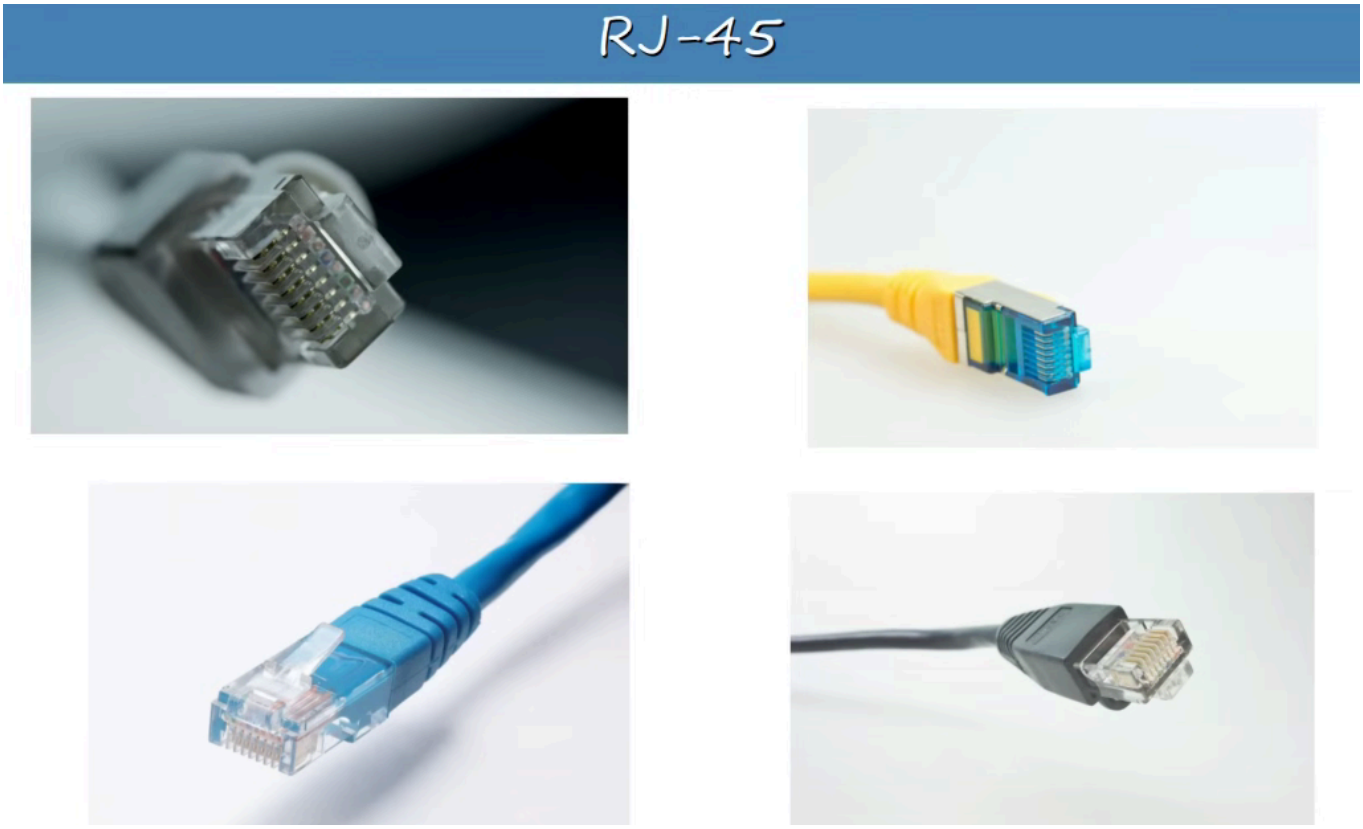
4. Interfaces and Cables

RJ-45 (Registered jack)

This is present at end node of ethernet cable.



Ethernet

it is the collection of network protocols / standards.

- why protocols needed?
  Because if everyone make own protocols they many device can't internet with each other properly. if one people know English and one know Hindi they can't communicate so a standard language need as well a standard protocols needed on which all device communicate.

Bit and Byte

Bite : 0 or 1
byte : 8 bite is 1 byte

device send one bite(0 or 1) at a time not byte at a time (1001011011).
so speed is measure in bites per second , not bytes per second.

