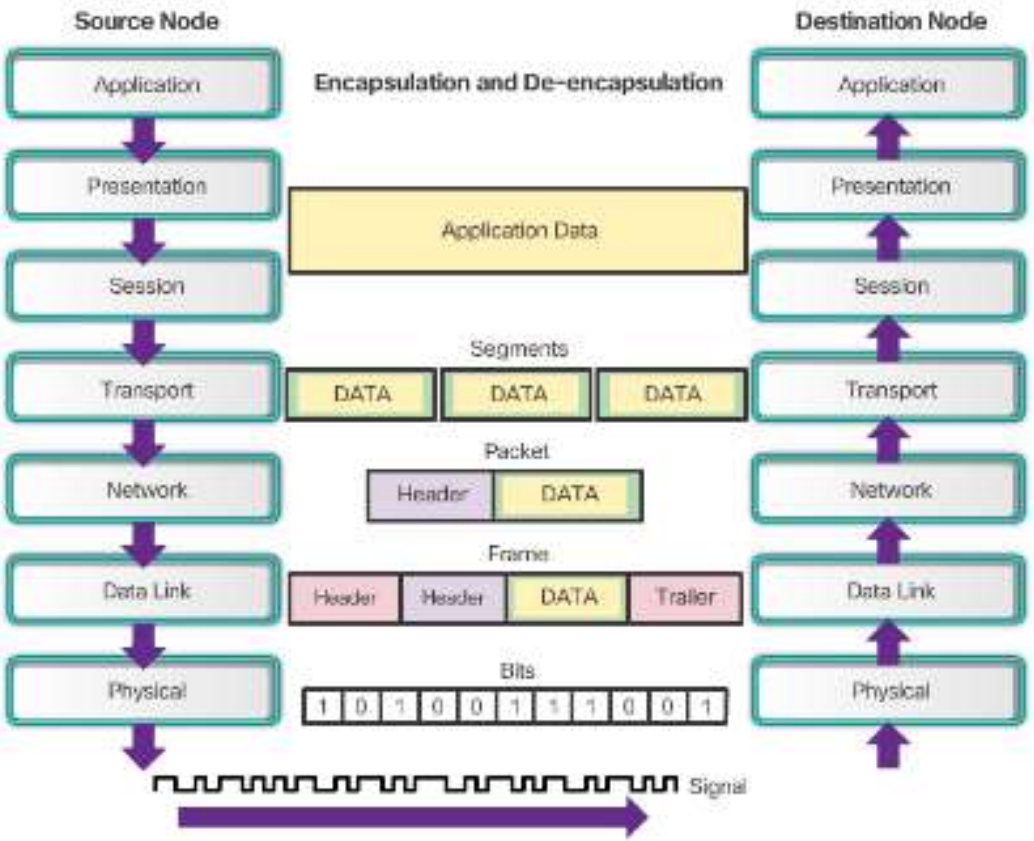
CAPITULO 2

TRANSMISIÓN DE DATOS EN MEDIOS COMPARTIDOS

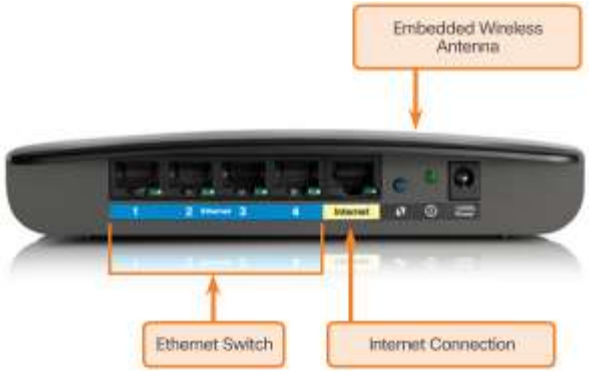
Purpose of the Physical Layer

- The Physical Layer
  - Accepts a complete frame from the data link layer
  - Encodes it as a series of signals that are transmitted onto the local media
- Physical Layer Media
  - Describe the media types
- Physical Layer Standards



