Computer Network

TCP/IP

Lecture : 4/5

Physical Layer

Gaurav Raj

1. Identify the ONE CORRECT matching between the OSI layers and their corresponding functionalities as shown. OSI Layers Functionalities

OSI Layer	Functionality
(a) Network Layer	(I) Packet routing
(b) Transport Layer	(II) Framing and error handling
(c) Datalink Layer	(III) Host to host communication

MCQ

A (a)-(I), (b)-(II), (c)-(III)
B (a)-(I), (b)-(III), (c)-(II)
C (a)-(II), (b)-(I), (c)-(III)
D (a)-(III), (b)-(II), (c)-(I)

2. In the following pairs of OSI protocol layer/sub-layer and its functionality, the INCORRECT pair is

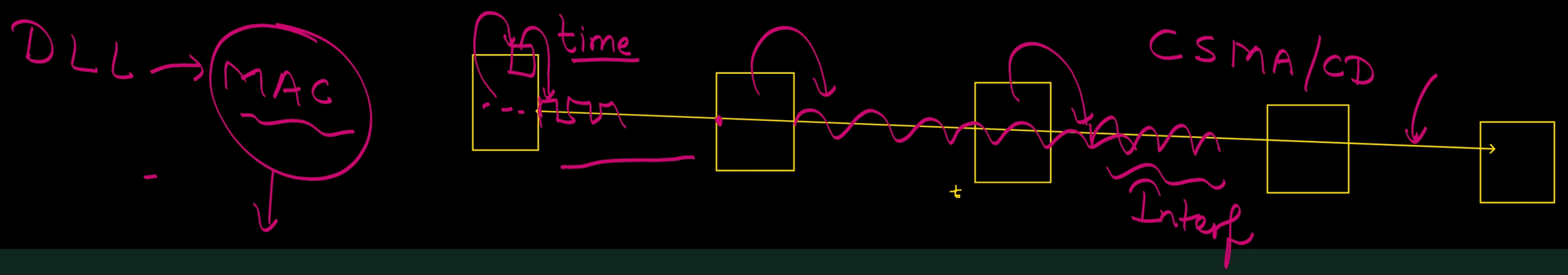
MCQ

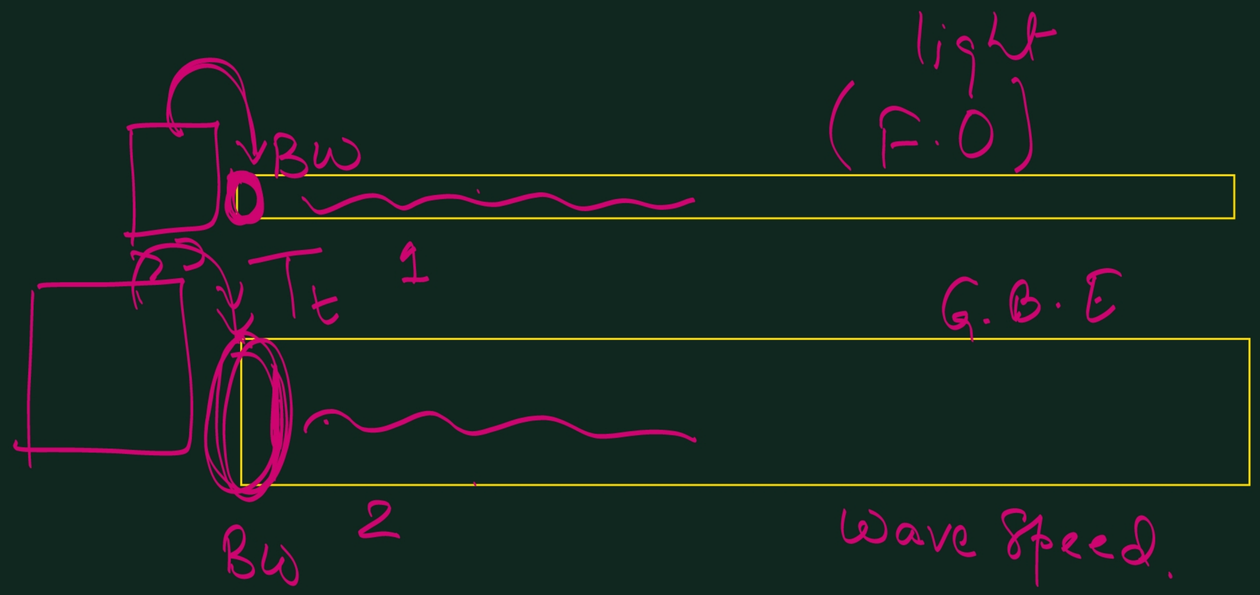
A. Network layer and Routing

B. Data Link Layer and Bit synchronization

C. Transport layer and End-to-end process communication

D. Medium Access Control sub-layer and Channel sharing

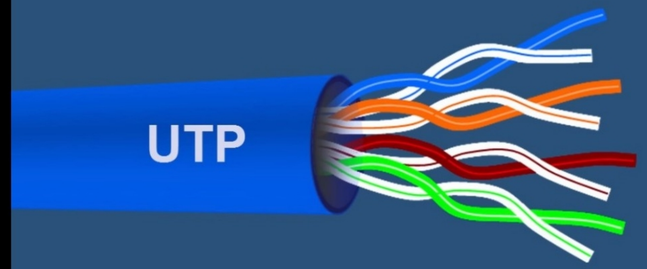




Prop Delay

Transmission Media: Medium Type Handling

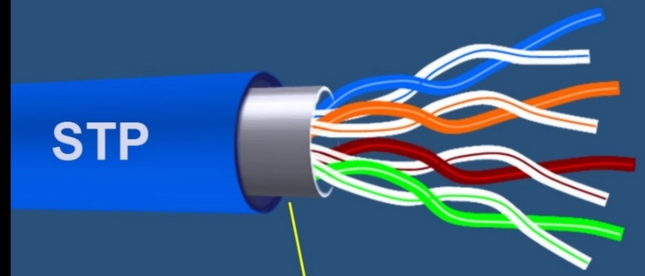
Unshielded Twisted Pair



UTP consists of 4 pairs of color-coded wires twisted around each other.

The wires are twisted to prevent electromagnetic interference (crosstalk).

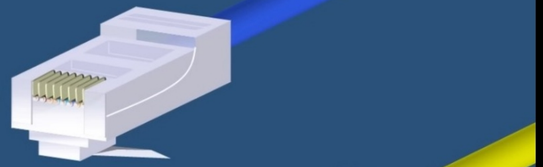
Shielded Twisted Pair



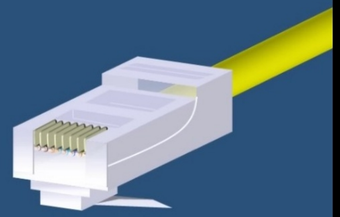
STP has a foil shield that covers the wires.

The foil shield adds a layer of protection against electro-magnetic interference leaking into and out of the cable.

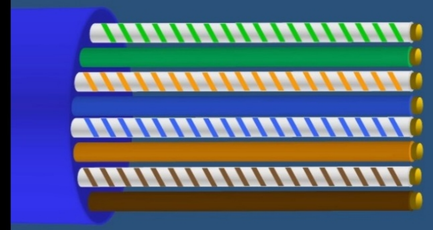
The most common types of twisted pair cables that are used in a LAN are:



Straight (patch) cable

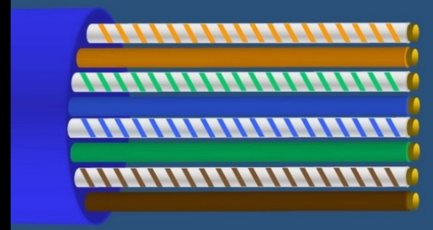


Crossover cable



White - Green
Green
White - Orange
Blue
White - Blue
Orange
White - Brown
Brown

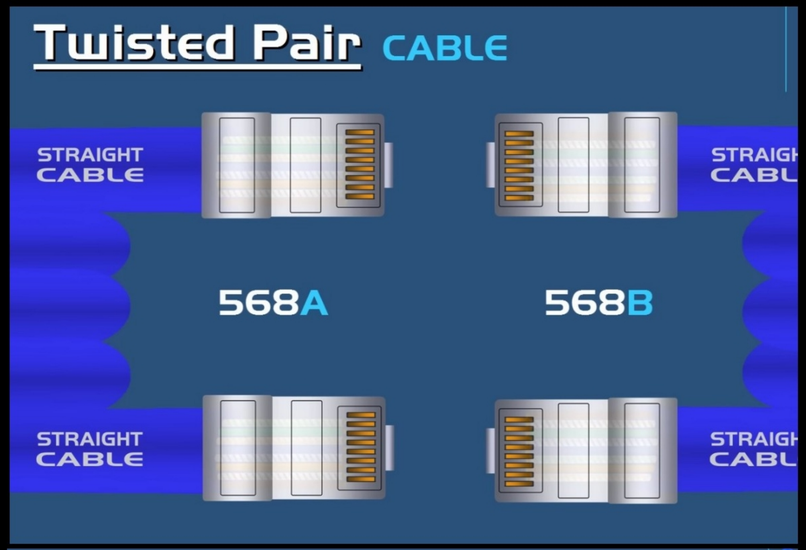
568A

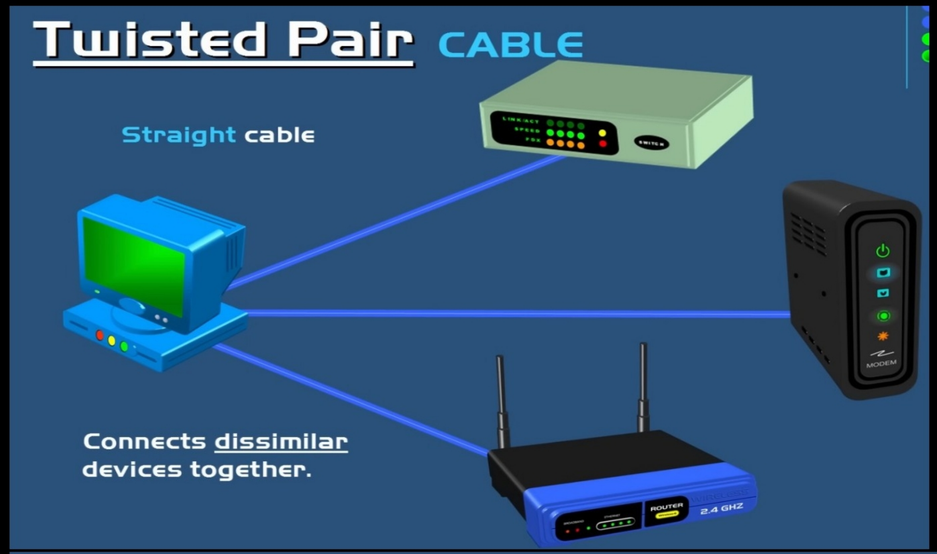


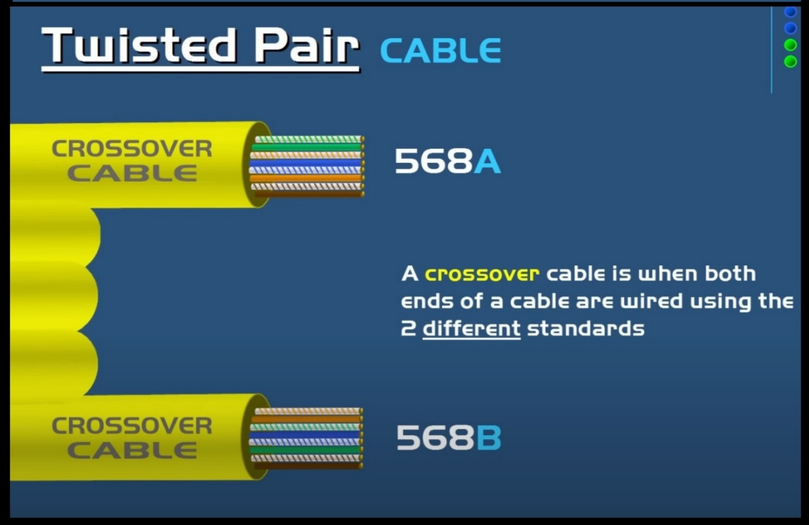
White - Orange
Orange
White - Green
Blue
White - Blue
Green
White - Brown
Brown

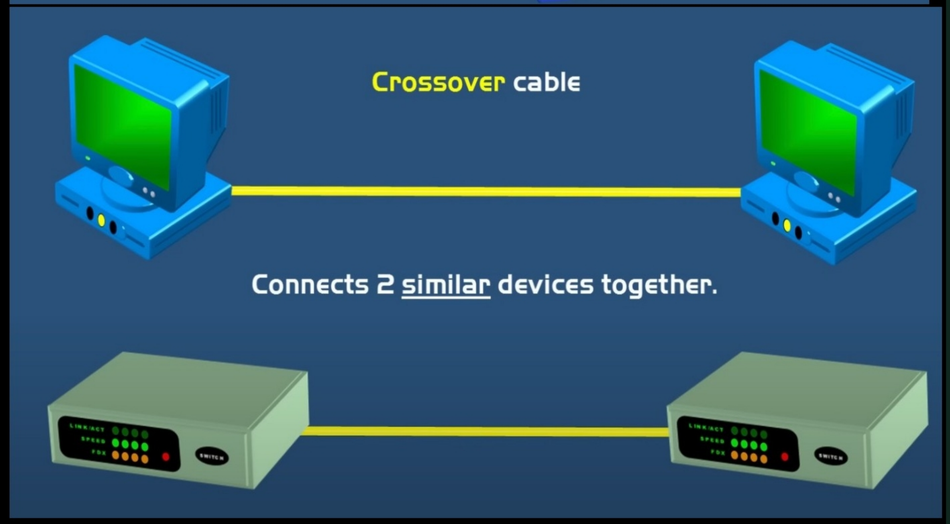
568B

Transmission Media: Medium Type Handling









Transmission Media: Medium Type Handling

CATEGORY
CATEGORY 3
CATEGORY 5
CATEGORY 5e
CATEGORY 6
CATEGORY 6a
CATEGORY 7

The difference between these is the maximum speed they can handle without having any crosstalk (interference).

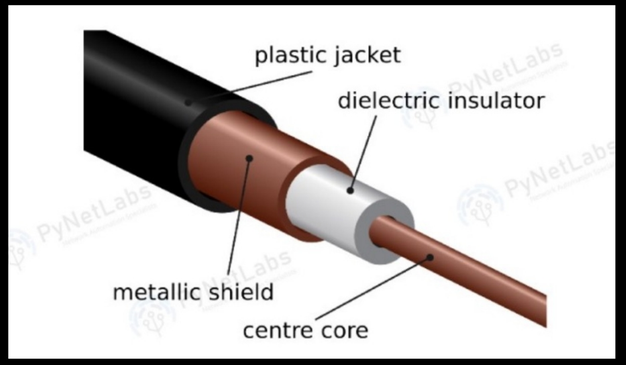
The numbers represent the tightness of the twists that are applied to the wires.

CATEGORY	SPEED	
CATEGORY 3	10 Mbps	
CATEGORY 5	100 Mbps	
CATEGORY 5e	1 Gbps	Enhanced
CATEGORY 6	1 Gbps	10 Gbps (cable length under 100 meters)
CATEGORY 6a	10 Gbps	Augmented
CATEGORY 7	10 Gbps	Added shielding to the wires.

CATEGORY 8 — 40 Gbps (Distance up to 30 meters.)

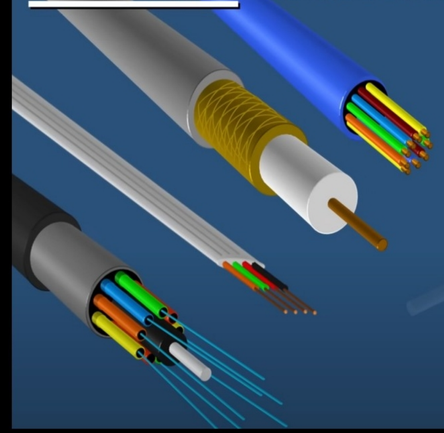
The ultimate copper cable.

Shielded twisted pair cable.



Transmission Media: Medium Type Handling

Network CONNECTORS



The different types of connectors that are used in networking.

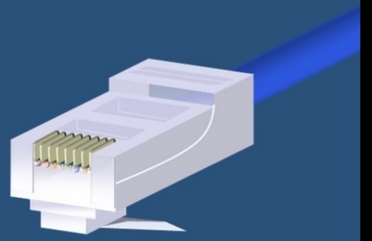
The connectors will vary depending upon the type of network and cable they are attached to.

RJ-45 CONNECTOR

The most common network connector that is used in networking.

8 pin modular connector.

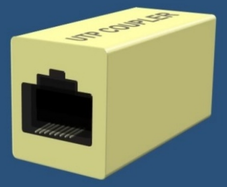
Used to connect computers and network devices in a local area network.

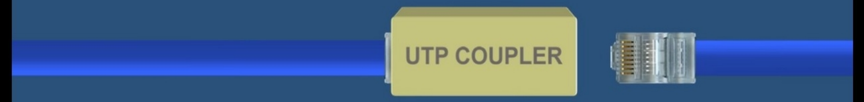


UTP COUPLER

Used to connect UTP network cables.

Typically used when running a longer cable is not an option.

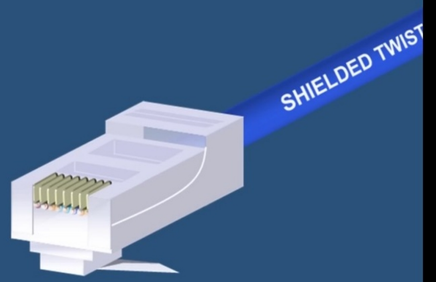


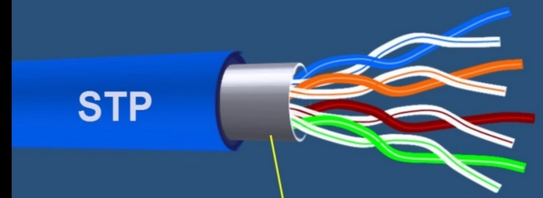


RJ-48 CONNECTOR

Looks similar to the RJ-45.

