



## Chapter 3: Jaringan Access

# Chapter 3: Objectives

Mahasiswa akan mampu :

- Menjelaskan bagaimana protokol pada layer fisik dan layanannya menyokong komunikasi melalui jaringan data.
- Membangun jaringan sederhana menggunakan peralatan yang ada.
- Menjelaskan peran dari layer data link dalam menyokong komunikasi melalui jaringan data.
- Membandingkan teknik media access control techniques dan logical topologies yang digunakan di jaringan.



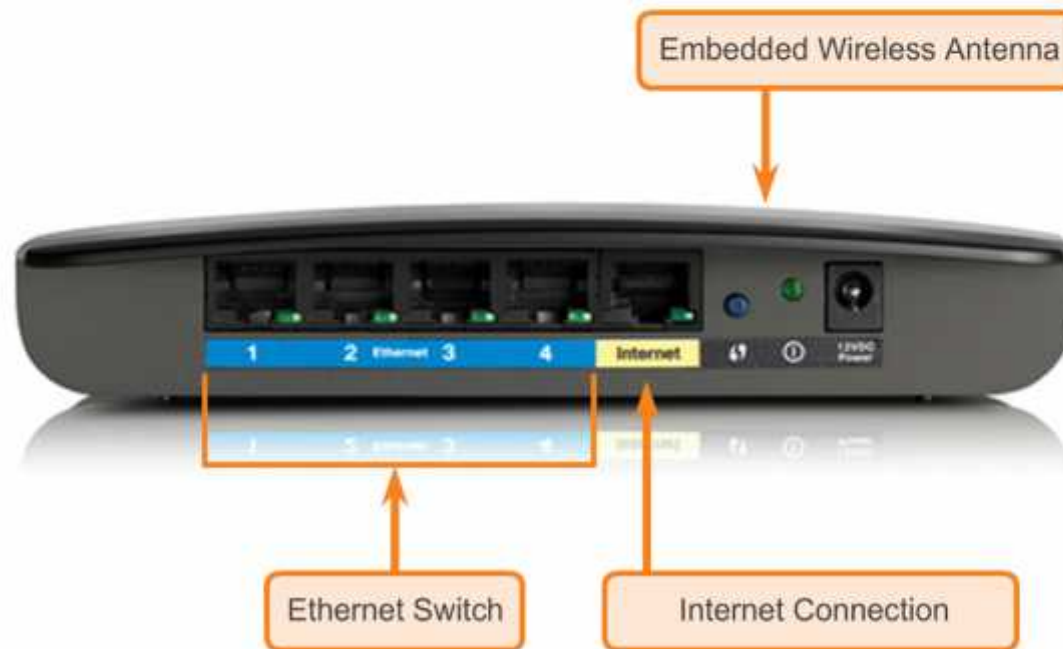
# Chapter 3

- 3.1 Protokol Layer Fisik
- 3.2 Media Jaringan
- 4.1 Protokol Layer Data Link
- 4.2 Media Access Control (MAC)
- 3-4 Simpulan

Membuatnya Terkoneksi

# Terhubung ke Jaringan

Home Router



Membuatnya Terkoneksi

# Terhubung ke Jaringan

Connecting to the Wired LAN

Connect your computer to the Ethernet port (1, 2, 3, or 4).



Membuatnya Terhubung

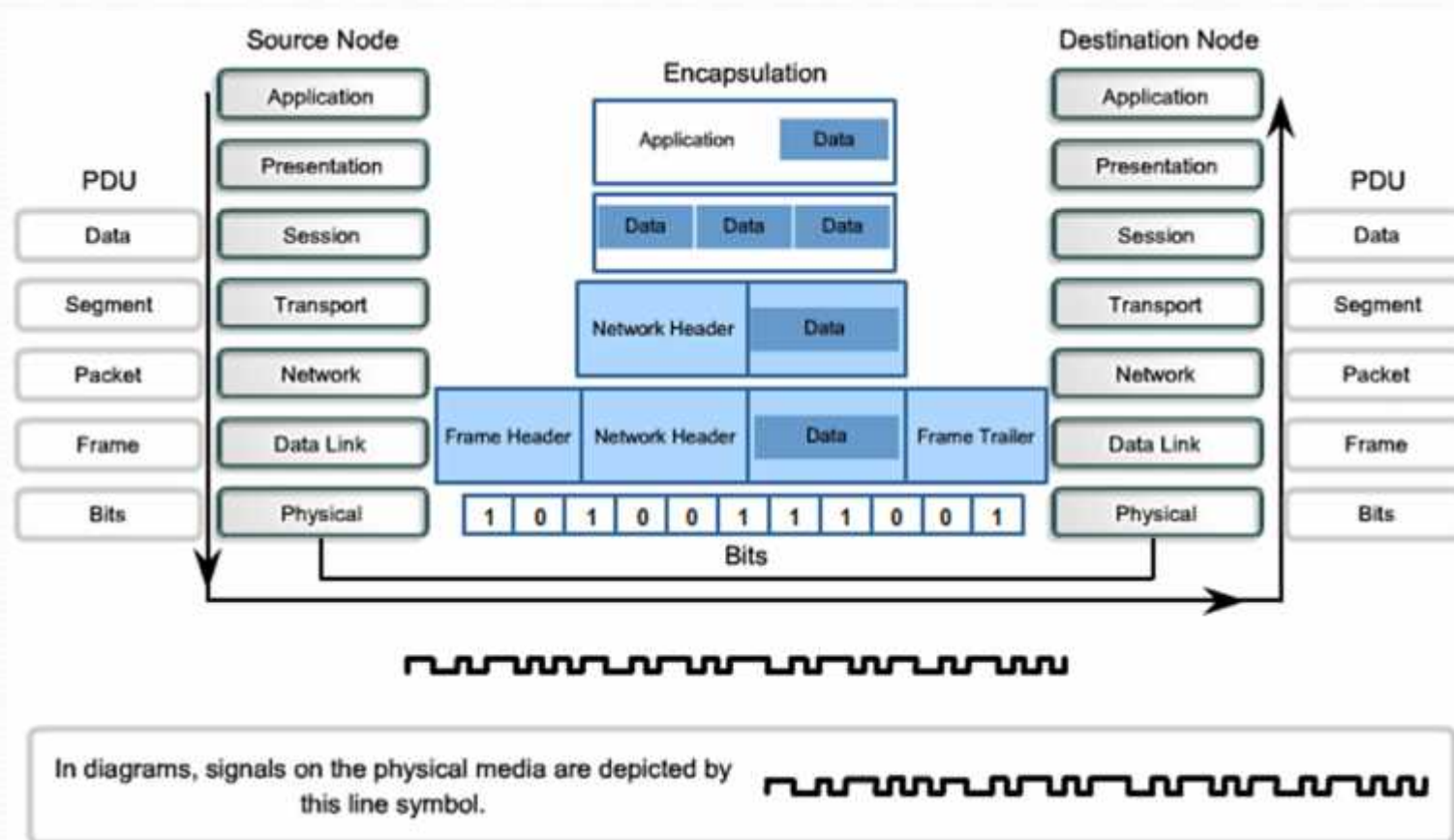
# Network Interface Cards

Terhubung dengan Wireless LAN menggunakan Range Extender



Tujuan dari Layer Fisik

# Layer Fisik





Tujuan dari Layer Fisik

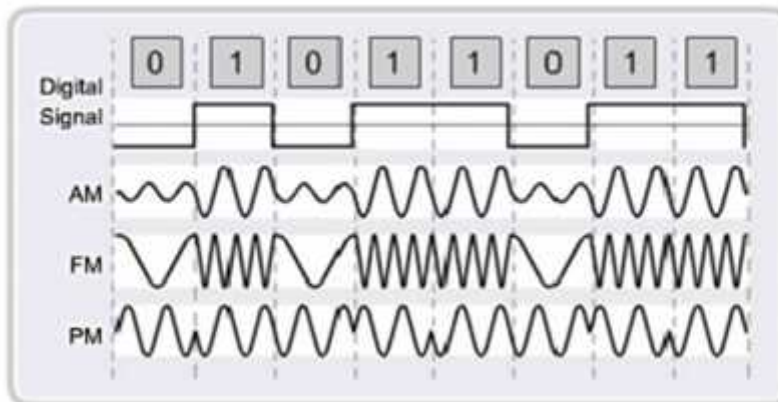
# Media Layer Fisik



Sample electrical signals  
transmitted on copper cable



Representative light pulse fiber  
signals



Microwave (wireless) signals



Tujuan dari Layer Fisik

# Standar dari Layer Fisik

Standard organization	Networking Standards
ISO	<ul style="list-style-type: none"><li>• ISO 8877: Officially adopted the RJ connectors (e.g., RJ-11, RJ-45)</li><li>• ISO 11801: jaringan cabling standard similar to EIA/TIA 568.</li></ul>
EIA/TIA	<ul style="list-style-type: none"><li>• TIA-568-C: Telecommunications cabling standards, used by nearly all voice, video dan data jaringan.</li><li>• TIA-569-B: Commercial Building Standards for Telecommunications Pathways dan Spaces</li><li>• TIA-598-C: Fiber optic color coding</li><li>• TIA-942: Telecommunications Infrastructure Standard for Data Centers</li></ul>
ANSI	<ul style="list-style-type: none"><li>• 568-C: RJ-45 pinouts. Co-developed with EIA/TIA</li></ul>
ITU-T	<ul style="list-style-type: none"><li>• G.992: ADSL</li></ul>
IEEE	<ul style="list-style-type: none"><li>• 802.3: Ethernet</li><li>• 802.11: Wireless LAN (WLAN) &amp; Mesh (Wi-Fi certification)</li><li>• 802.15: Bluetooth</li></ul>

Prinsip Fundamental dari Layer 1

# Prinsip – prinsip dari Layer Fisik

Media	Physical Components	Frame Encoding Technique	Signalling Method
<b>Copper cable</b>	<ul style="list-style-type: none"><li>• UTP</li><li>• Coaxial</li><li>• Connectors</li><li>• NICs</li><li>• Ports</li><li>• Interfaces</li></ul>	<ul style="list-style-type: none"><li>• Manchester Encoding</li><li>• Non-Return to Zero (NRZ) techniques</li><li>• 4B/5B codes are used with Multi-Level Transition Level 3 (MLT-3) signaling</li><li>• 8B/10B</li><li>• PAM<sub>5</sub></li></ul>	<ul style="list-style-type: none"><li>• Changes in the electromagnetic field</li><li>• Intensity of the electromagnetic field</li><li>• Phase of the electromagnetic wave</li></ul>
<b>Fiber Optic cable</b>	<ul style="list-style-type: none"><li>• Single-mode Fiber</li><li>• Multimode Fiber</li><li>• Connectors</li><li>• NICs</li><li>• Interfaces</li><li>• Lasers dan LEDs</li><li>• Photoreceptors</li></ul>	<ul style="list-style-type: none"><li>• Pulses of light</li><li>• Wavelength multiplexing using different colors</li></ul>	<ul style="list-style-type: none"><li>• A pulse equals 1.</li><li>• No pulse is 0.</li></ul>
<b>Wireless media</b>	<ul style="list-style-type: none"><li>• Access Points</li><li>• NICs</li><li>• Radio</li><li>• Antennae</li></ul>	<ul style="list-style-type: none"><li>• DSSS (direct-sequence spread-spectrum)</li><li>• OFDM (orthogonal frequency division multiplexing)</li></ul>	<ul style="list-style-type: none"><li>• Radio waves</li></ul>

