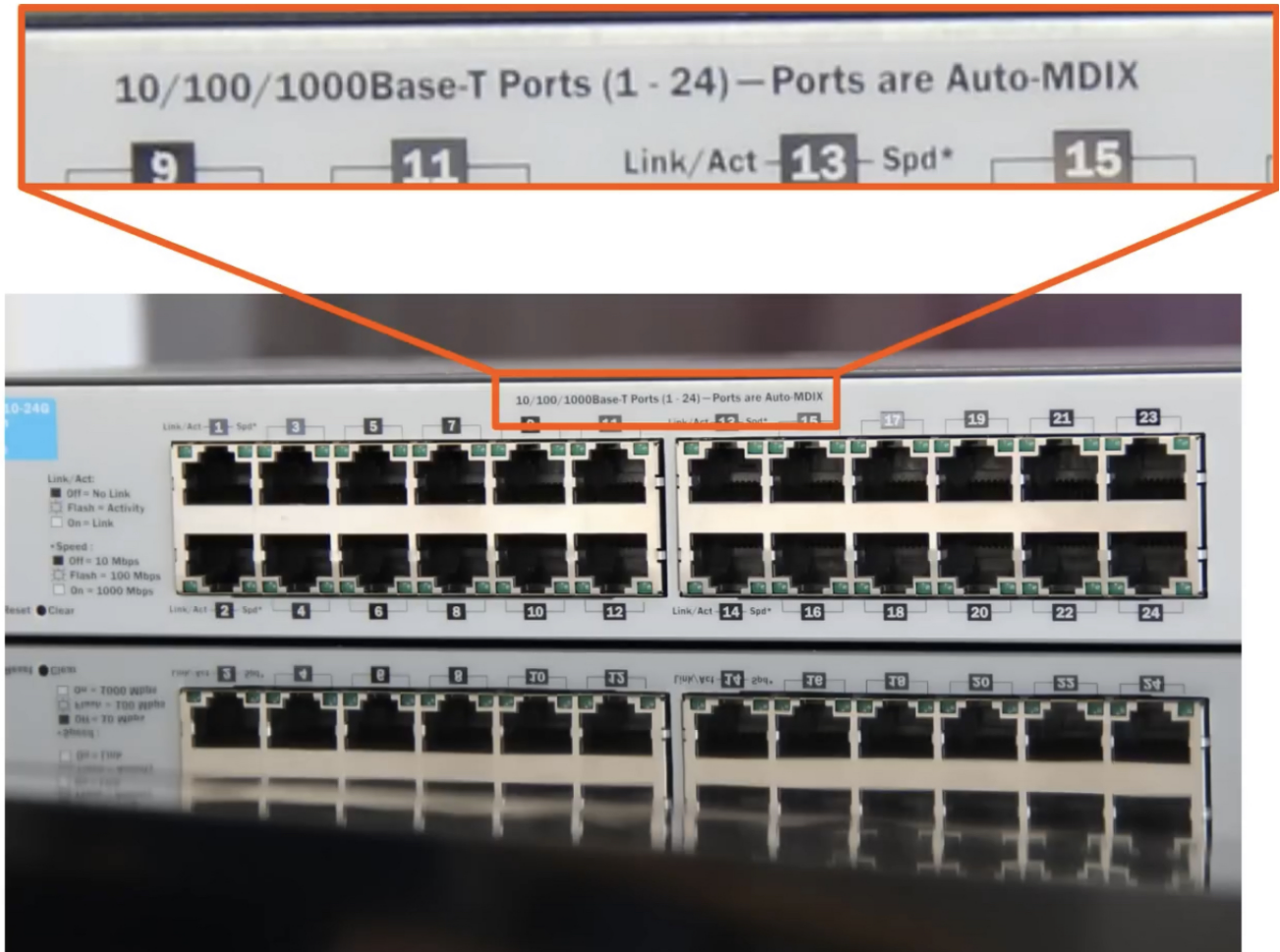# DAY 2 - Interfaces and Cables

Interfaces and Cables

Questions:

Take a look at the switch:

1. What are `10Base-T`, `100Base-T`, `1000Base-T`, and `auto-MDIX`?
2. What are used to plug into the switch ports?
3. What type of cables are used?