Used with shielded twisted pair cable.



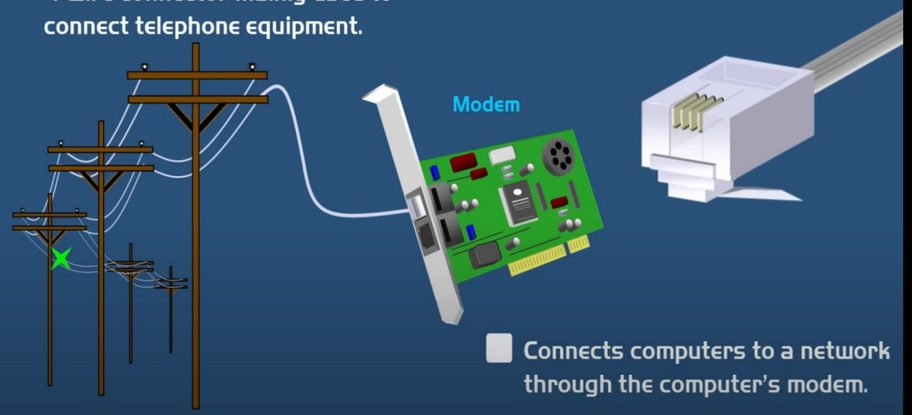


STP has a foil shield that covers the wires.

Transmission Media: Medium Type Handling

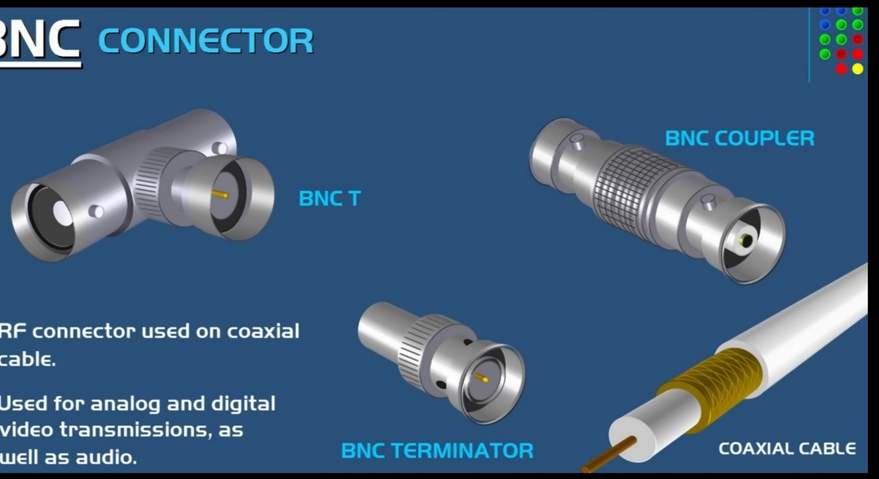
RJ-II CONNECTOR

4 wire connector mainly used to connect telephone equipment.



- Connects computers to a network through the computer's modem.

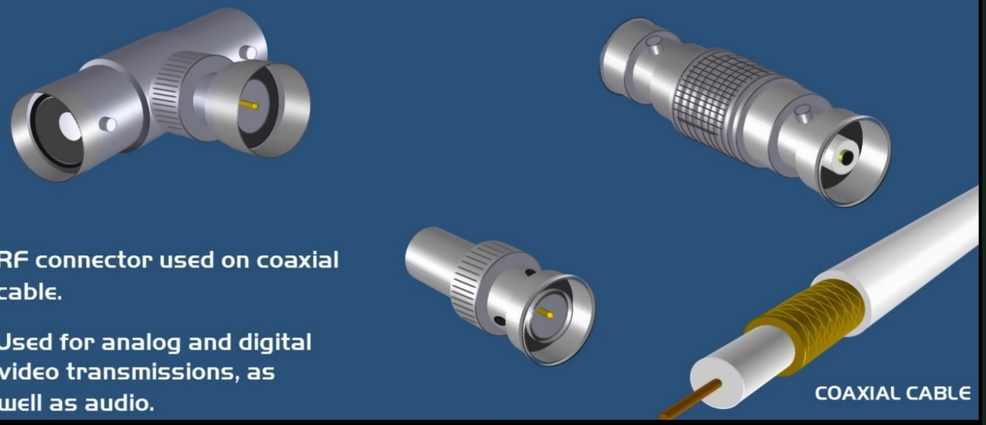
BNC CONNECTOR



RF connector used on coaxial cable.

Used for analog and digital video transmissions, as well as audio.

BNC CONNECTOR



RF connector used on coaxial cable.

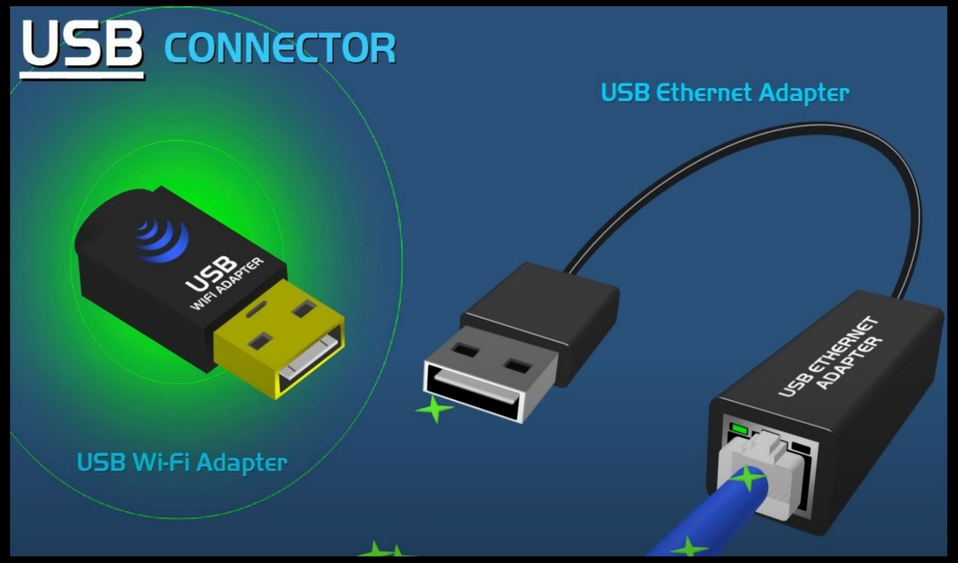
Used for analog and digital video transmissions, as well as audio.