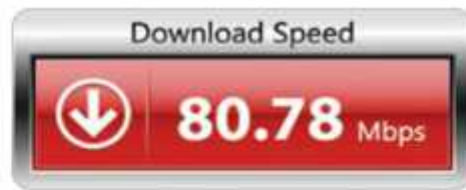
Prinsip Fundamental dari Layer 1

# 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

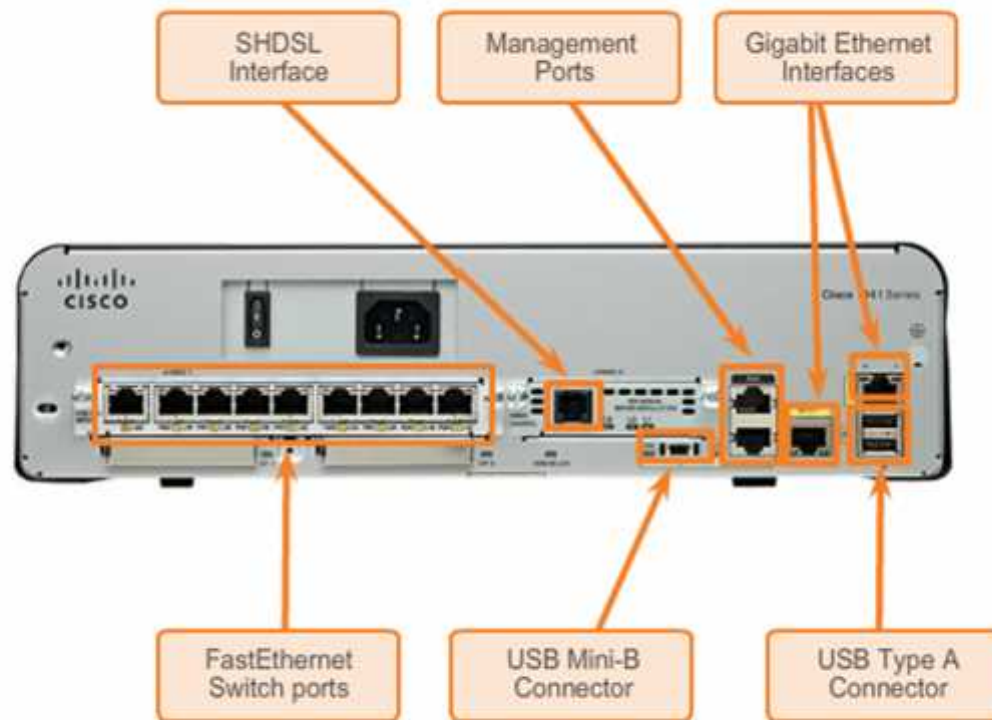
Prinsip Fundamental dari Layer 1

# Throughput



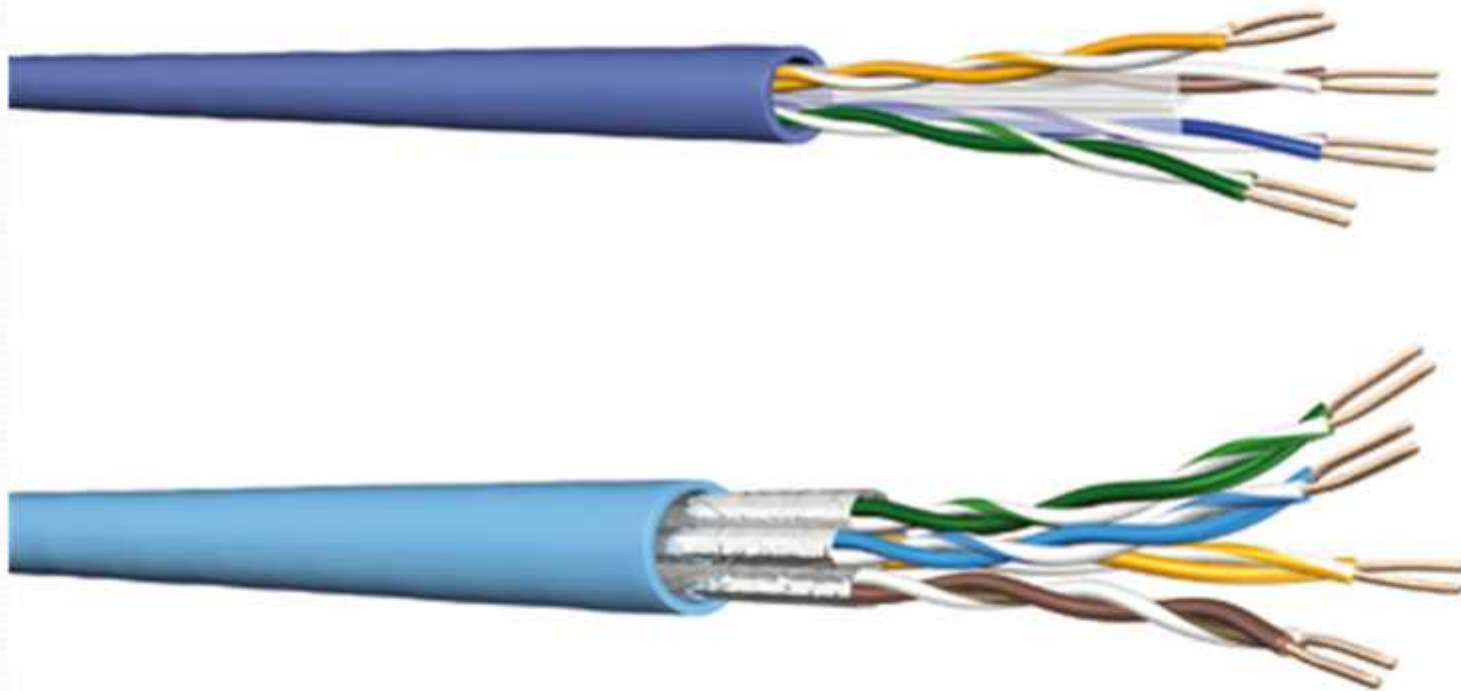
Prinsip Fundamental dari Layer 1

# Tipe – tipe media Fisik



Media Jaringan

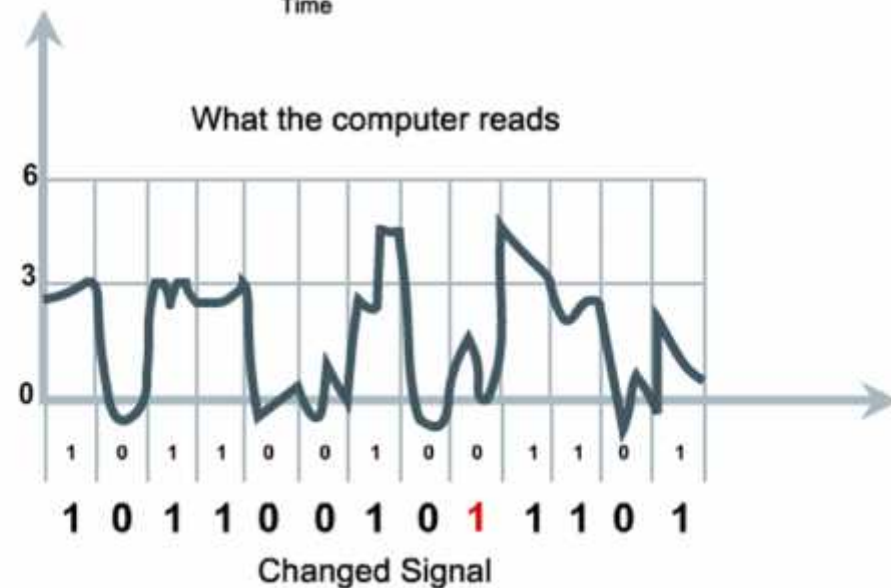
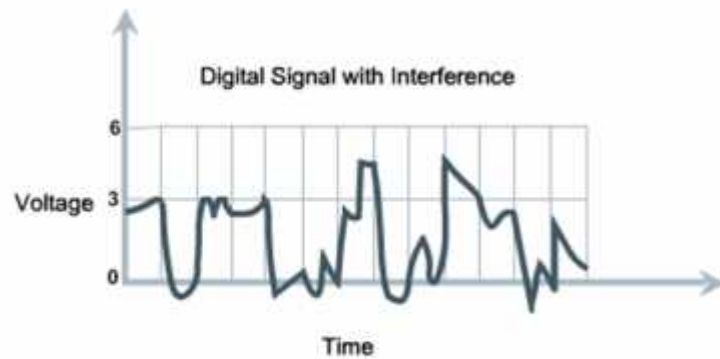
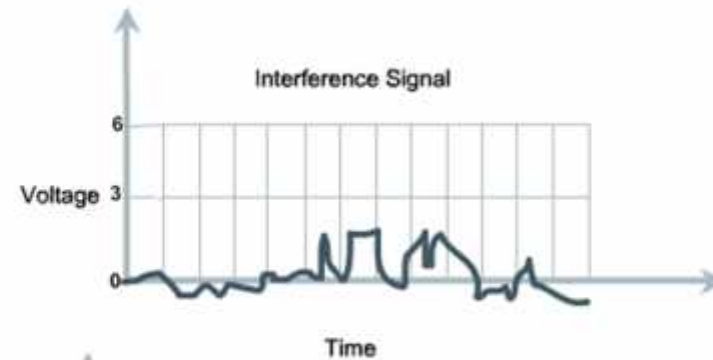
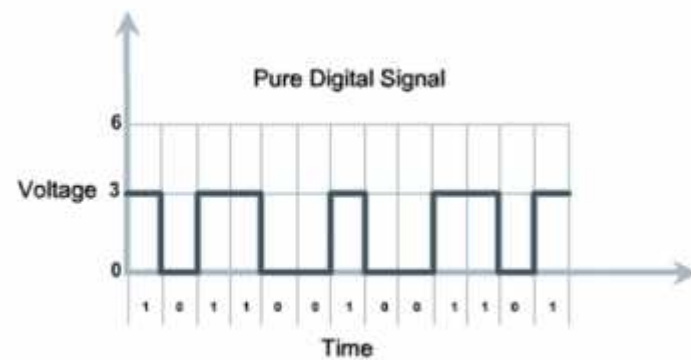
# Kabel Tembaga





