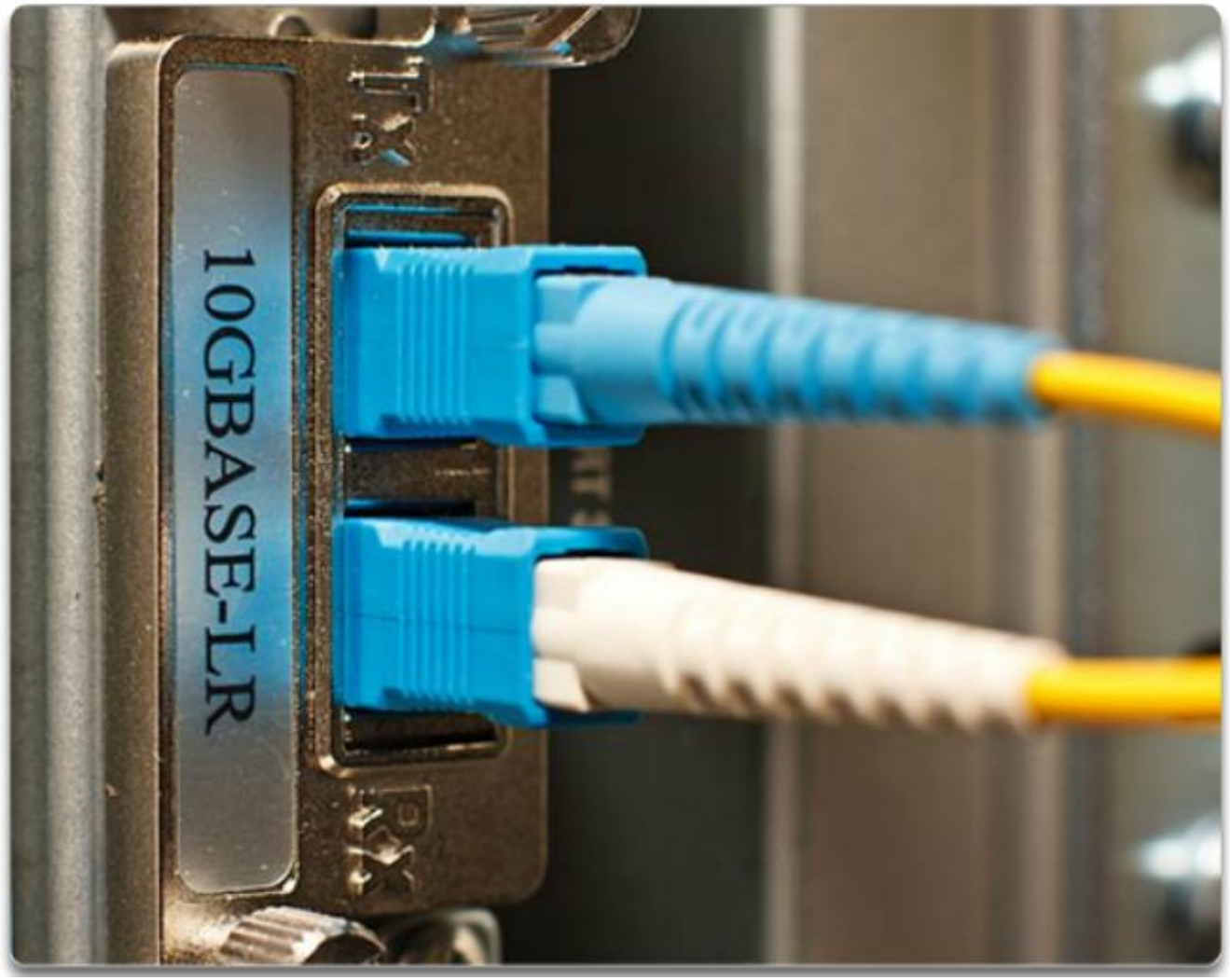
4.2.3: Fiber Optic Cabling
4.2.3.1 Properties of Fiber Optic Cabling



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4.2.3: Fiber Optic Cabling

4.2.3.2 Fiber Media Cable Design

Jacket

Typically a PVC jacket that protects the fiber against abrasion, moisture, and other contaminants. This outer jacket composition can vary depending on the cable usage.

Buffer

Used to help shield the core and cladding from damage.

Cladding

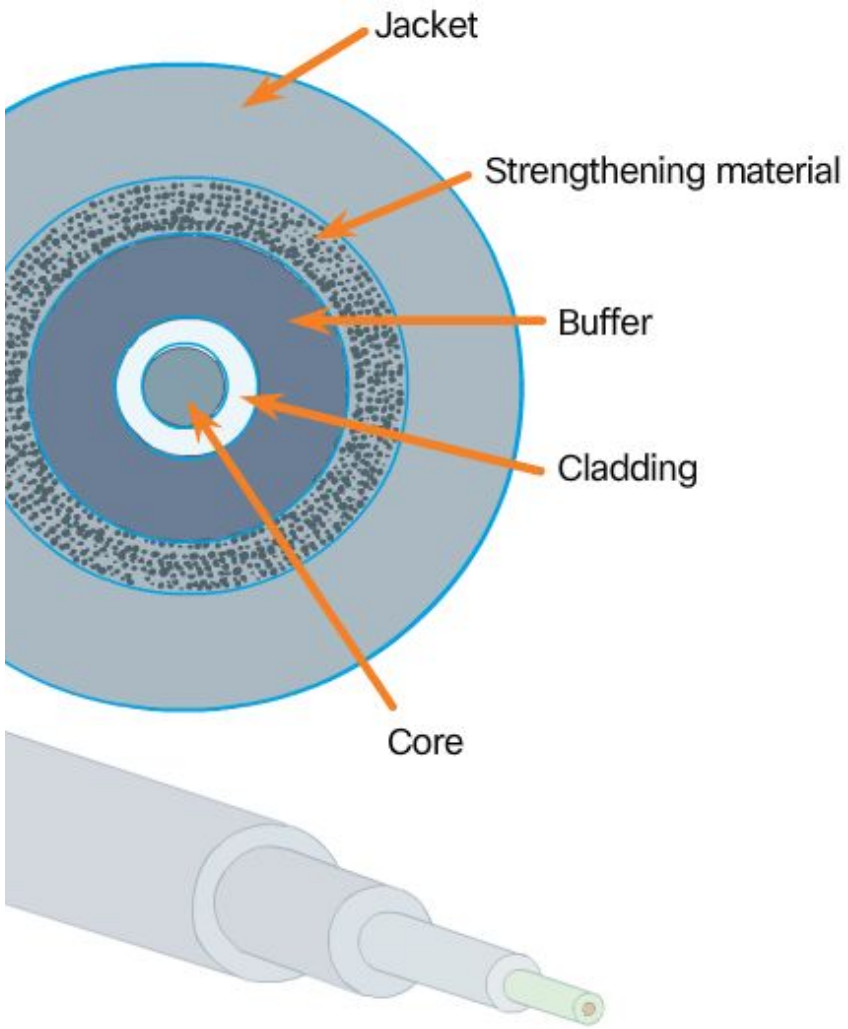
Made from slightly different chemicals than those used to create the core. It tends to act like a mirror by reflecting light back into the core of the fiber. This keeps light in the core as it travels down the fiber.

Core

The core is actually the light transmission element at the center of the optical fiber. This core is typically silica or glass. Light pulses travel through the fiber core.

Strengthening Material

Surrounds the buffer, prevents the fiber cable from being stretched when it is being pulled. The material used is often the same material used to produce bulletproof vests.



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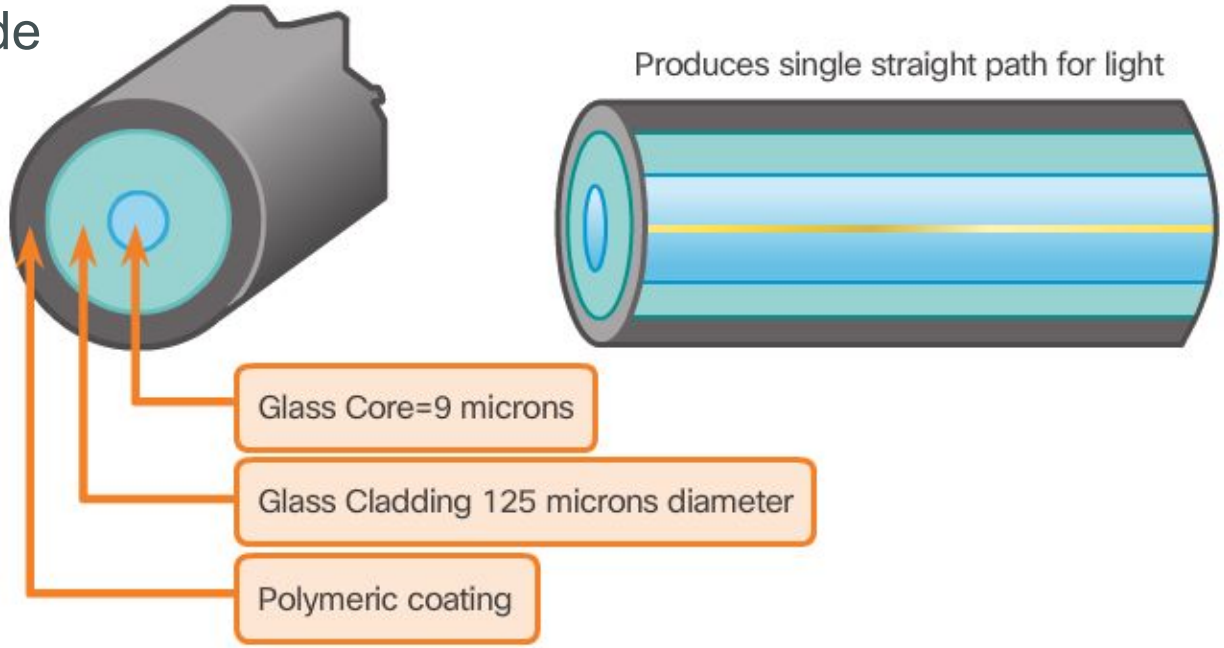
4.2.3: Fiber Optic Cabling

4.2.3.3 Types of Fiber Media

Single Mode



- Small core
- Less dispersion
- Suited for long distance applications
- Uses lasers as the light source
- Commonly used with campus backbones for distances of several thousand meters

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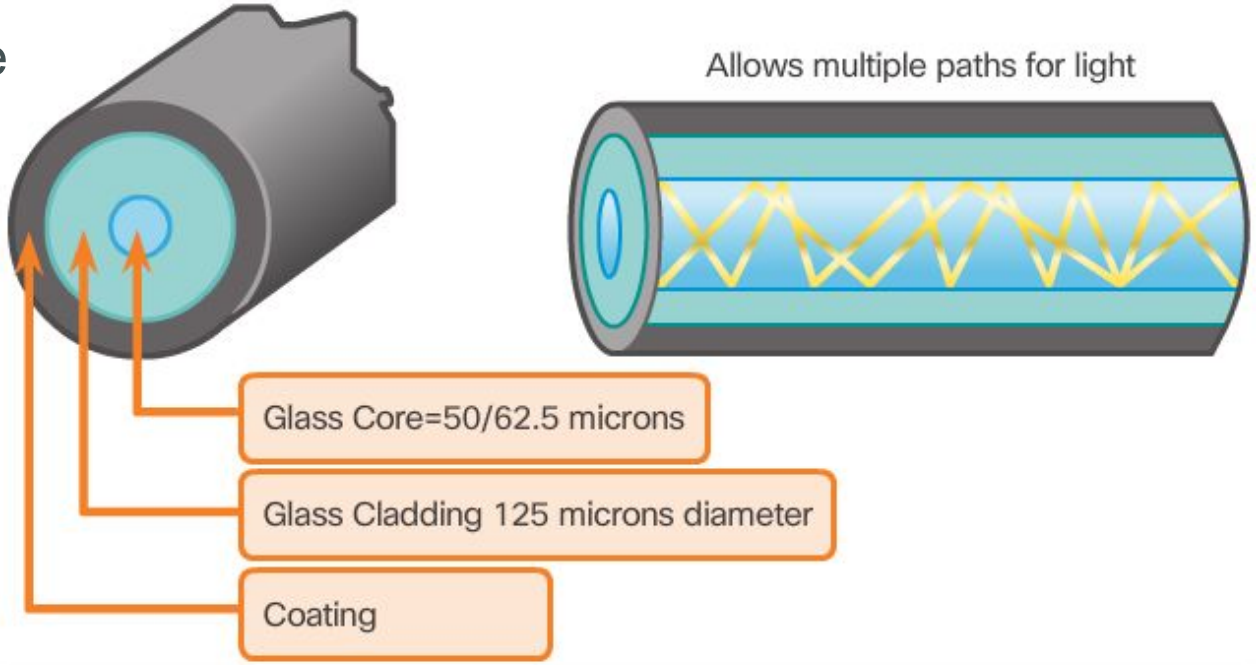
4.2.3: Fiber Optic Cabling

4.2.3.3 Types of Fiber Media (cont.)

Multimode



- Larger core than single mode cable
- Allows greater dispersion and therefore, loss of signal
- Suited for long distance applications, but shorter than single mode
- Uses LEDs as the light source
- Commonly used with LANs or distances of a couple hundred meters within a campus network

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4.2.3: Fiber Optic Cabling

4.2.3.4 Network Fiber Connectors

Fiber Optic Connectors

ST Connectors

SC Connectors

LC Connector

Duplex Multimode LC Connectors

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4.2.3: Fiber Optic Cabling

4.2.3.4 Network Fiber Connectors (cont.)

Common Fiber Patch Cords

SC-SC Multimode Patch Cord

LC-LC Single-mode Patch Cord

ST-LC Multimode Patch Cord

SC-ST Single-mode Patch Cord

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4.2.3: Fiber Optic Cabling

4.2.3.5 Testing Fiber Cables

Optical Time Domain Reflectometer (OTDR)

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4.2.3: Fiber Optic Cabling

4.2.3.6 Fiber versus Copper

Implementation Issues	UTP Cabling	Fiber-optic Cabling
Bandwidth supported	10 Mb/s – 10 Gb/s	10 Mb/s – 100 Gb/s
Distance	Relatively short (1 – 100 meters)	Relatively high (1 – 100,000 meters)
Immunity to EMI and RFI	Low	High (Completely immune)
Immunity to electrical hazards	Low	High (Completely immune)
Media and connector costs	Lowest	Highest
Installation skills required	Lowest	Highest
Safety precautions	Lowest	Highest

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4.2.3: Fiber Optic Cabling

4.2.3. Activity - Fiber-optics Terminology

	Multimode	Single-mode
1. Can help data travel approximately 1.24 miles or 2 km/2000 m		
2. Uses light emitting diodes (LEDs) as a data light source transmitter		
3. Uses lasers in a single stream as a data light source transmitter		
4. Used to connect long-distance telephony and cable TV applications		
5. Can travel approximately 62.5 miles or 100 km/100000 m		
6. Used within a campus network		

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4.2.3: Fiber Optic Cabling

4.2.3. Activity - Fiber-optics Terminology

	Multimode	Single-mode
1. Can help data travel approximately 1.24 miles or 2 km/2000 m	✓	
2. Uses light emitting diodes (LEDs) as a data light source transmitter	✓	
3. Uses lasers in a single stream as a data light source transmitter		✓
4. Used to connect long-distance telephony and cable TV applications		✓
5. Can travel approximately 62.5 miles or 100 km/100000 m		✓
6. Used within a campus network	✓	