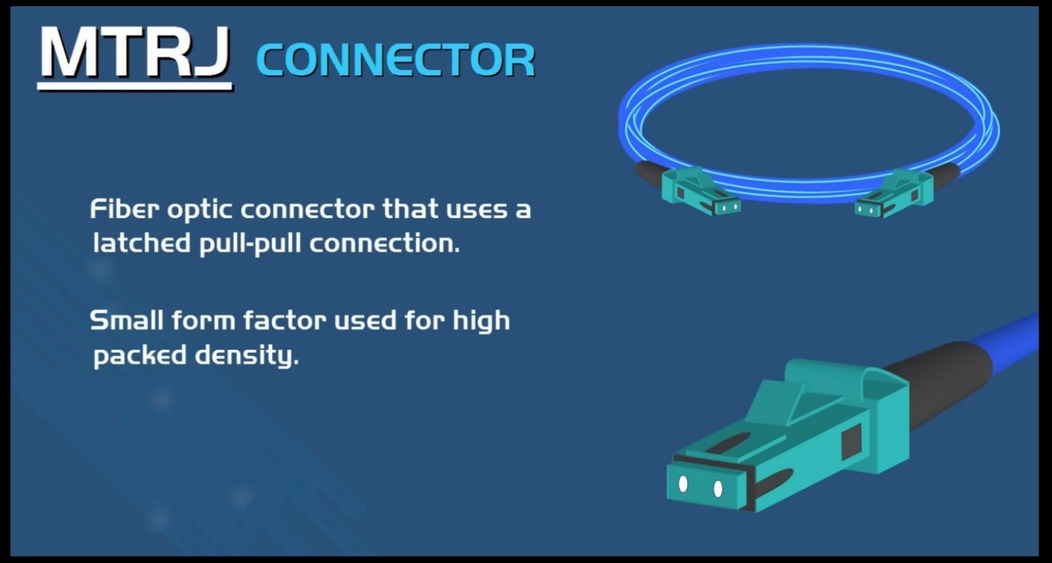
F-Type CONNECTOR

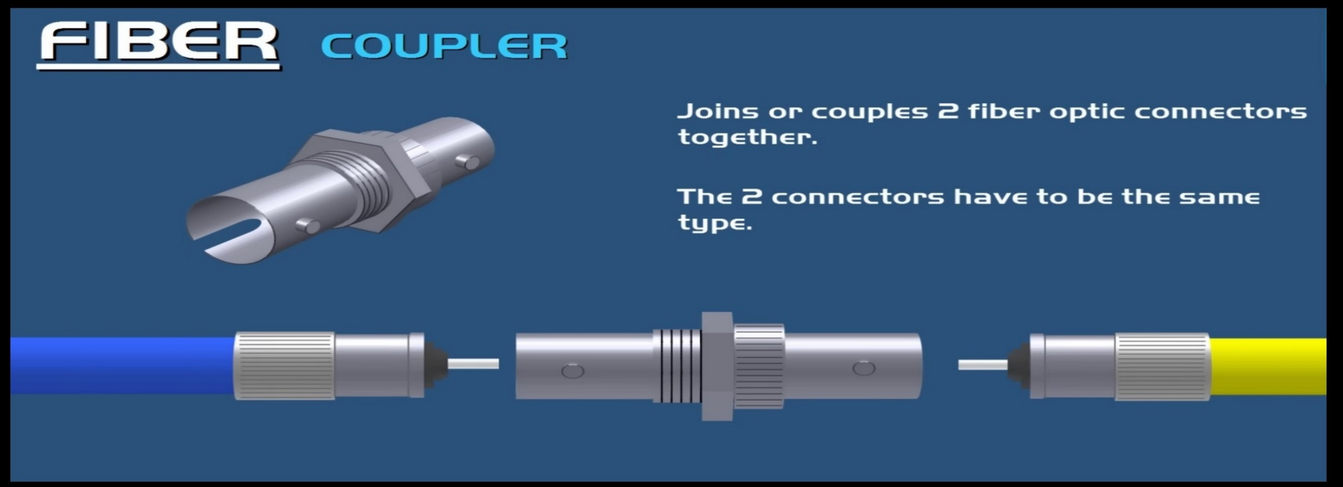
Threaded connector typically used on coaxial cables.

Primarily used by cable providers to attach to cable modems.

Transmission Media: Medium Type Handling





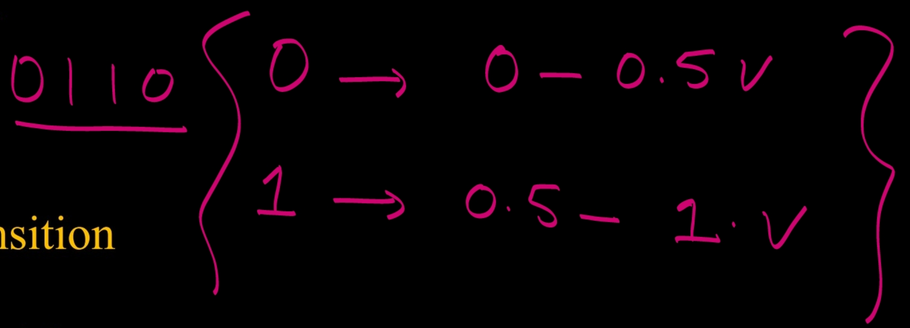


Signal Encoding with Synchronization

Manchester encoding is a method of data transmission used in computer networks and telecommunications. It works by combining the clock and data signals into one s

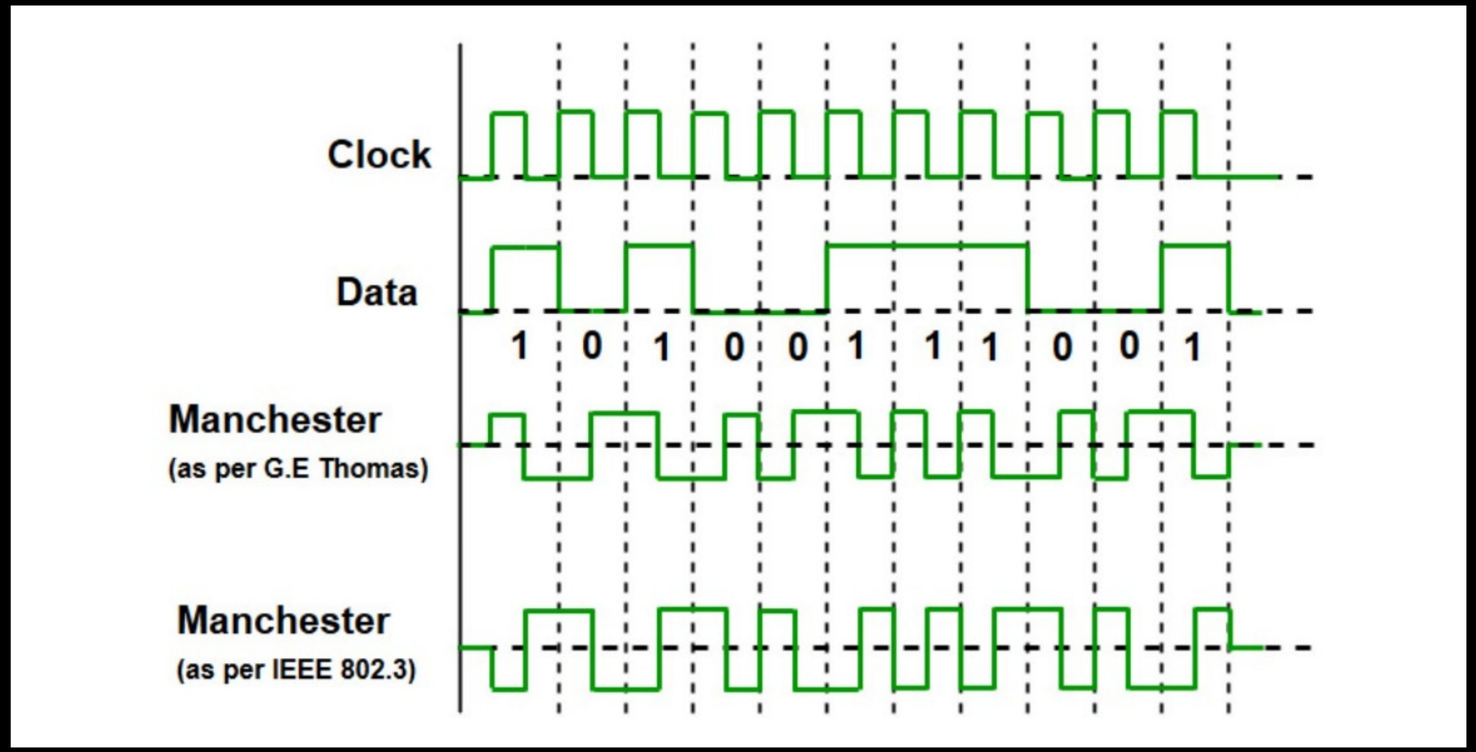
In Manchester encoding, each bit of data is represented by a transition in the signal. For example, let's consider a simple binary data sequence: **1101**.

- **Binary Data**: **1101**
- **Manchester Encoding**
  - **1**: At First it becomes High to Low transition
  - **1**: At second it also becomes High to Low transition
  - **0**: It becomes Low to High transition
  - **1**: The final time it becomes High to Low transition



That making it easier to synchronize the data.

Signal Encoding with Synchronization

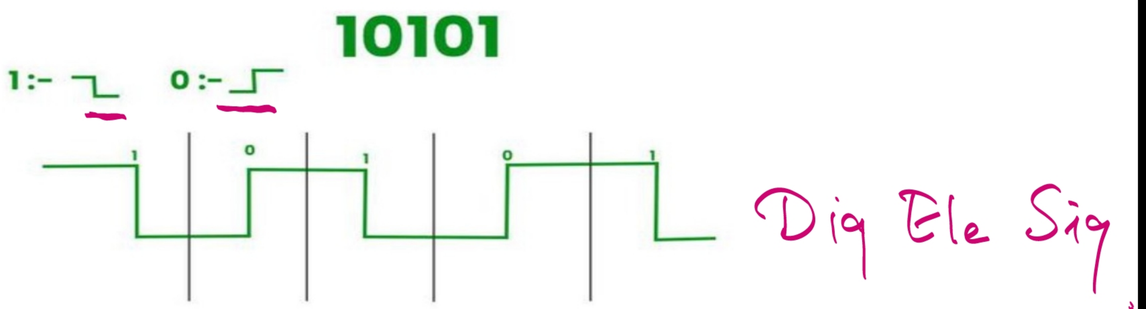


Baud rate ≠ Bit rate, unlike in some other encodings.

Baud rate = Bit rate × Number of transitions per bit

Manchester Encoding

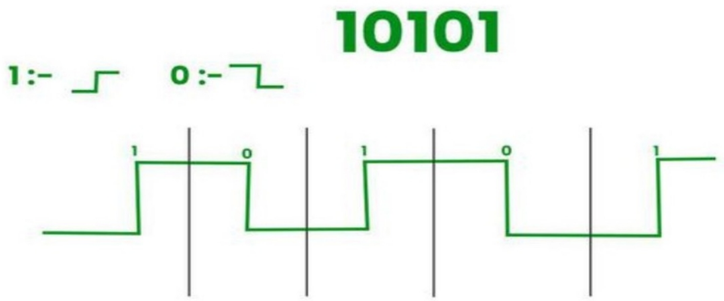
1. Dr. Thomas: In this manchester encoding 0 is represented as low-to-high and 1 is represented as high-to-low.



Dig Ele Sig.

