2. INTERFACES AND CABLES

SWITCHES

- Typically provide multiple PORTS for connectivity, usually 24.
- These PORTS are commonly RJ-45 (Registered Jack) ports.

WHAT IS ETHERNET?

- Ethernet refers to a set of network protocols and standards.

Why do we need network protocols and standards?

- To establish common communication standards across networks.
- To ensure hardware compatibility and connectivity between devices.

Connection Speeds

- Device connections operate at defined speeds, measured in "bits per second" (bps).
- A **bit** is a value of "0" or "1," while a **byte** equals 8 bits.

Size	Number of Bits
1 kilobit (Kb)	1,000
1 megabit (Mb)	1,000,000
1 gigabit (Gb)	1,000,000,000
1 terabit (Tb)	1,000,000,000,000

Ethernet Standards

- Defined by the IEEE 802.3 standard in 1983.
- IEEE stands for **Institute of Electrical and Electronics Engineers**.

ETHERNET STANDARDS (COPPER)

Speed	Common Name	Standard	Cable Type	Max Transmission Distance
10 Mbps	Ethernet	802.3i	10BASE-T	100 meters
100 Mbps	Fast Ethernet	802.3u	100BASE-T	100 meters
1 Gbps	Gigabit Ethernet	802.3ab	1000BASE-T	100 meters
10 Gbps	10 Gigabit	802.3an	10GBASE-T	100 meters

- **BASE**: Indicates Baseband Signaling.

- **T**: Refers to Twisted Pair cabling.

UTP (Unshielded Twisted Pair)

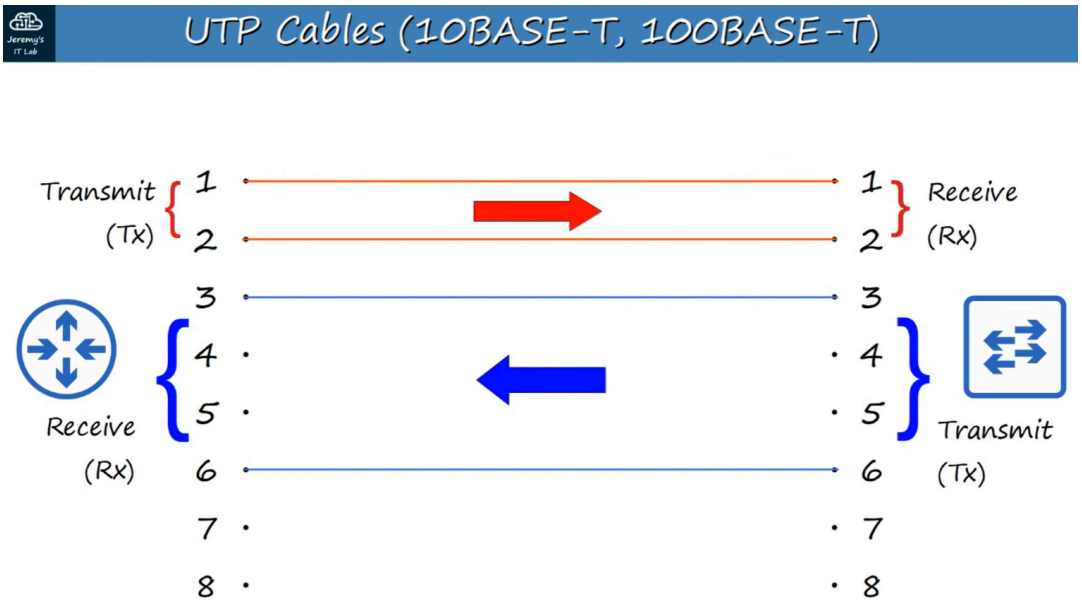
- Commonly used copper cable.
- Does not include a metallic shield.
- Twisted design protects against **EMI (Electromagnetic Interference)**.
- Usually contains 8 wires (4 pairs), but some standards use fewer wires:
    - **10/100BASE-T** uses 2 pairs (4 wires).

DEVICE COMMUNICATION VIA CONNECTIONS

RJ-45 Pins

- Ethernet cables have RJ-45 plugs with 8 pins.