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4.2.4: Wireless Media

4.2.4.1 Properties of Wireless Media

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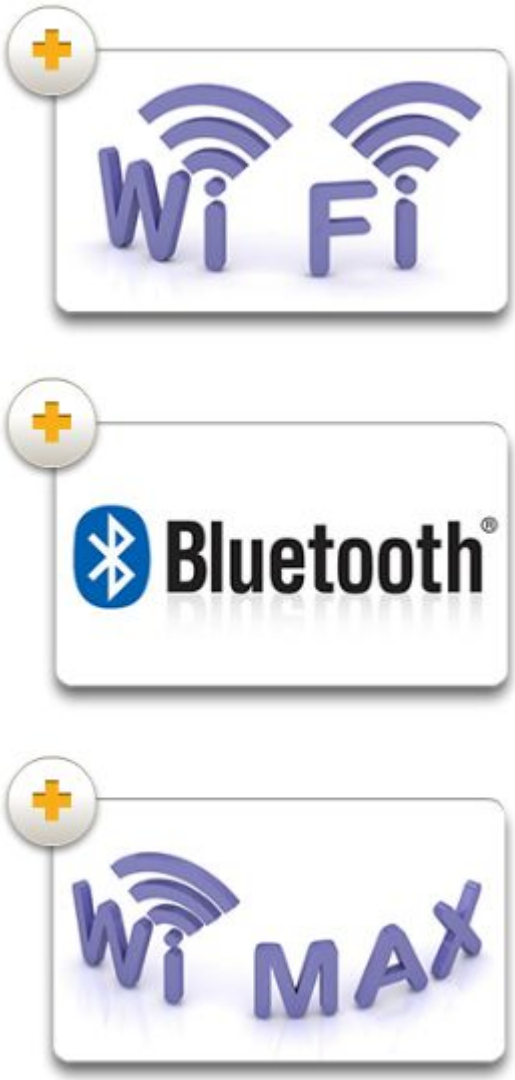
4.2.4: Wireless Media

4.2.4.2 Types of Wireless Media



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4.2.4: Wireless Media

4.2.4.3 Wireless LAN (WLAN)

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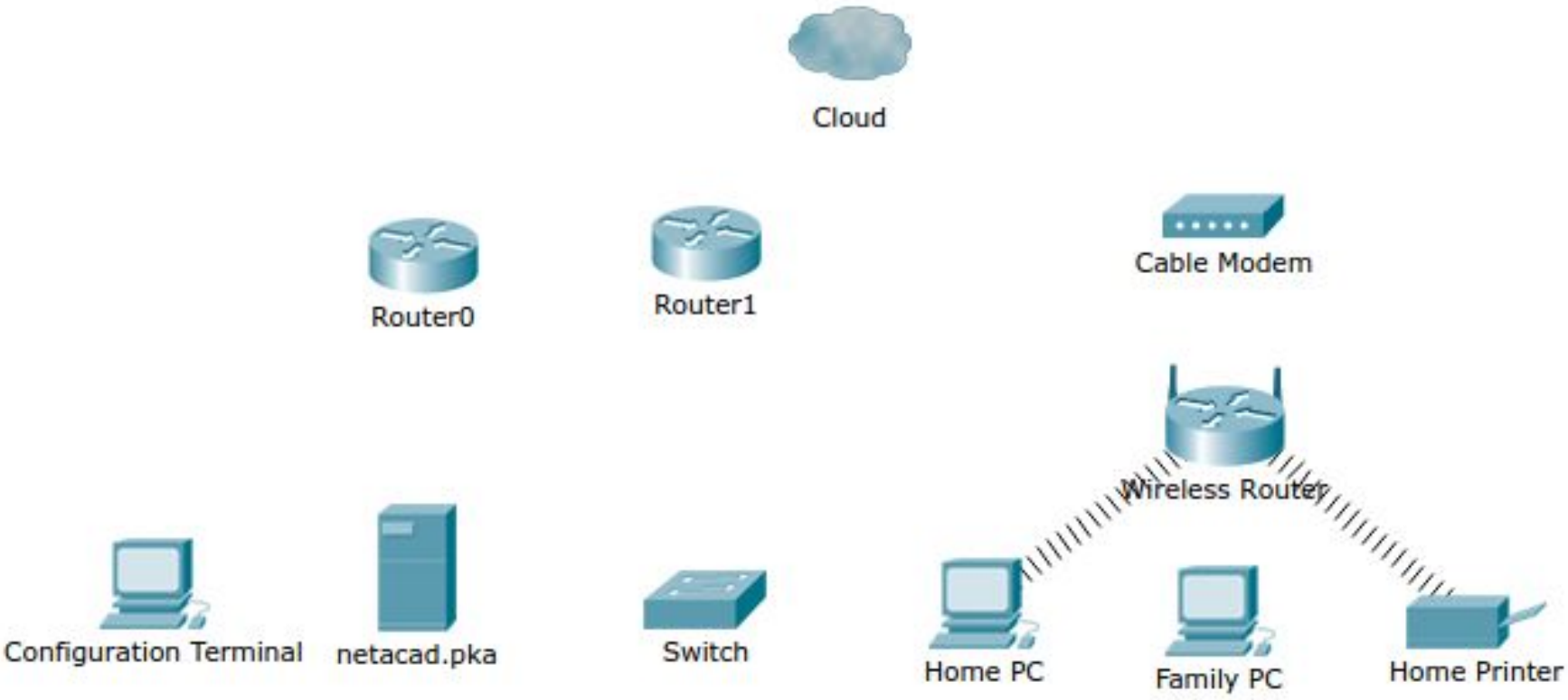
4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN



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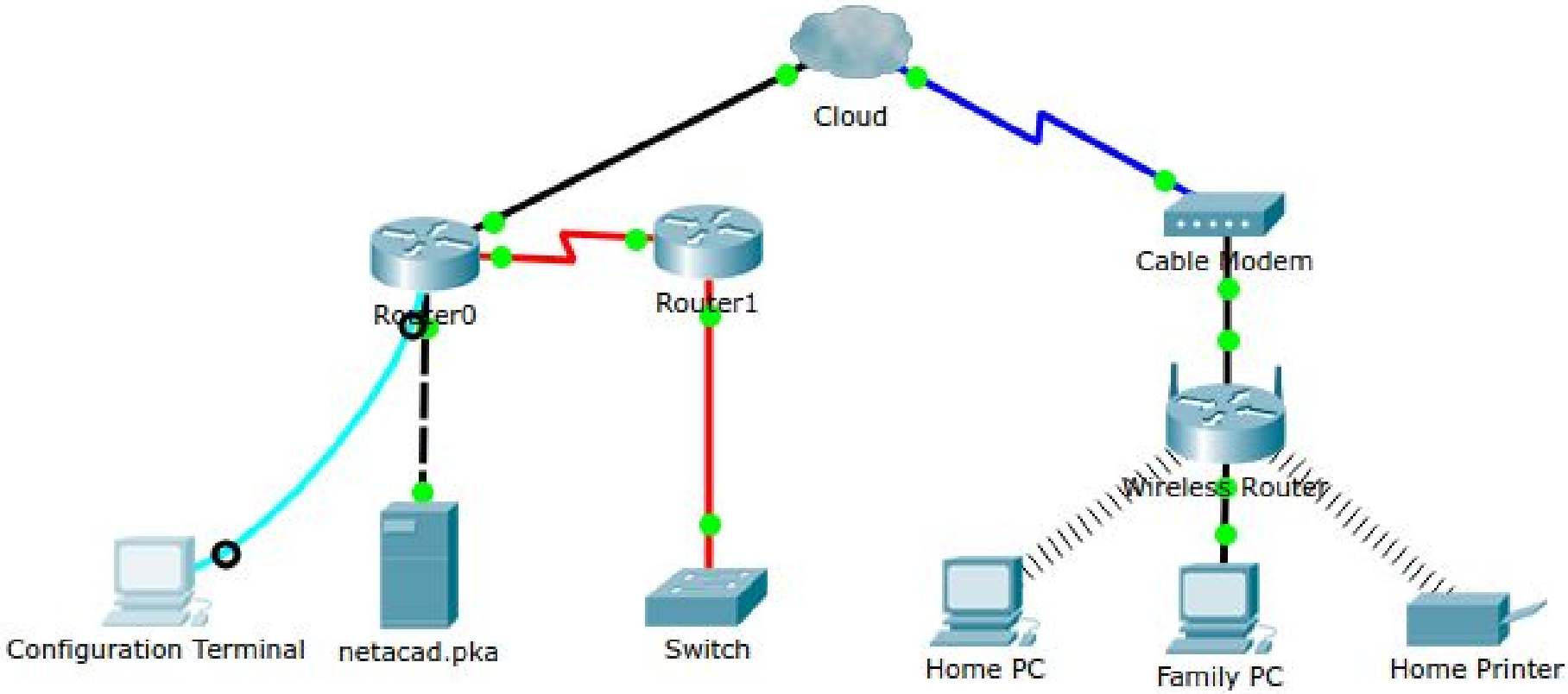
4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN



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4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN

```
PC>ping 10.0.0.254

Pinging 10.0.0.254 with 32 bytes of data:

Reply from 10.0.0.254: bytes=32 time=1ms TTL=126
Reply from 10.0.0.254: bytes=32 time=1ms TTL=126
Reply from 10.0.0.254: bytes=32 time=1ms TTL=126
Reply from 10.0.0.254: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.0.254:
    Packets: Sent = 4, Received = 4, L
Approximate round trip times in milli-
    Minimum = 1ms, Maximum = 1ms, Aver

PC>ping netacad.pka

Pinging 10.0.0.254 with 32 bytes of da

Reply from 10.0.0.254: bytes=32 time=1
Reply from 10.0.0.254: bytes=32 time=1ms TTL=126
Reply from 10.0.0.254: bytes=32 time=2ms TTL=126
Reply from 10.0.0.254: bytes=32 time=1ms TTL=126

Ping statistics for 10.0.0.254:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
Approximate round trip times in milli-seconds:
    Minimum = 1ms, Maximum = 10ms, Average = 3ms
```

Verify Connections

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4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN

```
PC>ping 172.16.0.2

Pinging 172.16.0.2 with 32 bytes of data:

Request timed out.
Request timed out.
Reply from 172.16.0.2: bytes=32 time=20ms TTL=252
Reply from 172.16.0.2: bytes=32 time=12ms TTL=252

Ping statistics for 172.16.0.2:
    Packets: Sent = 4, Received = 2, Lost = 2 (50% loss),
Approximate round trip times in milli-seconds:
    Minimum = 12ms, Maximum = 20ms, Average = 16ms
```

Verify Connections

```
Router0>show ip interface brief
Interface              IP-Address      OK? Method Status                Protocol
FastEthernet0/0        192.168.2.1     YES manual up                    up
FastEthernet0/1        10.0.0.1        YES manual up                    up
Serial0/0/0            172.31.0.1      YES manual up                    up
Serial0/0/1            unassigned      YES unset  administratively down down
Vlan1                  unassigned      YES unset  administratively down down
```

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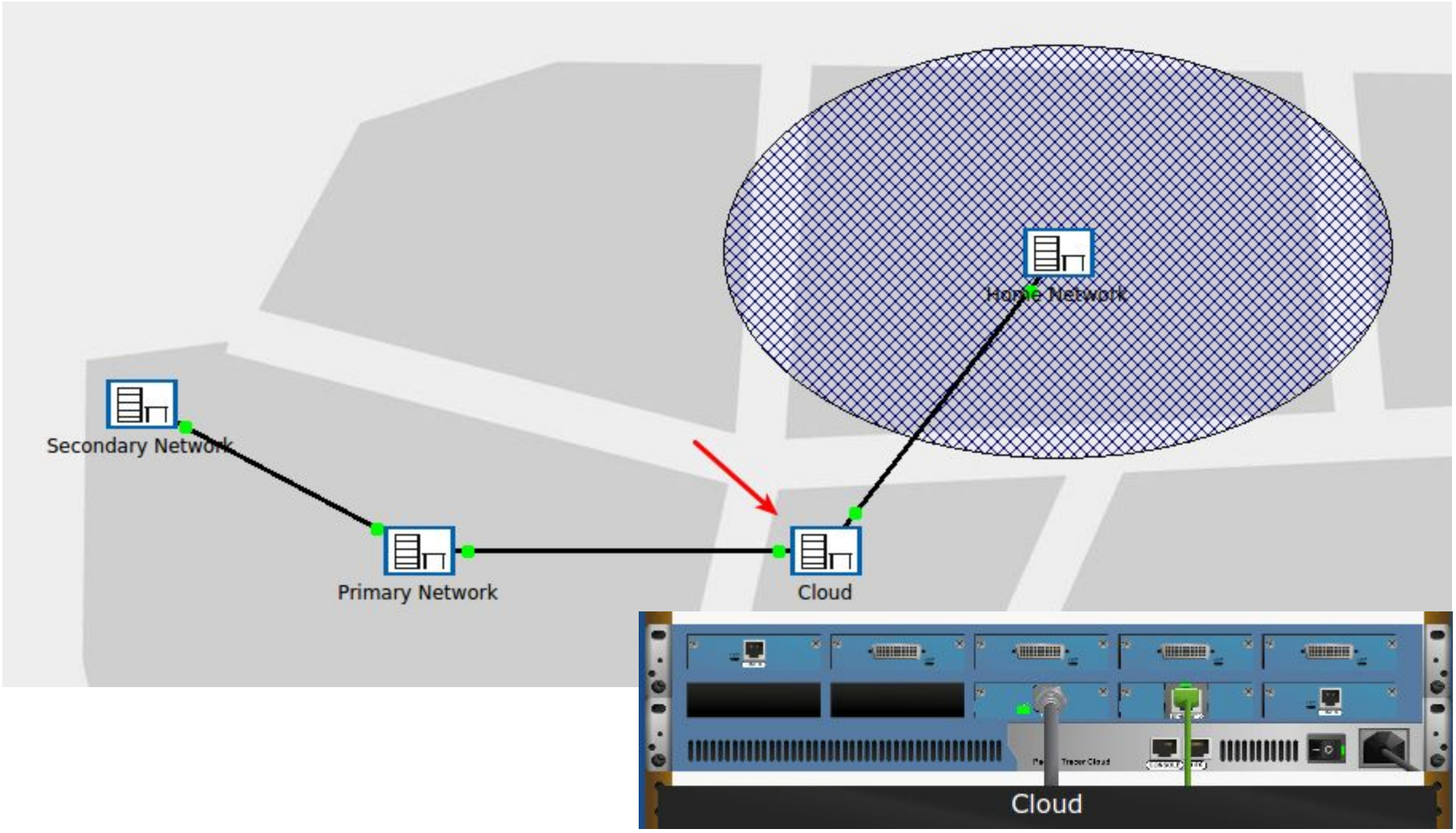
4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN



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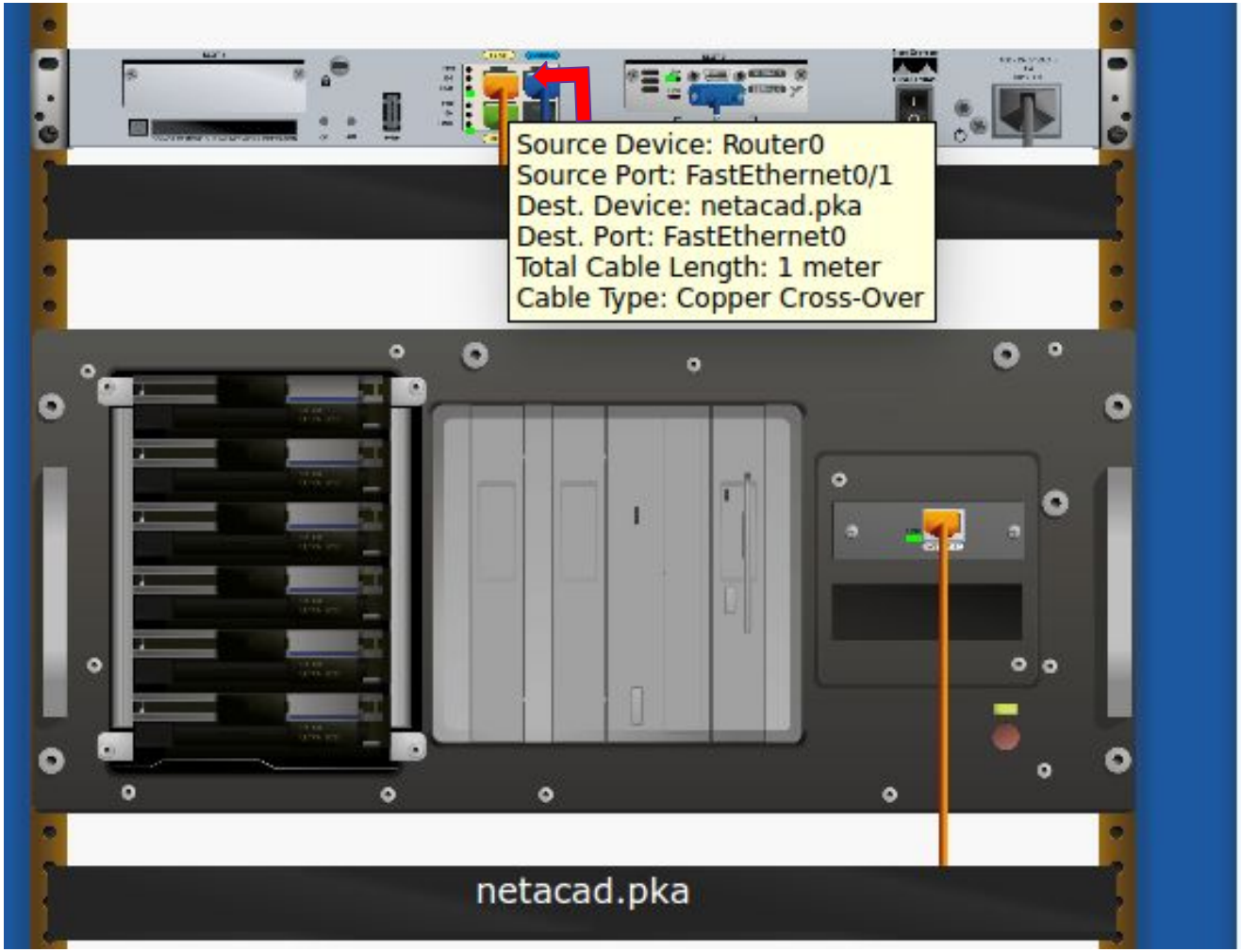
4.2.4: Wireless Media
4.2.4.4 Packet Tracer - Connecting a Wired and Wireless LAN



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Section 4.3:
Data Link Layer Protocols

- 4.3.1: Purpose of the Data Link Layer

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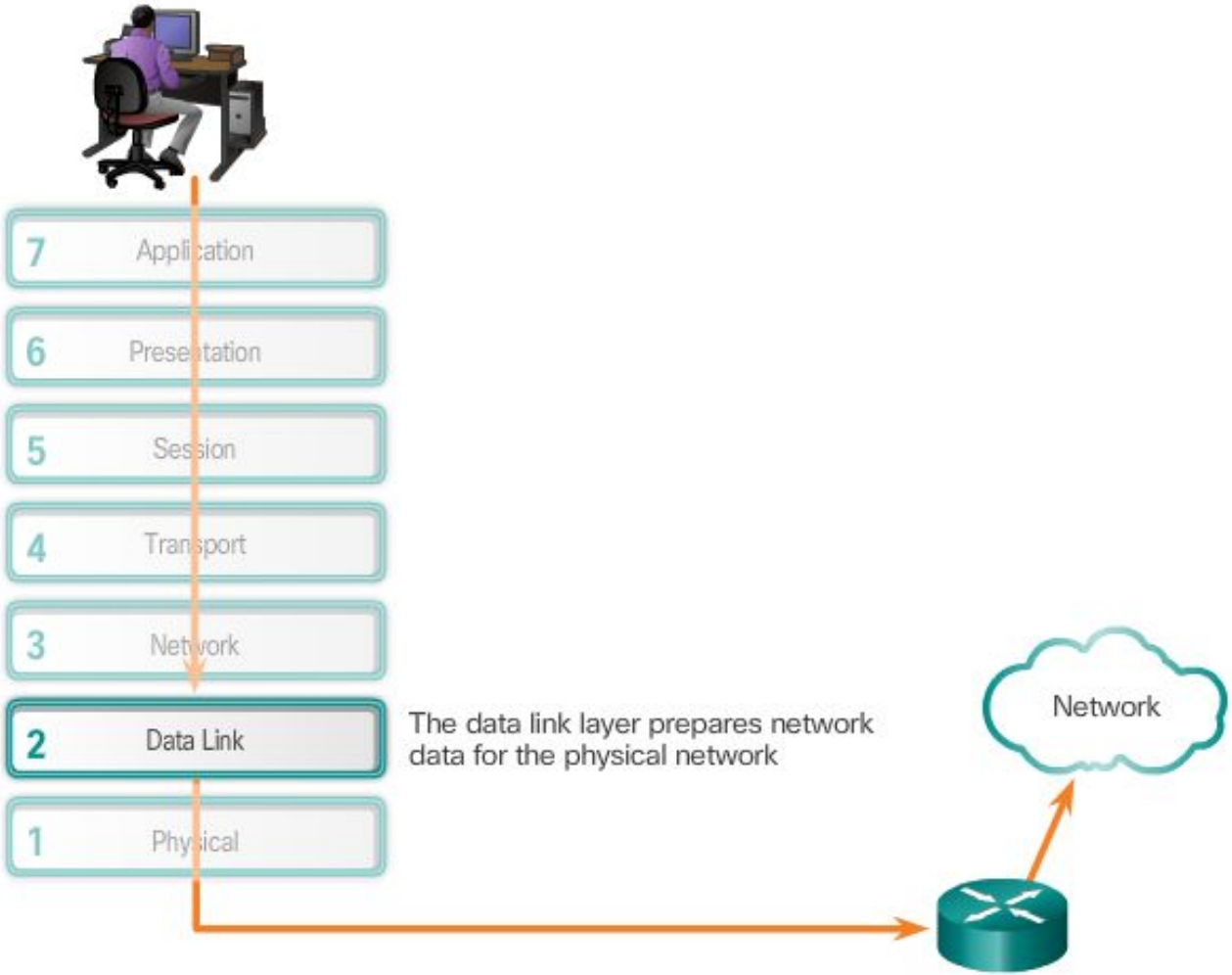
4.3.1: Purpose of the Data Link Layer
4.3.1.1 The Data Link Layer



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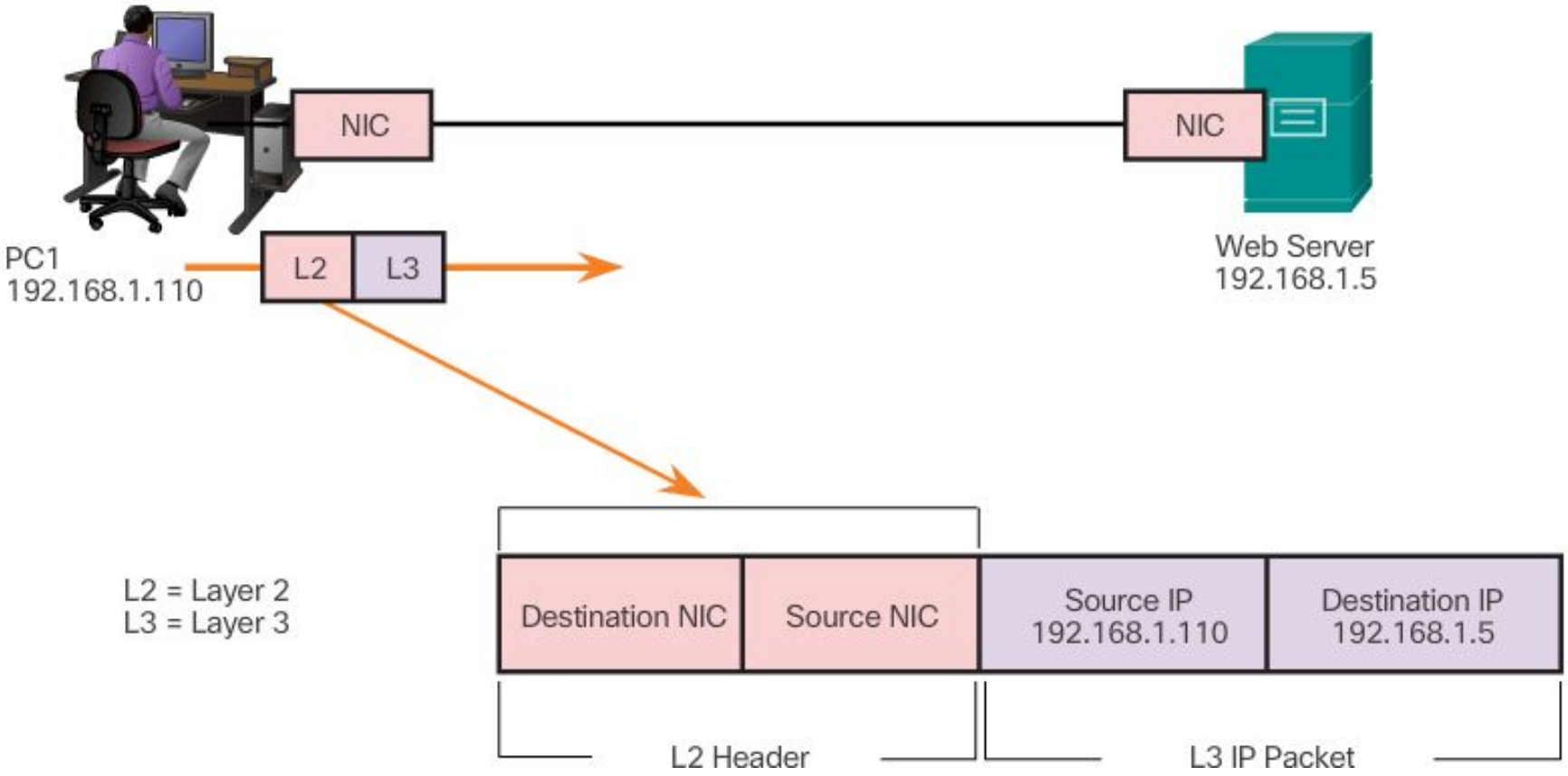
4.3.1: Purpose of the Data Link Layer

4.3.1.1 The Data Link Layer (cont.)

Layer 2 Data Link Address



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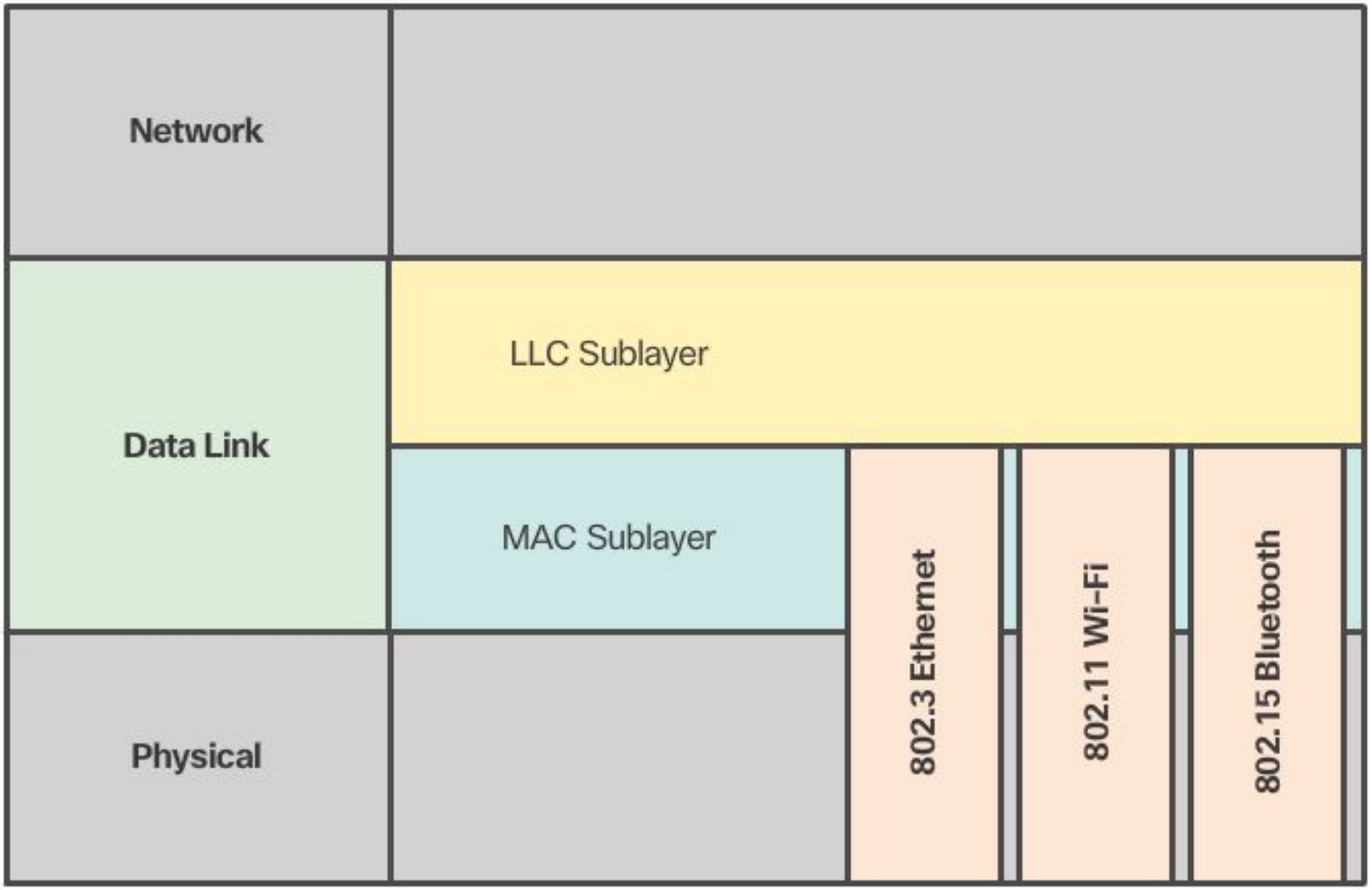
4.3.1: Purpose of the Data Link Layer
4.3.1.2 Data Link Sublayers