Dr. Thomas Manchester Encoding

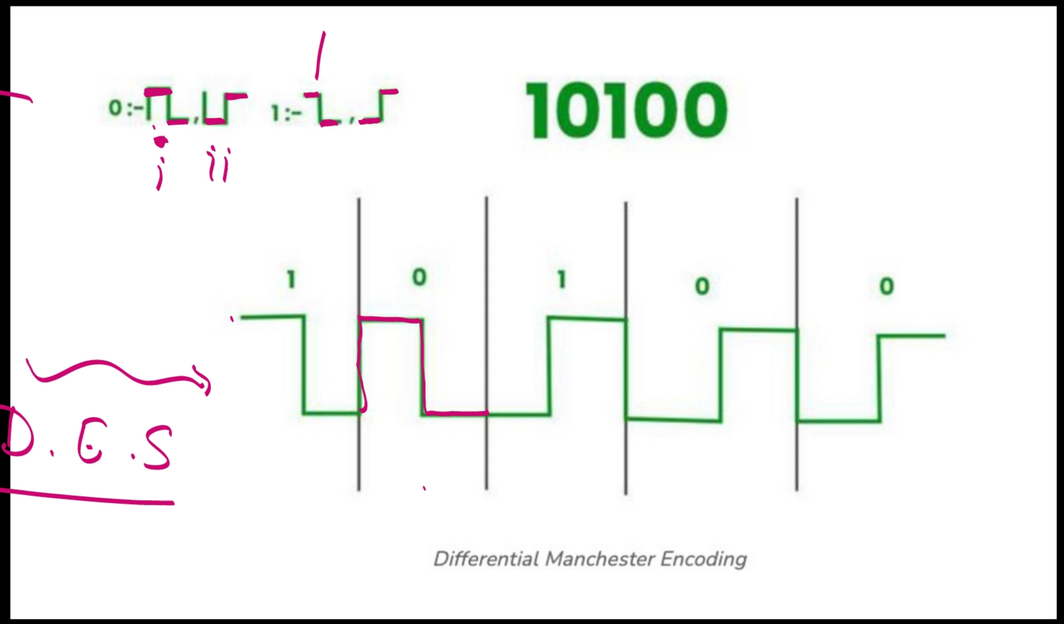
2. IEEE802.3: In this manchester encoding, 0 is represented as high-to-low and 1 is represented as low-to-high.



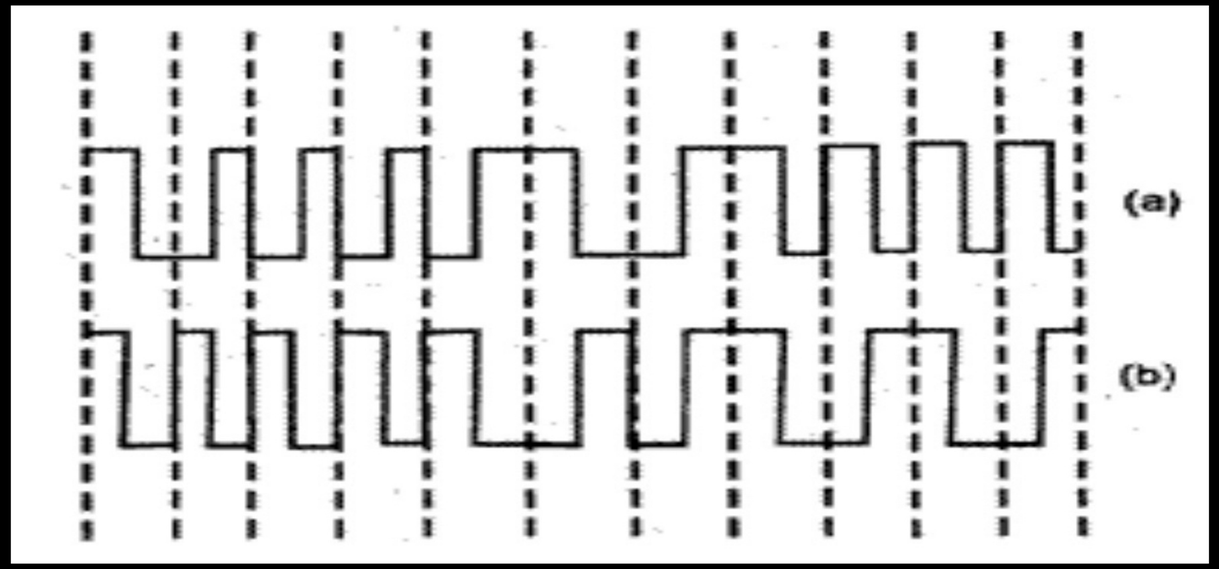
IEEE 802.3 Manchester Encoding

Differential Manchester Encoding

- It is also known as the Biphase mark code, etc.
- The presence and absence of the transition indicate the value.
- In Differential Manchester Encoding 0 should contain an edge but 1 should not contain any edge it should be continuous.



3. In the waveform (a) given below, a bit stream is encoded by Manchester encoding scheme. The same bit stream is encoded in a different coding scheme in wave form (b). The bit stream and the coding scheme are



MCQ

A. 1000010111 and Differential Manchester respectively
B. 0111101000 and Differential Manchester respectively
C. 1000010111 and Integral Manchester respectively
D. 0111101000 and Integral Manchester respectively

Signal Encoding

Manchester Encoding	Differential Manchester Encoding
Low to High represents 1 and High to Low represents 0.	No transition at the start of a bit period represents 1 and transition at the start of a bit period represents 0.
It provides **better signal synchronization.**	It provides **less signal synchronization** as compared to manchester encoding.
Used by IEEE 802.3 specification for Ethernet LAN	Used by IEEE 802.5 specification for Token Ring LAN

In manchester signal or differential manchester a data bit is encoded in two signal element so r = 1/2 because for half duration level is up and for half of bit duration its below so two signal element per data element