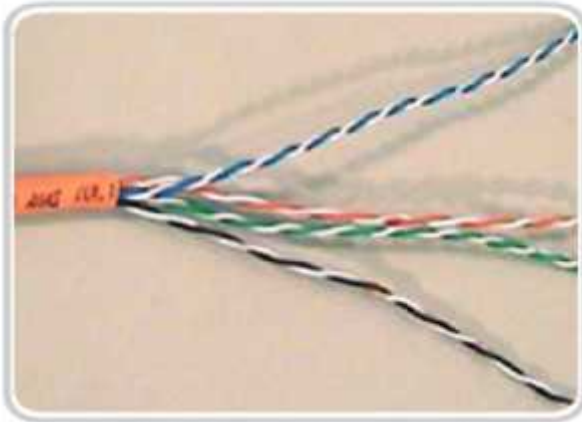
Kabel Tembaga

# Karakteristik dari Media Tembaga





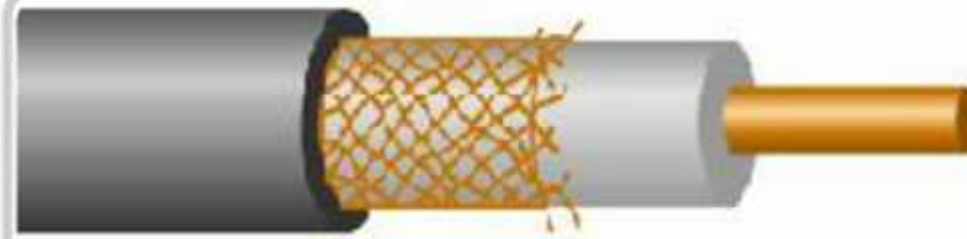
# Media Tembaga



Unshielded Twisted Pair (UTP) cable

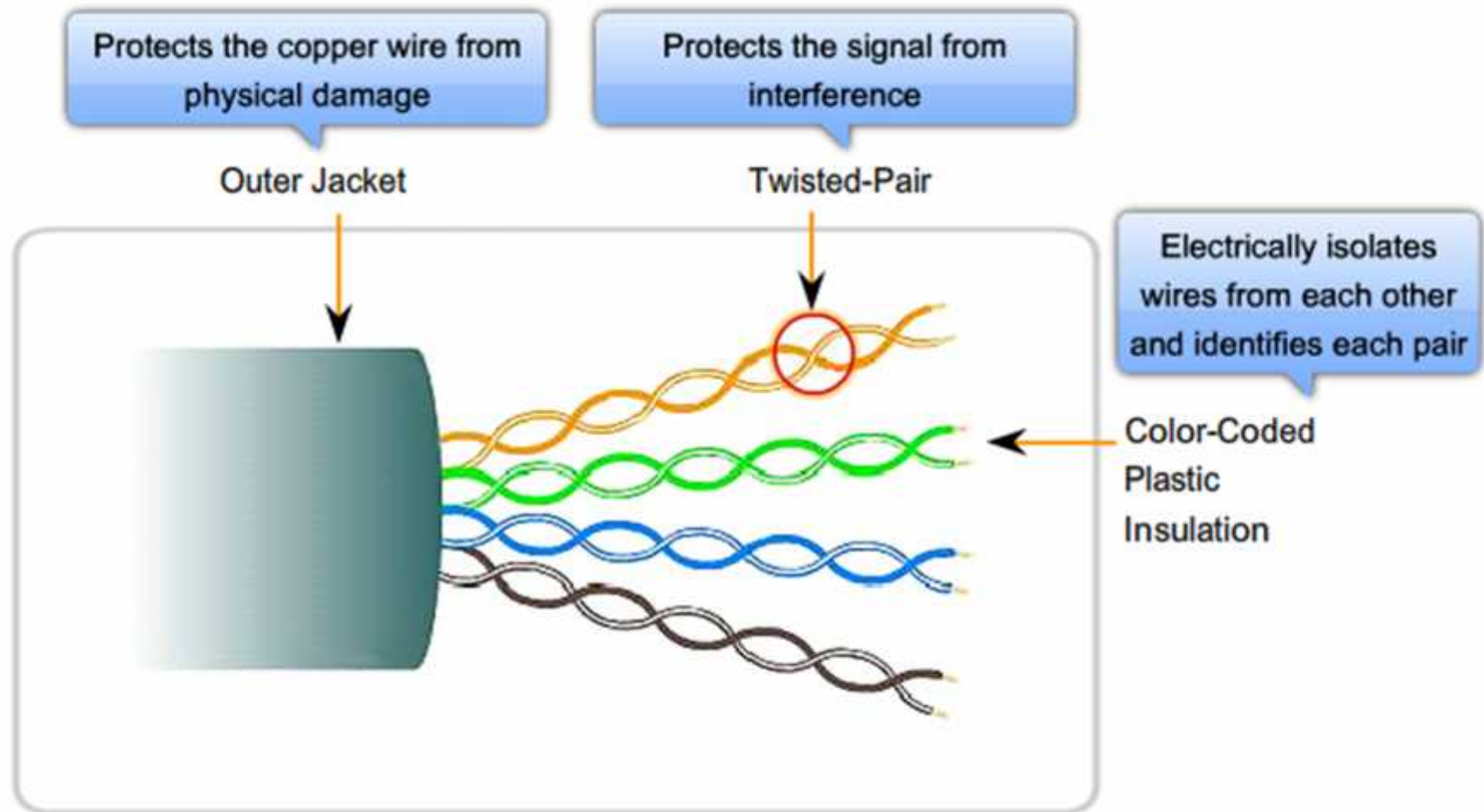


Shielded Twisted Pair (STP) cable



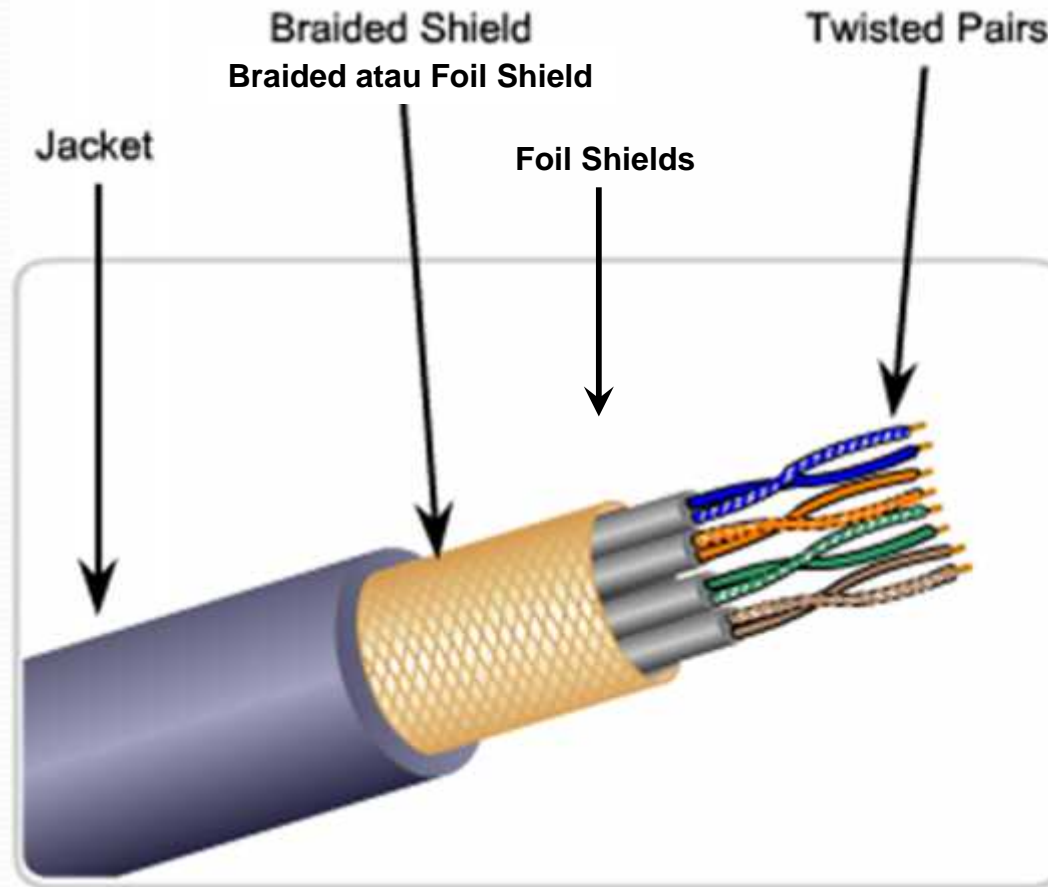
Coaxial cable

## Kabel Tembaga



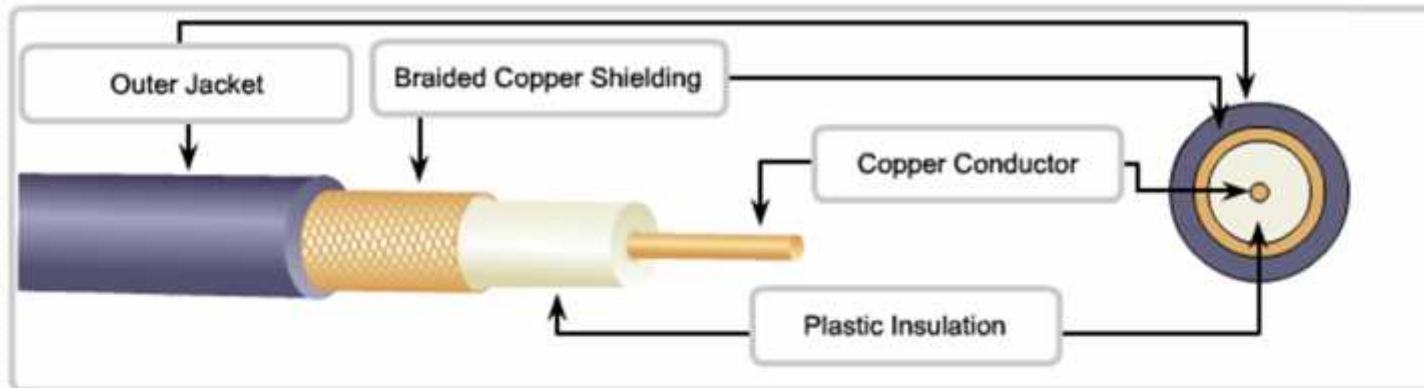
Kabel Tembaga

# Kabel Shielded Twisted-Pair (STP)



Kabel Tembaga

# Kabel Coaxial



Kabel Tembaga

# Pengamanan Media Tembaga



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



Cables must be connected correctly.



Installations must be inspected for damage.

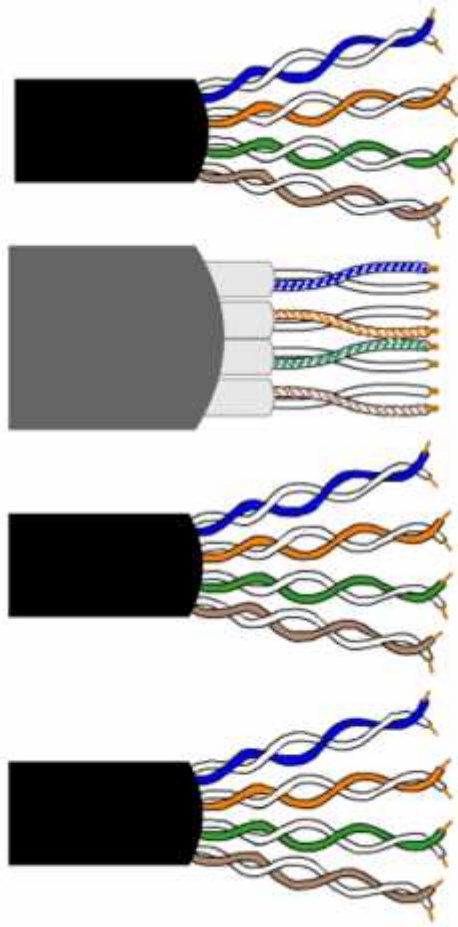


Equipment must be grounded correctly.