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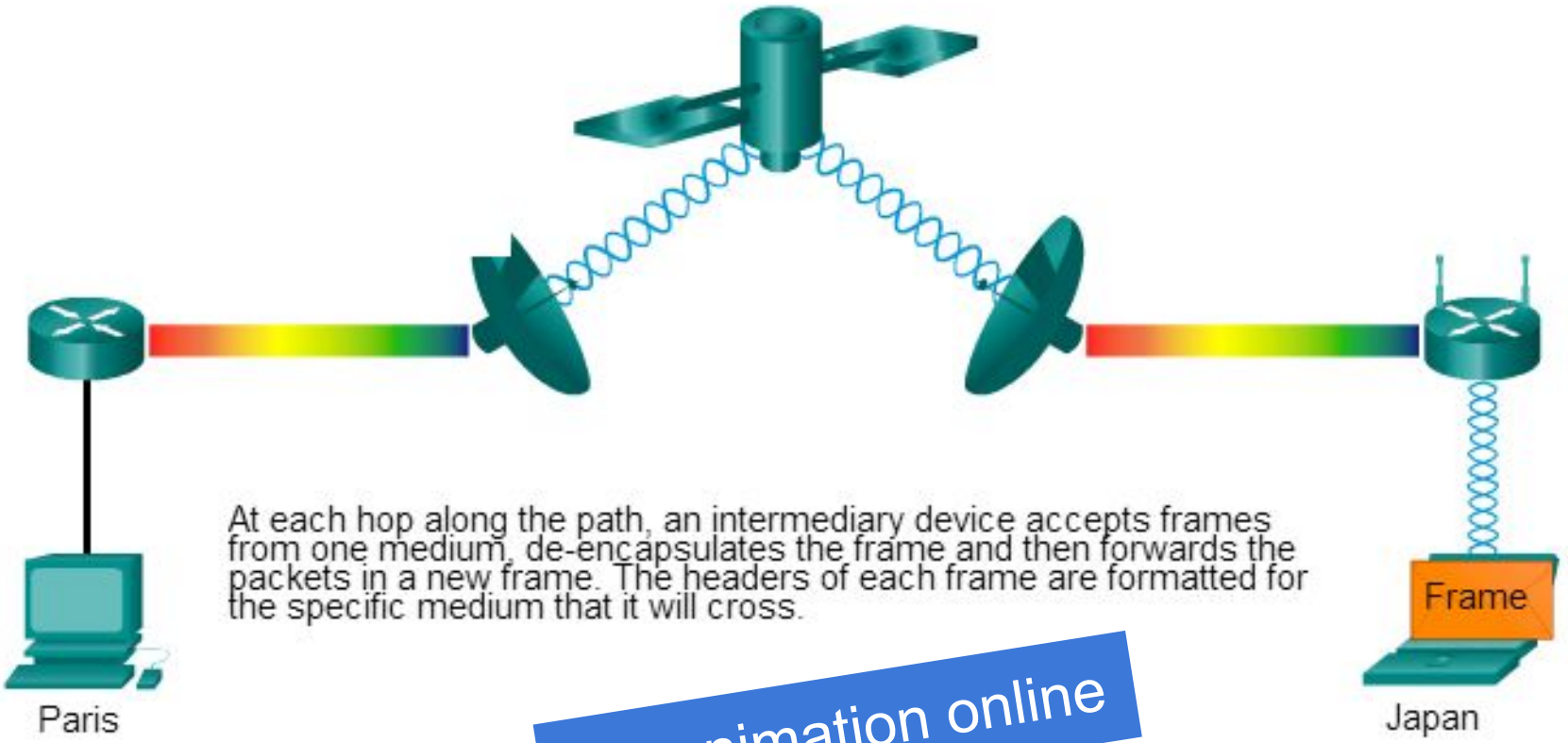
4.3.1: Purpose of the Data Link Layer
4.3.1.3 Media Access Control

Data link layer protocols govern how to format a frame for use on different media.

Different protocols may be in use for different media.



At each hop along the path, an intermediary device accepts frames from one medium, de-encapsulates the frame and then forwards the packets in a new frame. The headers of each frame are formatted for the specific medium that it will cross.

see animation online

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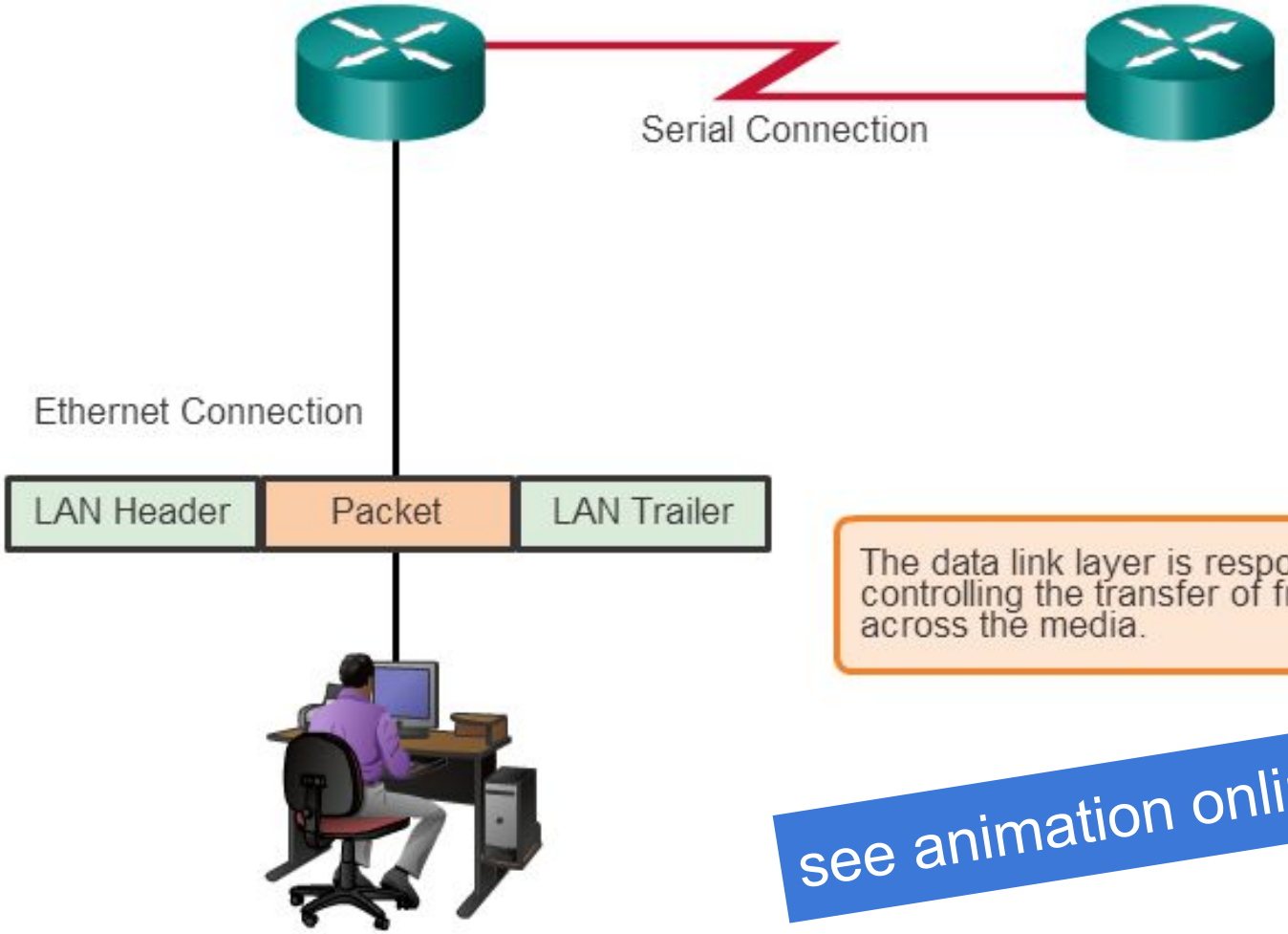
4.3.1: Purpose of the Data Link Layer
4.3.1.4 Providing Access to Media



The data link layer is responsible for controlling the transfer of frames across the media.

see animation online

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Section 4.4: Media Access Control

- 4.4.1: Topologies
- 4.4.2: WAN Topologies
- 4.4.3: LAN Topologies
- 4.4.4: Data Link Frame

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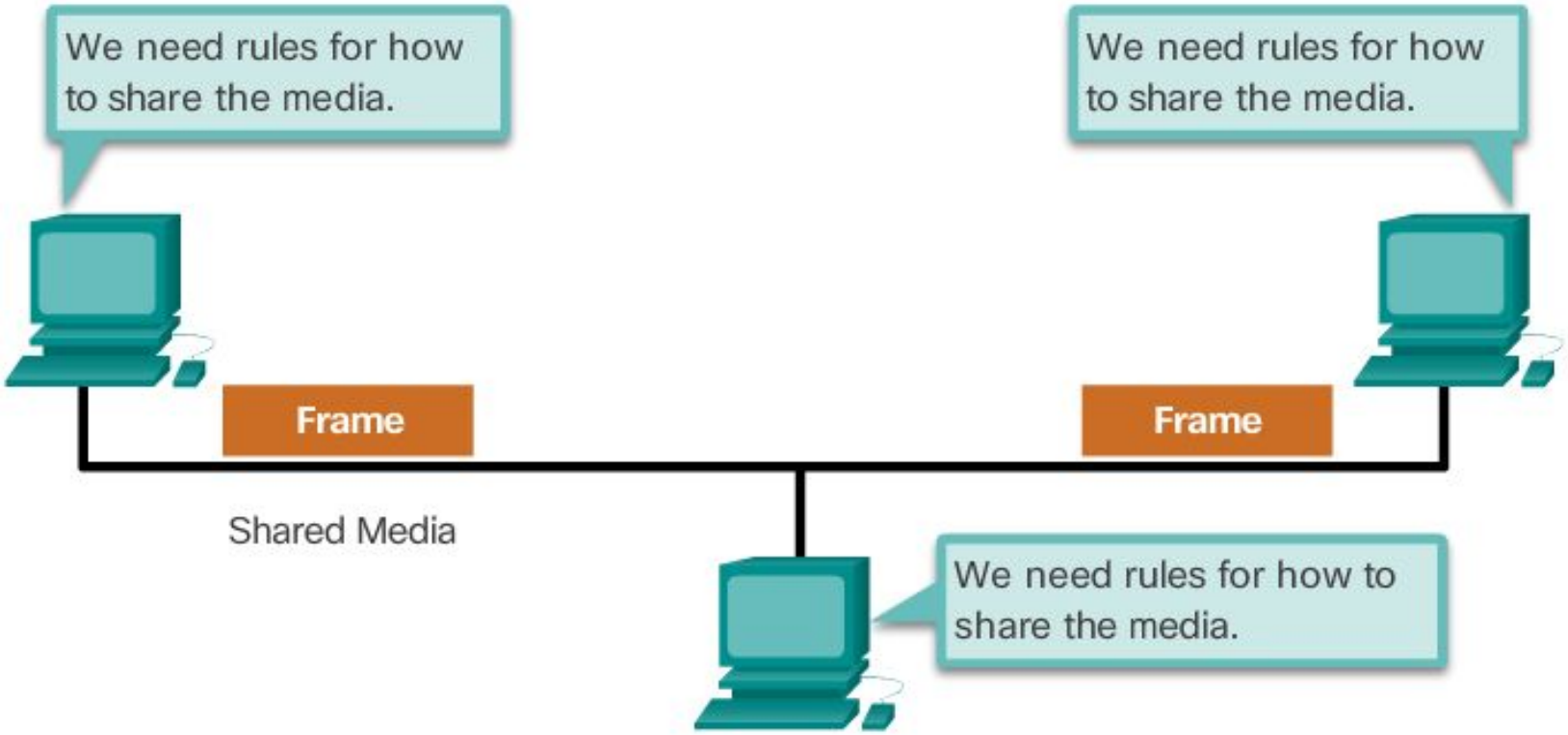
4.4.1: Topologies
4.4.1.1 Controlling Access to the Media



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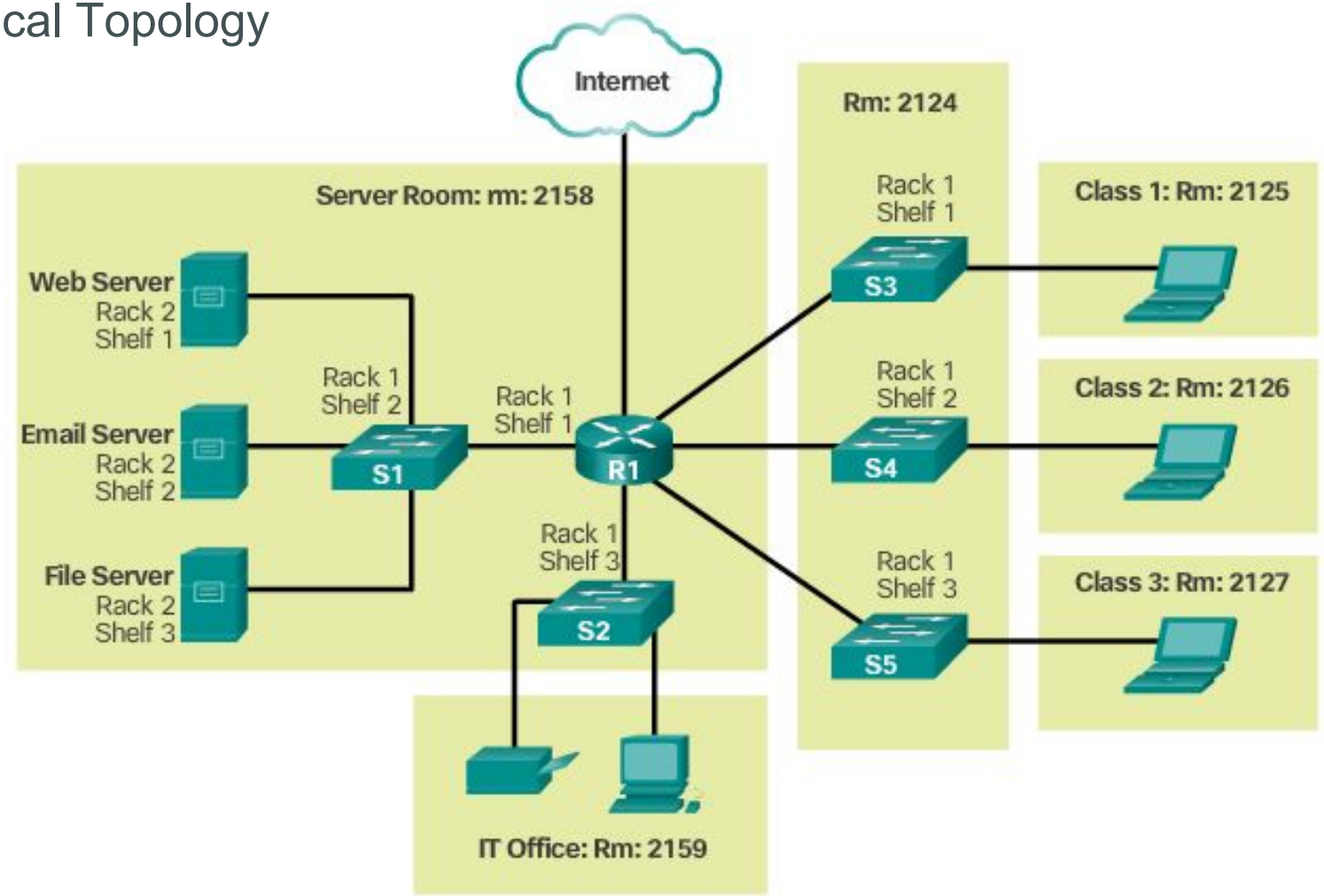
4.4.1: Topologies
4.4.1.2 Physical and Logical Topologies