1 kb = 1,000 bites
1Mb = 1,000,000 bites
1GB = 1,000,000,000 bites
1Tb = 1,000,000,000,000 bites

Ethernet standards
Standard Ethernet also known as **IEEE 802.3** was the LAN standard proposed by IEEE (the Institute of Electrical and Electronics Engineers) . Data rate for standard Ethernet is 10 Mbps.

Name	Code	Standard	Speed	Distance	Cable
Ethernet	10BASE-T	802.3i-1990	10 Mbps	100 m	Copper
Fast Ethernet	100BASE-TX	802.3u-1995	100 Mbps	100 m	Copper
Fast Ethernet	100BASE-SX	802.3u-1995	100 Mbps	2000 m	Fiber
Giga Ethernet	1000BASE-T	802.3ab-1999	1000 Mbps	100 m	Copper
Giga Ethernet	1000BASE-LX	802.3z-1998	1000 Mbps	5 km	Fiber
10 Gigabit Ethernet	10GBASE-T	802.3an-2006	10 Gbps	100 m	Copper
10 Gigabit Ethernet	10GBASE-LR	802.3ae-2002	10 Gbps	10 km	Fiber
100 Gigabit Ethernet	100GBASE-LR4	802.3ba-2010	100 Gbps	10 km	Fiber

10BASE-T, 10GBASE-T
BASE = refer to baseband signaling.
T = Twisting pair

UTP cables (unshielded Twisted pair)

due to **Unshielded** they can be vulnerable to electrical interference.
Twisting helps against electromagnetic interference (EMI).
Advantages:- cheap, easy to work with **Disadvantages**:- low data rate, short range

> 4 Twisted pair of cable mean 8 wire, each pair have 2 wire.

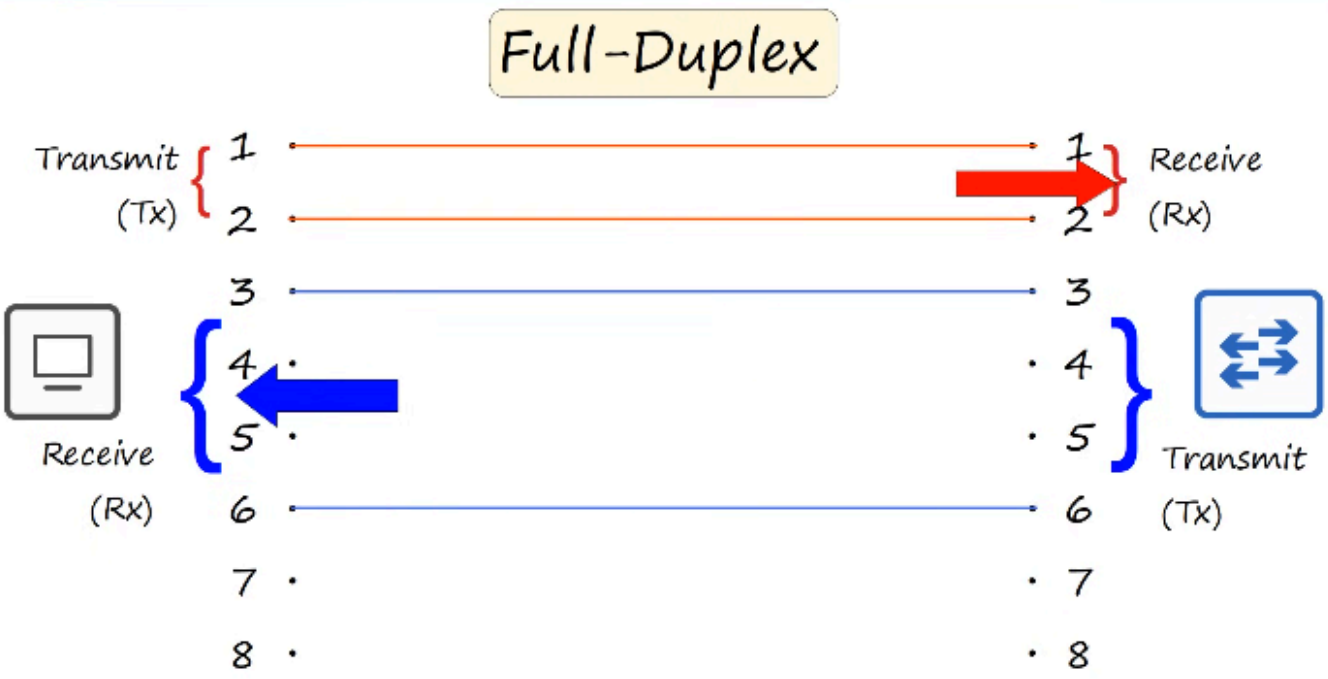
> UTP cable only used up to 100meter

RJ45 connector have 8 pin to connect these 8 wire.
but not all cable have 8 wire:

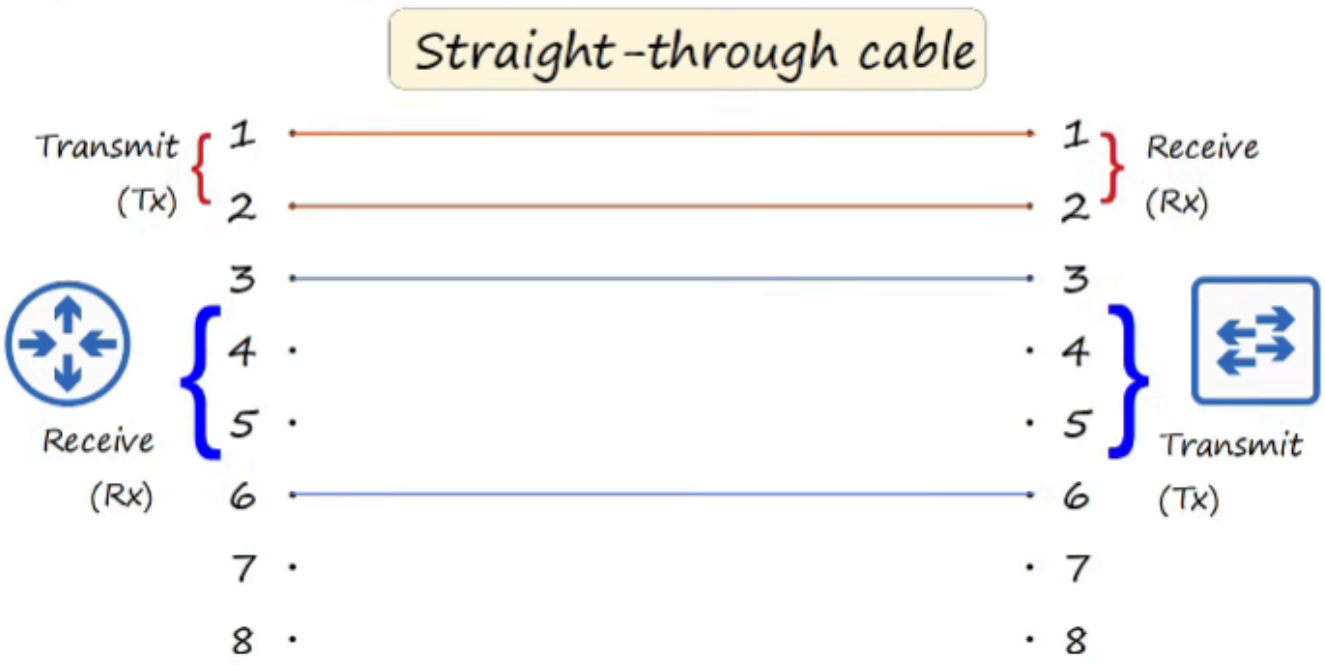
- 10BASE-T or 100BASE-T = 2 pairs (4 wires) (fast)
- 1000BASE-T or 10GBASE-T = 4 pairs (8 wires) (super fast)

Lets take a look at 10BASE-T/ 100BASE-T cables:

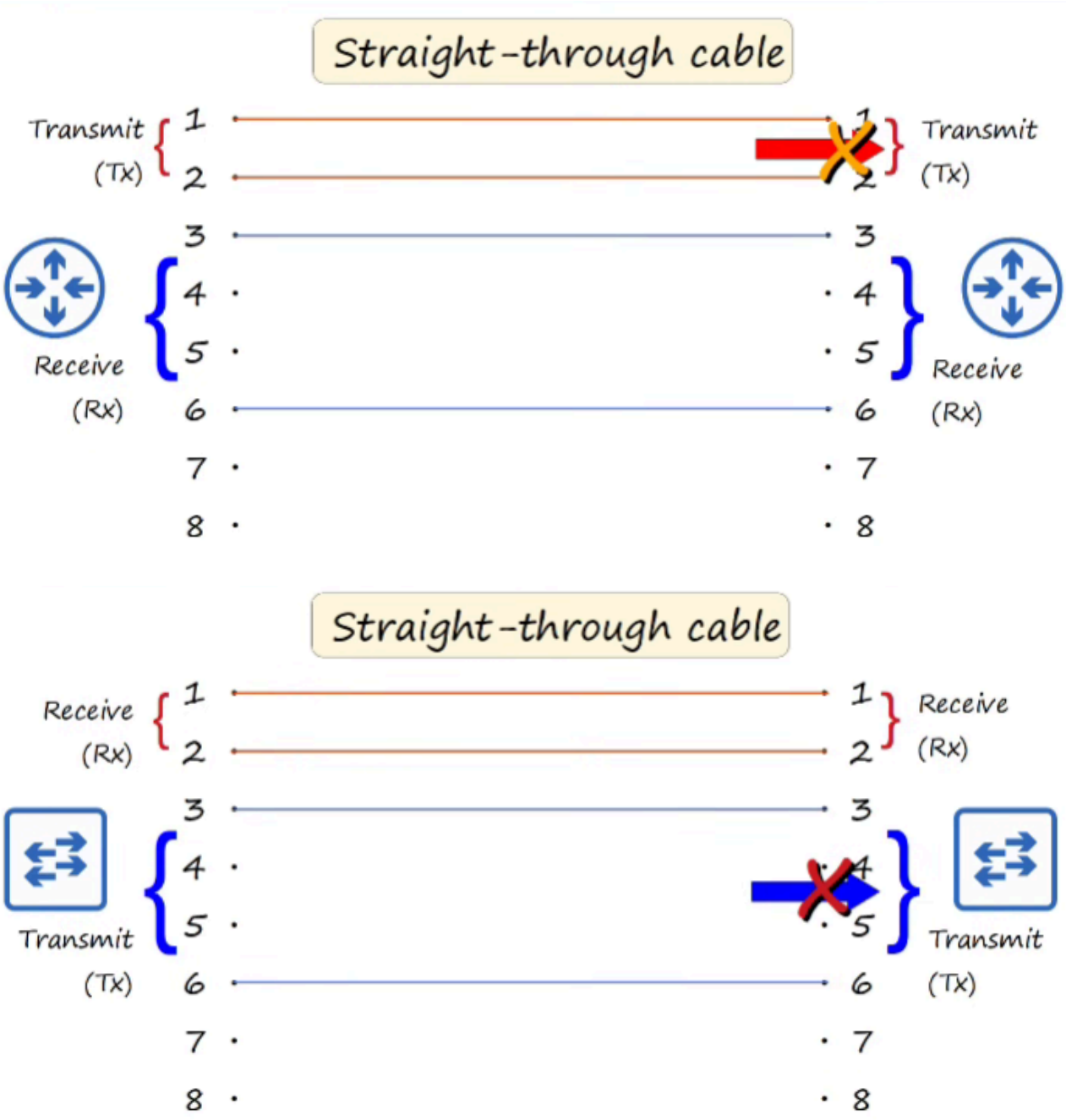
1. To connect PC to a switch we use **Full Duplex cable.**
   wire 1,2 send data from pc and 1,2 receive data in switch.
   wire 3,4 receive data in pc and 3,4 send data in switch.