Pengkabelan UTP

# Standar Pengkabelan UTP



Category 3 Cable  
(UTP)

Category 7 Cable  
(ScTP)

Category 6 Cable  
(UTP)

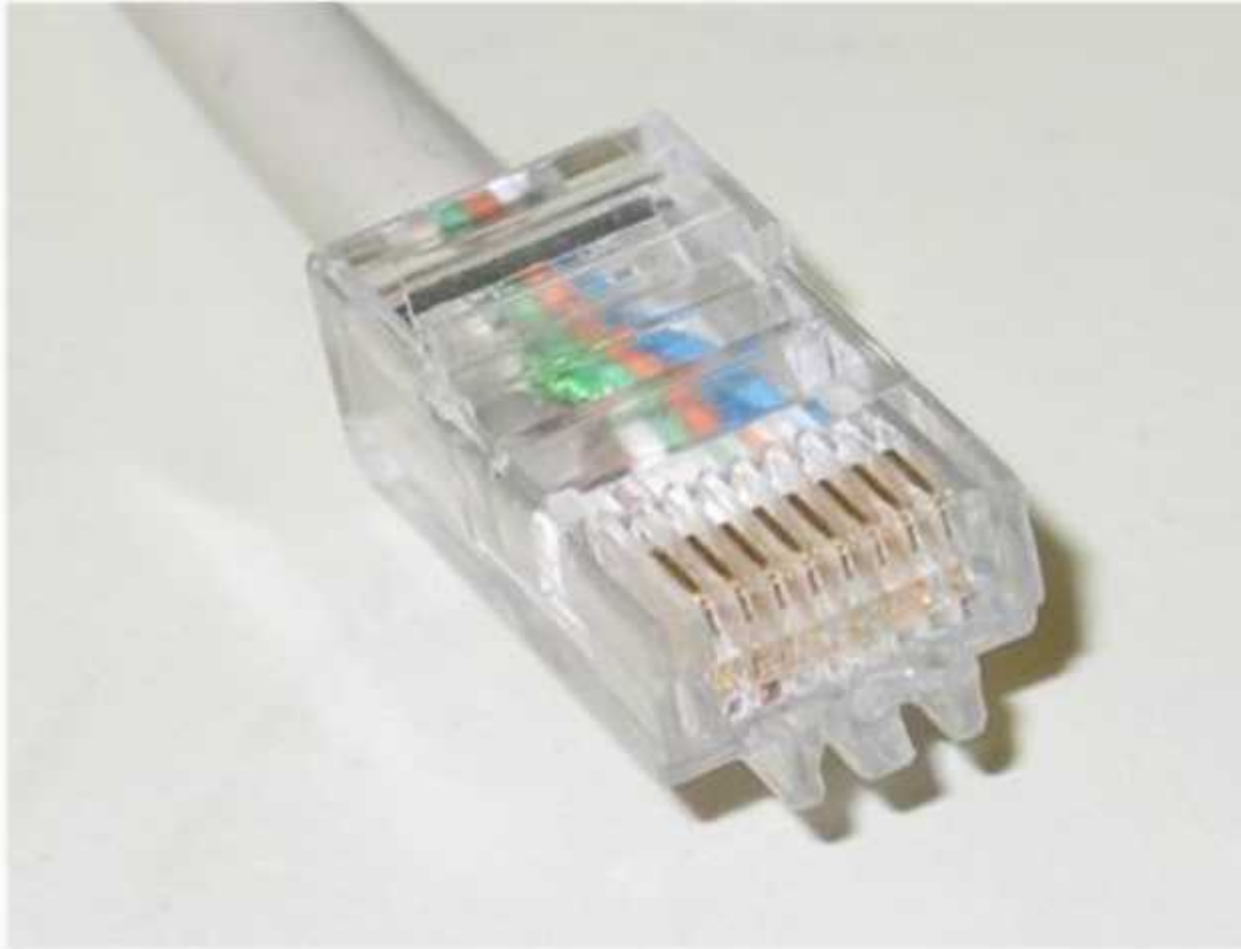
Category 5 and 5e  
Cable (UTP)

Category 5 and 5e Cable  
(UTP)

- Used for Data transmission
- Cat 5 supports 100 Mbps and can support 1000 Mbps but it is not recommended
- Cat 5e supports 1000 Mbps

Pengkabelan UTP

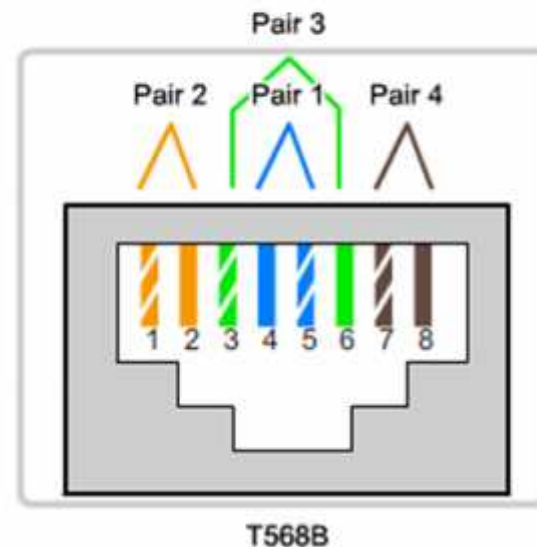
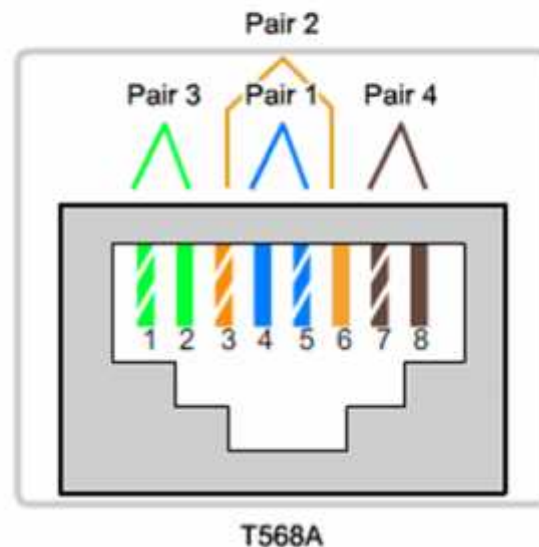
# Konektor UTP





# Tipe – tipe Kabel UTP Cable

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



Pengkabelan UTP

# Menguji Kabel UTP



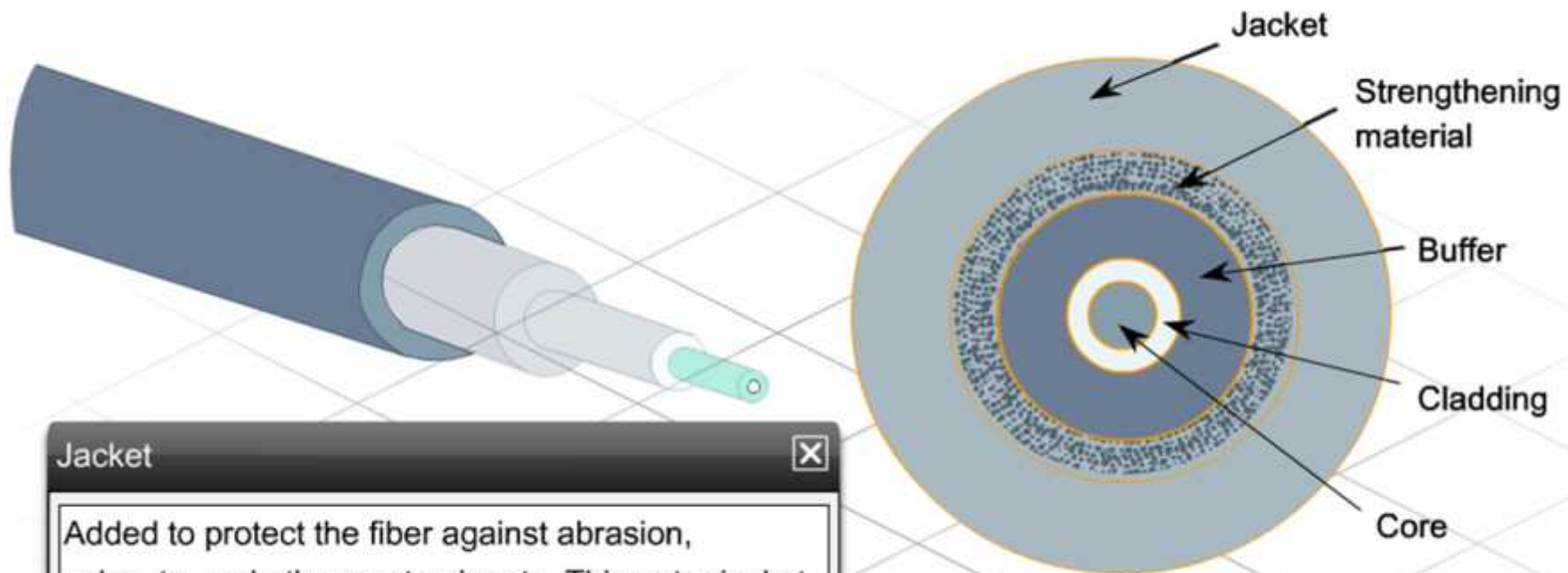
Pengkabelan Fiber Optic

# Properti dari Pengkabelan Fiber Optic



Pengkabelan Fiber Optic

# Desain Media Kabel Fiber



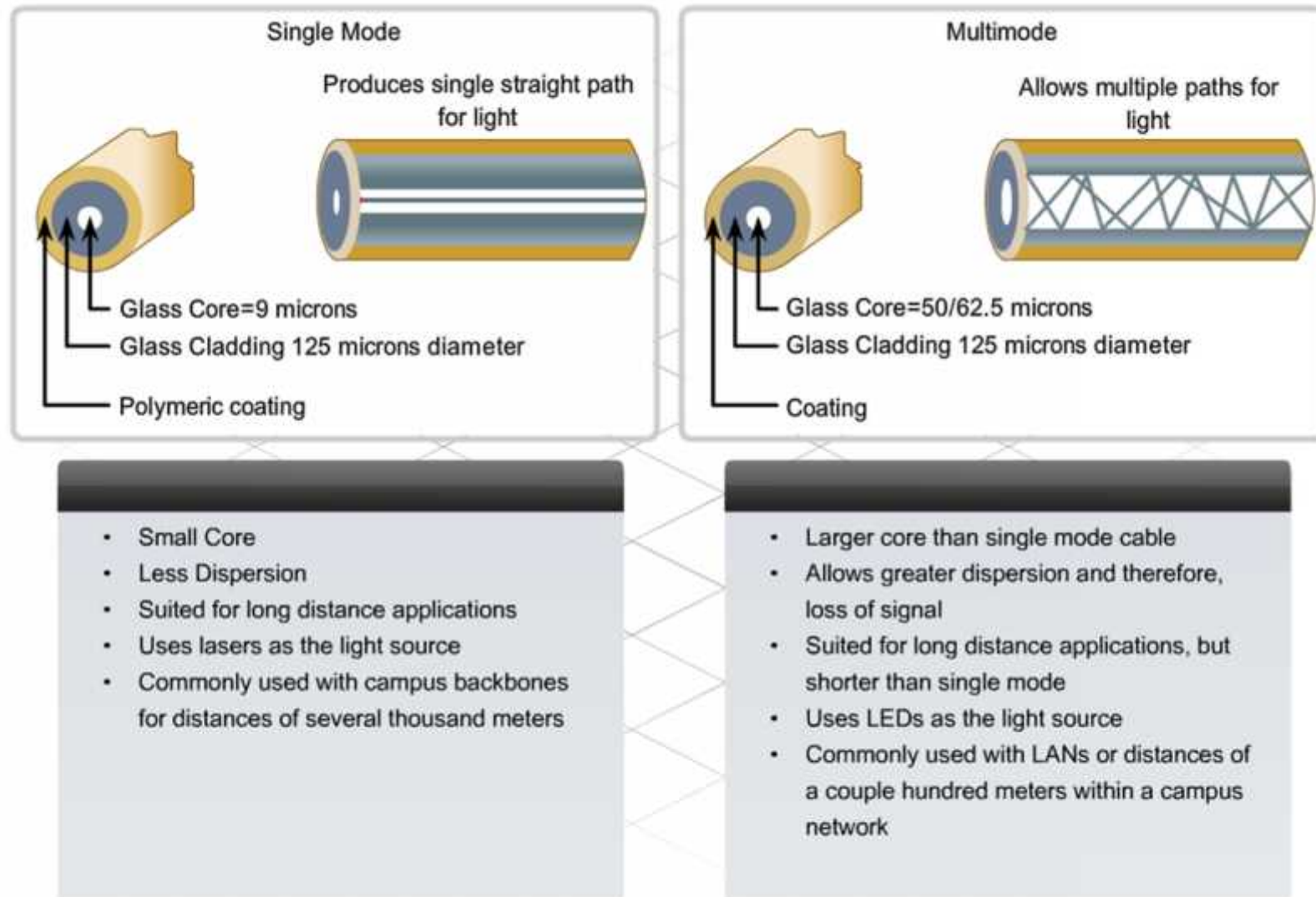
## Jacket

Added to protect the fiber against abrasion, solvents, and other contaminants. This outer jacket composition can vary depending on the cable usage.

Click on each component for more information.