Answer:

The answers are all related to the "**Ethernet**"
Important

- **Ethernet** is a <u>collection</u> of network protocols and standards. For now we will only focus on the **cabling** Ethernet standards.

Ethernet Cabling Standards

Are defined in the **IEEE 802.3** (IEEE = `Institude of Electrical and Electronics Engineers`)

Ethernet Standards (**Copper**): *REMEMBER!*

| Speed	Common Name	IEEE Standards	Informal Name	Maximum Length
10 Mbps	Ethernet	802.3i	10Base-T	100m
100 Mbps	Fast Ethernet	802.3u	100Base-T	100m
1000 Mbps	Gigabit Ethernet	802.3ab	1000Base-T	100m
10 Gbps	10 Gigabit Ethernet	802.3an	10GBase-T	100m

<u>Trivia</u>:
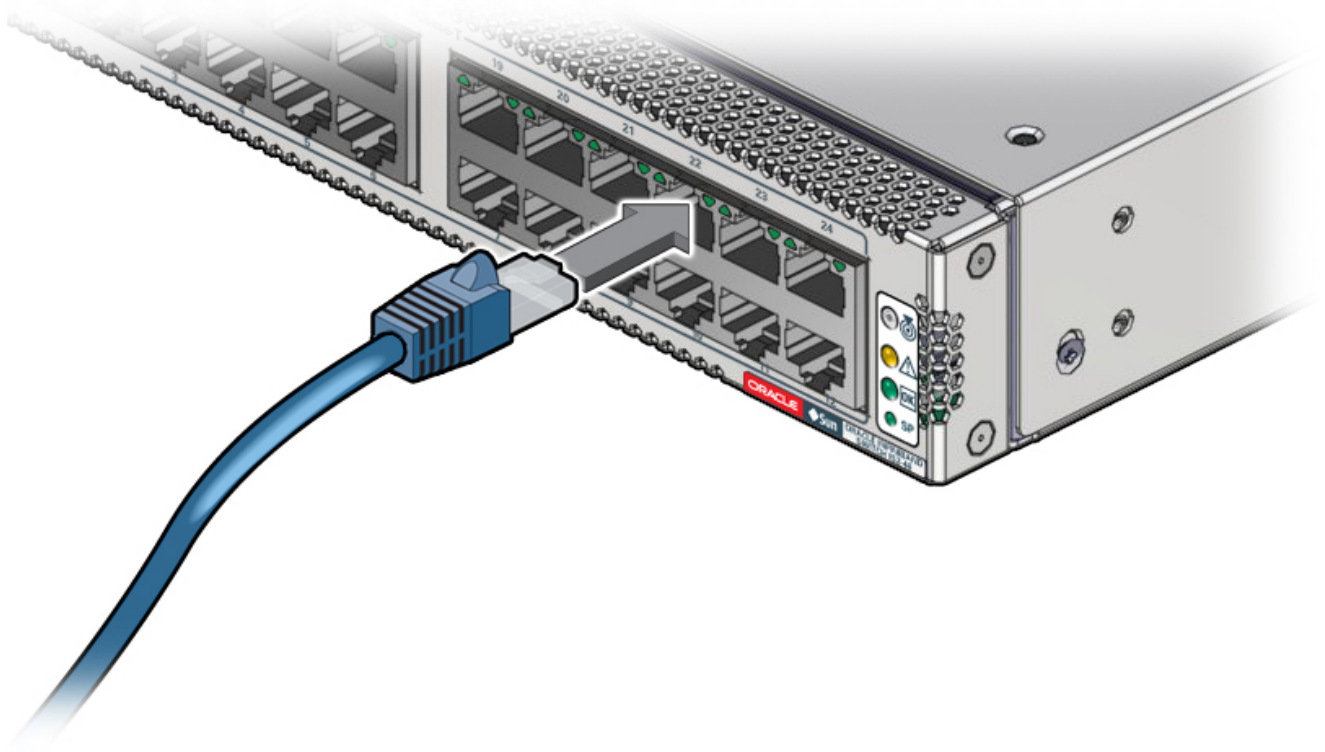`100Base-T`
100 = Speed (*100 Mbps*)
Base = Baseband Signaling (<u>Outside the scope of CCNA</u>)
T = Twisted Pair cabling