Physical Topology



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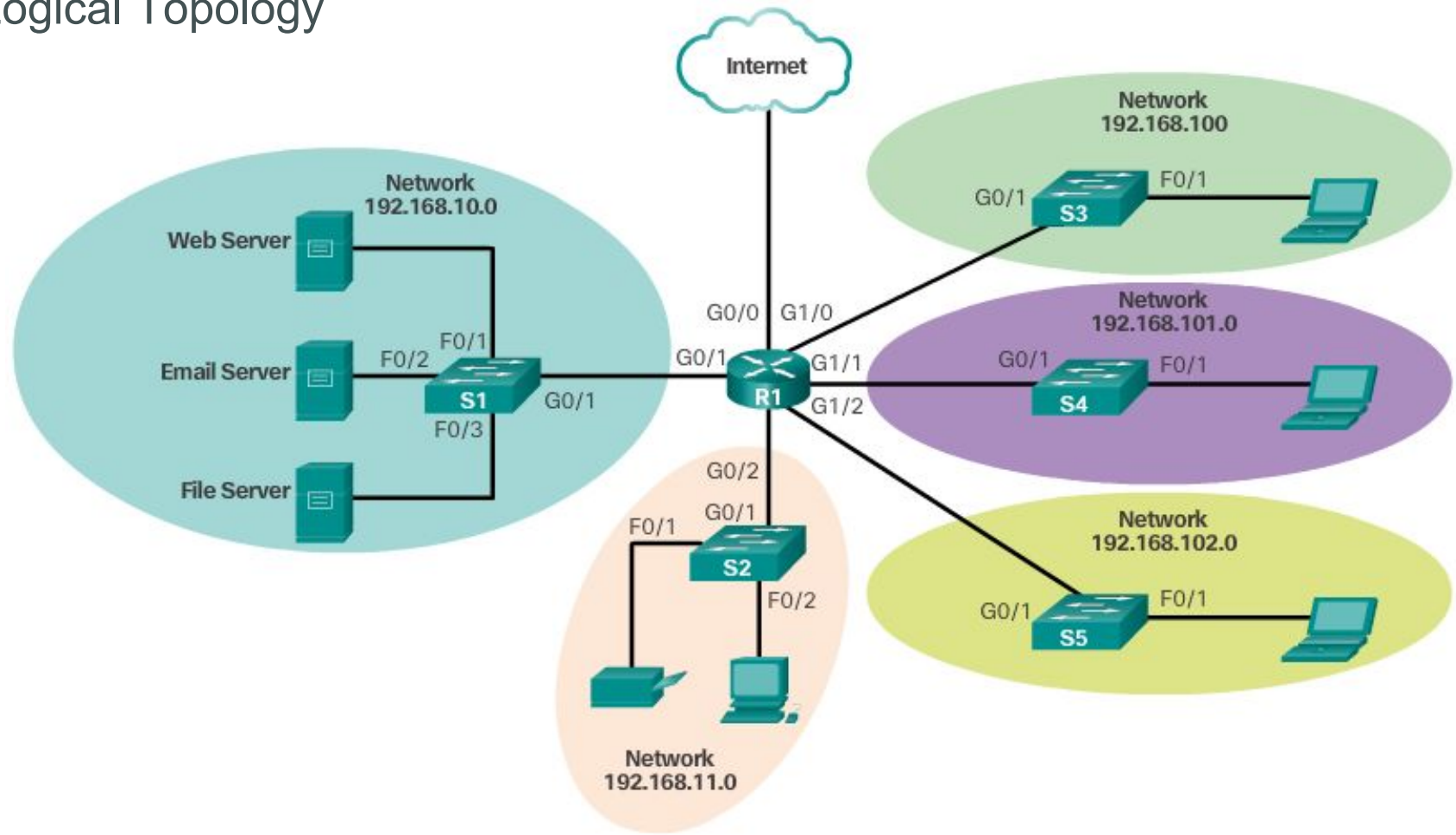
4.4.1: Topologies
4.4.1.2 Physical and Logical Topologies (cont.)

Logical Topology



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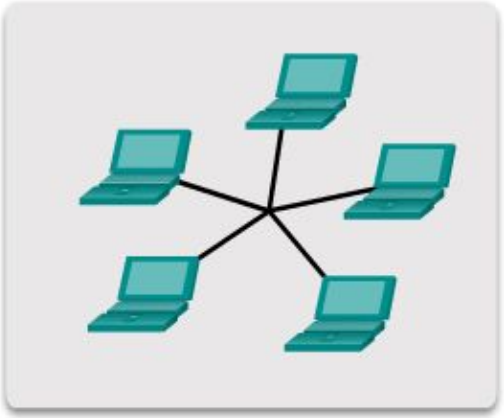
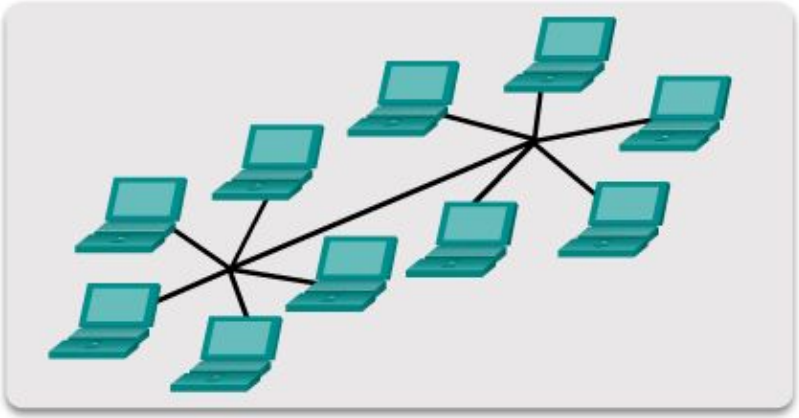
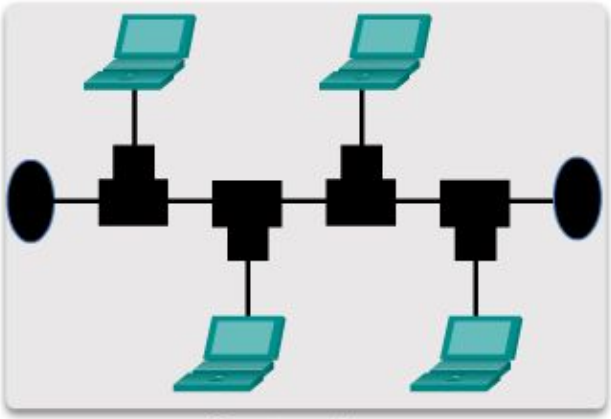
4.4.3: LAN Topologies
4.4.3.1 Physical LAN Topologies



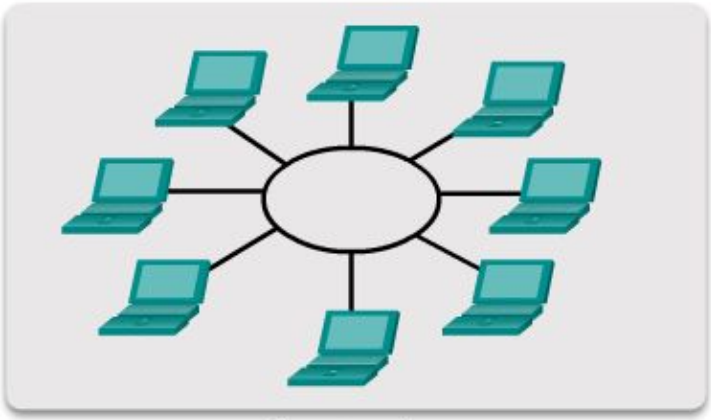
Star topology



Extended star topology



Bus topology



Ring topology

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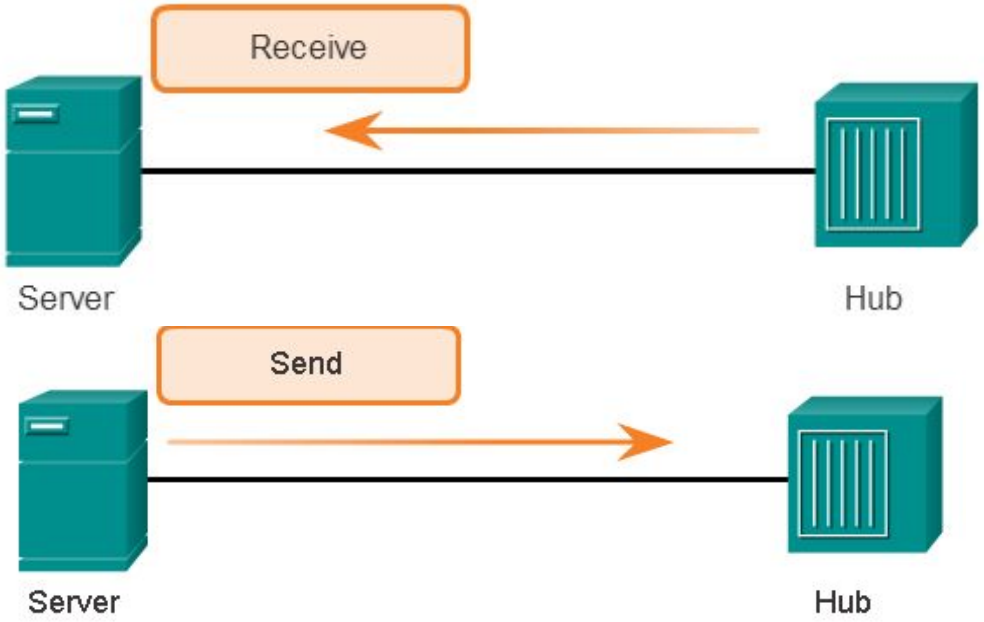
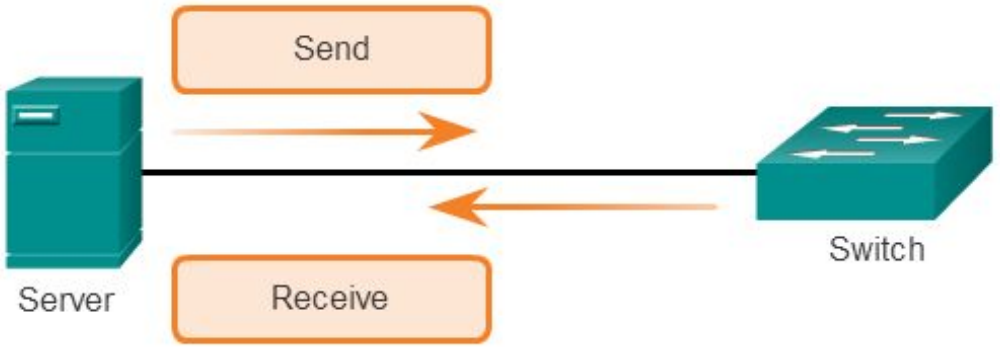
4.4.3: LAN Topologies
4.4.3.2 Half and Full Duplex



Half-Duplex Communication

see animation online

Full-Duplex Communication



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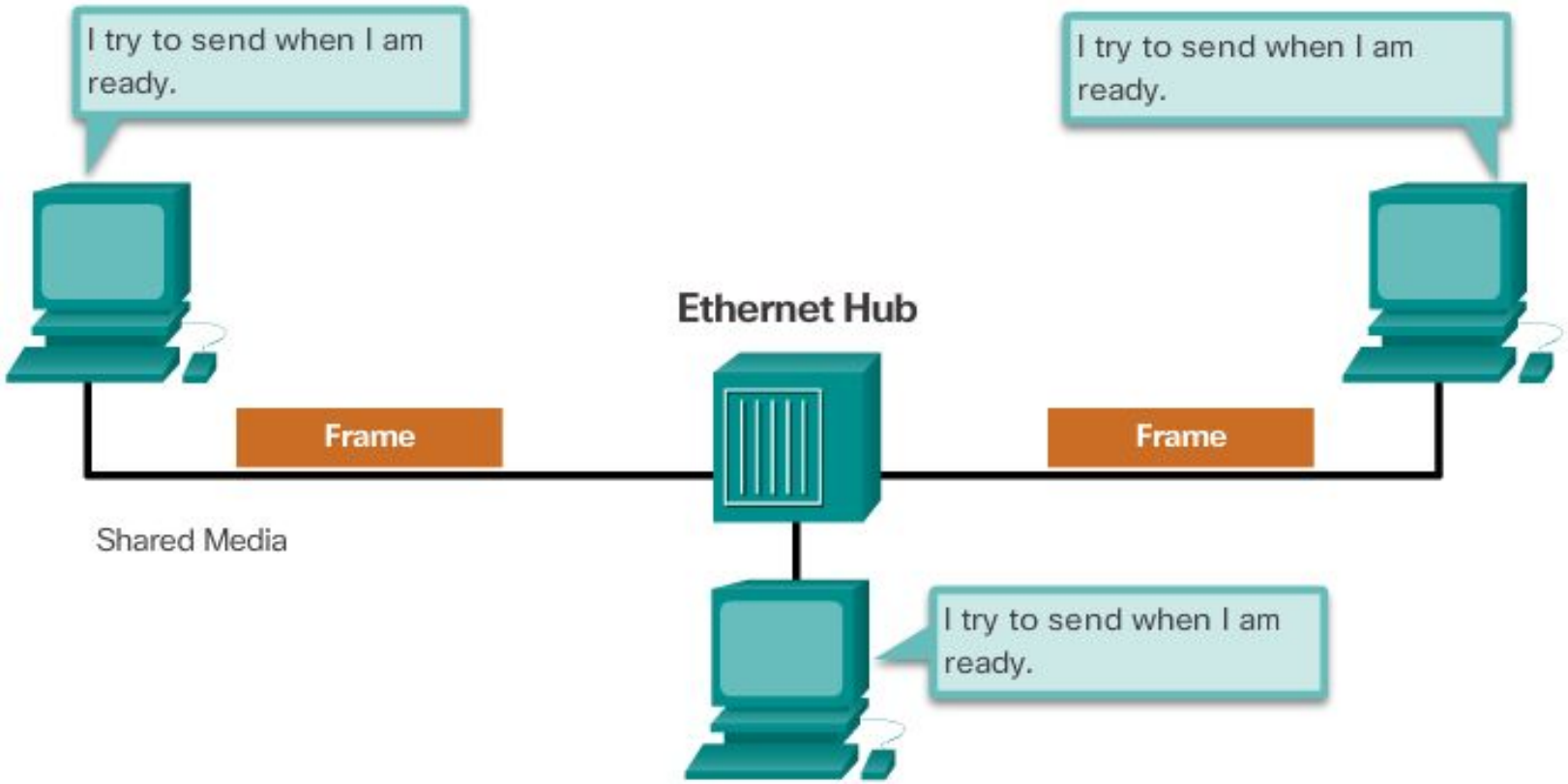
4.4.3: LAN Topologies
4.4.3.3 Media Access Control Methods