# Tipe – tipe Media Fiber



Pengkabelan Fiber Optic

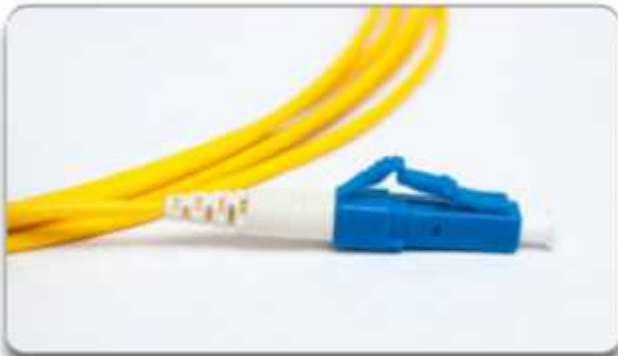
# Konektor Jaringan Fiber



ST Connectors



SC Connectors



LC Connector



Duplex Multimode LC Connectors

Fiber Optic Pengkabelan

# Menguji Kabel Fiber



Optical Time Domain Reflectometer (OTDR)



# Fiber versus Tembaga

Implementation issues	Copper media	Fibre-optic
Bandwidth supported	10 Mbps – 10 Gbps	10 Mbps – 100 Gbps
Distance	Relatively short (1 – 100 meters)	Relatively High (1 – 100,000 meters)
Immunity to EMI dan RFI	Low	High (Completely immune)
Immunity to electrical hazards	Low	High (Completely immune)
Media dan connector costs	Lowest	Highest
Installation skills required	Lowest	Highest
Safety precautions	Lowest	Highest

# Properti dari Media Nirkabel



# Tipe – tipe dari Media Nirkabel



- IEEE 802.11 standards
- Commonly referred to as Wi-Fi.
- Uses CSMA/CA
- Variations include:
  - 802.11a: 54 Mbps, 5 GHz
  - 802.11b: 11 Mbps, 2.4 GHz
  - 802.11g: 54 Mbps, 2.4 GHz
  - 802.11n: 600 Mbps, 2.4 dan 5 GHz
  - 802.11ac: 1 Gbps, 5 GHz
  - 802.11ad: 7 Gbps, 2.4 GHz, 5 GHz, dan 60 GHz



- IEEE 802.15 standard
- Supports speeds up to 3 Mbps
- Provides device pairing over distances from 1 to 100 meters.



- IEEE 802.16 standard
- Provides speeds up to 1 Gbps
- Uses a point-to-multipoint topology to provide wireless broadband access.

Media Nirkabel

# Wireless LAN



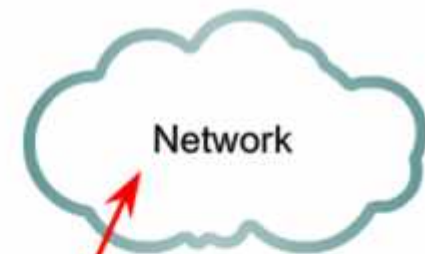
Cisco Linksys EA6500 802.11ac wireless router

# Standar 802.11 Wi-Fi

Standard	Maximum Speed	Frequency	Backwards compatible
802.11a	54 Mbps	5 GHz	No
802.11b	11 Mbps	2.4 GHz	No
802.11g	54 Mbps	2.4 GHz	802.11b
802.11n	600 Mbps	2.4 GHz atau 5 GHz	802.11b/g
802.11ac	1.3 Gbps (1300 Mbps)	2.4 GHz dan 5.5 GHz	802.11b/g/n
802.11ad	7 Gbps (7000 Mbps)	2.4 GHz, 5 GHz dan 60 GHz	802.11b/g/n/ac