The cables are joined with **RJ-45** connectors, which can be plugged into devices' ports.
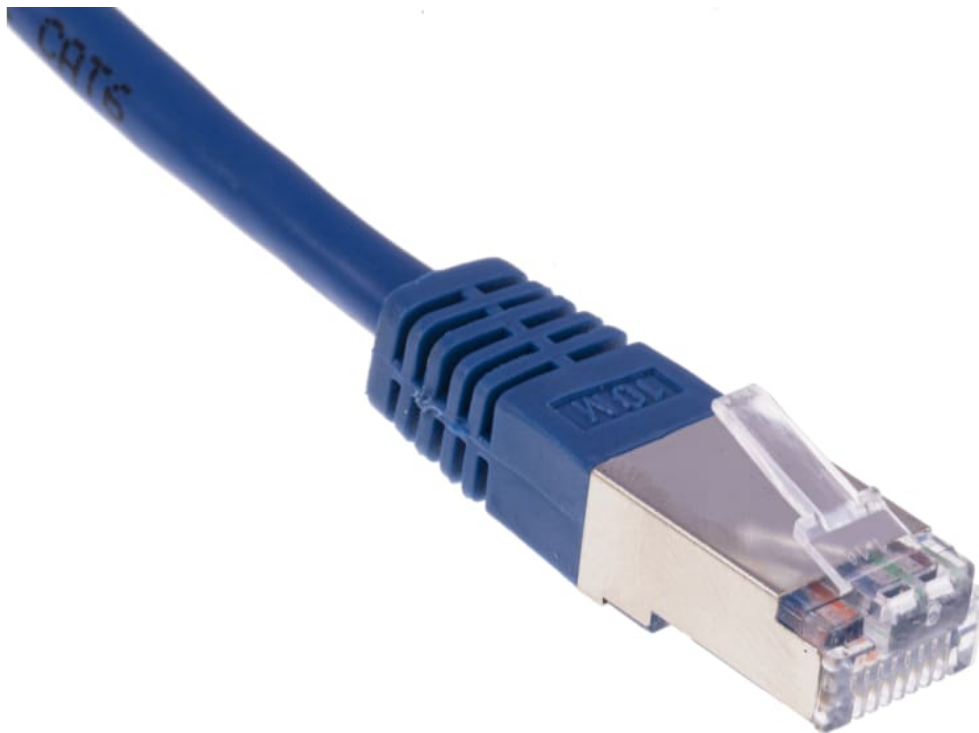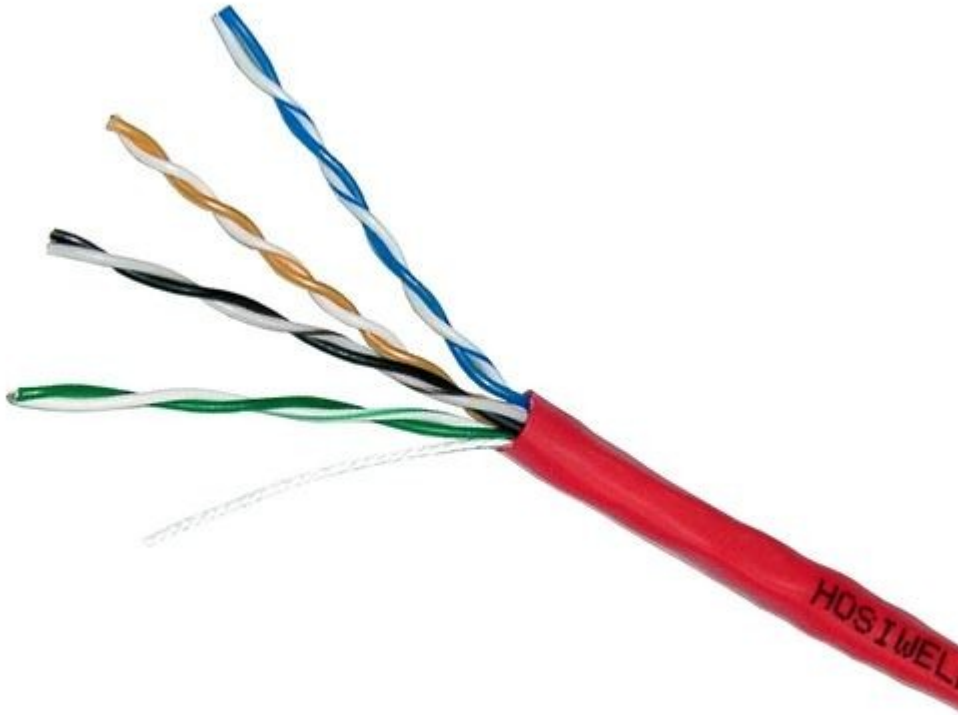
An RJ-45 connector.