Contention-Based Access



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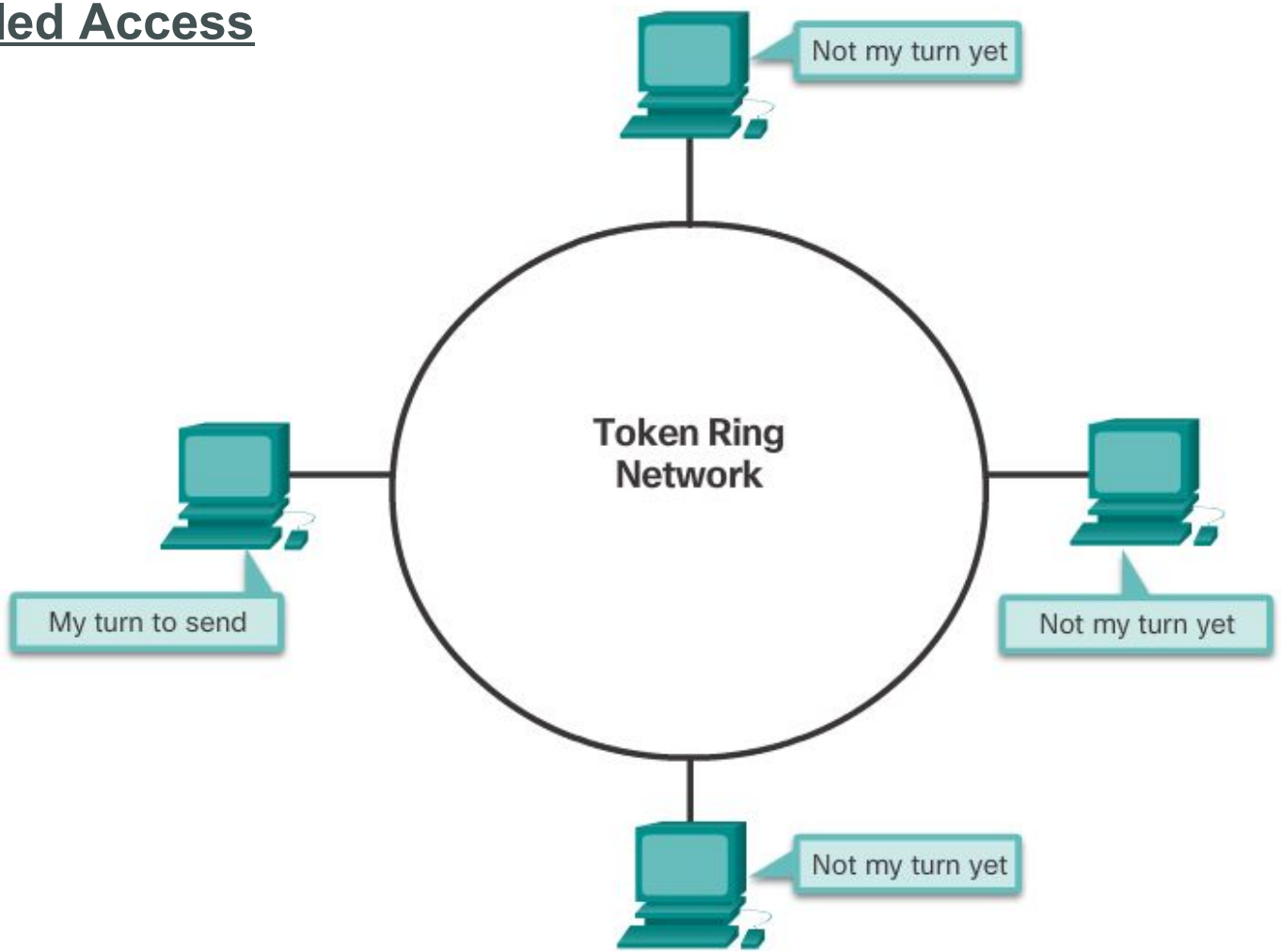
4.4.3: LAN Topologies
4.4.3.3 Media Access Control Methods (cont.)

Controlled Access



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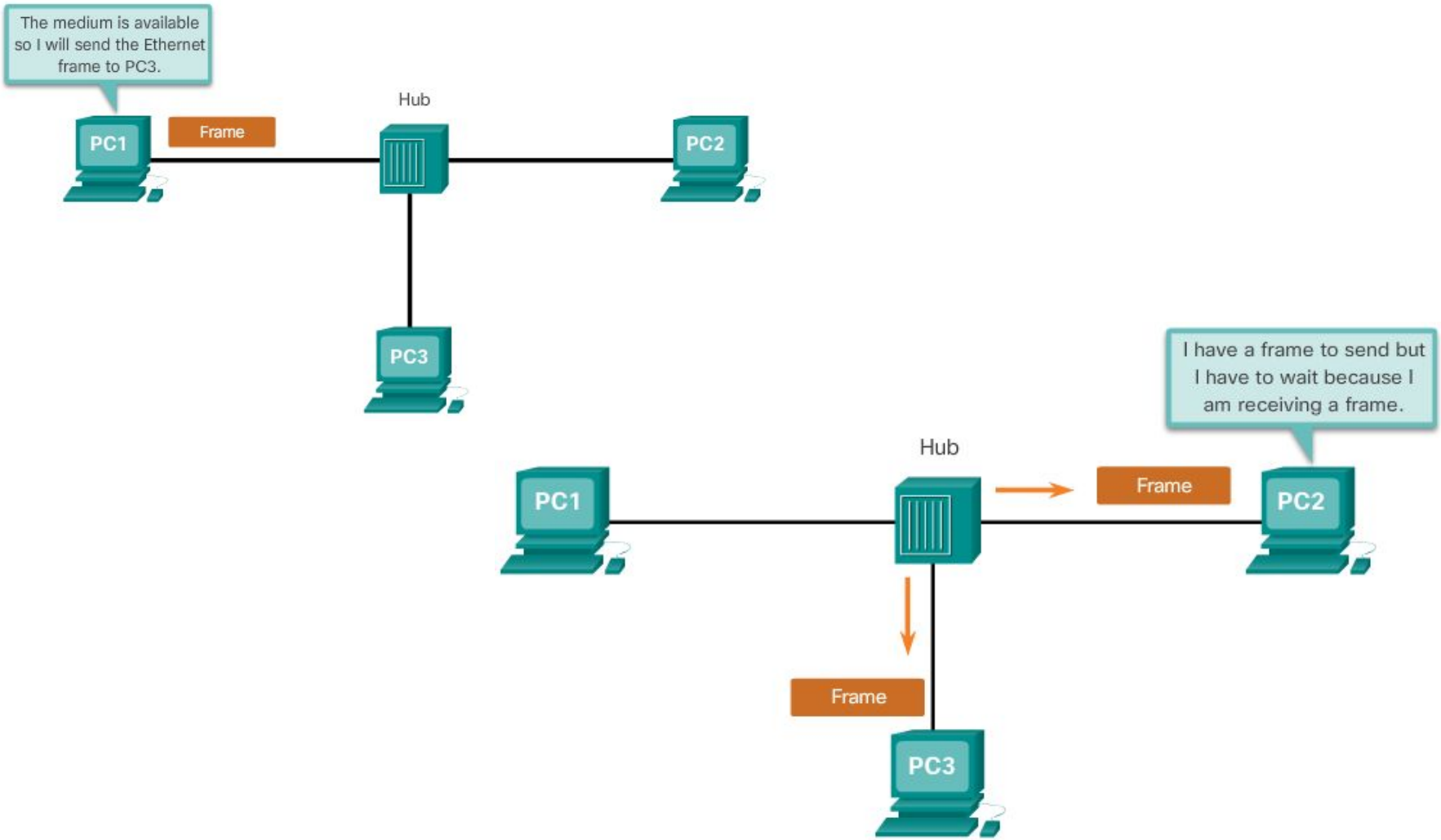
4.4.3: LAN Topologies
4.4.3.4 Contention Based Access – CSMA/CD



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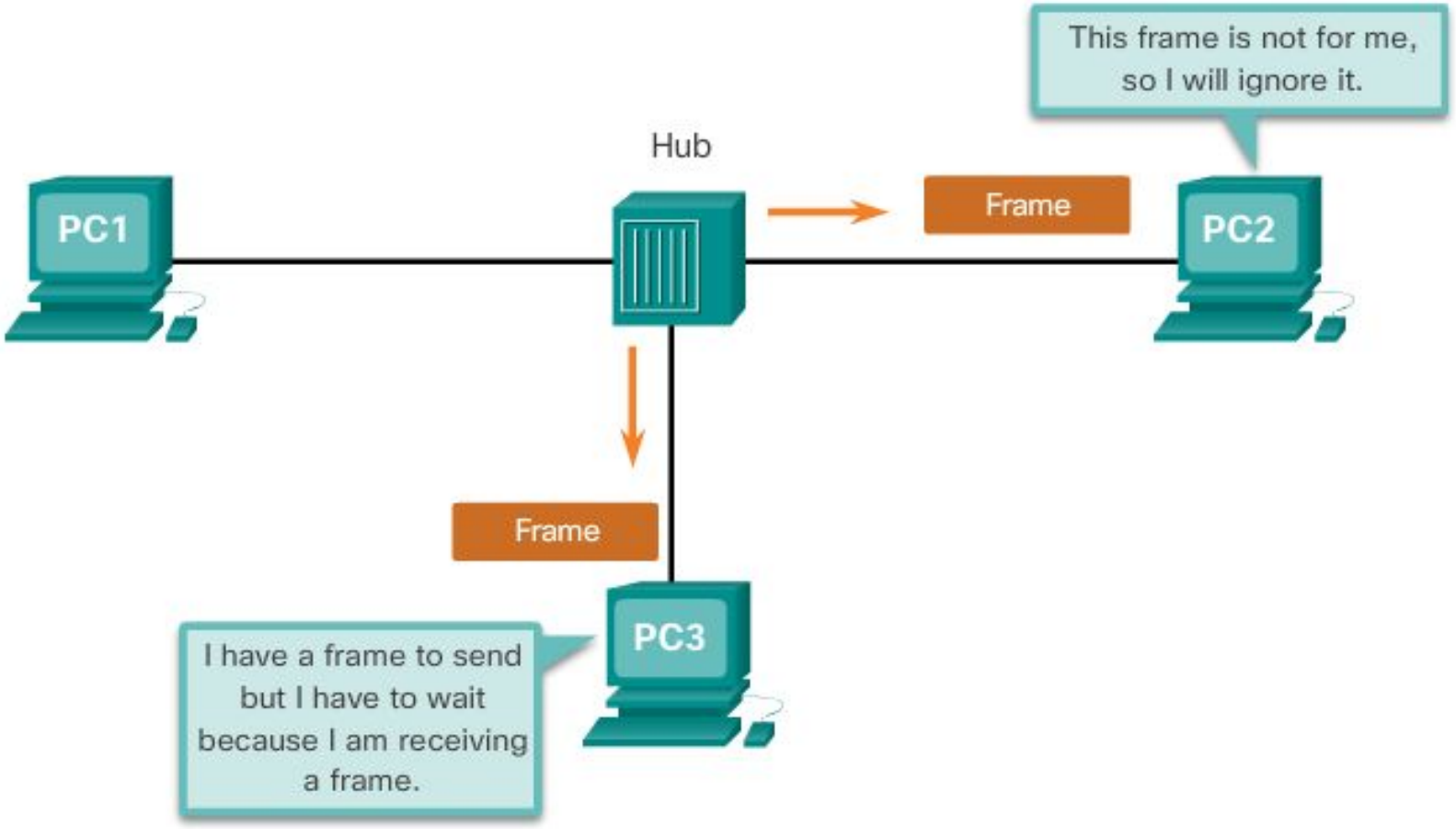
4.4.3: LAN Topologies
4.4.3.4 Contention Based Access – CSMA/CD (cont.)



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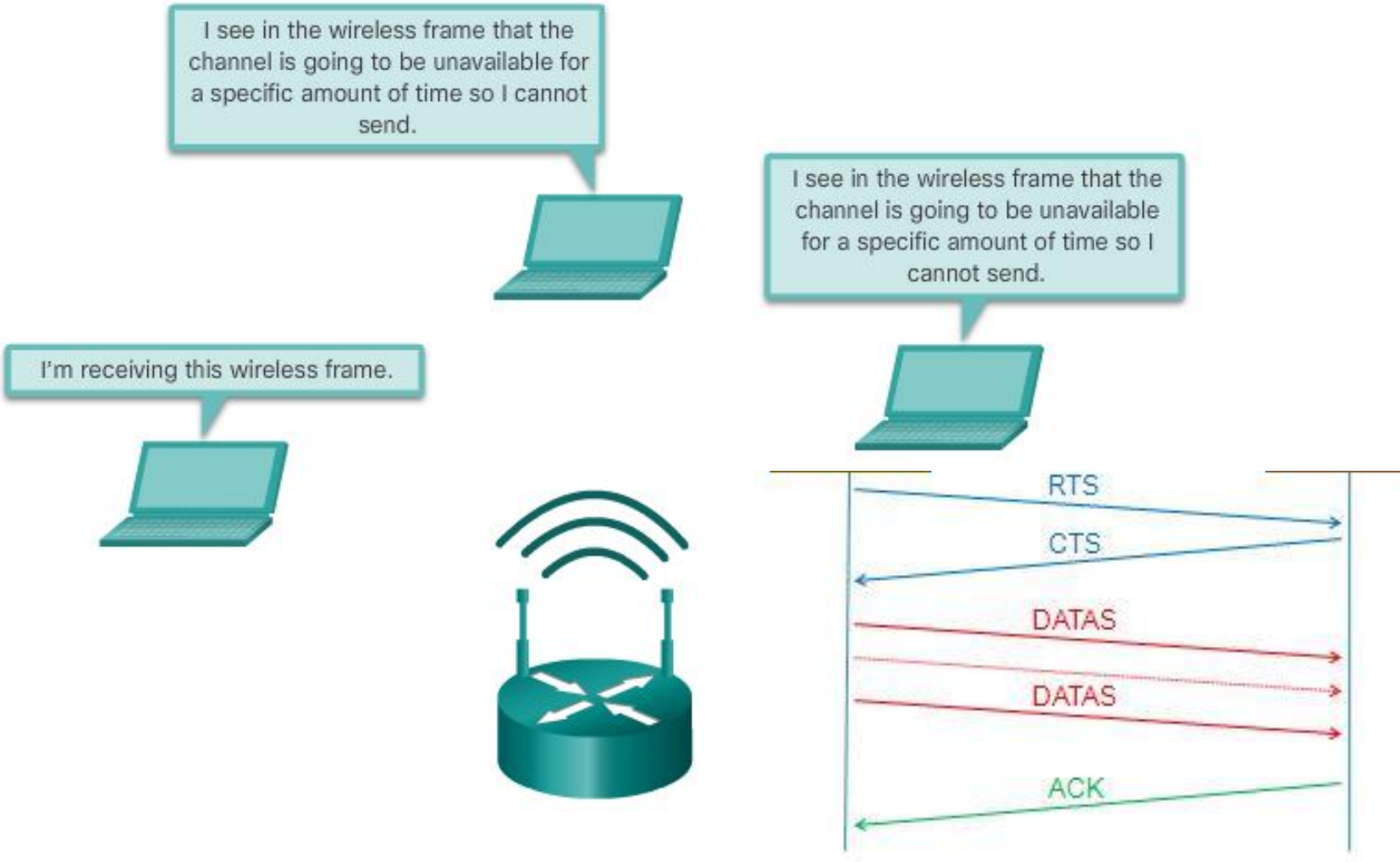
4.4.3: LAN Topologies
4.4.3.5 Contention Based Access – CSMA/CA