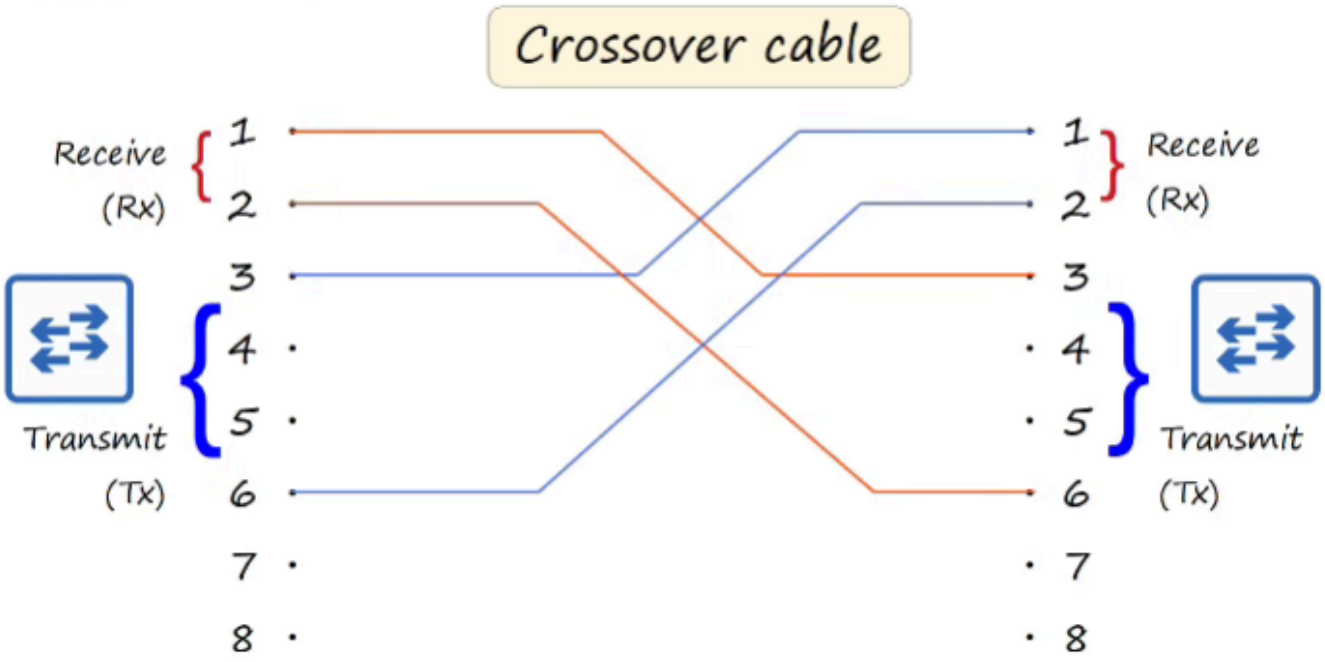
2. **To connect ROUTER To SWITCH Straight through cable use:**



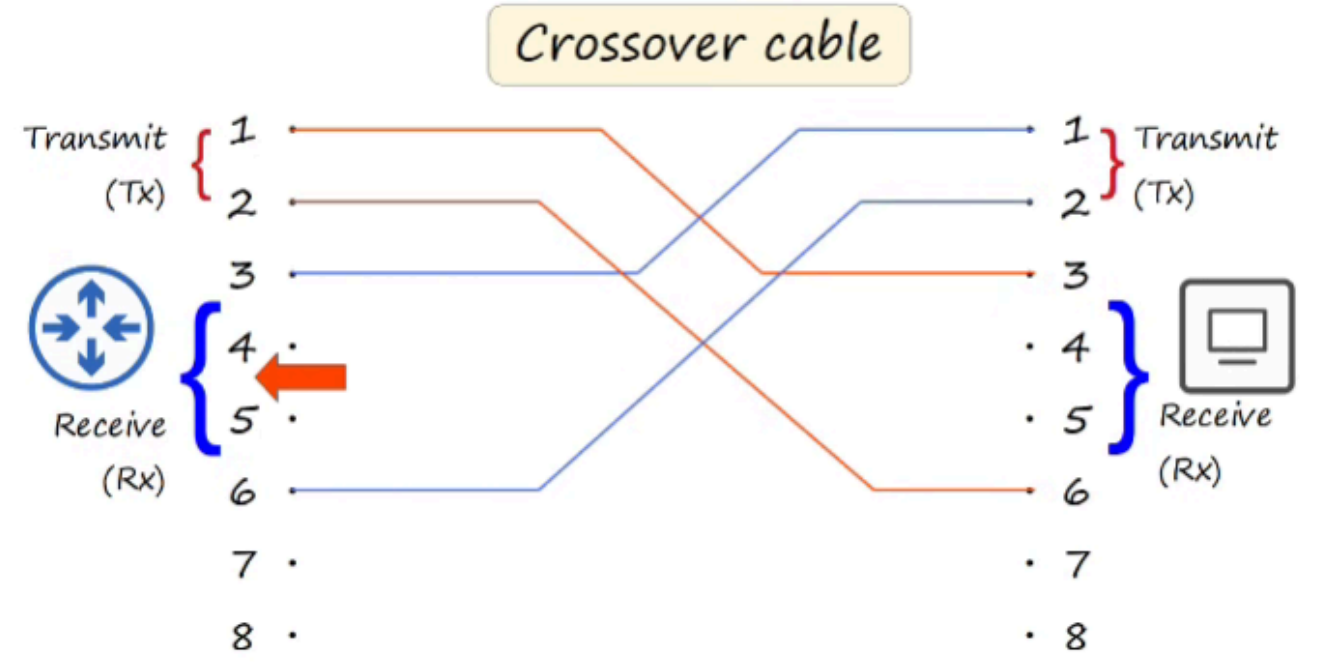
3. **To connect** router to router **or** switch to switch **we can't use straight through cable**
   **we have to use crossover cable