An RJ-45 joined with an ethernet cable being plugged into a switch.

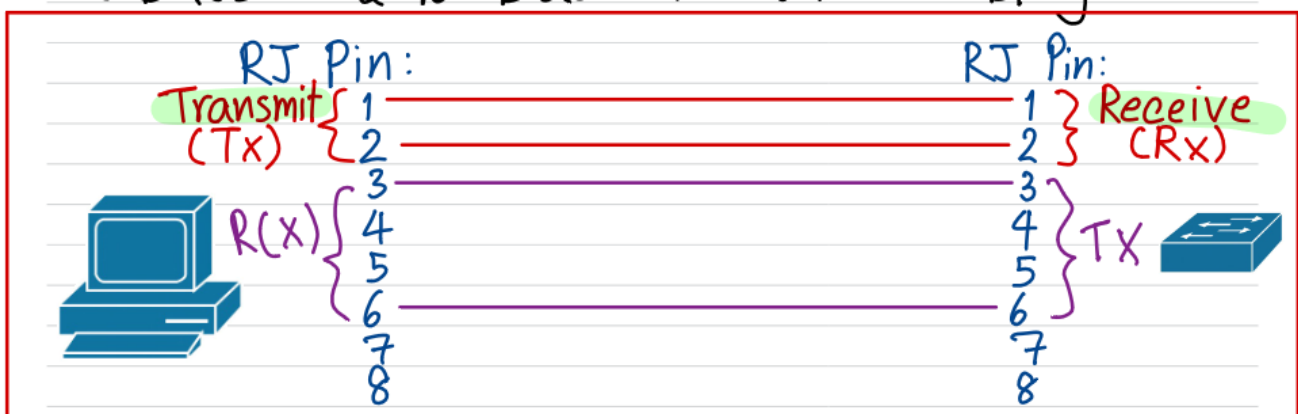## UTP Cabling (Unshielded Twisted Pair)

Contains 8 copper wires (4 pairs):