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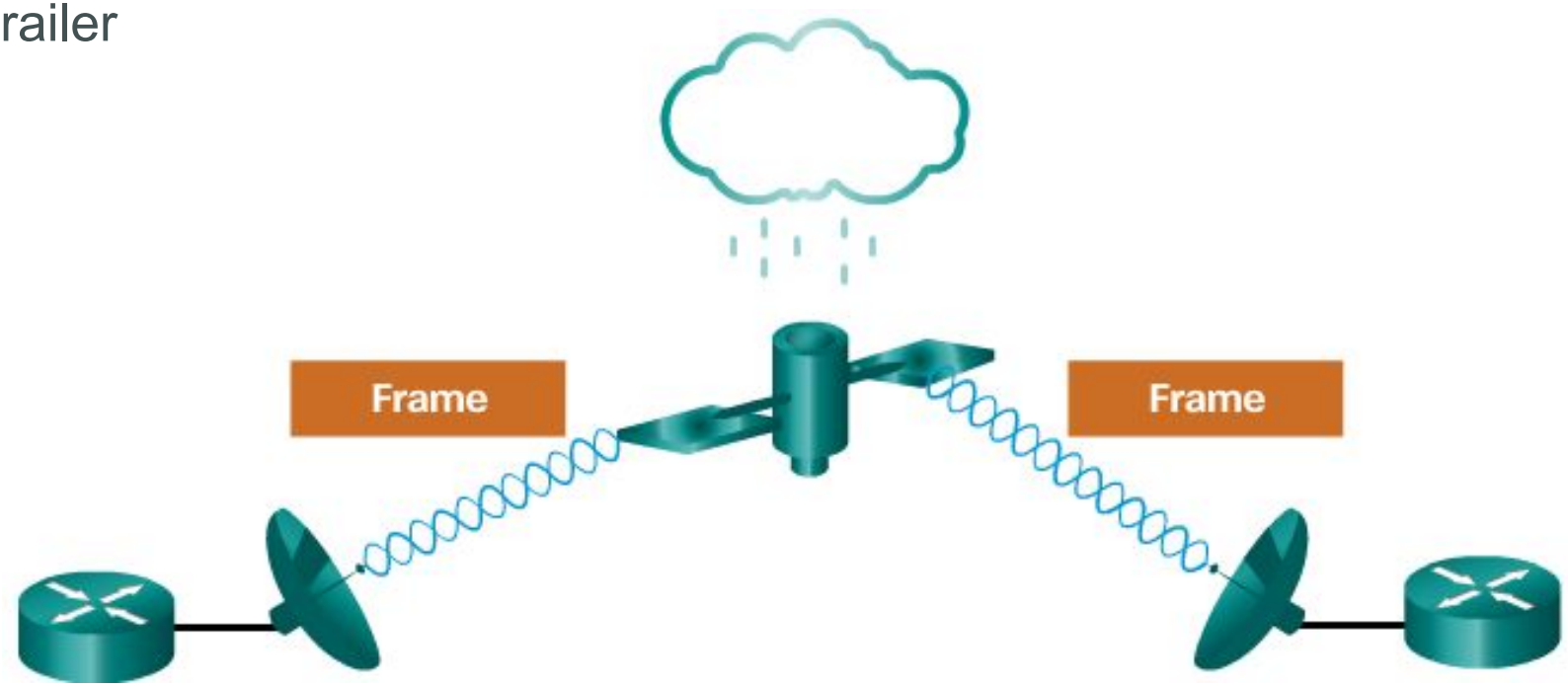
4.4.4: Data Link Frame

4.4.4.1 The Frame

Frames have three basic parts:

- Header
- Data
- Trailer



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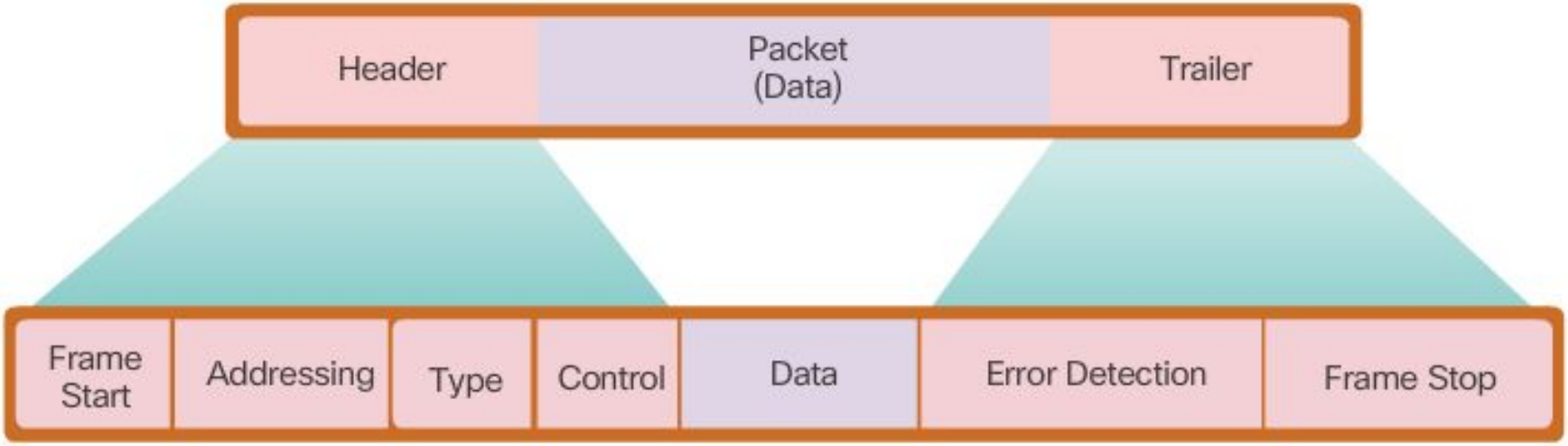
4.4.4: Data Link Frame
4.4.4.2 Frame Fields



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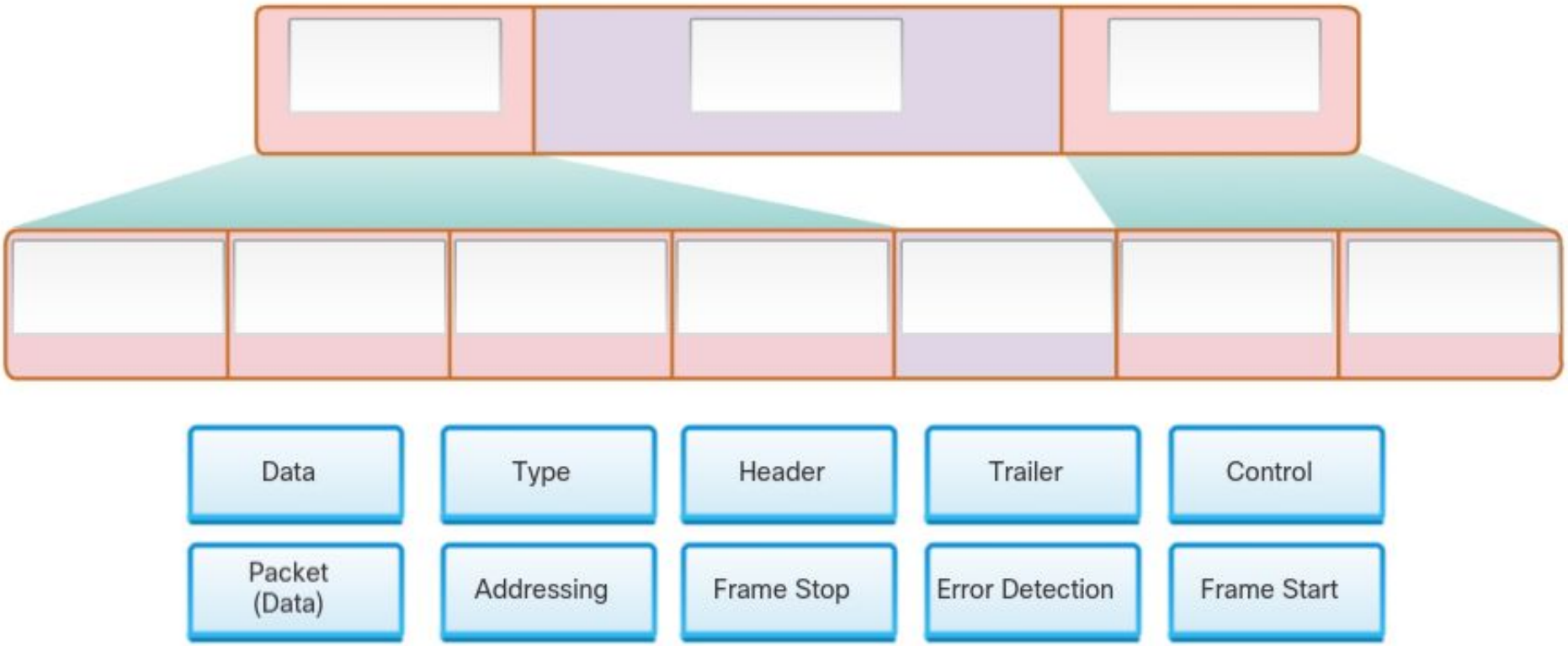
4.4.4: Data Link Frame
4.4.4.3 Activity - Generic Frame Fields



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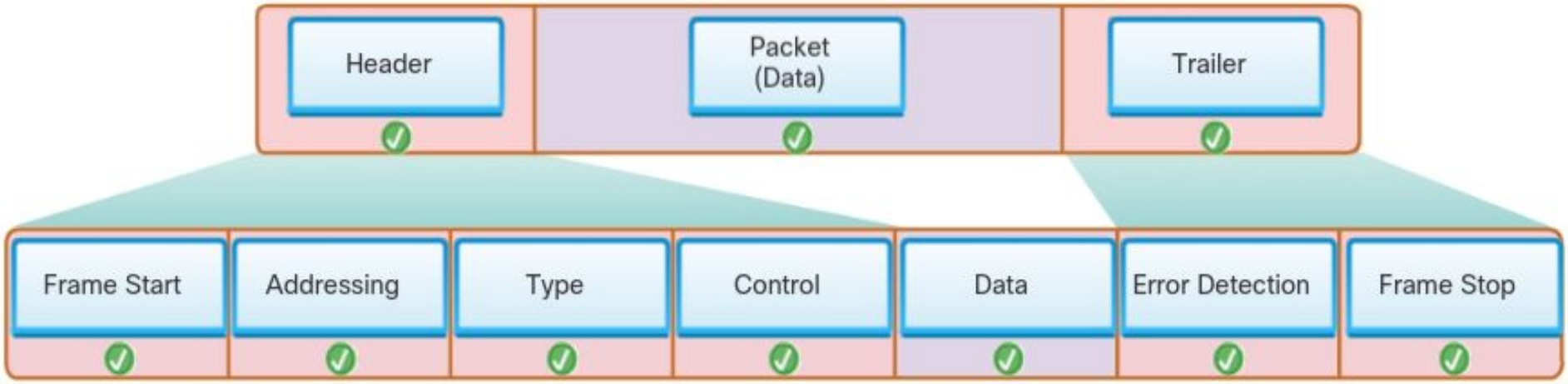
4.4.4: Data Link Frame
4.4.4.3 Activity - Generic Frame Fields



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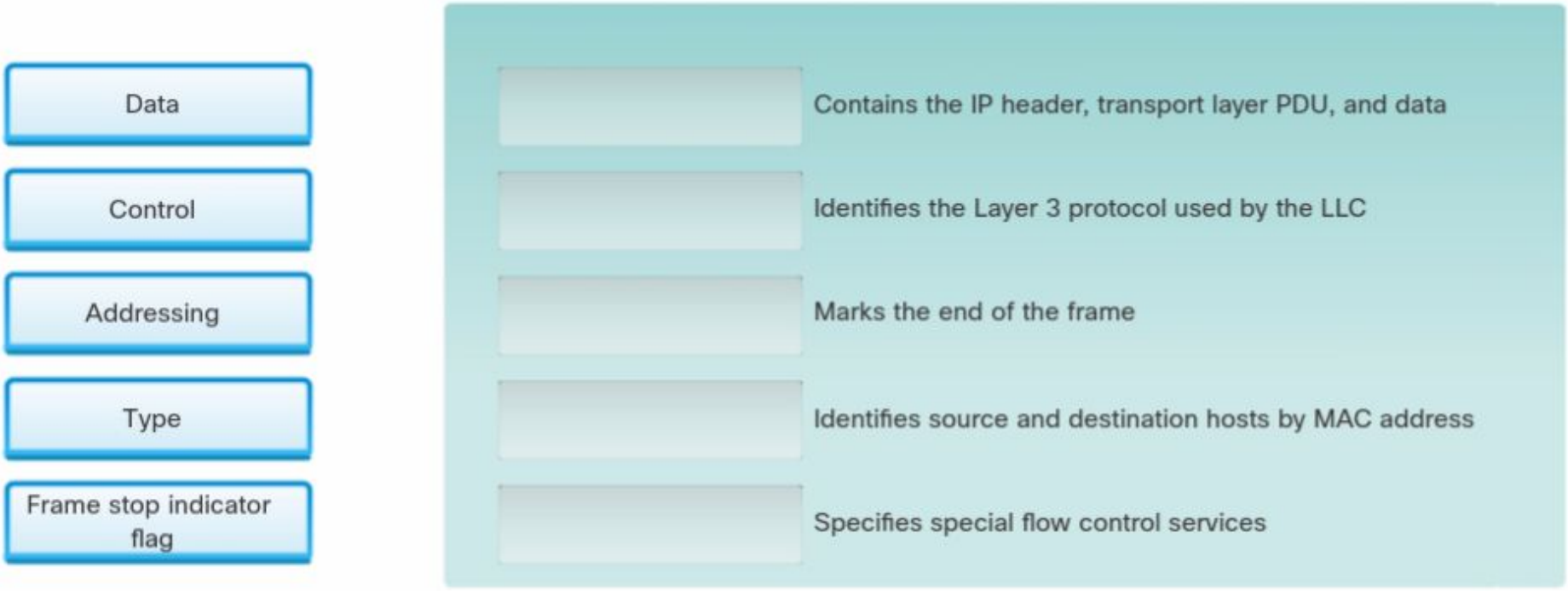
4.4.4: Data Link Frame

4.4.4.3 Activity - Part 2: Generic Frame Fields



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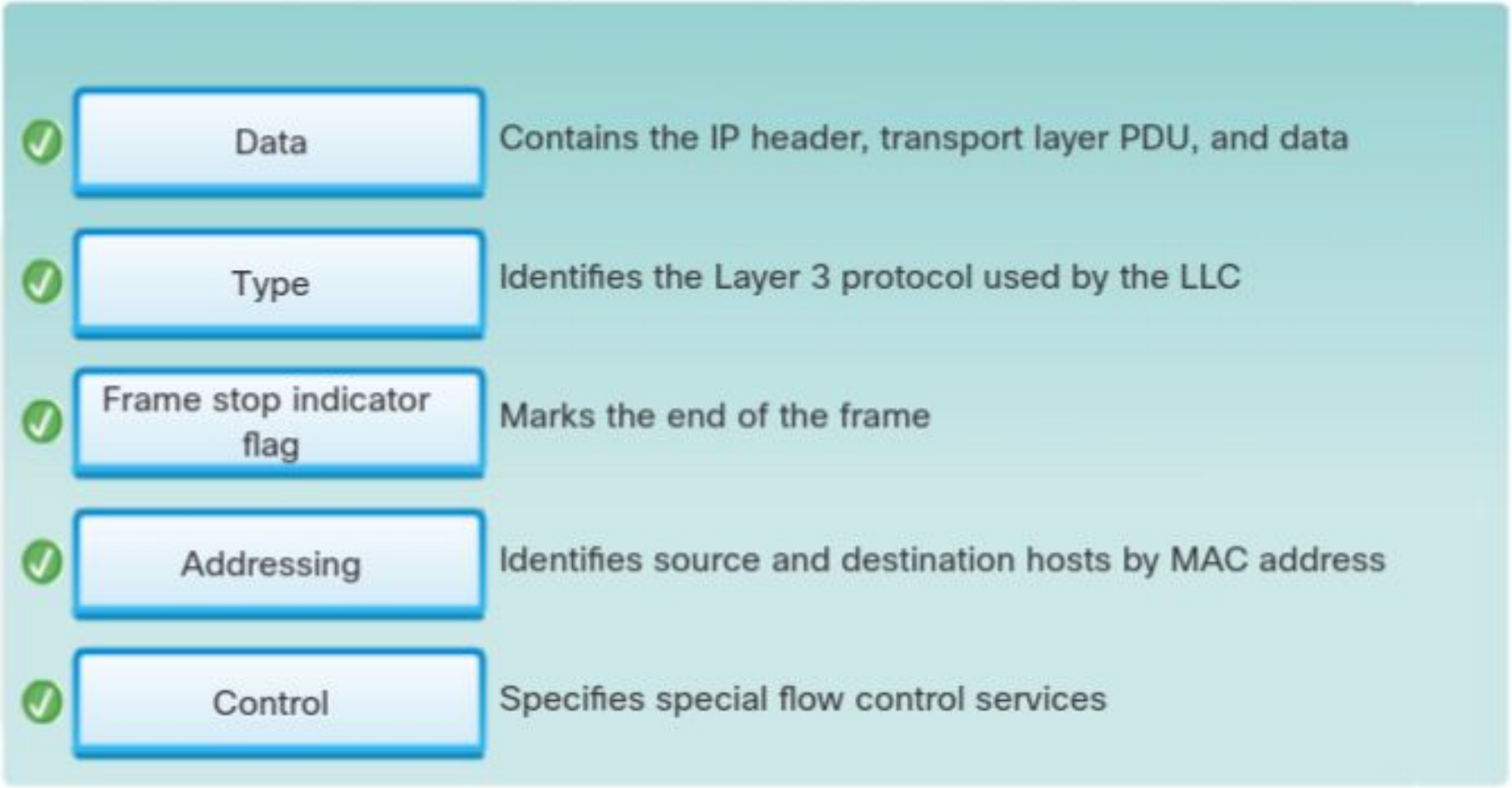
4.4.4: Data Link Frame