**we have to use crossover cable to connect switch to switch or router to router.



- we can also use **crossover cable to connect router to pc.**



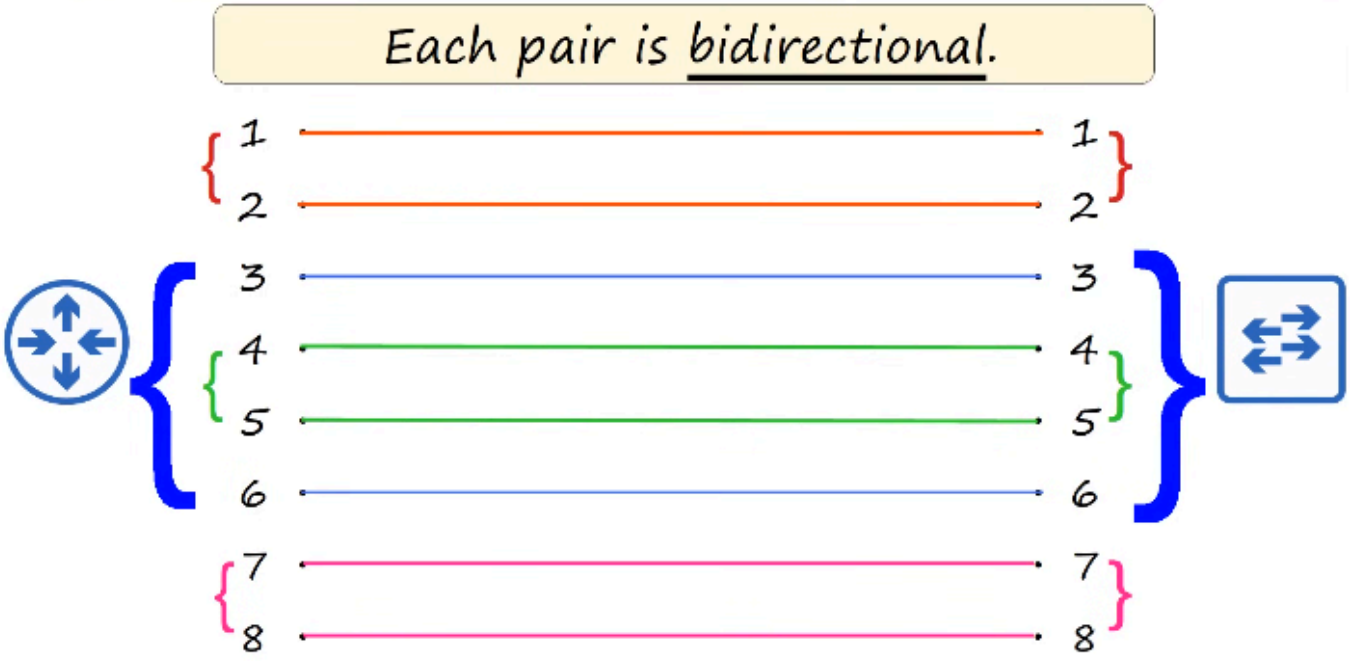
Device Type	Transmit (Tx) Pins	Receive (Rx) Pins
Router	1 and 2	3 and 6
Firewall	1 and 2	3 and 6
PC	1 and 2	3 and 6
Switch	3 and 6	1 and 2

10G-BASE-T

this also use 4,5 and 7,8 wire as well for faster interconnection.

They are bidirectional.

