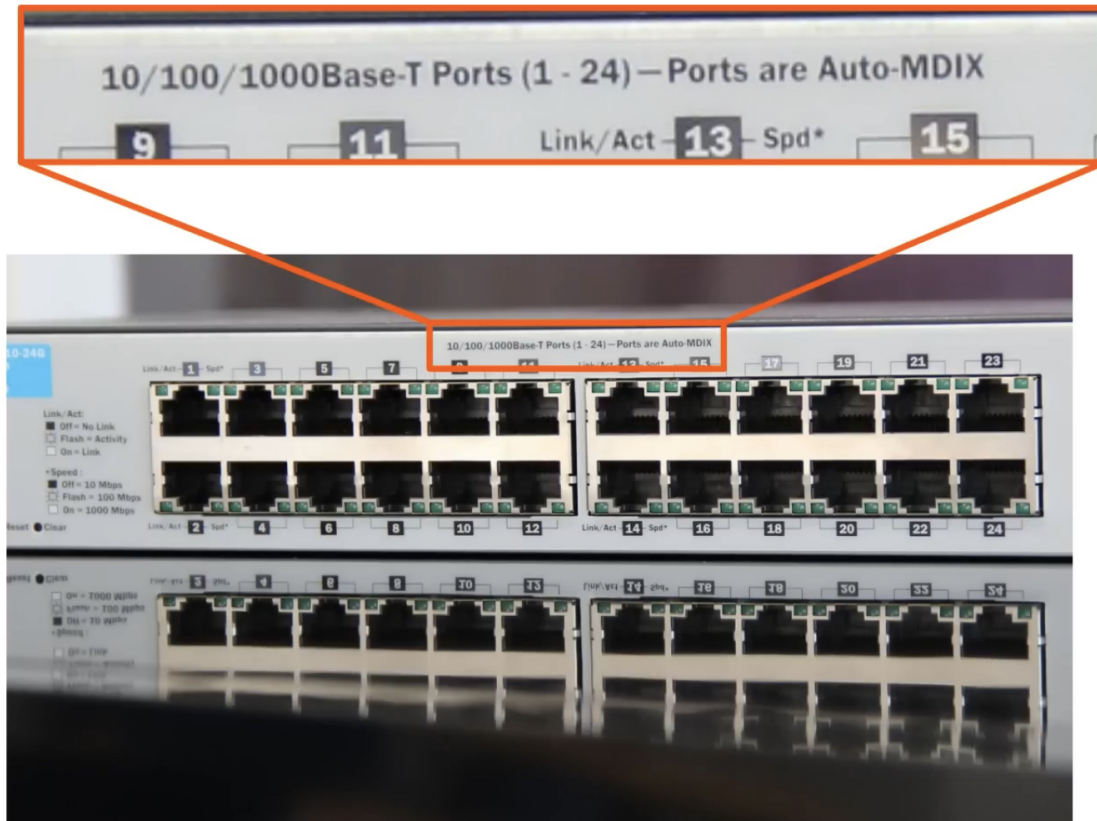


DAY 2 - Interfaces and Cables

Purinat33

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 collection 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 = Institute 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 |

Trivia:

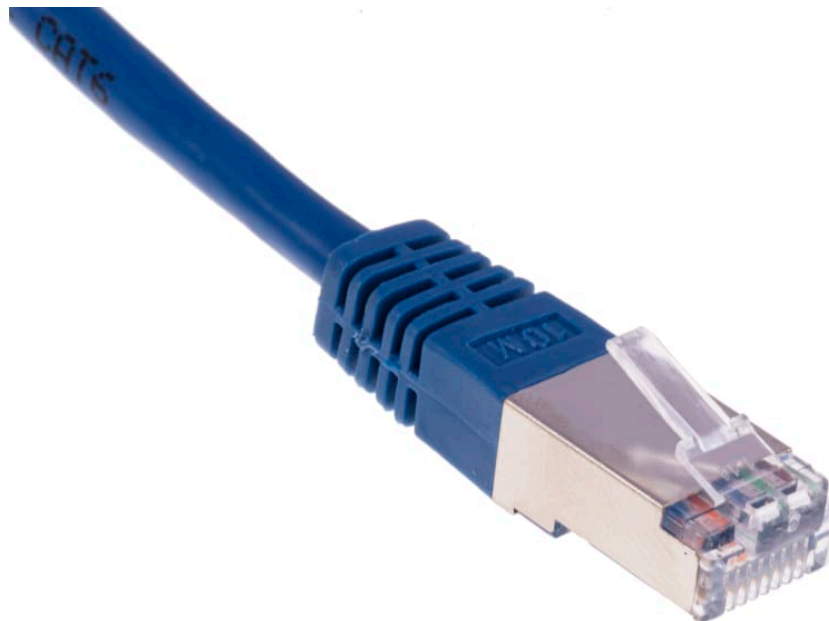
100Base-T

100 = Speed (*100 Mbps*)

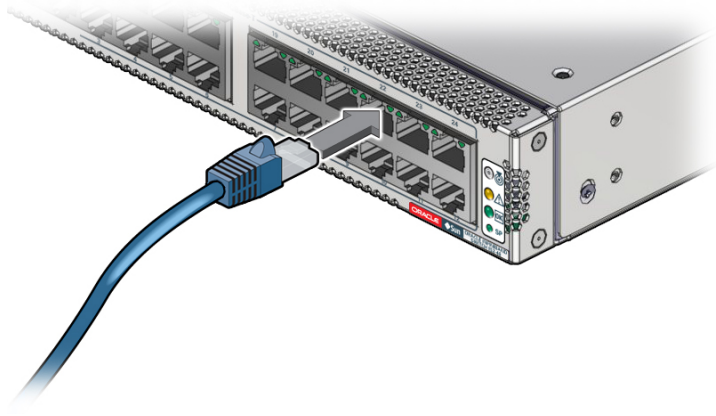
Base = *Baseband Signaling* (*Outside the scope of CCNA*)

T = Twisted Pair cabling

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

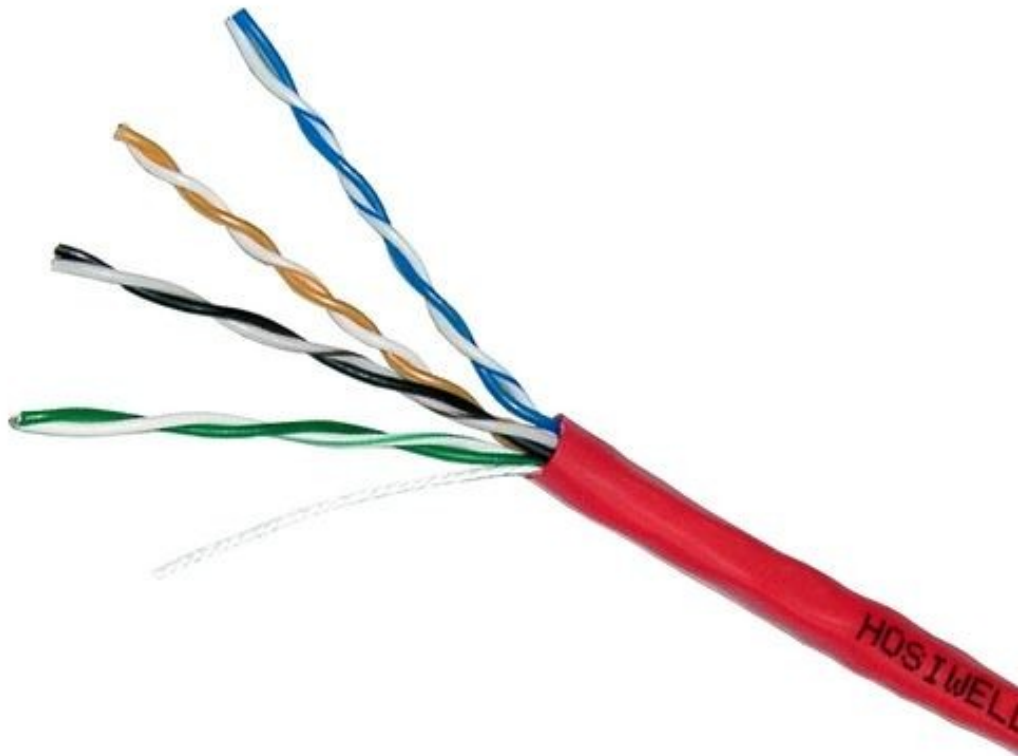


An RJ-45 connector.