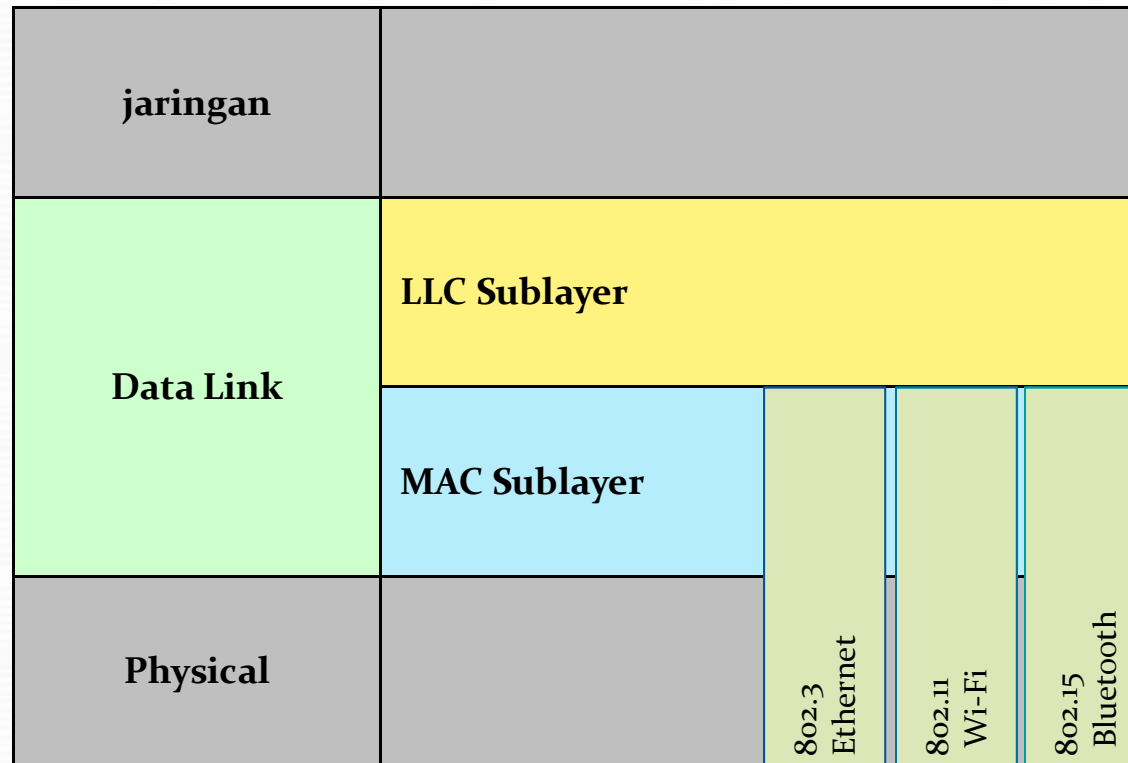
Penggunaan Layer Data Link

# Layer Data Link



Penggunaan Layer Data Link

# Sublayer Data Link

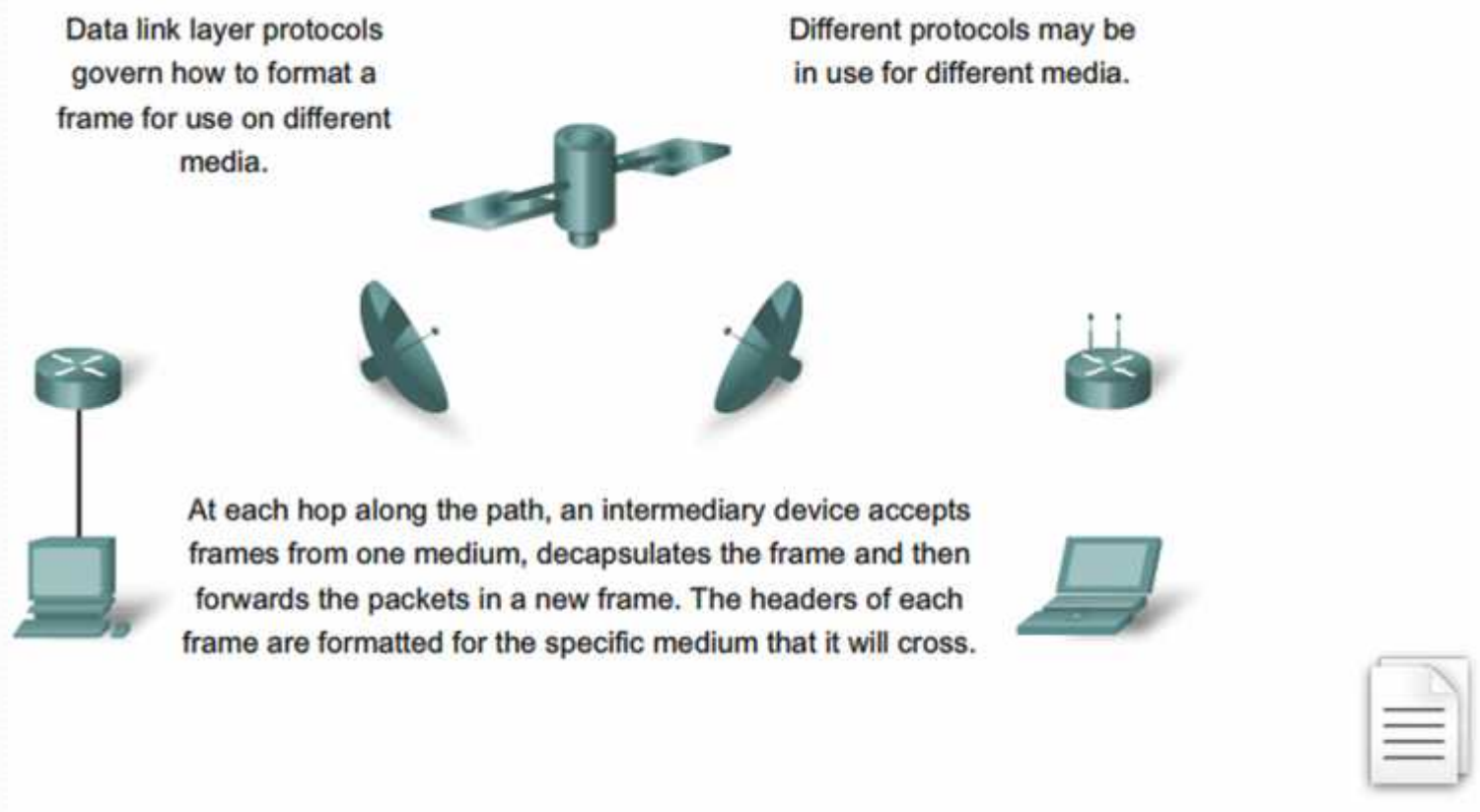




# Chapter 4

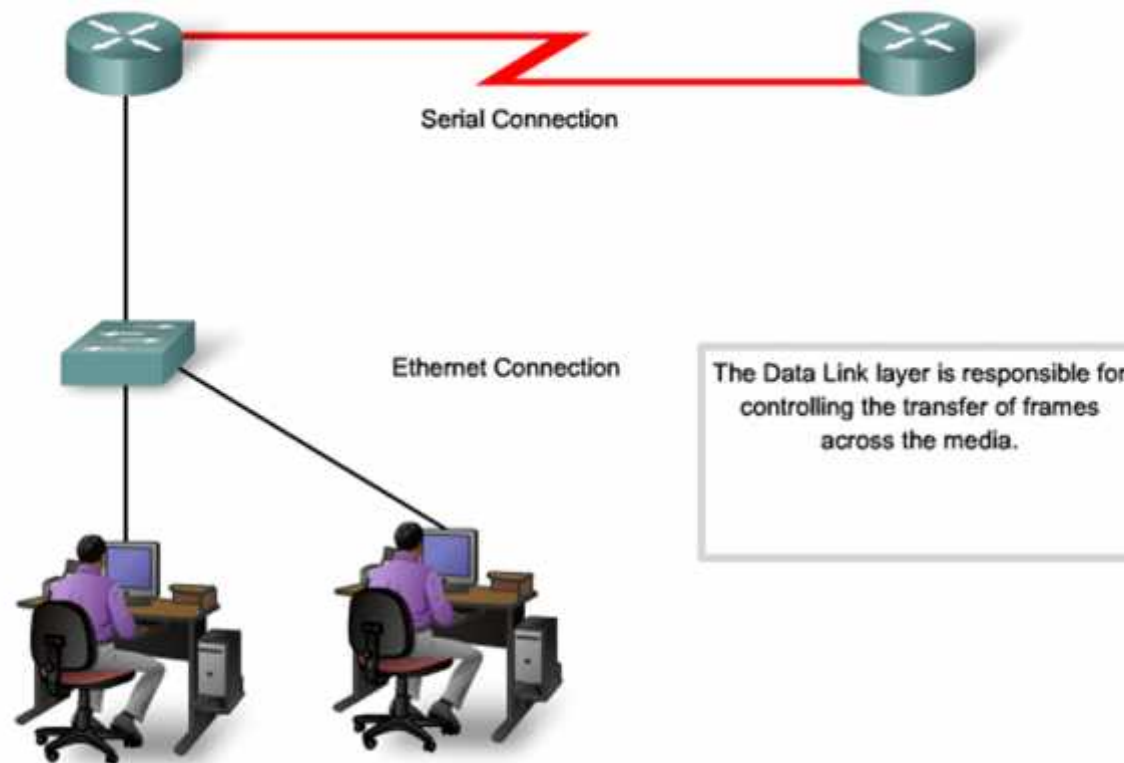
Penggunaan Layer Data Link

## Media Access Control



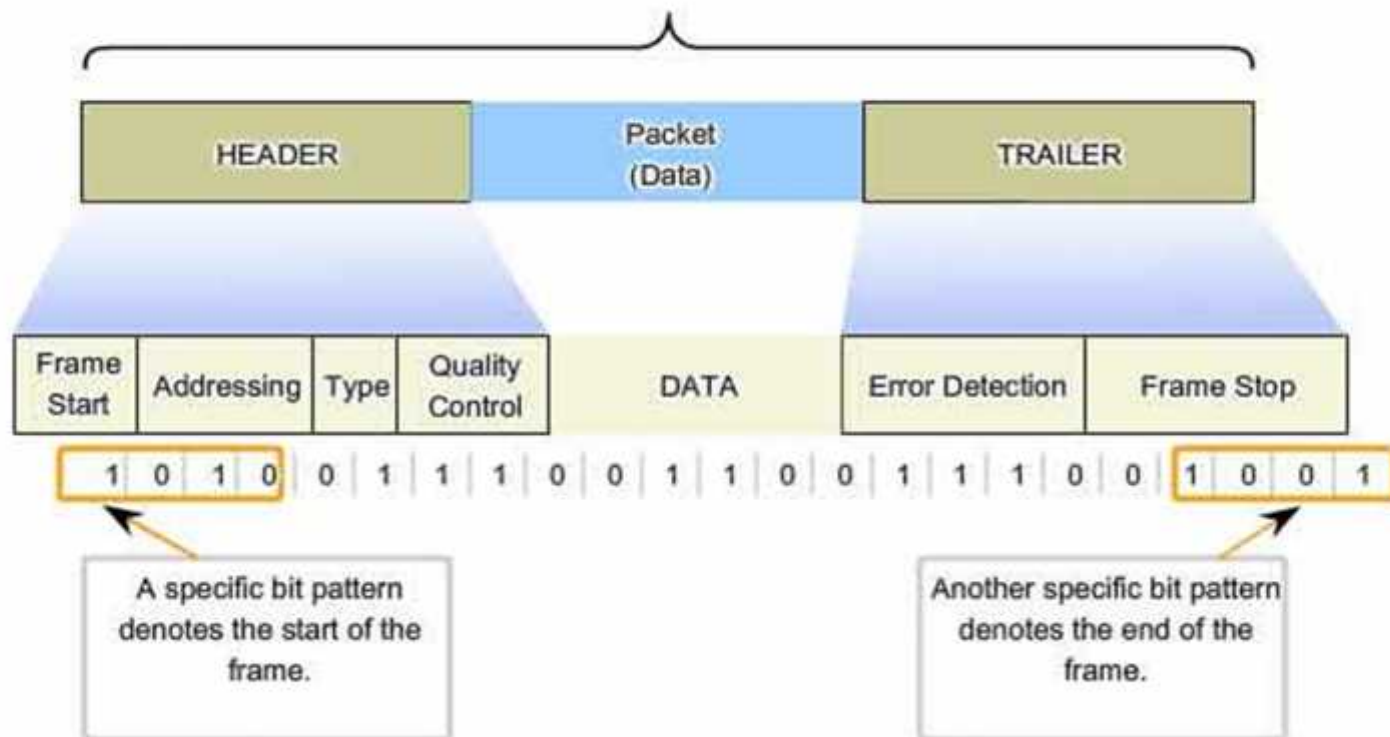
Penggunaan Layer Data Link

# Menyediakan Akses ke Media



# Struktur Frame Layer 2

Formatting Data for Transmission



Layer Data Link

# Standar-standar Layer 2

Data Link Layer	LLC Sublayer	Ethernet	IEEE 802.2				
	MAC Sublayer		IEEE 802.3 (Ethernet)	IEEE 802.3u (FastEthernet)	IEEE 802.3z (GigabitEthernet)	IEEE 802.3ab (GigabitEthernet over Copper)	Token Ring/IEEE 802.6
Physical Layer	Physical Layer						FDDI

OSI Layers

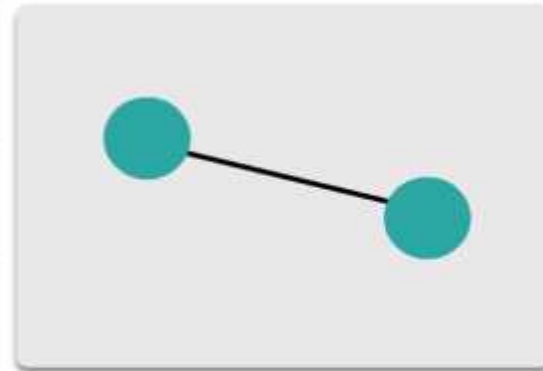
LAN Specification

Standar Layer 2

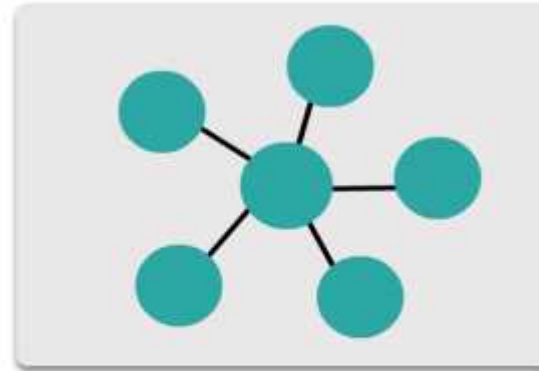
# Standar Layer Data Link

Standard organization	Networking Standards
<b>IEEE</b>	<ul style="list-style-type: none"><li>• 802.2: Logical Link Control (LLC)</li><li>• 802.3: Ethernet</li><li>• 802.4: Token bus</li><li>• 802.5: Token passing</li><li>• 802.11: Wireless LAN (WLAN) &amp; Mesh (Wi-Fi certification)</li><li>• 802.15: Bluetooth</li><li>• 802.16: WiMax</li></ul>
<b>ITU-T</b>	<ul style="list-style-type: none"><li>• G.992: ADSL</li><li>• G.8100 - G.8199: MPLS over Transport aspects</li><li>• Q.921: ISDN</li><li>• Q.922: Frame Relay</li></ul>
<b>ISO</b>	<ul style="list-style-type: none"><li>• HDLC (High Level Data Link Control)</li><li>• ISO 9314: FDDI Media Access Control (MAC)</li></ul>
<b>ANSI</b>	<ul style="list-style-type: none"><li>• X3T9.5 dan X3T12: Fiber Distributed Data Interface (FDDI)</li></ul>

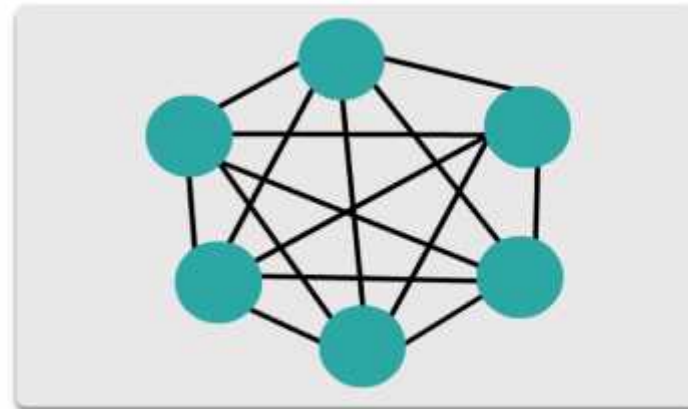
# Topologi Fisik Umum dari WAN



Point-to-point topology



Hub and spoke topology

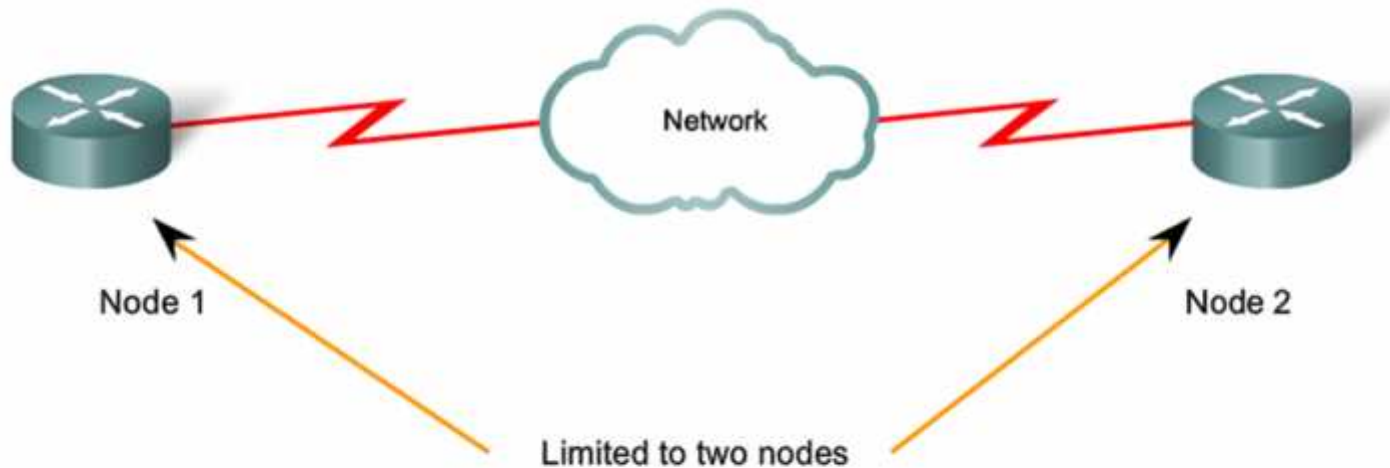


Full mesh topology



Topologi WAN

# Topologi Fisik Point-to-Point



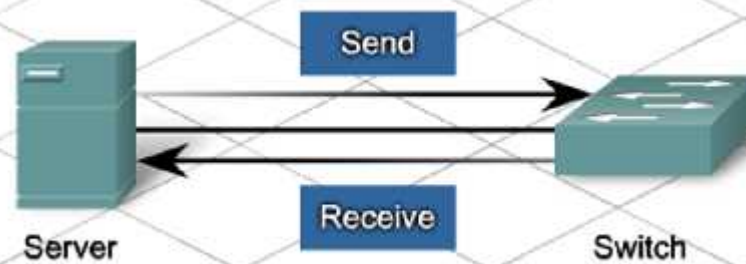
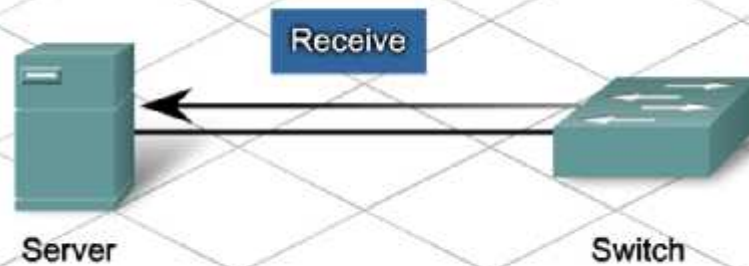
Topologi WAN