Physical Layer Connection

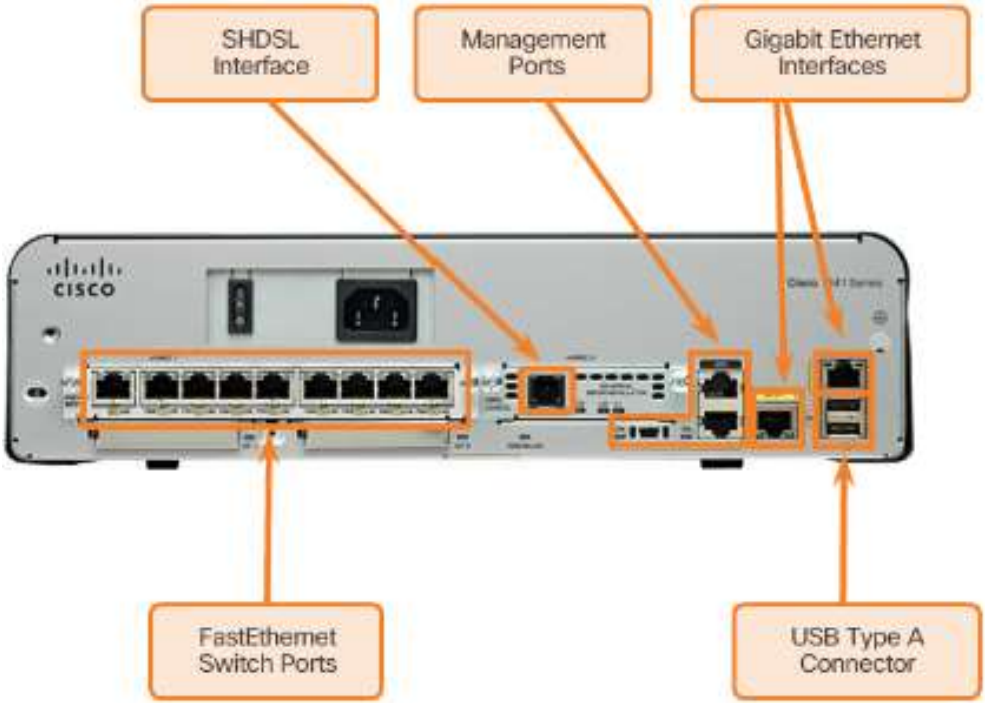
- Types of Connections



- Network Interface Cards

Physical Layer Characteristics

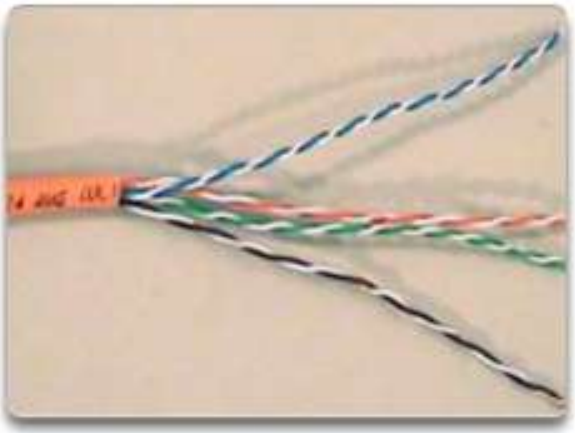
- Functions
  - Physical components
  - Encoding
  - Signaling
- Data Transfer
  - Bandwidth – capacity to a medium to carry data
  - Throughput - measure of the transfer of bits across the media
- Types of Physical Media



Network Media

Copper Cabling

- Characteristics of Copper Cabling
  - Inexpensive, easy to install, low resistance to electric current
  - Distance and signal interference
- Copper Media
- Unshielded Twisted-Pair Cable
- Shielded Twisted-Pair Cable
- Coaxial Cable
- Copper Media Safety
  - Fire and electrical hazards



Unshielded Twisted-Pair (UTP) cable

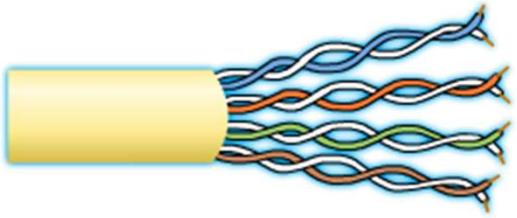
Shielded Twisted-Pair (STP) cable

Coaxial cable

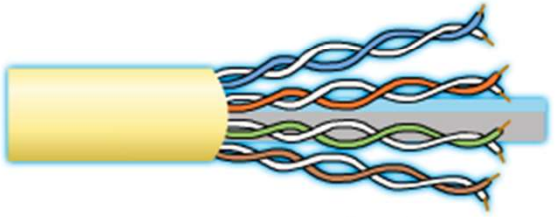
Network Media

UTP Cabling

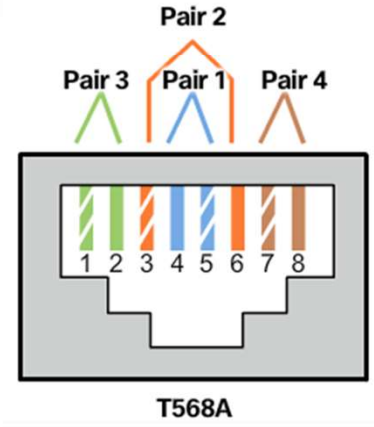
- Properties of UTP Cabling
  - Cancellation of EMI and RFI signals with twisted pairs
- UTP Cabling Standards
  - TIA/EIA-568
  - IEEE: Cat5, Cat5e, Cat6, Cat6e
- UTP Connectors
- Types of UTP Cable
  - Rollover
  - Crossover
  - Straight-through
- Testing UTP Cables
- Cable Pinouts

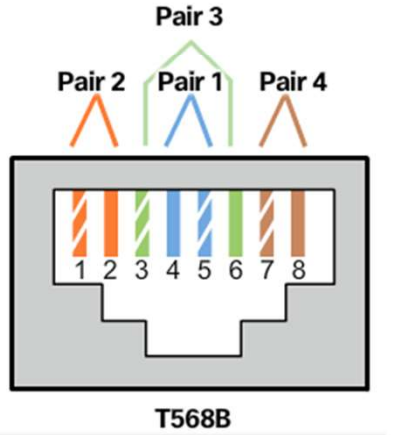


Category 5 and 5e Cable (UTP)



Category 6 Cable (UTP)