- Wiring Usage:
  1. `10Base-T` and `100Base-T` : Use **2 pairs** of wires.
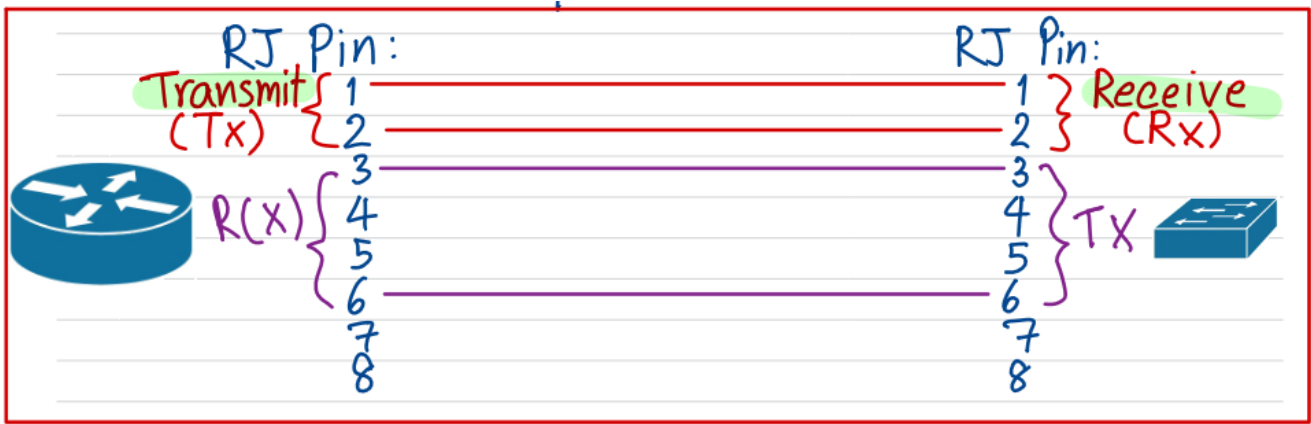 2. `1000Base-T` and `10GBase-T` : Use **All pairs** of wires.

`10Base-T` **and** `100Base-T` :

Uses Pin **1,2** and **3,6** in Transmission (*Tx*) and Receiving (*Rx*).

According to the diagram:

- PC transmits on **Pin 1,2** and Receives on **Pin 3,6**.
- Switch transmit on **Pin 3,6** and Receives on **Pin 1,2**.

According to the diagram:

- Router transmits on **Pin 1,2** and Receives on **Pin 3,6**.
- Switch transmit on **Pin 3,6** and Receives on **Pin 1,2**.

Devices with transmission and receiving on different pairs use **Straight-Through** cabling.

Q: What about devices that both transmit and receive on the same pair? (eg. 2 PC)

A: We connect transmission pins to receiving pins of the other device, and vice-versa.

Devices with transmission and receiving on the same pairs use **Crossover** cabling.

10Base-T and 100Base-T pins usage:

Transmits on PIN 1,2	Transmits on PIN 3,6
PC	Hub
Router	Switch
Wireless Access Point	
Firewall	

Traditionally devices must be connected correctly using either **Straight-Through Cable** or **Crossover Cable**, else the connection will not be established.

Though modern devices possess **Auto MDI-X** capability, which automatically detects when either type of cables is used and will change/switch `Tx` and `Rx` pins if needed.

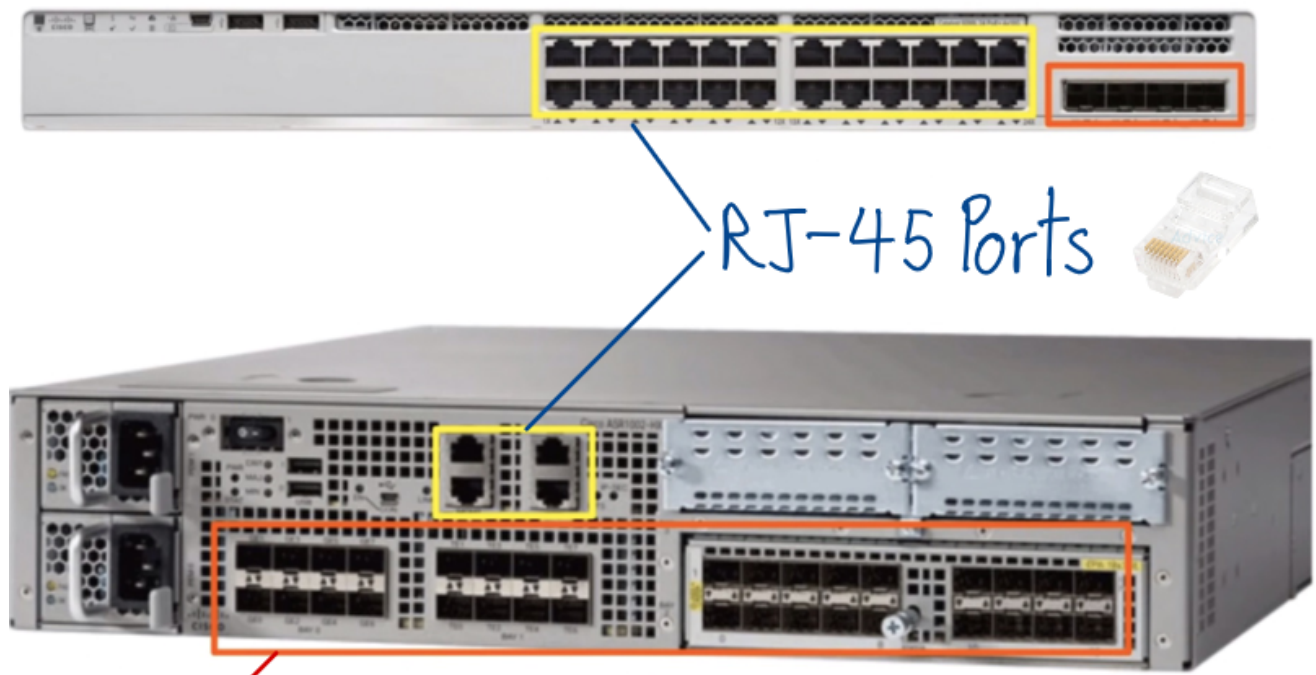`1000Base-T` **and** `10GBase-T` **cabling**