# Topologi Logik Point-to-Point



Topologi WAN

# Half dan Full Duplex



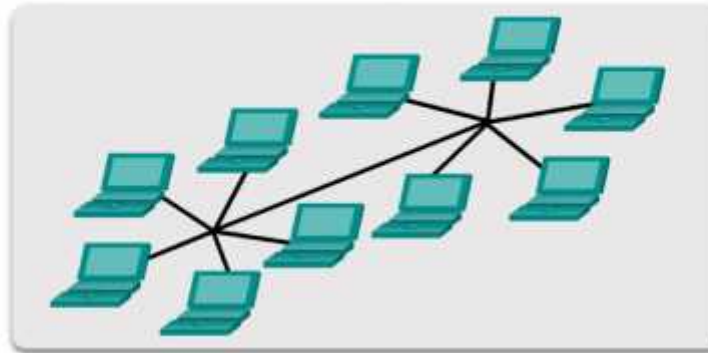
Topologi LAN

# Topologi Fisik LAN

## Physical Topologies



Star topology



Extended star topology

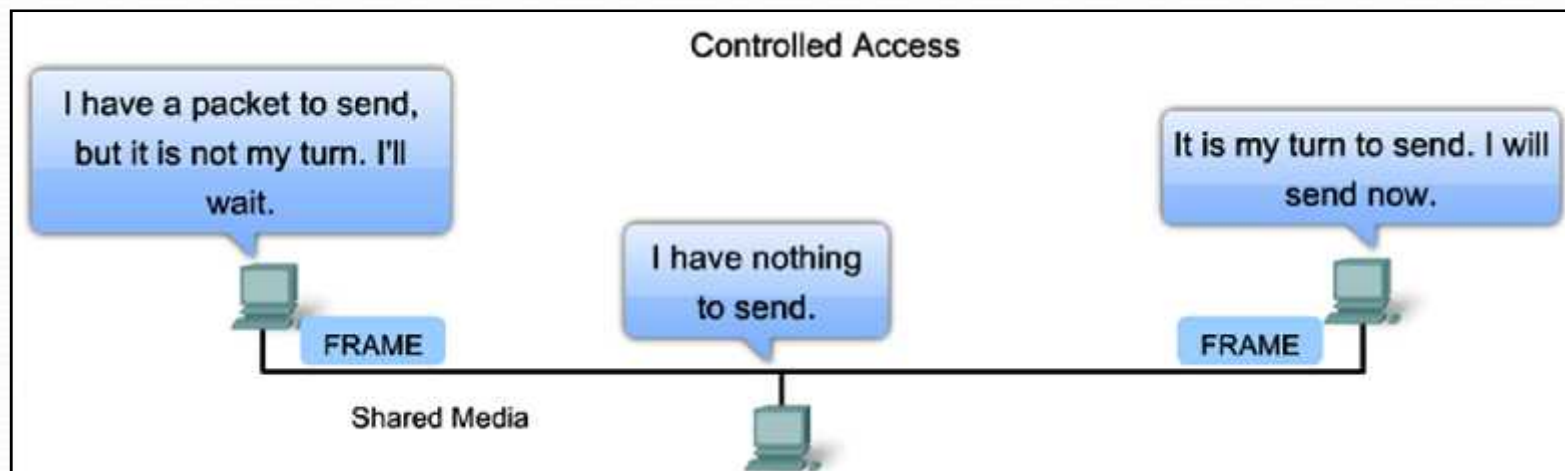
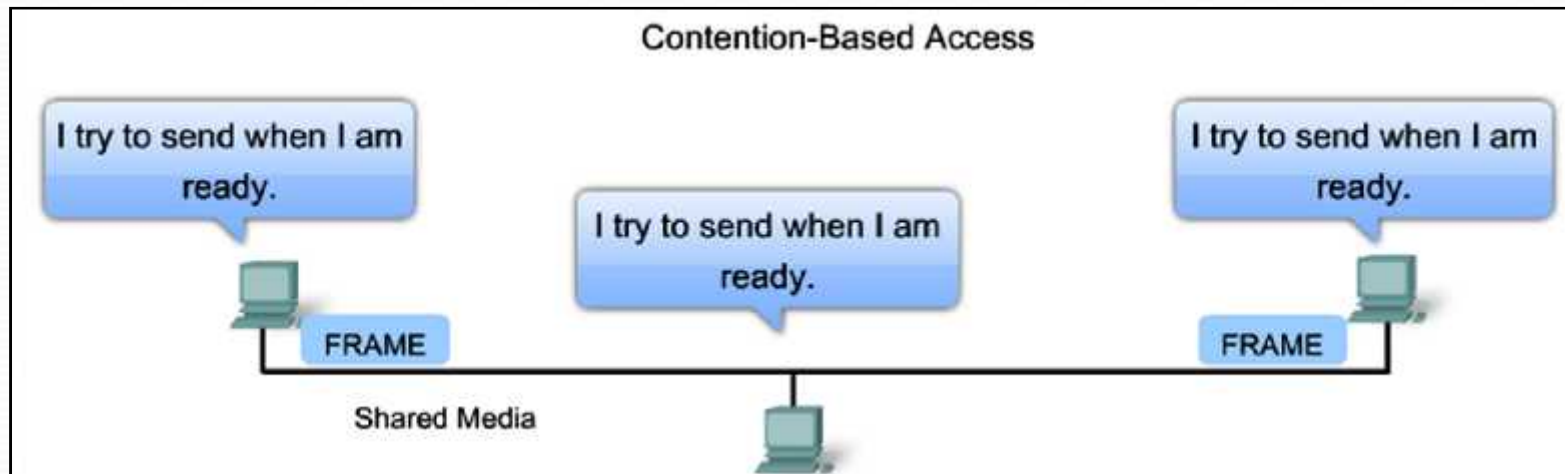