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 (T_x) and Receiving (R_x).



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.

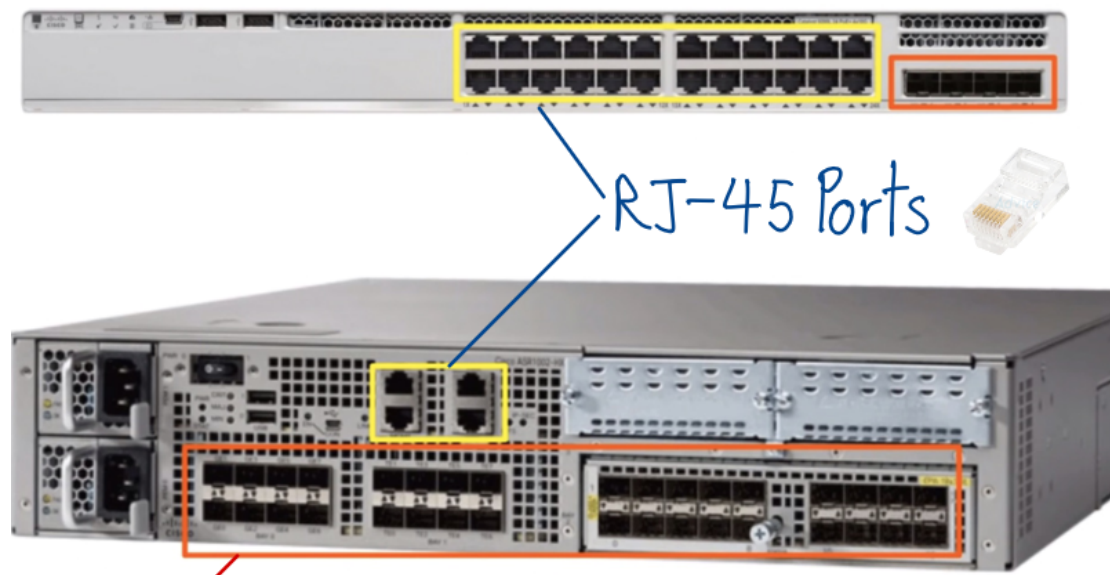
1000Base-T and 10GBase-T cabling

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



Fiber Optics

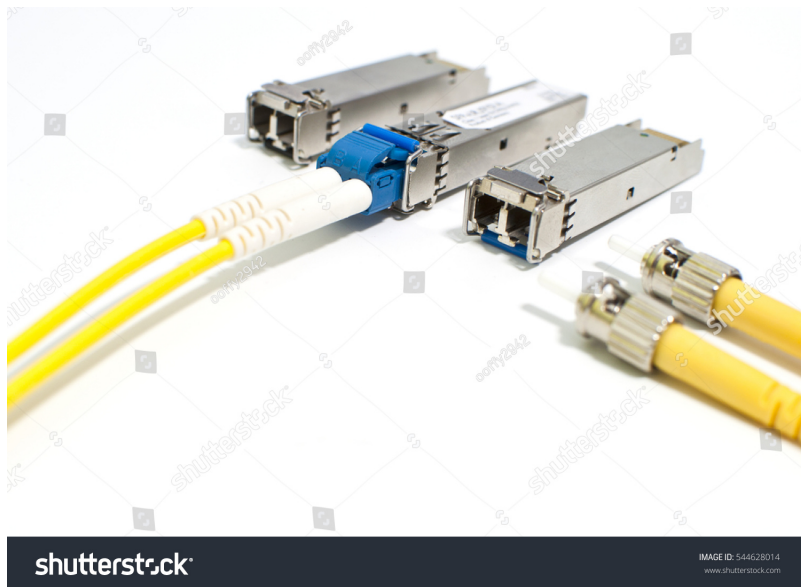
In addition to **RJ-45** ports on devices, modern devices have **SFP** ports as well.
(SFP = **S**mall **F**orm **P**luggable)