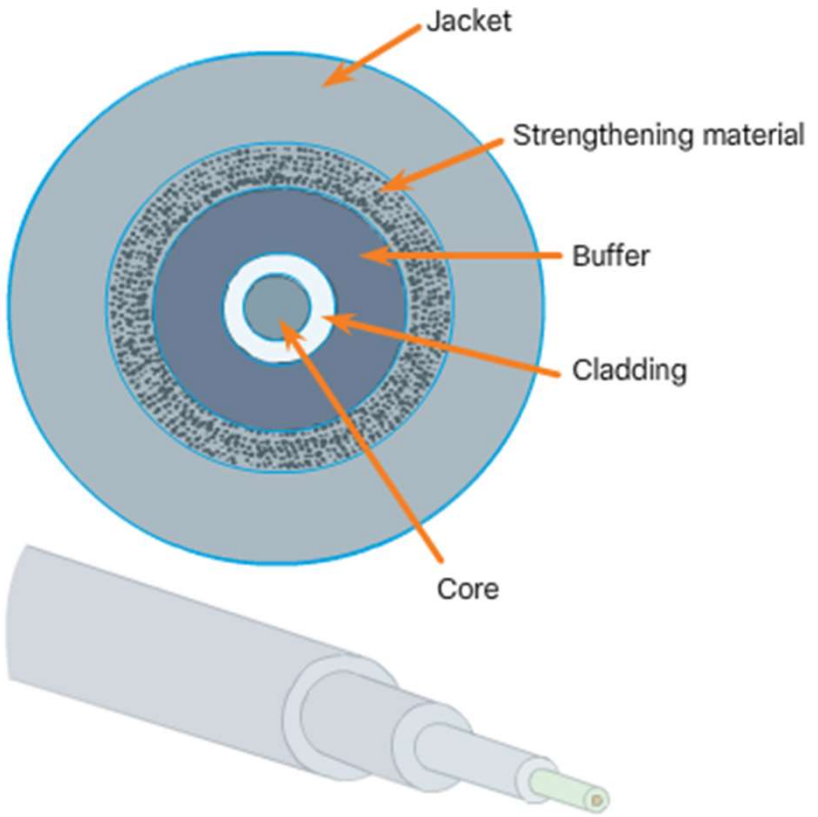




Network Media

Fiber-Optic Cabling

- Properties of Fiber-Optic Cabling
  - Transmits data over longer distances
  - Flexible, but thin strands of glass
  - Transmits with less attenuation
  - Immune to EMI and RFI
- Fiber Media Cable Design
- Types of Fiber Media
  - Single mode and multimode
- Fiber-Optic Connectors
- Testing Fiber Cables
- 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

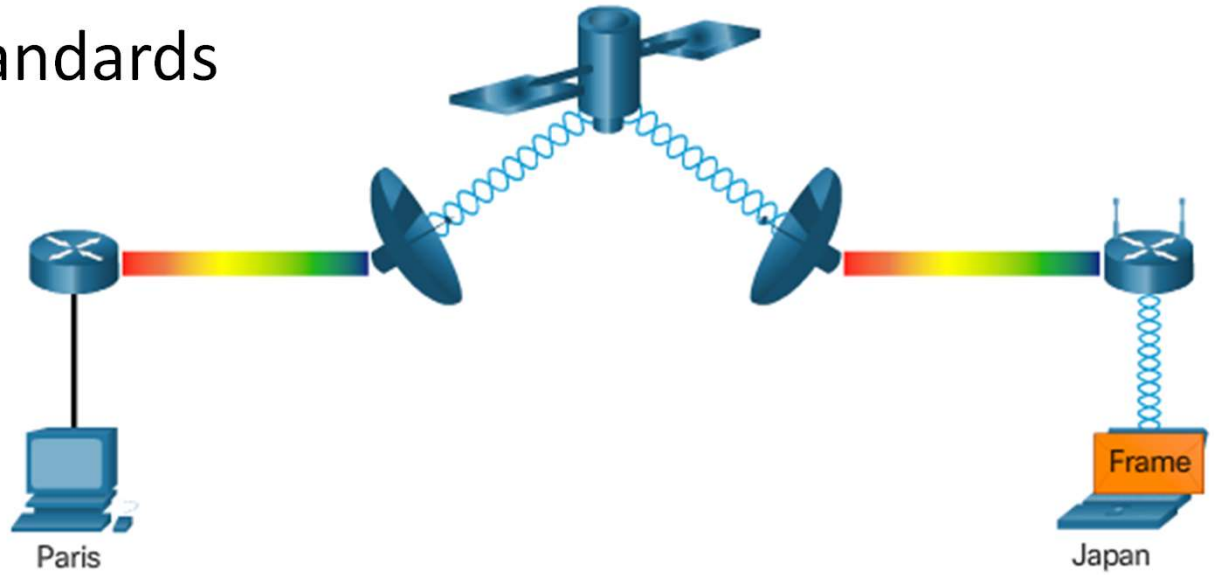
Network Media

Wireless Media

- Properties of Wireless Media
  - Data communications using radio or microwave frequencies
- Types of Wireless Media
  - Wi-Fi, Bluetooth, WiMax
- Wireless LAN
  - Wireless Access Point
  - Wireless NIC adapters