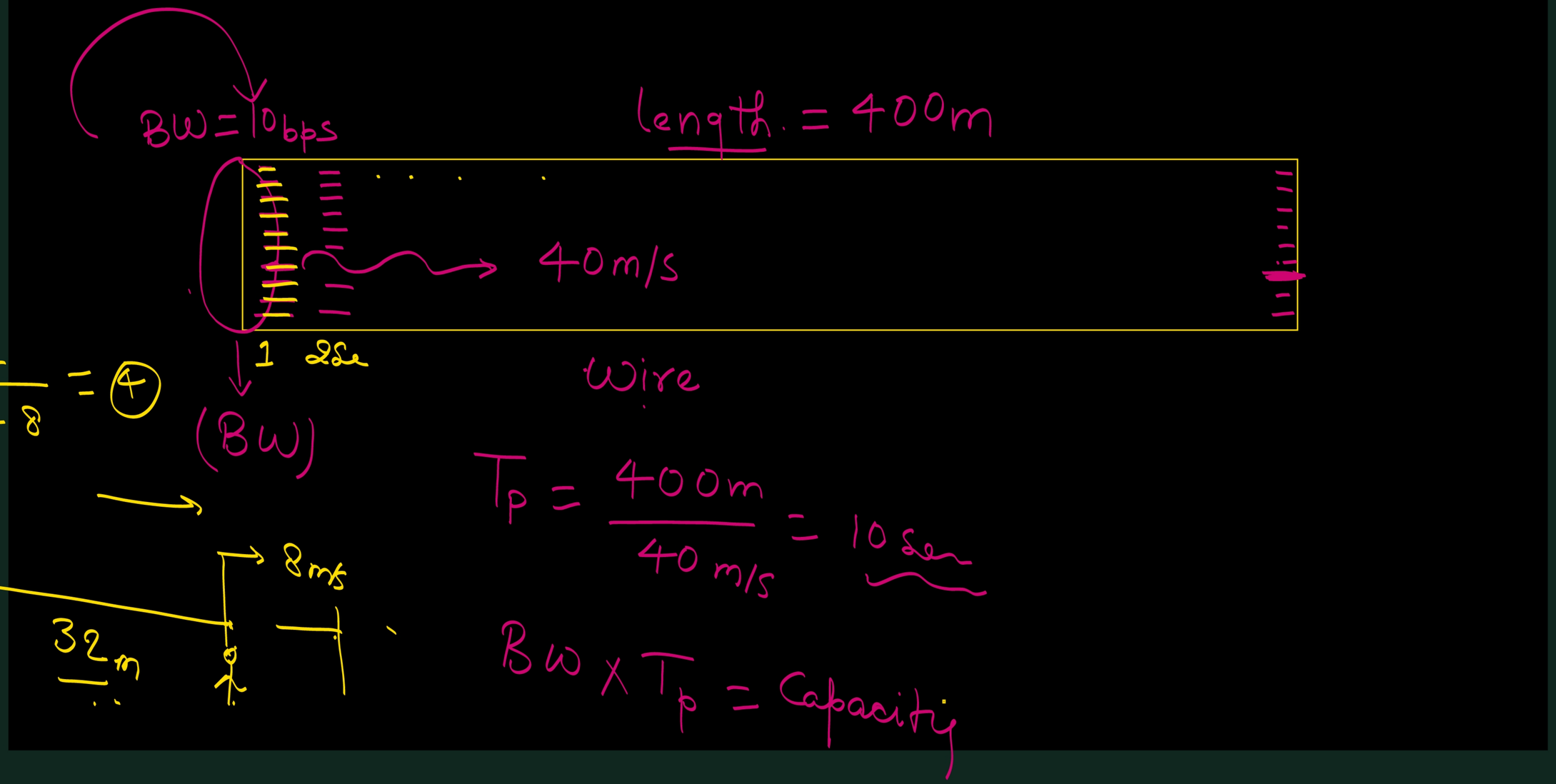
Baud rate = 2* Bit rate

4. In Ethernet when Manchester encoding is used, the bit rate is:

A. Half the baud rate.
B. Twice the baud rate
C. Same as the baud rate
D. None of the above

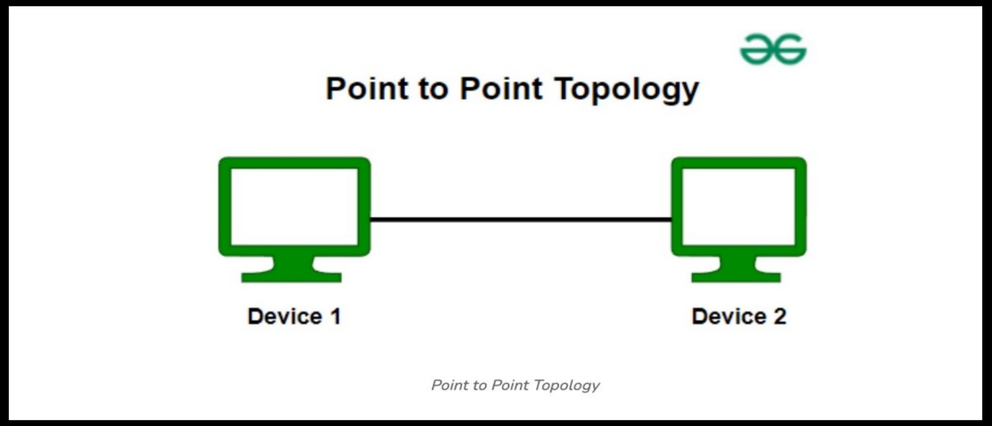
MCQ

Data Rate Control: Bandwidth and Capacity

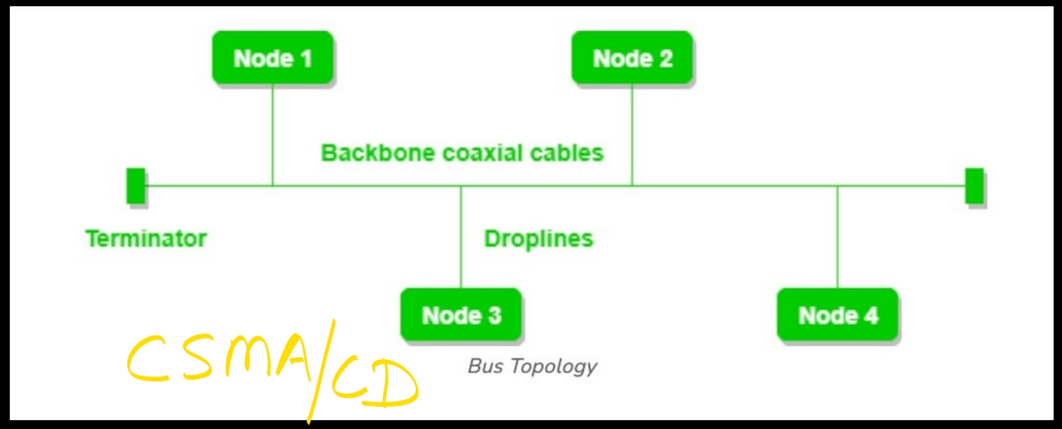


Data Rate Control: Bandwidth and Capacity

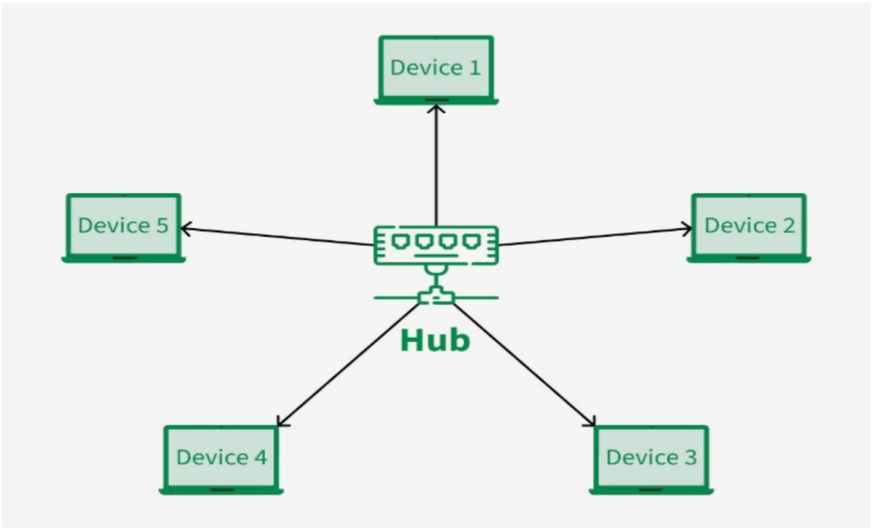
Topology Specification



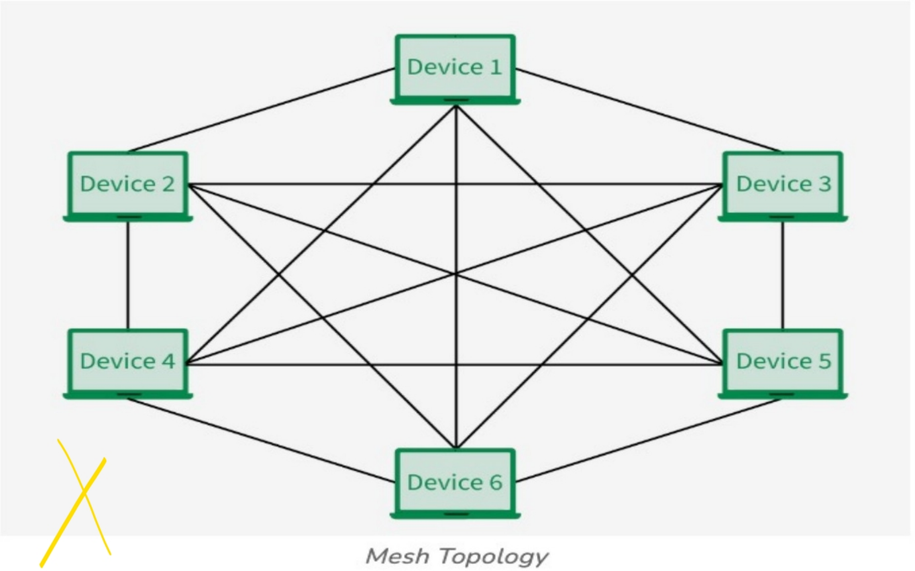
Point to Point Topology



Bus Topology

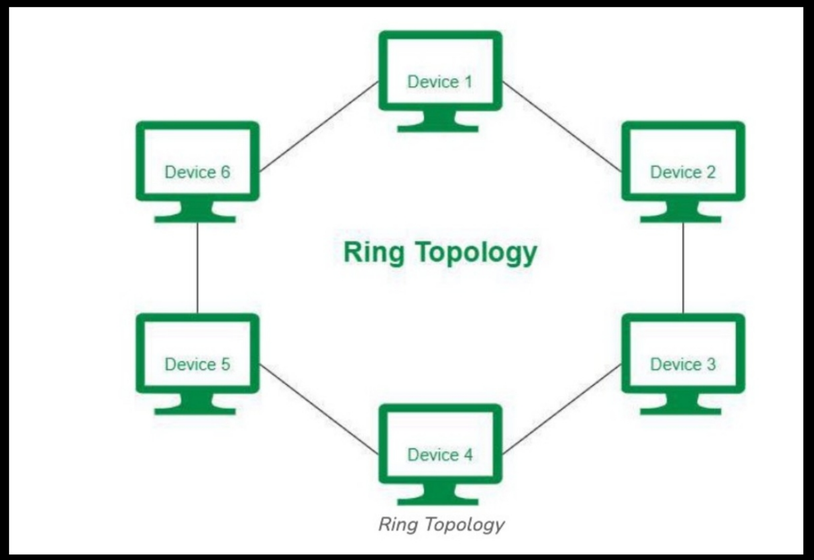


Star Topology