4.4.4.3 Activity - Part 2: Generic Frame Fields



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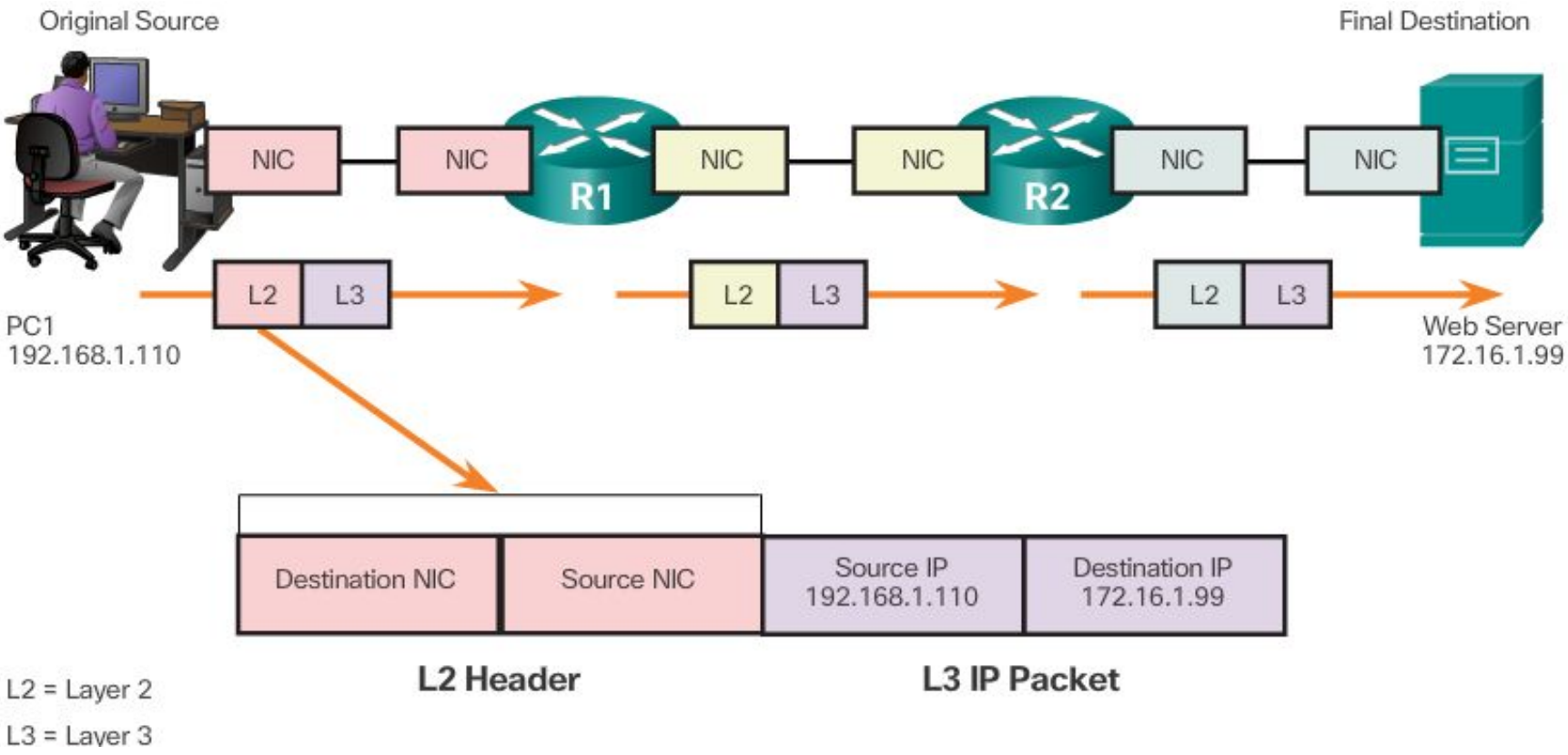
4.4.4: Data Link Frame
4.4.4.4 Layer 2 Address



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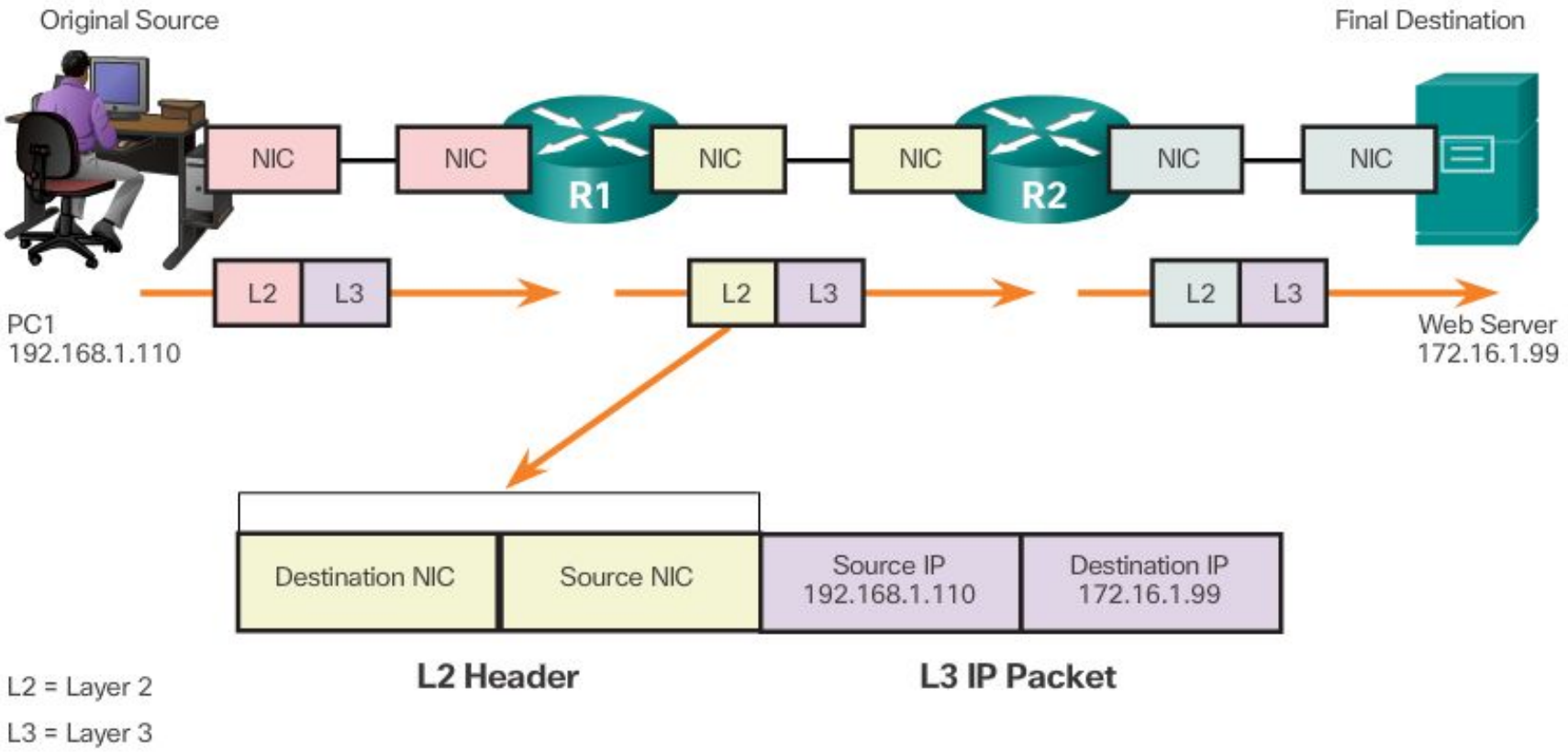
4.4.4: Data Link Frame
4.4.4.4 Layer 2 Address (cont.)



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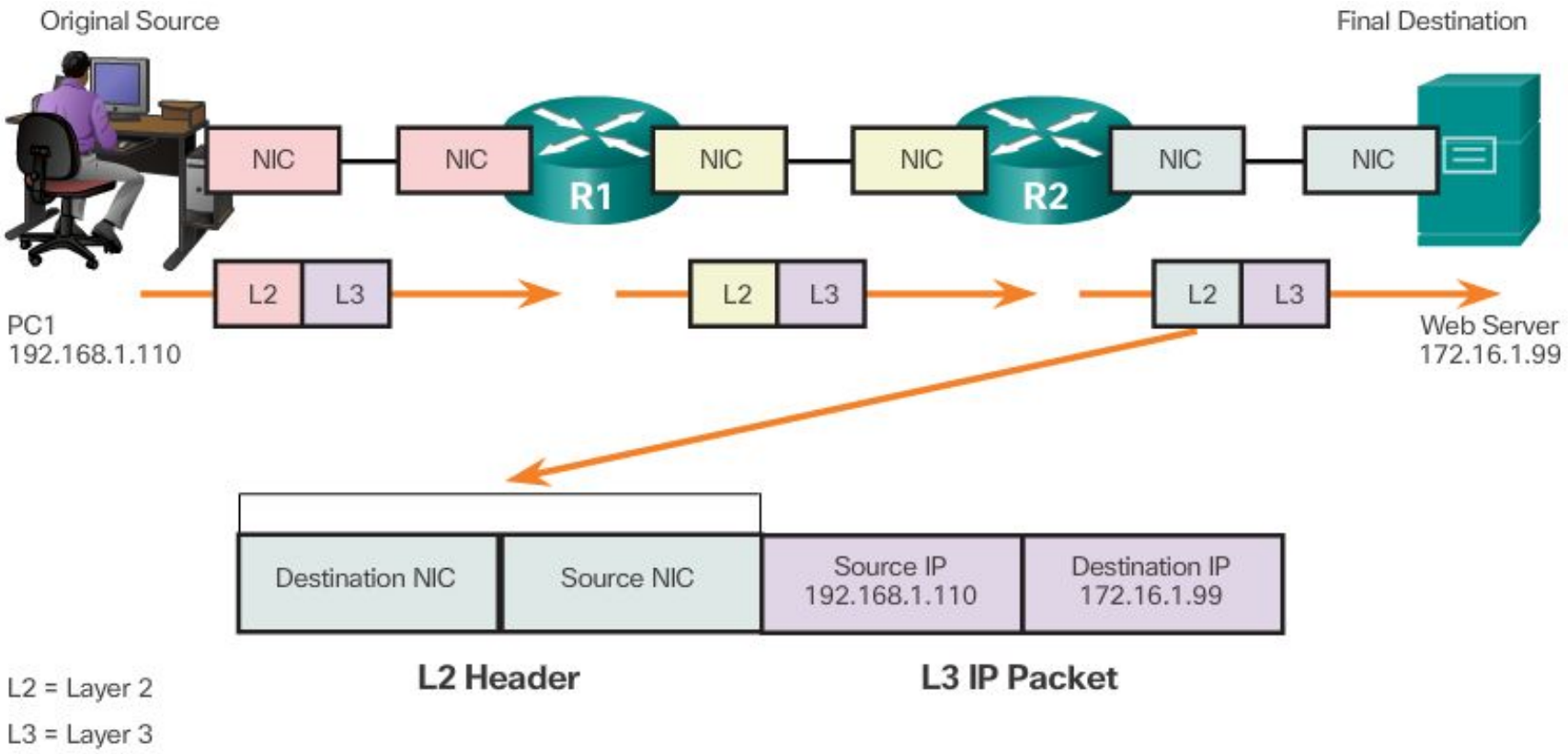
4.4.4: Data Link Frame
4.4.4.4 Layer 2 Address (cont.)



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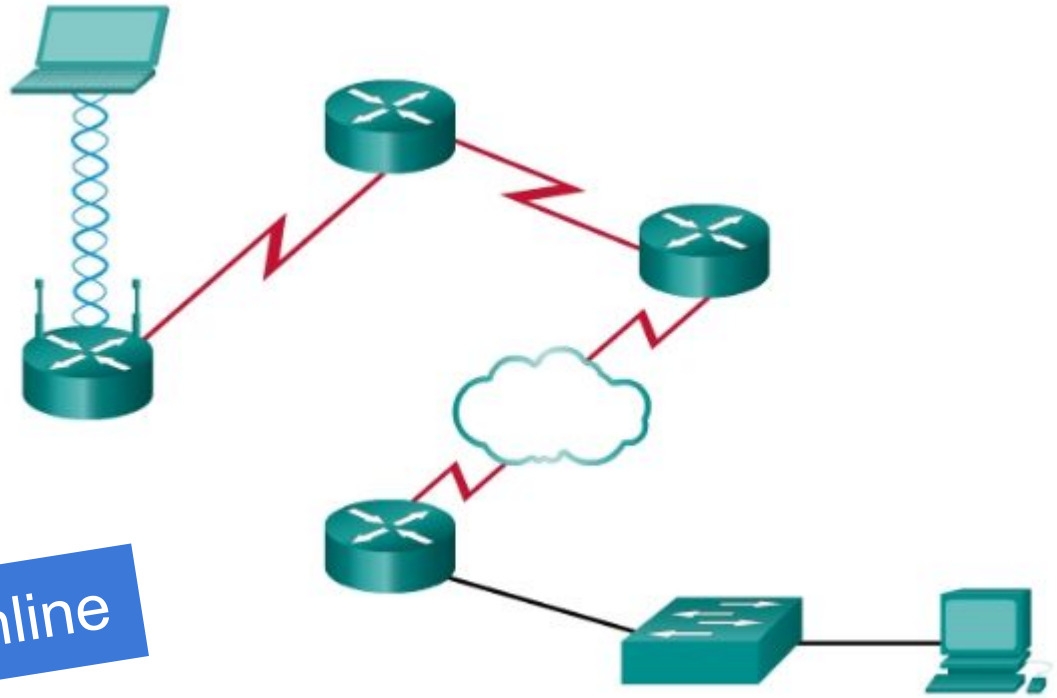
4.4.4: Data Link Frame
4.4.4.5 LAN and WAN Frames

Examples of Layer 2 protocols:

- 802.11 Wireless Frame
- PPP Frame
- HDLC
- Frame Relay
- Ethernet Frame



see animation online

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Section 4.5: Summary

- 4.0 Introduction
- 4.1 Physical Layer Protocols
- 4.2 Network Media
- 4.3 Data Link Layer Protocols
- 4.4 Media Access Control
- 4.5 Summary

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