Purpose of the Data Link Layer

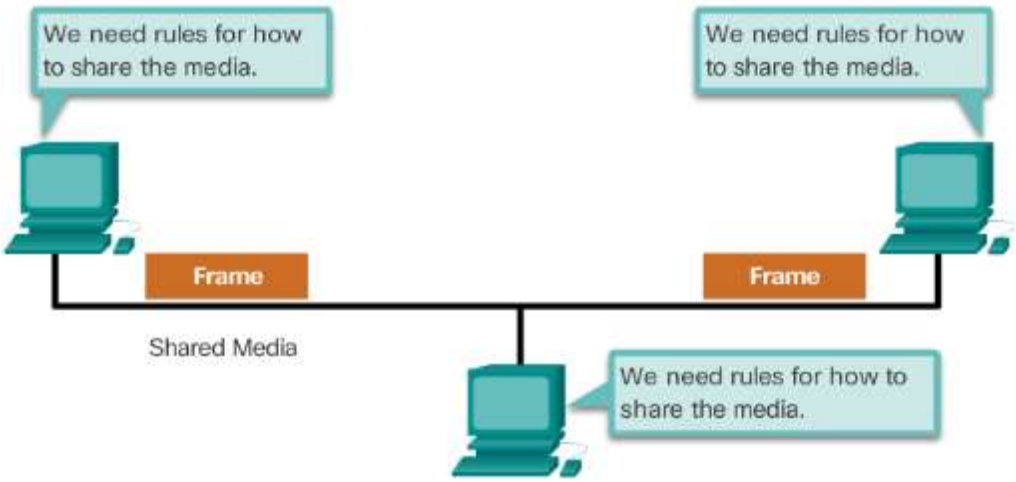
- The Data Link Layer
  - What is this layer responsible for?
- Data Link Sublayers
  - LLC communicates with the network layer
  - MAC defines the media access processes
- Providing Access to Media
- Data Link Layer Standards
  - IEEE
  - ITU
  - ISO
  - ANSI