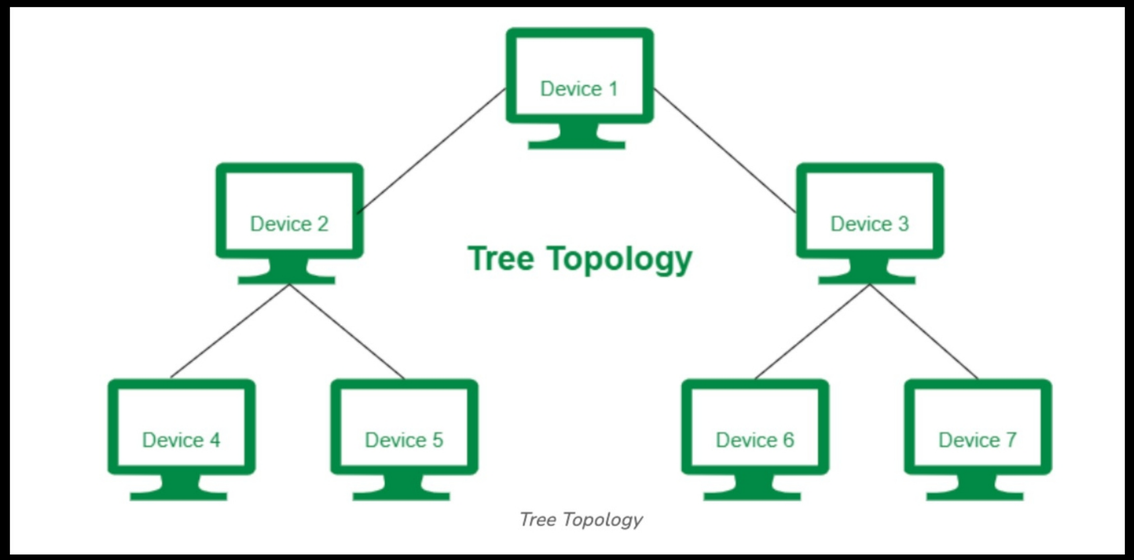


Mesh Topology

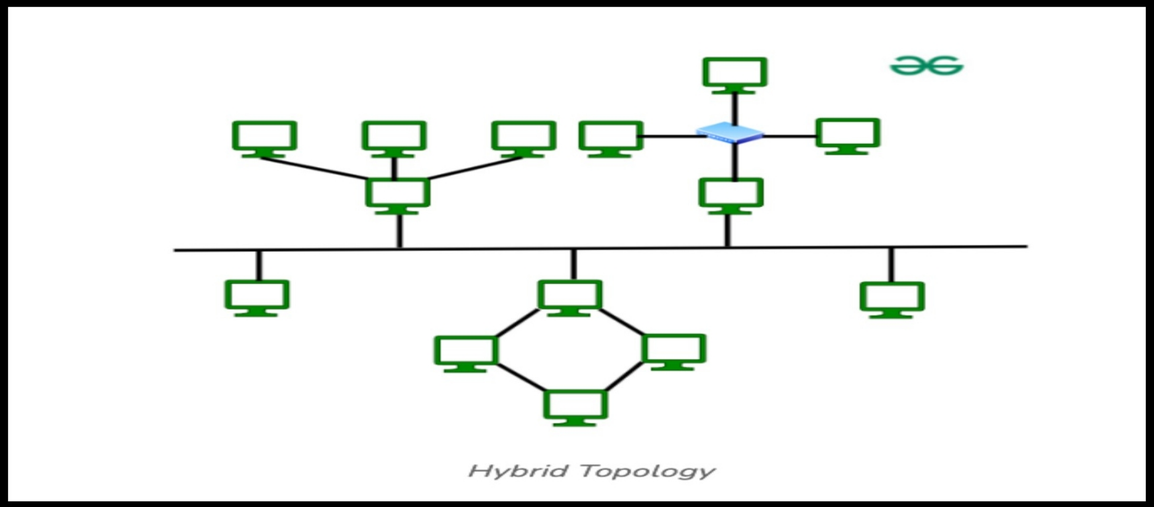
Topology Specification



Ring Topology



Tree Topology


Hybrid Topology

Topology Specification

1. Cost
Best Topologies: Bus and Star

2. Reliability
Best Topologies: Mesh and Hybrid

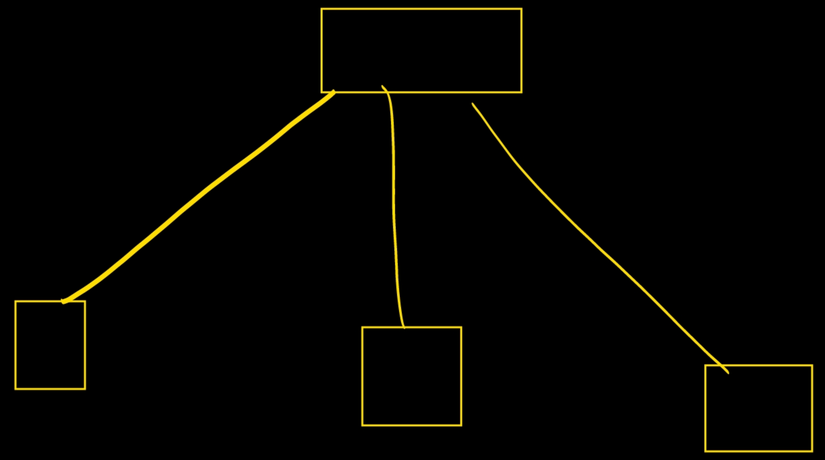
3. Scalability
Best Topologies: Tree and Mesh

4. Performance
Best Topologies: Mesh and Star

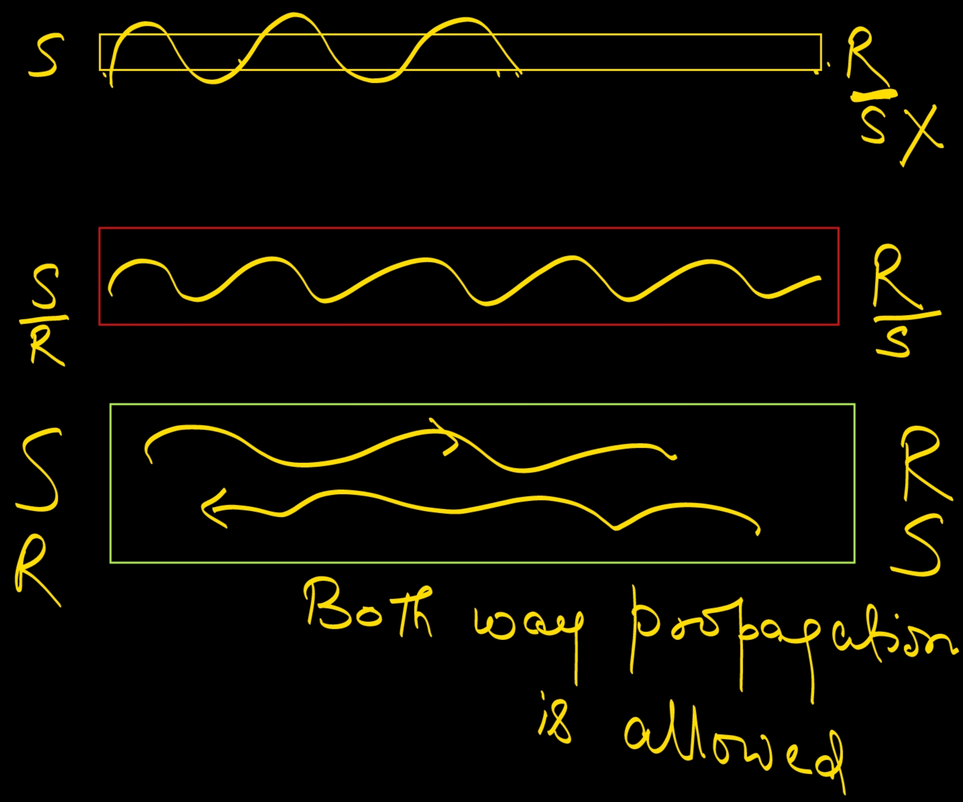
5. If there are n devices (nodes) in a network, what is the number of cable links required for a fully connected mesh and a star topology respectively