Device	Transmit (TX) Pins	Receive (RX) Pins
PCs/Firewalls	Pins 1 and 2	Pins 3 and 6
Switches	Pins 3 and 6	Pins 1 and 2

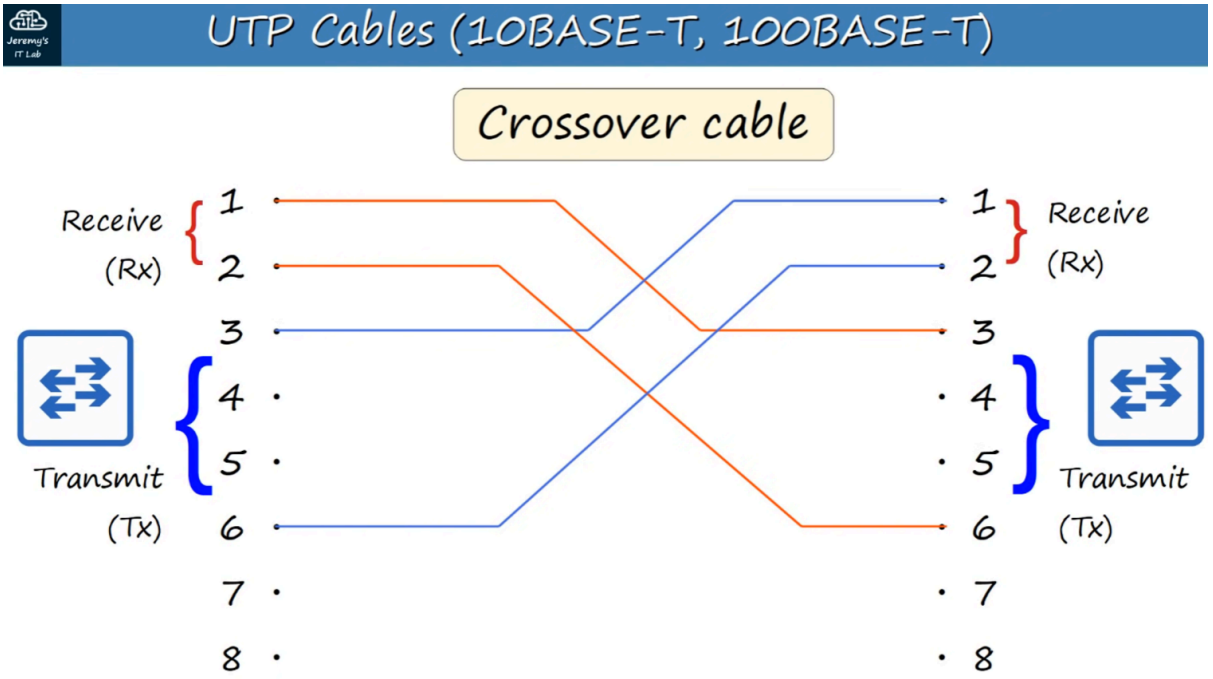


This configuration allows for **Full-Duplex** data transmission.

Connecting Similar Devices

- For connections between similar devices (e.g., Router to Router), a **Crossover Cable** is required.
- Crossover cables swap the pin assignments:
    - PIN#1 → PIN#3
    - PIN#2 → PIN#6
    - PIN#3 → PIN#1

- PIN#6 → PIN#2



Modern Equipment

- Most modern devices support **AUTO MDI-X**, which automatically adjusts pins for compatibility, removing the need for crossover cables.

Higher Speed Standards (1000BASE-T/10GBASE-T)

- Use 4 pairs (8 wires) where each wire pair is bidirectional, allowing faster transmission compared to 10/100BASE-T.

FIBER-OPTIC CONNECTIONS

- Governed by the IEEE 802.3ae standard.
- SFP (Small Form-Factor Pluggable) transceivers enable fiber-optic cables to connect to switches or routers.
- Fiber-optic cables use separate lines for transmitting and receiving.

Types of Fiber-Optic Cables

1. **Single-Mode Fiber**:
   - Narrower core for laser-based transmission.
   - Supports longer distances than UTP or multimode.
   - More expensive due to laser-based SFP transmitters.
2. **Multimode Fiber**:
   - Wider core for LED-based transmission.
   - Supports multiple light wave angles (modes).
   - Cheaper but shorter distance compared to single-mode.