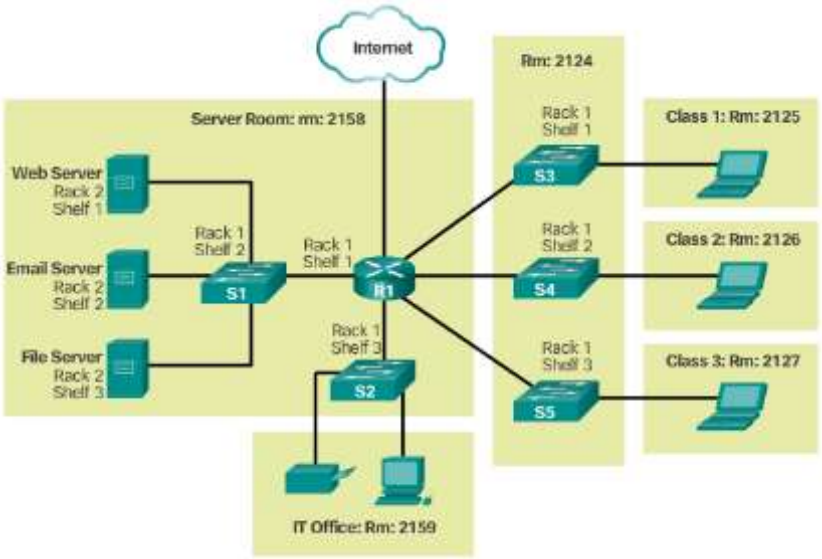
Media Access Control

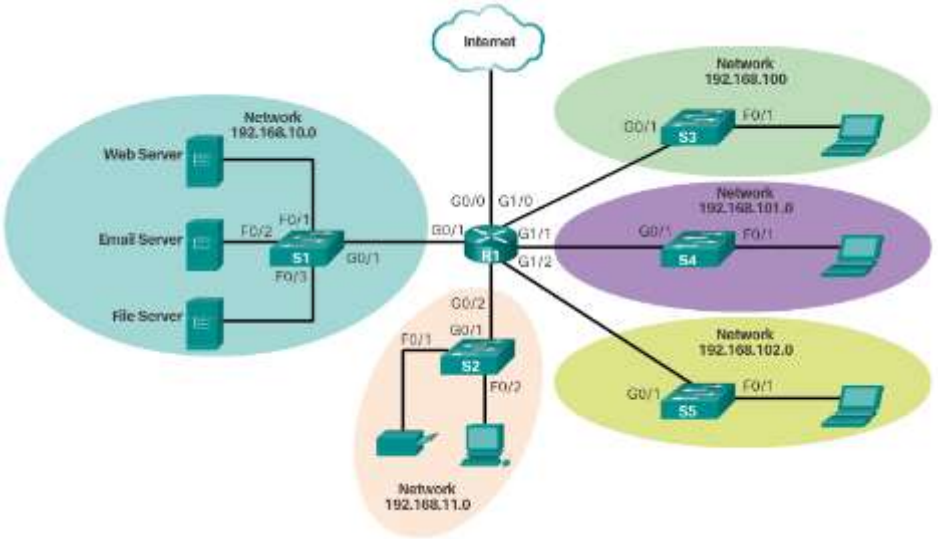
Topologies

- Controlling Access to the Media



- Physical and Logical Topologies

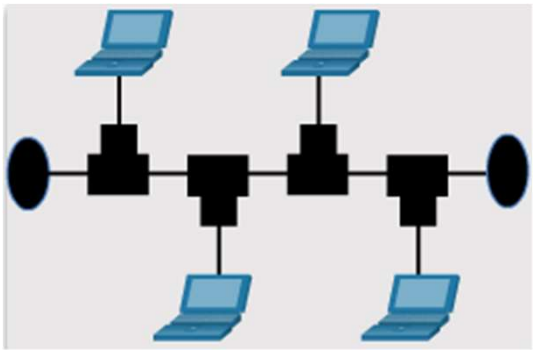


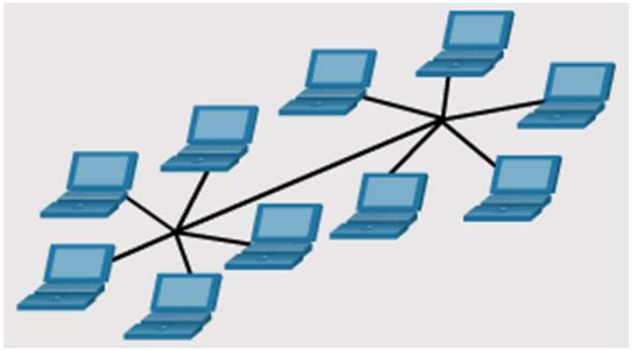


Media Access Control

LAN Topologies

- Physical LAN Topologies
- Half and Full Duplex
- Media Access Control Methods
- Contention-Based Access
  - CSMA/CD vs. CSMA/CA



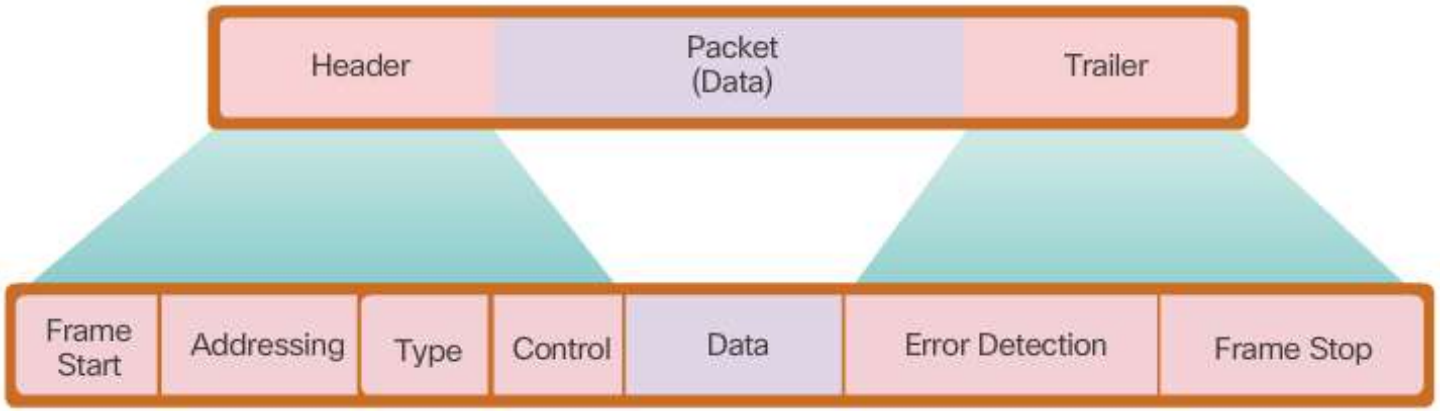


Media Access Control

Data Link Frame

- The Frame
  - Header
  - Data
  - Trailer
- Frame Fields
- Layer 2 Address

- LAN and WAN Frames
  - 802.11 Wireless Frame
  - PPP Frame
  - HDLC
  - Frame Relay
  - Ethernet Frame