MCQ

A. n(n-1)/2 , n-1
B. n, n-1
C. n-1, n
D. n-1, n(n-1)/2



Transmission Mode: Simplex, Half-duplex, Full-duplex



Transmission Mode: Simplex, Half-duplex, Full-duplex

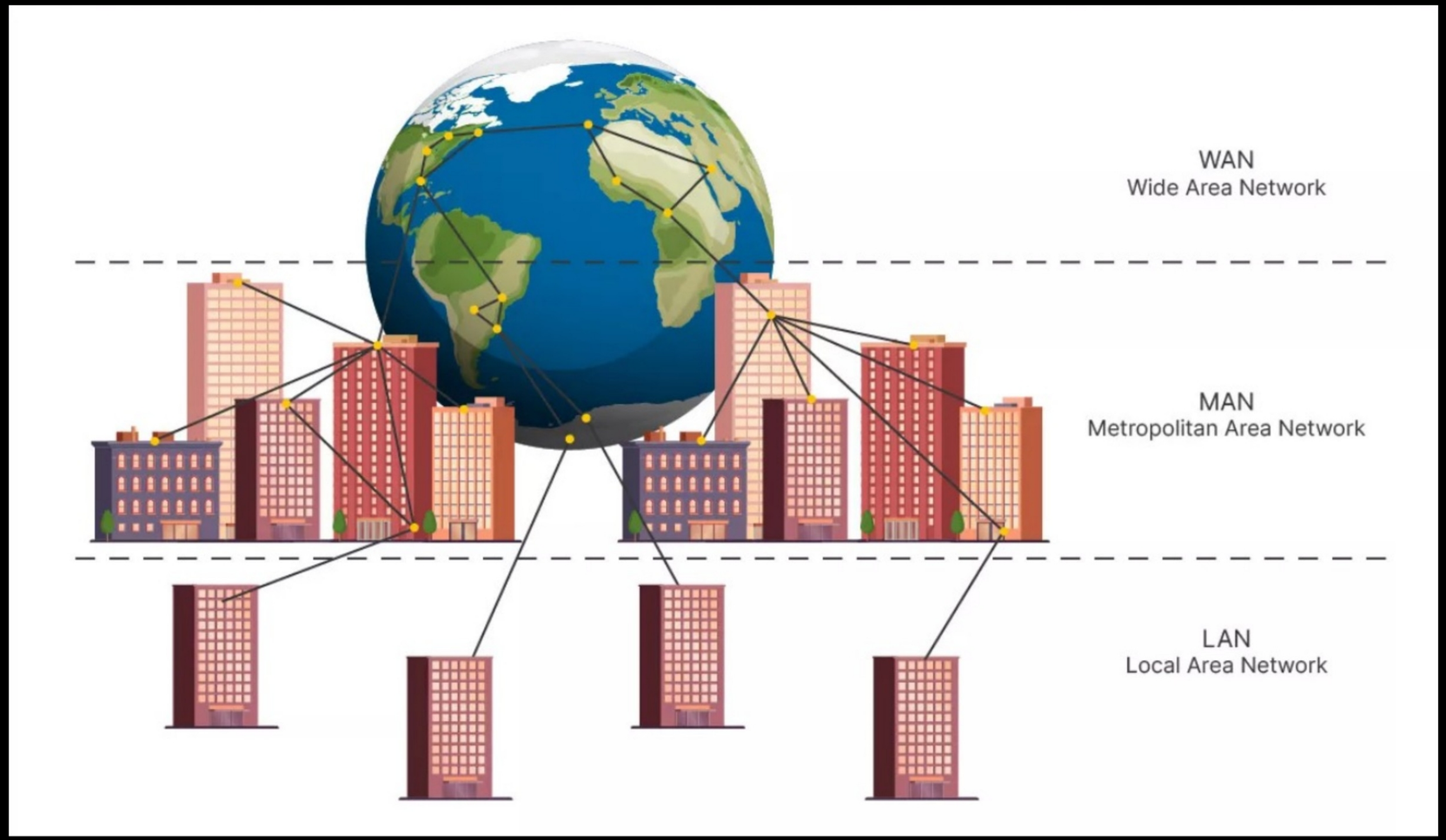
Communication Mode	Direction	Description	Supported Physical Media (Examples)
Simplex	One-way only	Data flows in one direction only	Coaxial cable (e.g., TV cable), Optical fiber (broadcast)
Half-Duplex	Two-way (but one at a time)	Data flows both ways, but not simultaneously	Walkie-talkies (over radio), Ethernet with hub (legacy)
Full-Duplex	Two-way simultaneous	Data flows in both directions at the same time	Twisted pair (Ethernet with switch), Optical fiber, 5G

LAN, MAN, WAN

- **LAN: local-area network**
- **MAN: metropolitan area network**
- **WAN: wide-area network**

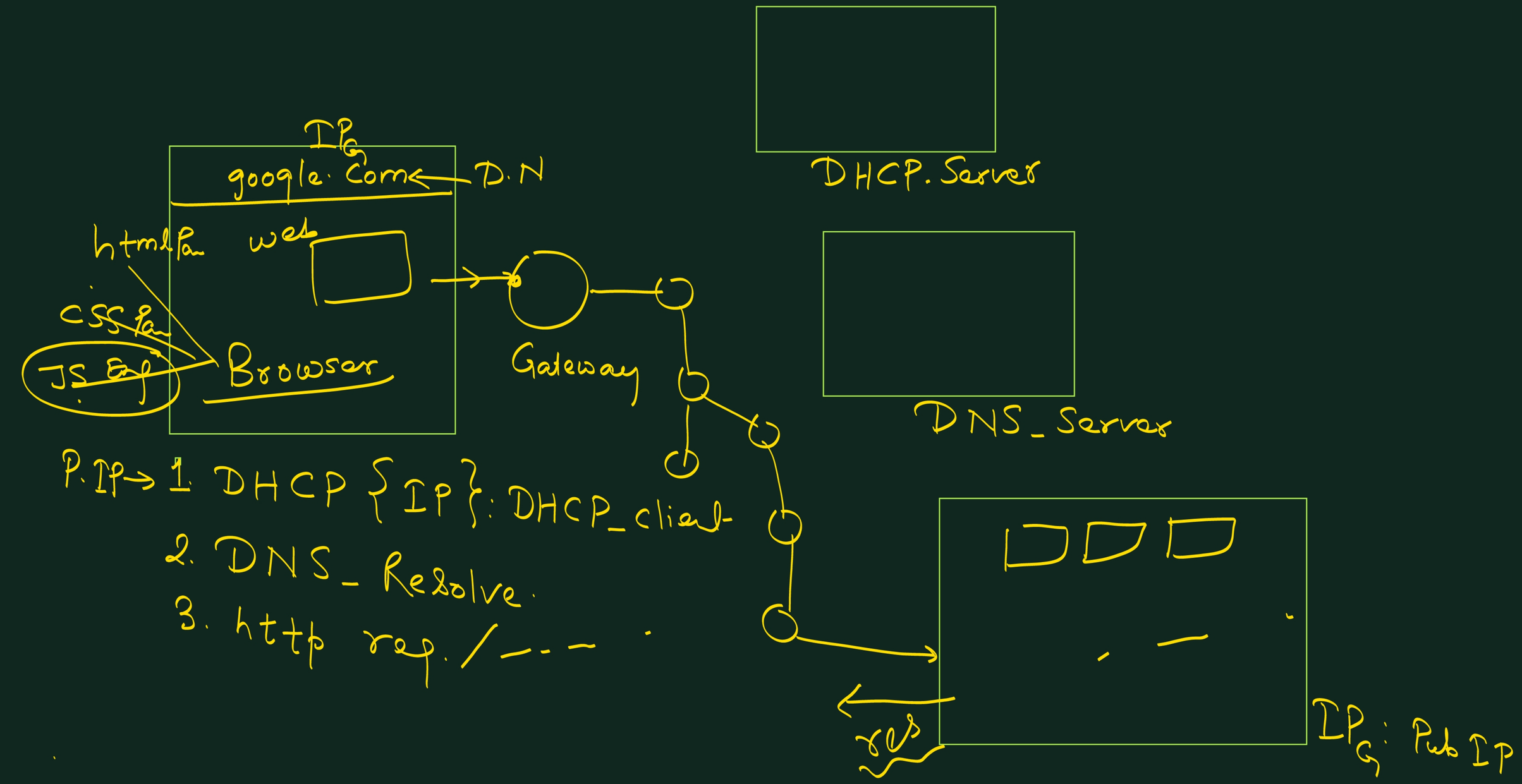
- **SAN: SAN (storage area network)** is a high-speed **network** of storage devices that also connects those storage devices with servers.
- **CAN:** A **Controller Area Network** is a vehicle bus standard designed to allow microcontrollers and devices to communicate with each other in applications without a host computer.
- **PAN:** A **personal area network (PAN)** is a computer **network** used for data transmission amongst devices such as computers, telephones, tablets, personal digital assistants, fax machines and printers, that are located close to a single user.
- **GAN:** A global area network (GAN) is a network used for supporting mobile across an arbitrary number of wireless LANs, satellite coverage areas, etc.

LAN, MAN, WAN


WAN
Wide Area Network
MAN
Metropolitan Area Network
LAN
Local Area Network

Physical Standards

Standard	Name	Technology	Medium	Speed
IEEE 802.3	Ethernet (Wired LAN)	CSMA/CD (Carrier Sense Multiple Access with Collision Detection)	Twisted Pair, Coaxial	10 Mbps to 400 Gbps
IEEE 802.5	Token Ring	Token Passing	Twisted Pair	4 Mbps / 16 Mbps
IEEE 802.11	Wireless LAN (Wi-Fi)	CSMA/CA (Collision Avoidance)	Radio Waves	1 Mbps to 6.9 Gbps (802.11ax)
IEEE 802.15	Wireless Personal Area Network (WPAN)	Bluetooth, Zigbee	Radio Waves	Up to 2 Mbps (Bluetooth 5.0)
IEEE 802.16	Broadband Wireless (WiMAX)	Wireless MAN	Microwave	Up to 1 Gbps
ITU G.992	DSL (Digital Subscriber Line)	Broadband over Telephone lines	Copper Wires	Up to 100 Mbps
SONET/SDH	Synchronous Optical Network / Hierarchy	Fiber Optic Transmission	Optical Fiber	155 Mbps to 10 Gbps+


IP
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html/a
web
CSS/a
JS Eng
Browser
Gateway
DHCP. Server
DNS_ Server
P. IP → 1. DHCP {IP} : DHCP_client
2. DNS_ Resolve.
3. http req. / ---
res
IP_G : Pub IP

Thank You