"bidirectional" refers to the ability to transmit and receive data simultaneously in both directions over the same medium.



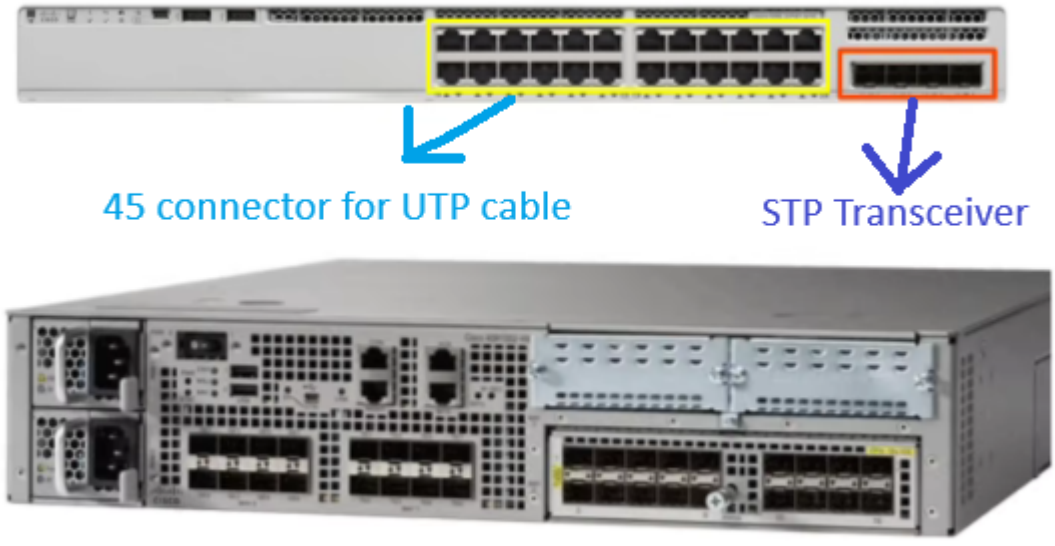
Auto MDI-X

Auto MDI-X (Automatic Medium Dependent Interface Crossover) is a technology used in Ethernet networking that automatically detects and configures the connection type for network devices. This feature allows devices to connect using either straight-through or crossover Ethernet cables without requiring manual configuration.

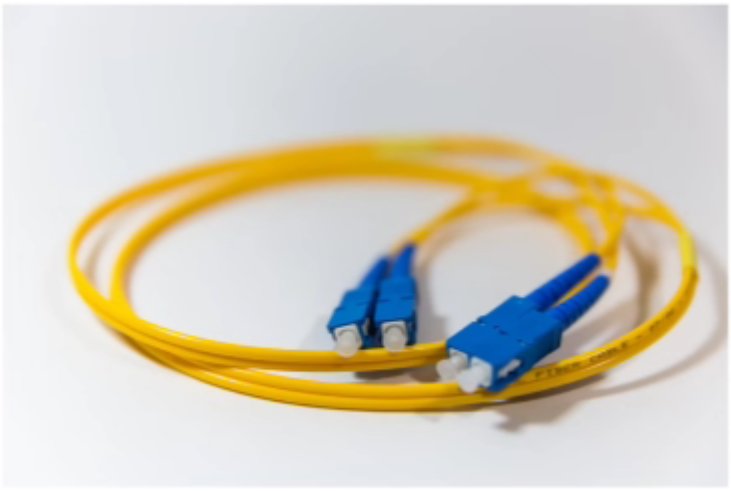
HOW auto MDI-X do it:
he device analyzes the incoming signals to determine whether it is connected to another switch, router, or end device. Based on the detection, the device reconfigures its transmit (Tx) and receive (Rx) pairs accordingly.

Fiber optic connections

- **STP Transceiver (Small form factor pluggable)**
  STP is used to connect fiber optic fire to switch.