Bus topology



Ring topology

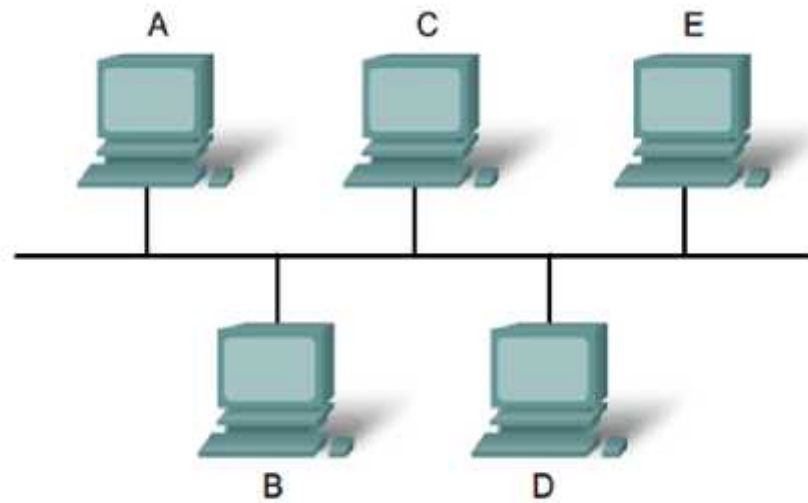
# Topologi Logik untuk Shared Media





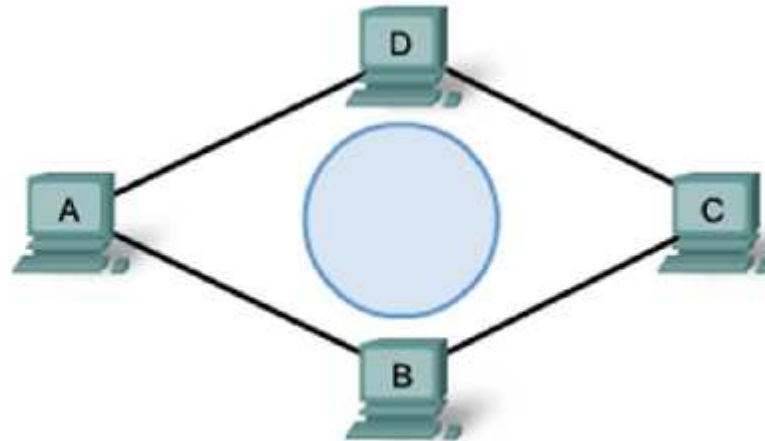
Topologi LAN

# Topologi Multi-Access

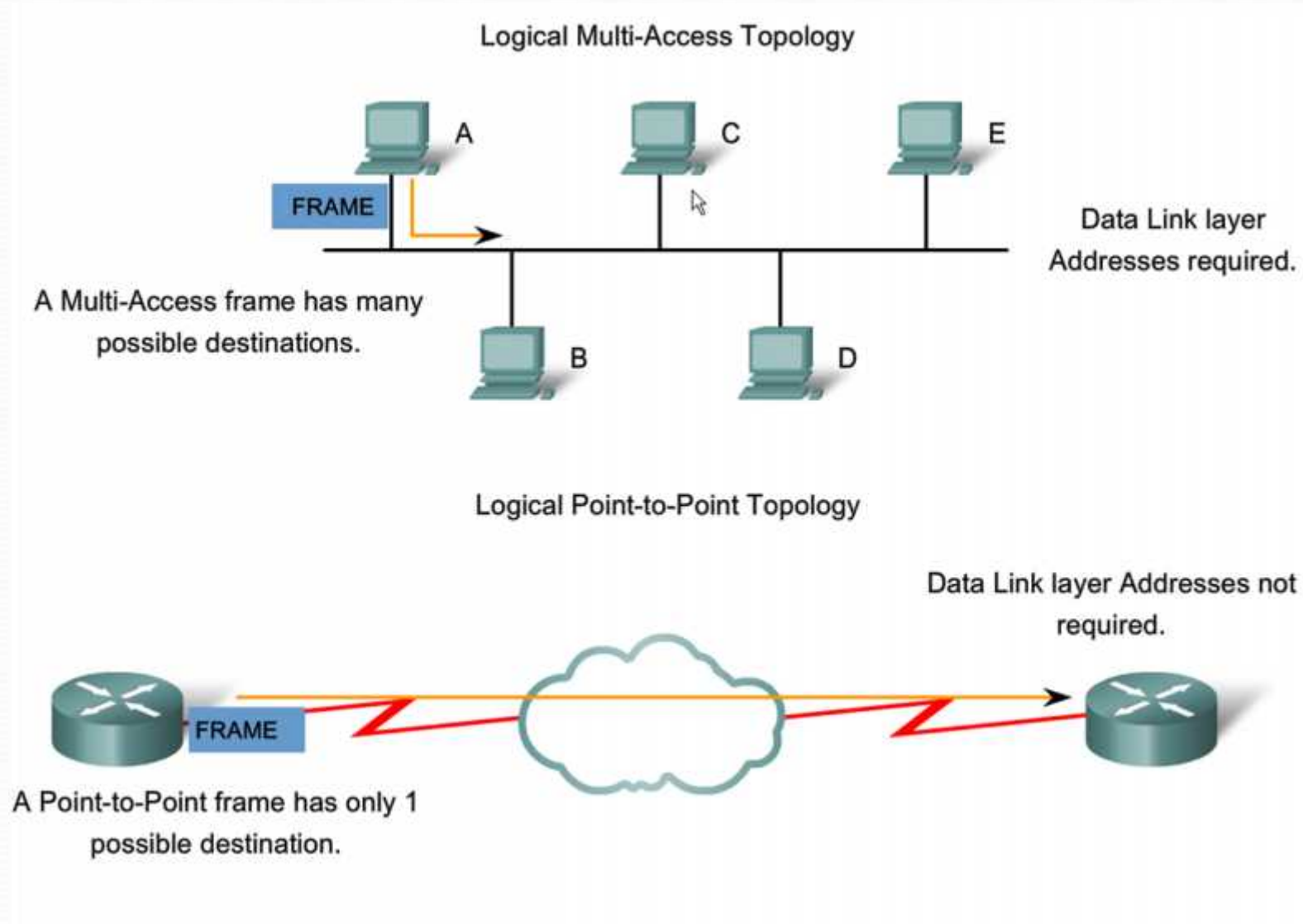


Topologi LAN

# Topologi Ring

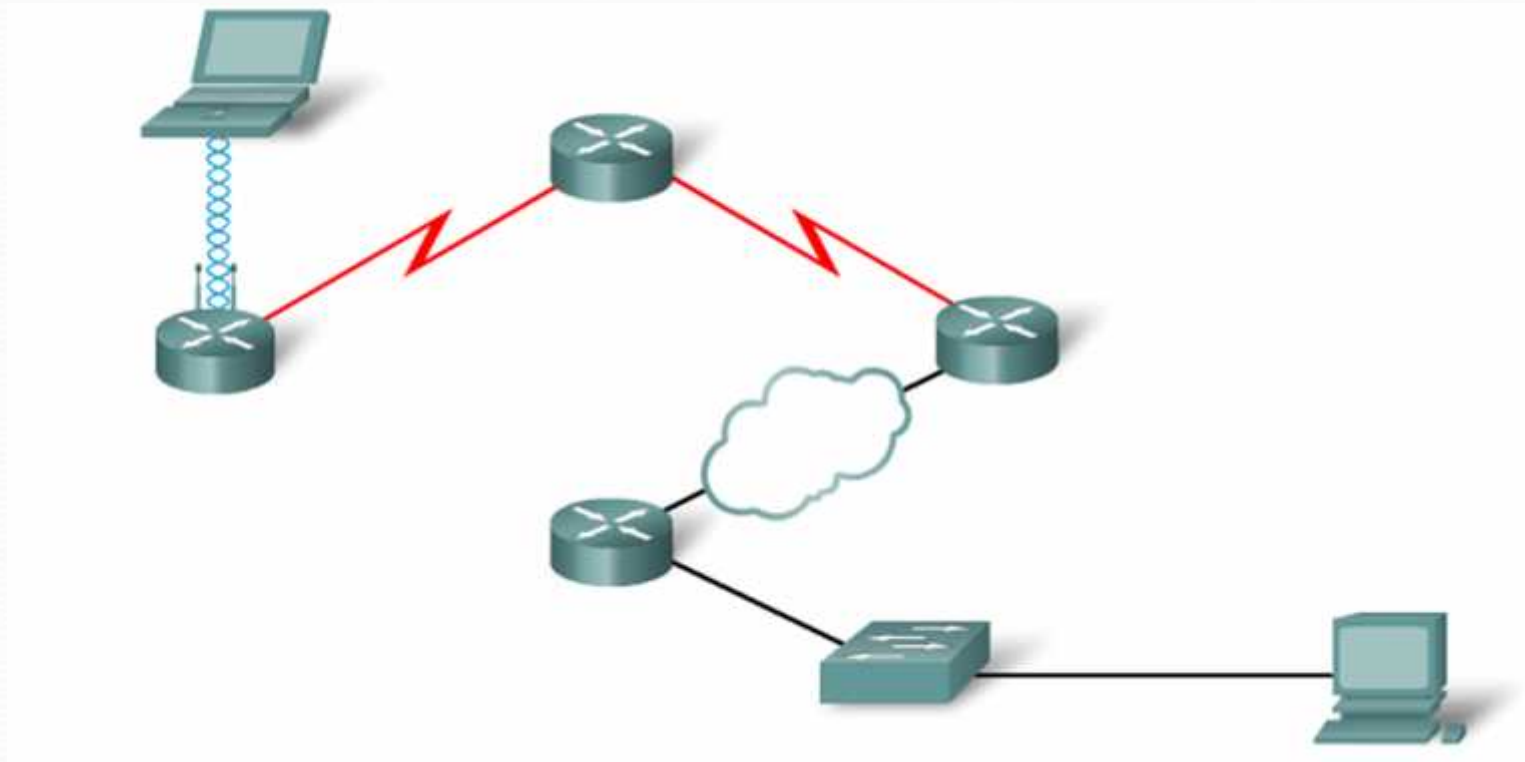


# Alamat Layer 2



Frame Data Link

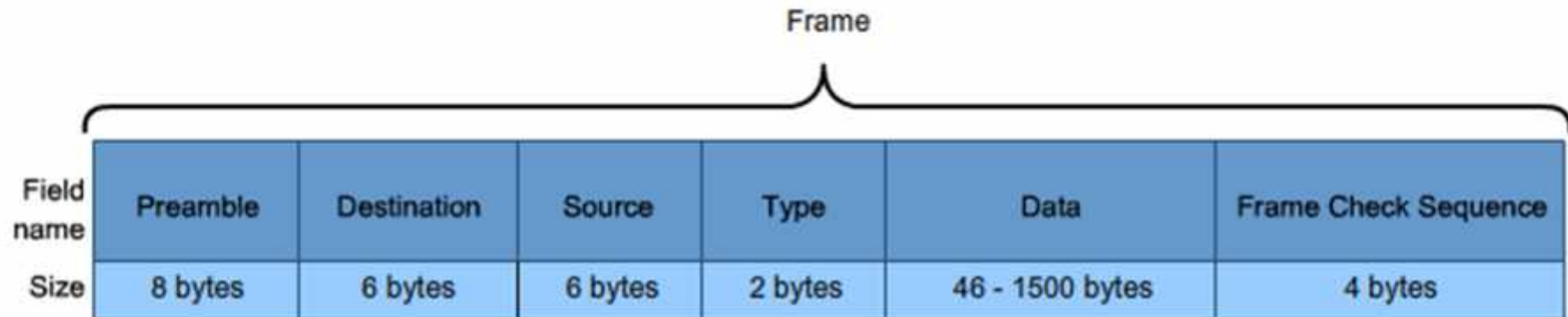
# Frame LAN dan Frame WAN



Frame Data Link

# Frame Ethernet

A Common Data Link Layer Protocol for LANs



**Preamble** - used for synchronization; also contains a delimiter to mark the end of the timing information.

**Destination Address** - 48 bit MAC address for the destination node.

**Source Address** - 48 bit MAC address for the source node.

**Type** - value to indicate which upper layer protocol will receive the data after the Ethernet process is complete.

**Data or payload** - this is the PDU, typically an IPv4 packet, that is to be transported over the media.

**Frame Check Sequence (FCS)** - A value used to check for damaged frames.



Frame Data Link

# Protokol Frame Point-to-Point

A Common Data Link Protocol for WANs

Frame

Field name	Flag	Address	Control	Protocol	Data	FCS
Size (bytes)	1 byte	1 byte	1 byte	2 bytes	variable	2 or 4 bytes

**Flag** - A single byte that indicates the beginning or end of a frame. The flag field consists of the binary sequence 01111110.

**Address** - A single byte that contains the standard PPP broadcast address. PPP does not assign individual station addresses.

**Control** - A single byte that contains the binary sequence 00000011, which calls for transmission of user data in an unsequenced frame.

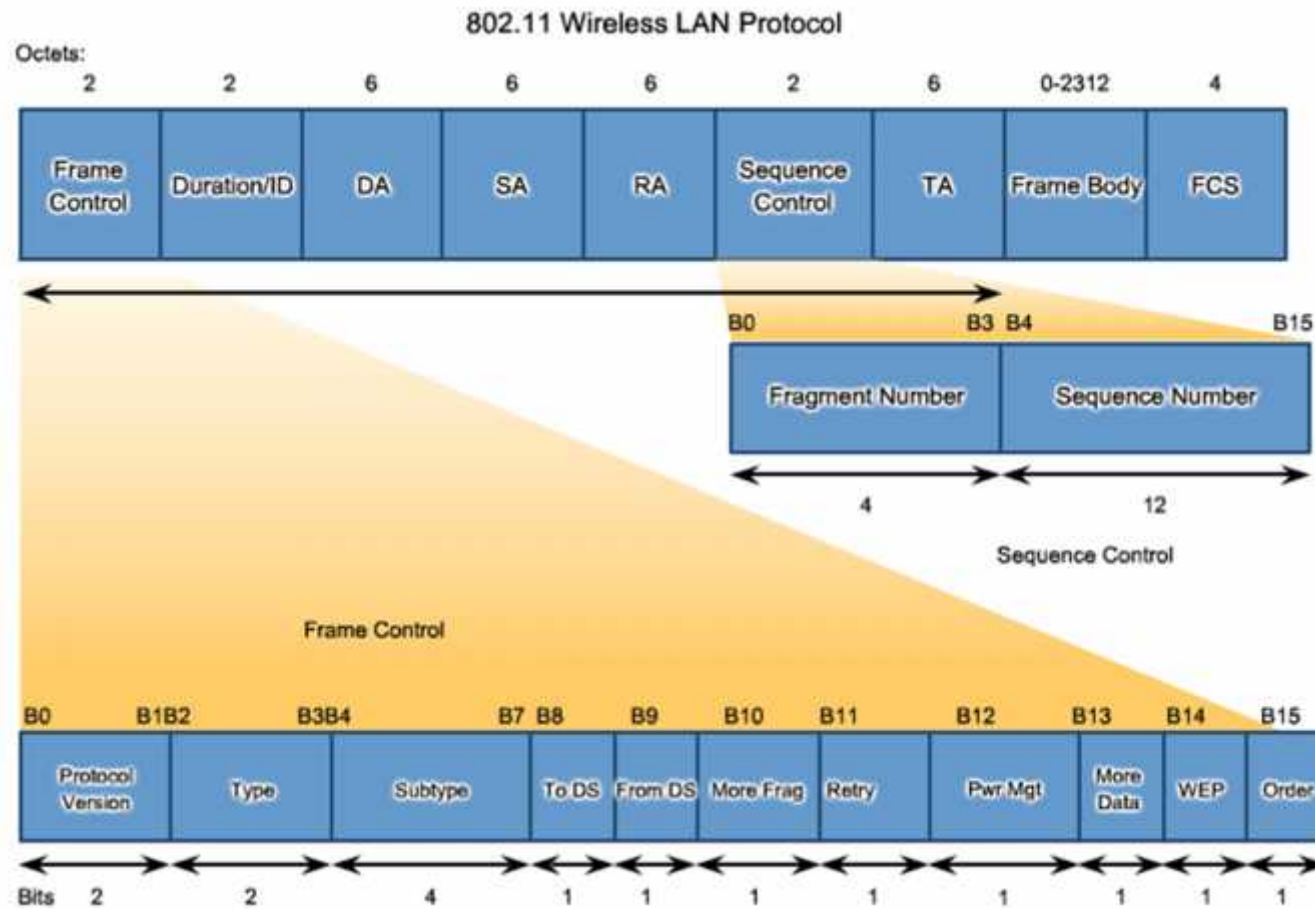
**Protocol** - Two bytes that identify the protocol encapsulated in the data field of the frame. The most up-to-date values of the protocol field are specified in the most recent Assigned Numbers Request For Comments (RFC).

**Data** - Zero or more bytes that contain the datagram for the protocol specified in the protocol field.

**Frame Check Sequence (FCS)** - Normally 16 bits (2 bytes). By prior agreement, consenting PPP implementations can use a 32-bit (4-byte) FCS for improved error detection.

Frame Data Link

# Frame Nirkabel 802.11





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