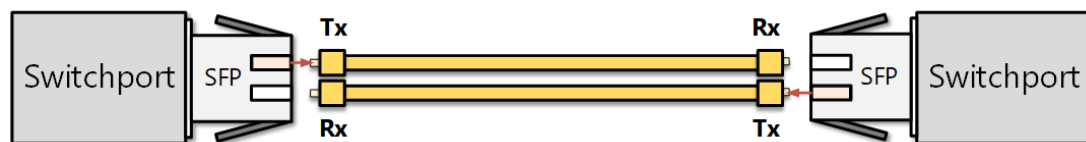
Ports for SFP (Orange)



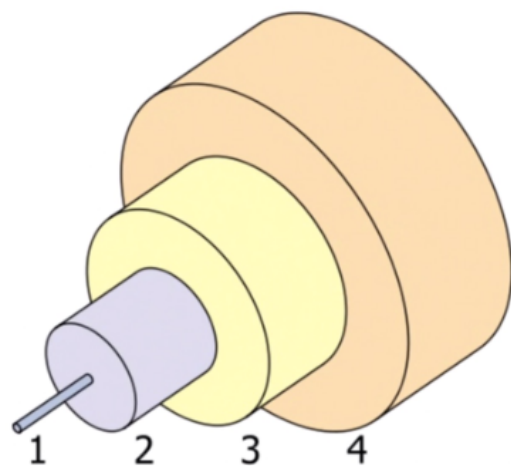
Fiber optic cables are then connected to the SFP



Transmission and Receiving on Fiber Optic cables.



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



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>

- 1: the fiberglass core itself
- 2: cladding that reflects light
- 3: a protective buffer
- 4: the outer jacket of the cable

2 Types of Fiber Optic Cables:

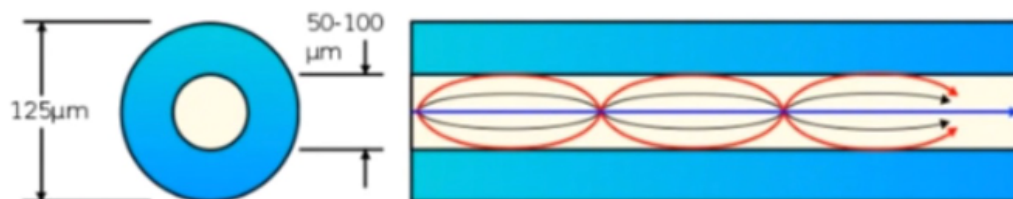
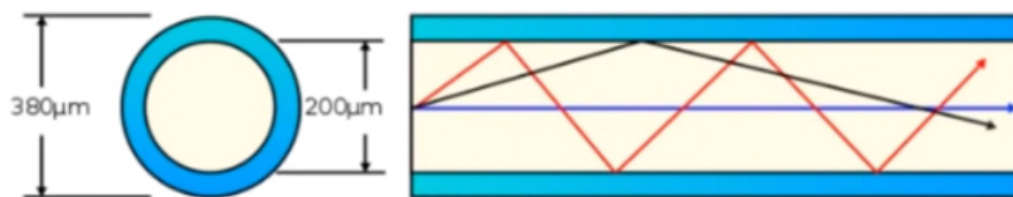
1. Single-Mode:



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 | 802.3z | 1000Base-LX | 550m (MM) |
| | Single-Mode | | | 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 |
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| 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 | 802.3z | 1000Base-LX | 550m (MM) |
| | Single-Mode | | | 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 |

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

Router

Hub

Switch

| | |
|-----------------------|----------------------|
| Transmits on PIN 1,2 | Transmits on PIN 3,6 |
| 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 |