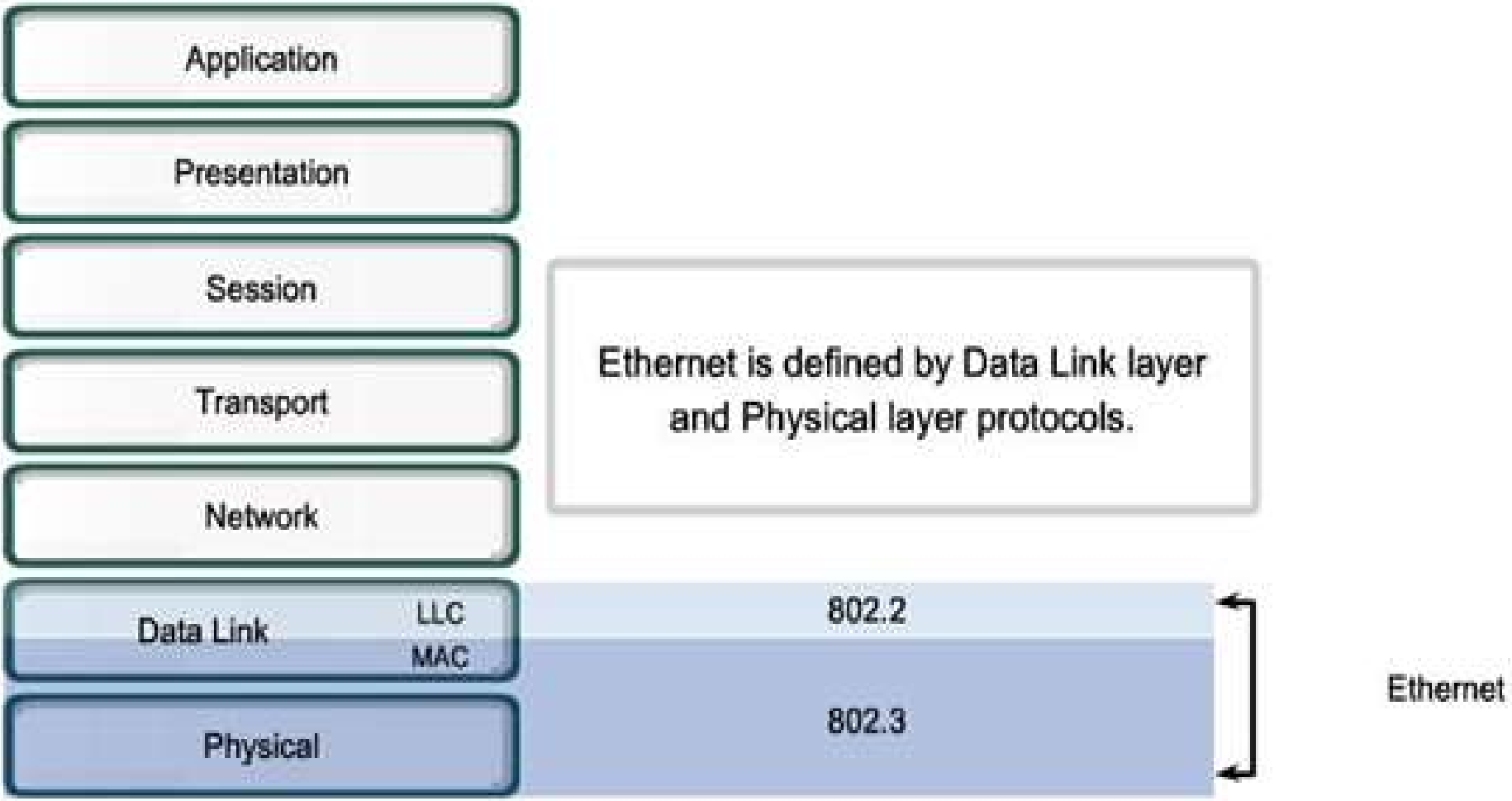


Ethernet Protocol

Ethernet Frame

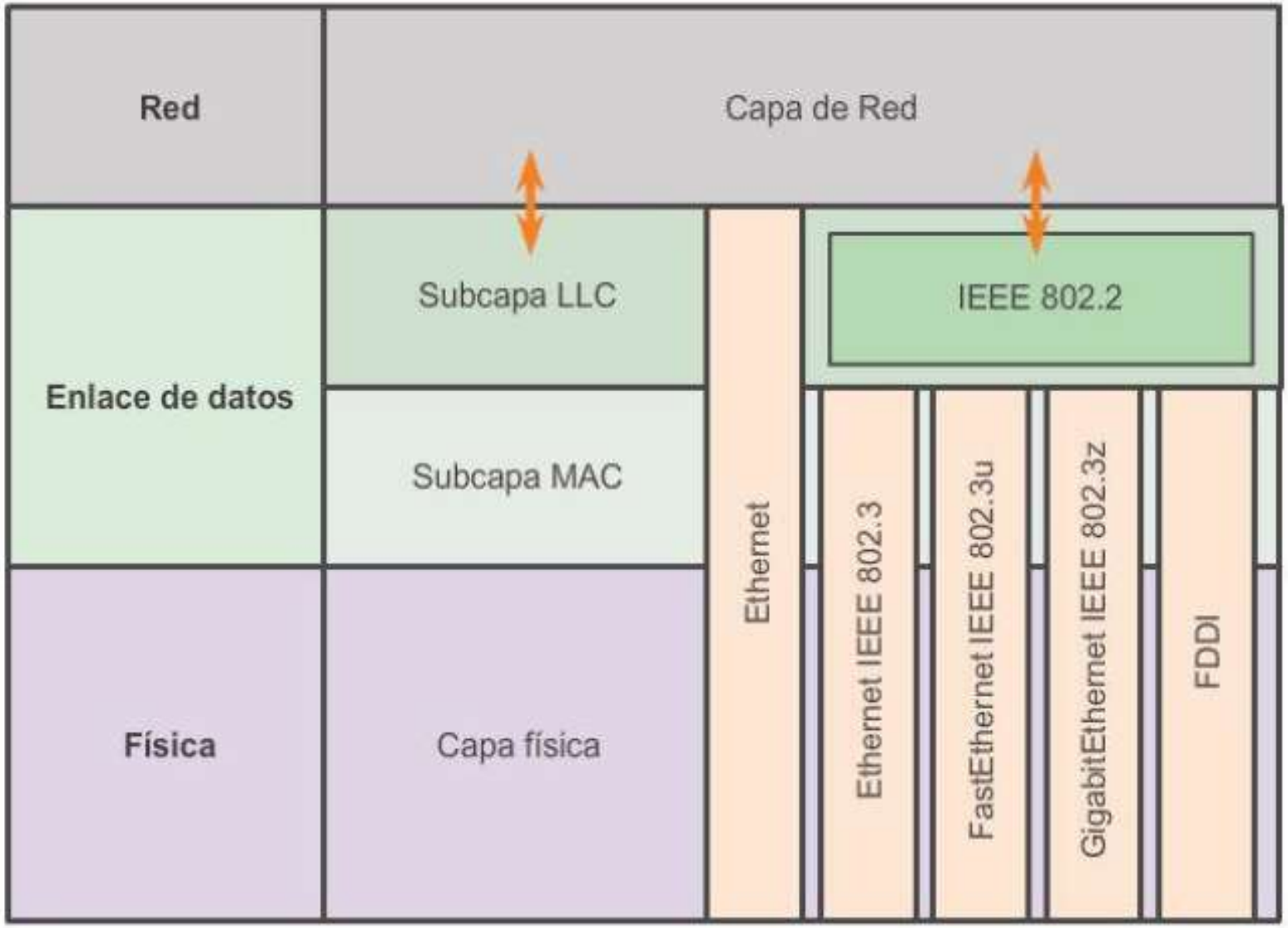
Ethernet Operation

LLC and MAC Sublayers



Ethernet Operation

LLC and MAC Sublayers

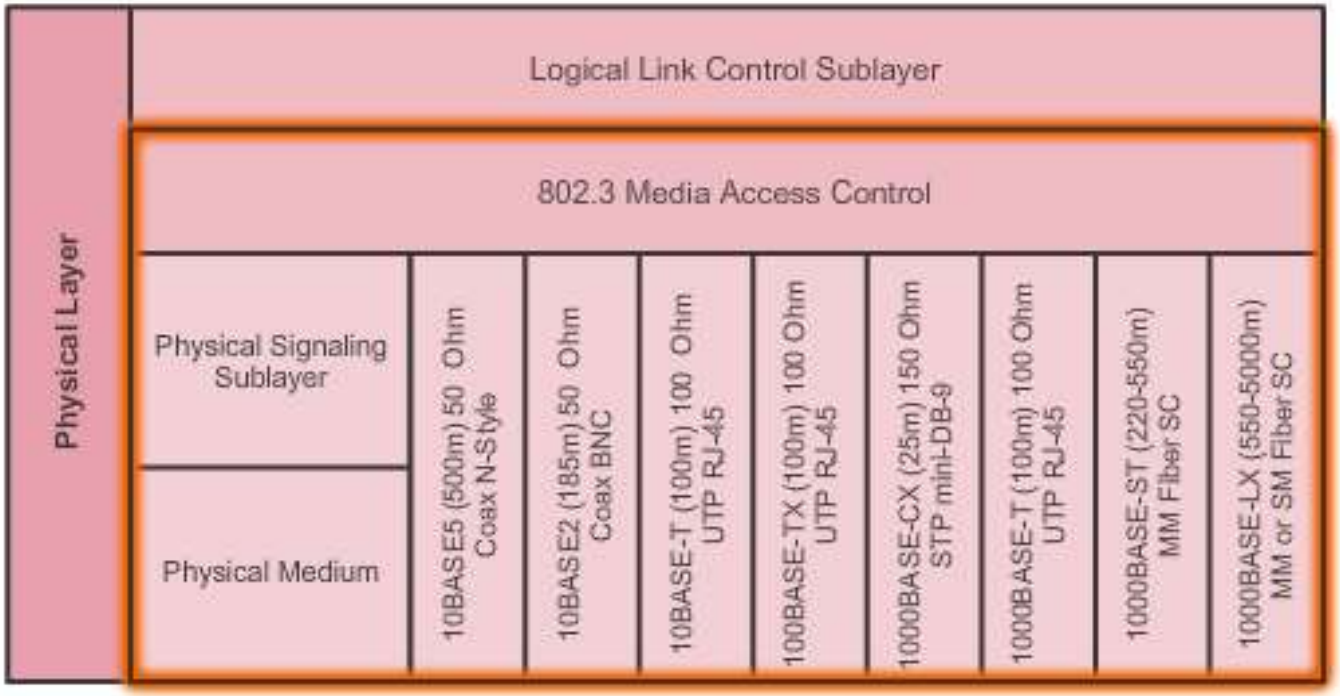


Ethernet Operation

MAC Sublayer

Data Encapsulation
- Frame delimiting
- Addressing
- Error detection

Media Access Control
- Control of frame placement on and off the media
- Media recovery



The Evolution of Ethernet Standards to Meet Higher Speeds				
Date	**IEEE Std.**	**Name**	**Data Rate**	**Type of Cabling**
1990	802.3i	10BASE-T	10 Mb/s	Category 3 cabling
1995	802.3u	100BASE-TX	100 Mb/s*	Category 5 cabling
1998	802.3z	1000BASE-SX	1 Gb/s	Multimode fiber
	802.3z	1000BASE-LX/EX		Single mode fiber
1999	802.3ab	1000BASE-T	1 Gb/s*	Category 5e or higher Category
2003	802.3ae	10GBASE-SR	10 Gb/s	Laser-Optimized MMF
	802.3ae	10GBASE-LR/ER		Single mode fiber
2006	802.3an	10GBASE-T	10 Gb/s*	Category 6A cabling
2015	802.3bq	40GBASE-T	40 Gb/s*	Category 8 (Class I & II) Cabling
2010	802.3ba	40GBASE-SR4/LR4	40 Gb/s	Laser-Optimized MMF or SMF
	802.3ba	100GBASE-SR10/LR4/ER4	100 Gb/s	Laser-Optimized MMF or SMF
2015	802.3bm	100GBASE-SR4	100 Gb/s	Laser-Optimized MMF
2016	SG	Under development	400 Gb/s	Laser-Optimized MMF or SMF
Note: *with auto negotiation				