All 8 wires (4 pairs) are used. Each wire is bidirectional.

Fiber Optics

In addition to **RJ-45** ports on devices, modern devices have **SFP** ports as well. (SFP = **Small Form Pluggable**)
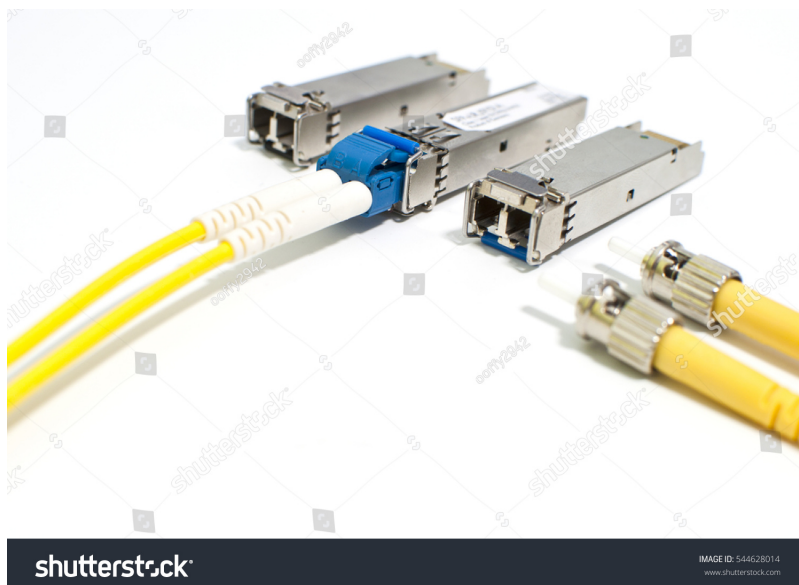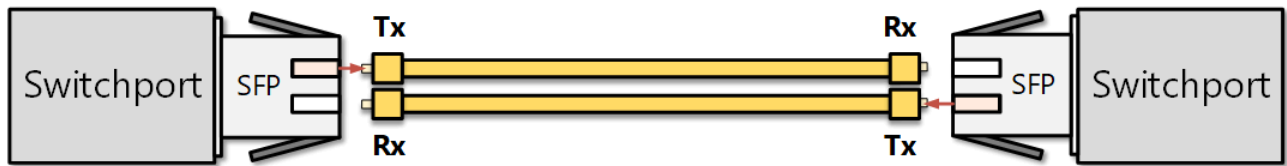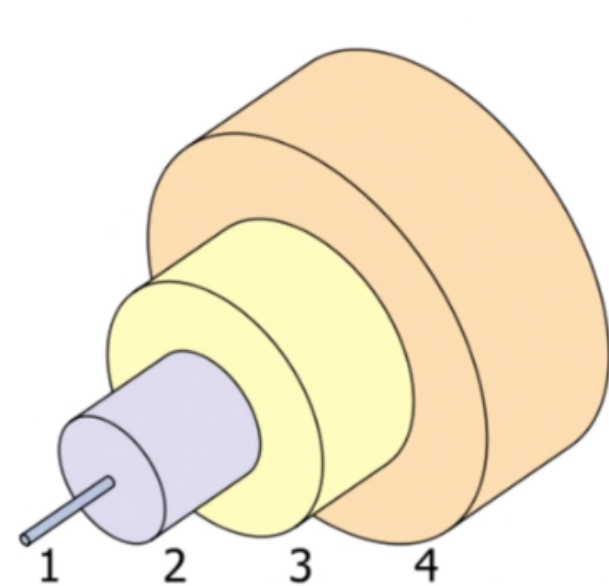
Ports for SFP (Orange)