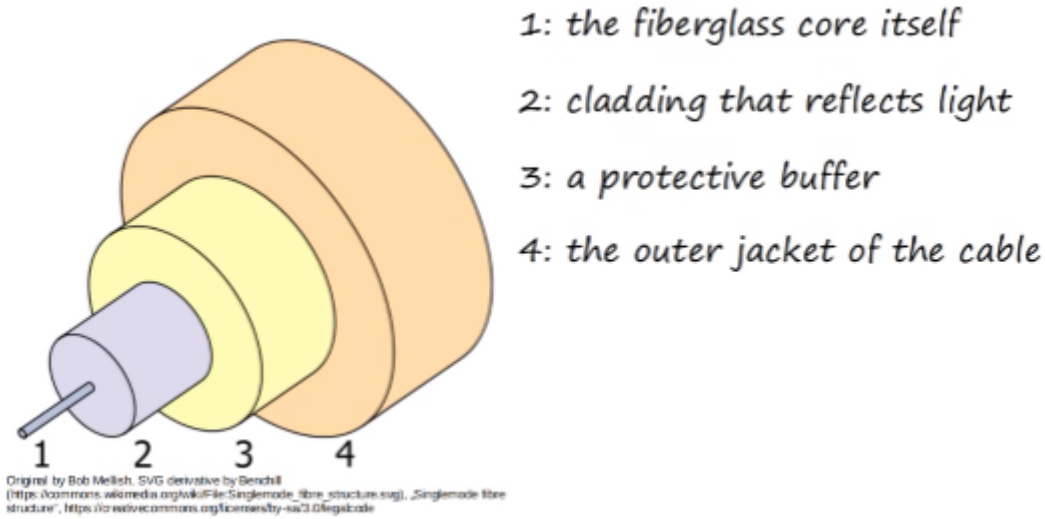
- This is a fiber optic cable connects to STP transceiver.



- This is how fiber optic wire send and receive data.
  as we see before it have 2 wire one for sending data and another for receiving data.

- Inside the Fiber Optic cable their are 4 parts.

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

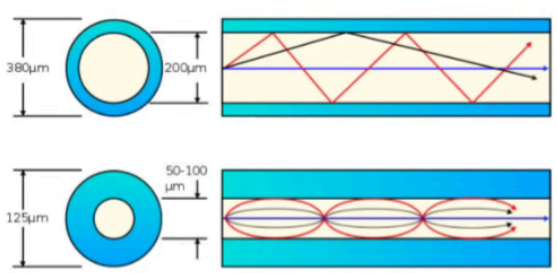


- 2 type of fiber optic

1. multi mode
2. single mode

center white represent the **fiberglass**. blue represent the **reflect glass.**

- In single mode reflective glass width is less.
- In multi mode reflective glass width is more. as you can see in diagram.



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- Core diameter is wider than single-mode fiber.
- Allows multiple angles (modes) of light waves to enter the fiberglass core.
- Allows longer cables than UTP, but shorter cables than single-mode fiber.
- Cheaper than single-mode fiber (due to cheaper LED-based SFP tranmitters).

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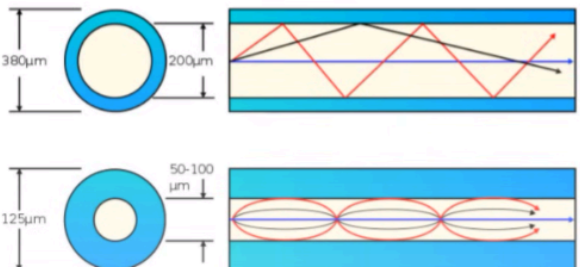

- Core diameter is narrower than multimode fiber.
- Light enters at a single angle (mode) from a laser-based transmitter.
- Allows longer cables than both UTP and multimode fiber.
- More expensive than multimode fiber (due to more expensive laser-based SFP transmitters)

- **fiber optic standard**

Informal Name	IEEE Standard	Speed	Cable Type	Maximum Length
1000BASE-LX	802.3z	1 Gbps	Multimode or Single-Mode	550 m (MM) 5 km (SM)
10GBASE-SR	802.3ae	10 Gbps	Multimode	400 m
10GBASE-LR	802.3ae	10 Gbps	Single-Mode	10 km
10GBASE-ER	802.3ae	10 Gbps	Single-Mode	30 km

Feature	UTP (Unshielded Twisted Pair)	Fiber Optic
Transmission Medium	Copper wires	Glass or plastic fibers
Bandwidth and Speed	Limited (up to 1 Gbps)	High (often exceeding 100 Gbps)
Distance	Effective up to 100 meters	Several kilometers without significant loss
Interference	Susceptible to EMI	Immune to EMI and crosstalk
Cost and Installation	Cheaper and easier to install	More expensive and requires specialized skills