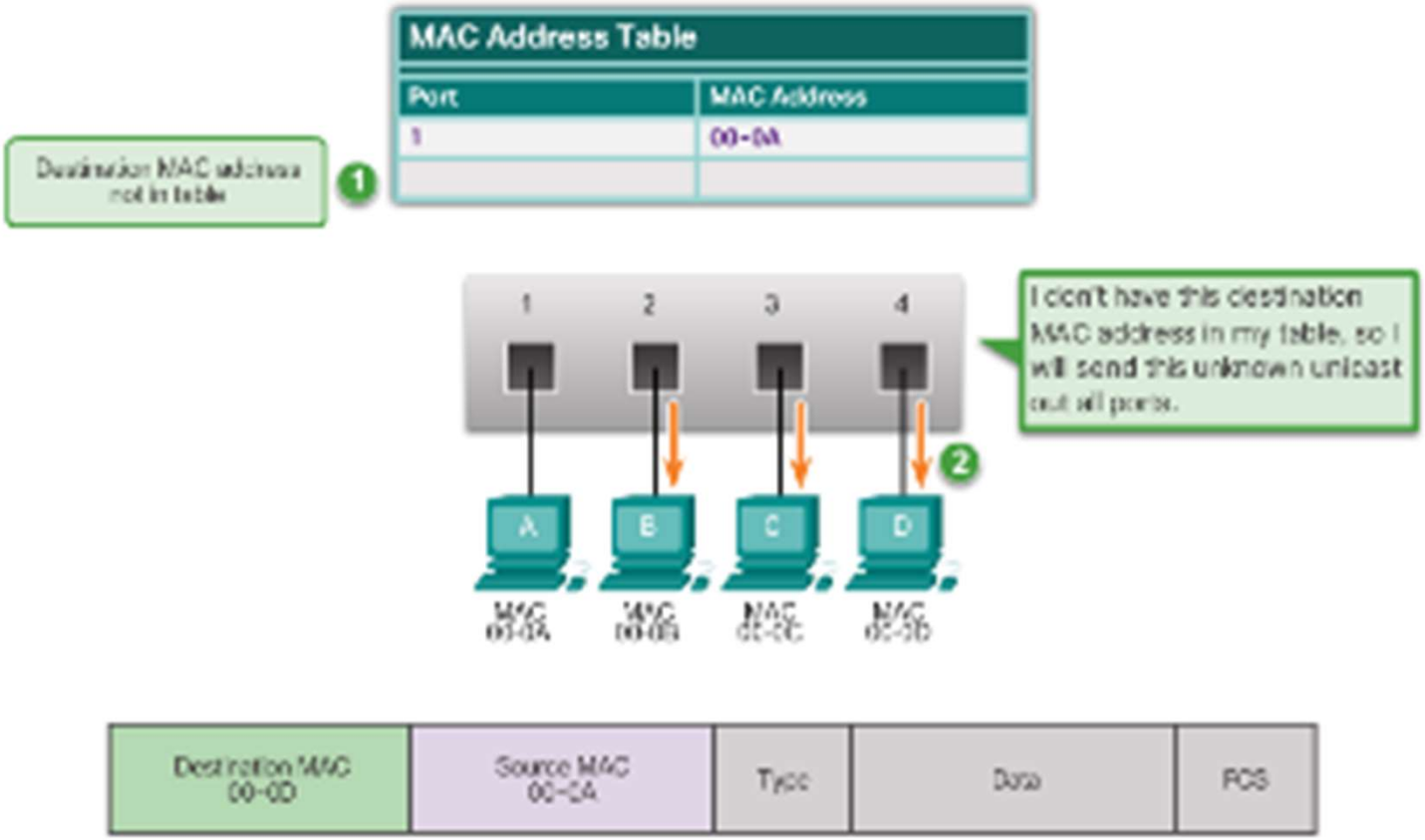
Ethernet Standard	Media Type	Bandwidth Limit	Distance Limit
10BASE5	Coax (Thicknet)	10 Mbps	500 m
10BASE2	Coax (Thinnet)	10 Mbps	185 m
10BASE-T	Category 3 (or higher) UTP	10 Mbps	100 m
100BASE-TX	Category 5 (or higher) UTP	100 Mbps	100 m
100BASE-FX	MMF	100 Mbps	2 km
1000BASE-T	Category 5e (or higher) UTP	1 Gbps	100 m
1000BASE-TX	Category 6 (or higher) UTP	1 Gbps	100 m
1000BASE-LX	MMF/SMF	1 Gbps/1 Gbps	550 m/5 km
1000BASE-LH	SMF	1 Gbps	10 km
1000BASE-ZX	SMF	1 Gbps	70 km
10GBASE-SR	MMF	10 Gbps	20 - 300 m
10GBASE-LR	SMF	10 Gbps	10 - 25 km
10GBASE-ER	SMF	10 Gbps	40 km
10GBASE-SW	MMF	10 Gbps	300 m
10GBASE-T	Category 6a (or higher)	10 Gbps	100 m
100GBASE-SR10	MMF	100 Gbps	125 m
100GBASE-LR4	SMF	100 Gbps	10 km
100GBASE-ER4	SMF	100 Gbps	40 km

Switch Forwarding Methods

- Frame Forwarding Methods on Cisco Switches
  - Store-And-Forward
  - Cut-Through
- Cut-Through Switching
  - Fast-forward switching
    - Lowest level of latency immediately forwards a packet after reading the destination address.
    - Typical cut-through method of switching.
  - Fragment-free switching
    - Switch stores the first 64 bytes of the frame before forwarding.
    - Most network errors and collisions occur during the first 64 bytes.
- Memory Buffering on Switches
  - Port-based memory & Share memory

LAN Switches

Switch Forwarding



Circuit Switching vs Packet Switching