Fiber optic cables are then connected to the SFP

Transmission and Receiving on Fiber Optic cables.

Instead of copper + electricity, Fiber Optic uses *fiber glass* + *light beam*

1: the fiberglass core itself

2: cladding that reflects light

3: a protective buffer

4: the outer jacket of the cable

Original by Bob Mellish, SVG derivative by Benchill
(https://commons.wikimedia.org/wiki/File:Singlemode_fibre_structure.svg), „Singlemode fibre
structure", https://creativecommons.org/licenses/by-sa/3.0/legalcode

2 Types of Fiber Optic Cables:

1. **Single-Mode**:

Mrzeon (https://commons.wikimedia.org/wiki/File:Optical_fiber_types.svg),
„Optical fiber types", edited,
https://creativecommons.org/licenses/by-sa/3.0/legalcode

- Thinner core diameter than Multi-Mode
- Light enters at a single angle (Mode) from a laser-based transmission.
- Allows longer cables than both UTP and Multi-Mode fiber.
- More expensive than multi-mode fiber (laser-based transmitter)

2. **Multi-Mode**:
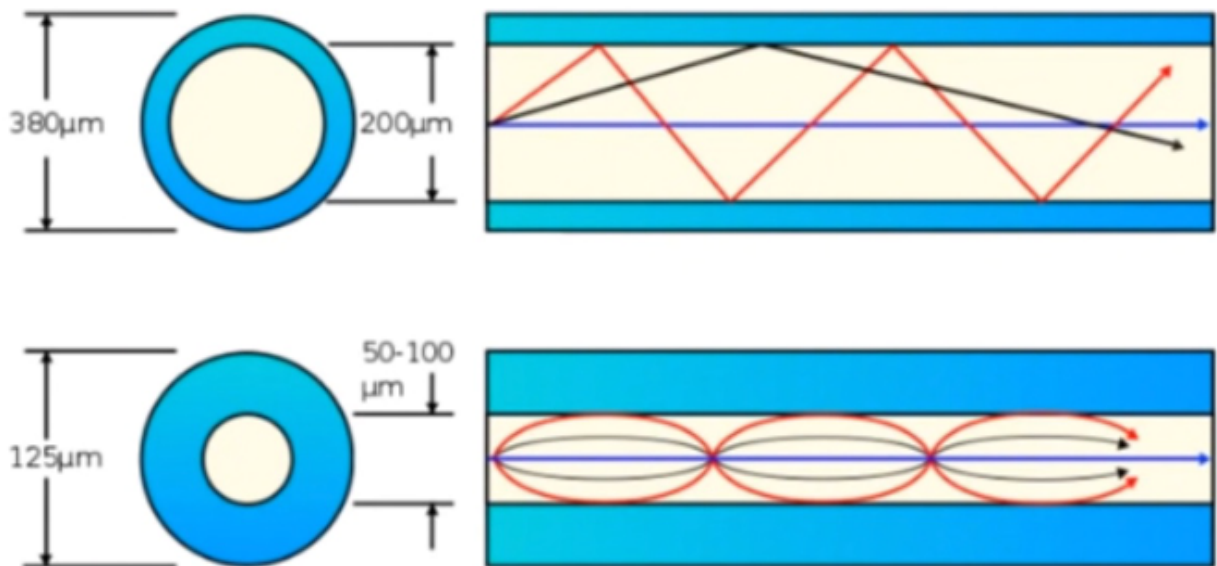
- Core diameter is wider than single-mode fiber.
- Allows multiple angles (Modes) of light waves to enter the code.
- Allows longer cable than UTP but shorter than single-mode.
- Cheaper than Single-Mode fiber. (LED-based transmitter).

Ethernet Standards (**Fiber**): *REMEMBER!*

Speed	Cable Type	IEEE Standards	Informal Name	Maximum Length
1 Gbps	Multi-Mode Single-Mode	802.3z	1000Base-LX	550m (MM) 5km (SM)
10 Gbps	Multi-Mode	802.3ae	10GBase-SR	400m
10 Gbps	Single-Mode	802.3ae	10GBase-LR	10km
10 Gbps	Single-Mode	802.3ae	10GBase-ER	30km

Table 2-5 Comparisons Between UTP, MM, and SM Ethernet Cabling

Criteria	UTP	Multimode	Single-Mode
Relative Cost of Cabling	Low	Medium	Medium
Relative Cost of a Switch Port	Low	Medium	High
Approximate Max Distance	100m	500m	40km
Relative Susceptibility to Interference	Some	None	None
Relative Risk of Copying from Cable Emissions	Some	None	None

Interference = EMI (Electromagnetic Interference)

UTP emits a faint signal outside the cable. Fiber Optic doesn't.

Summary

1. UTP Cabling standard.

Speed	Common Name	IEEE Standards	Informal Name	Maximum Length
10 Mbps	Ethernet	802.3i	10Base-T	100m
100 Mbps	Fast Ethernet	802.3u	100Base-T	100m
1000 Mbps	Gigabit Ethernet	802.3ab	1000Base-T	100m
10 Gbps	10 Gigabit Ethernet	802.3an	10GBase-T	100m

2. Fiber Optic Cabling standard.

Speed	Cable Type	IEEE Standards	Informal Name	Maximum Length
1 Gbps	Multi-Mode Single-Mode	802.3z	1000Base-LX	550m (MM) 5km (SM)
10 Gbps	Multi-Mode	802.3ae	10GBase-SR	400m
10 Gbps	Single-Mode	802.3ae	10GBase-LR	10km

Speed	Cable Type	IEEE Standards	Informal Name	Maximum Length
10 Gbps	Single-Mode	802.3ae	10GBase-ER	30km

3. UTP cabling connects to **RJ-45** connector and has 8 wires (4 pairs). Fiber Optic cable connects to **SFP** connector and has only 2 wires.

4. **10Base-T** and **100Base-T** uses 2 pairs of UTP cable while **1000Base-T** and **10GBase-T** uses all 4 pairs, each being bidirectional.

Transmits on PIN 1,2	Transmits on PIN 3,6
PC	Hub
Router	Switch
Wireless Access Point	-
Firewall	-

5. Devices transmitting on the same pins are connected using **Crossover Cable** while opposite pins transmission uses **Straight Through Cable**.

6. Devices with capabilities to detect and correct crossover and straight-through cables are said to have **Auto MDI-X**.

7. Comparison between UTP, Single-Mode, and Multi-Mode

Table 2-5 Comparisons Between UTP, MM, and SM Ethernet Cabling

Criteria	UTP	Multimode	Single-Mode
Relative Cost of Cabling	Low	Medium	Medium
Relative Cost of a Switch Port	Low	Medium	High
Approximate Max Distance	100m	500m	40km
Relative Susceptibility to Interference	Some	None	None
Relative Risk of Copying from Cable Emissions	Some	None	None