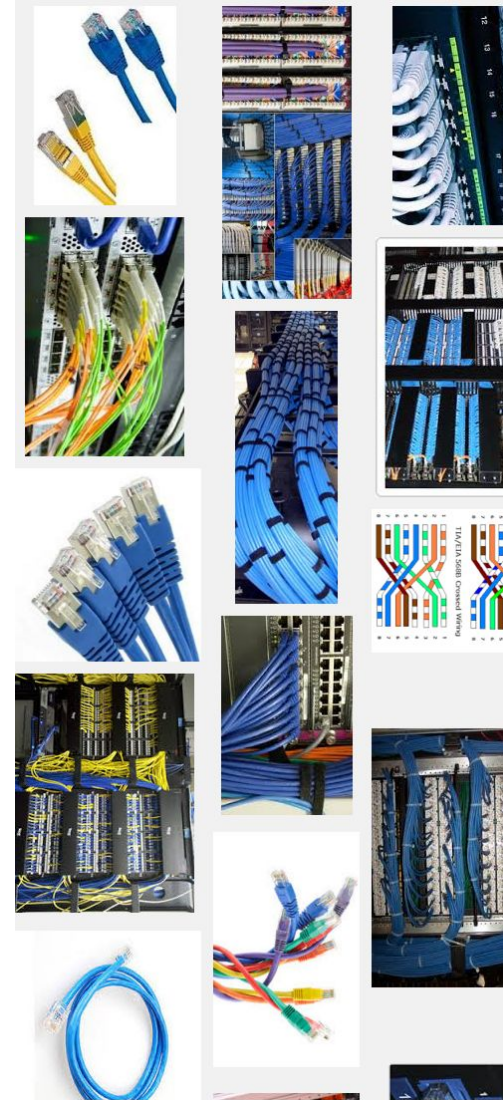
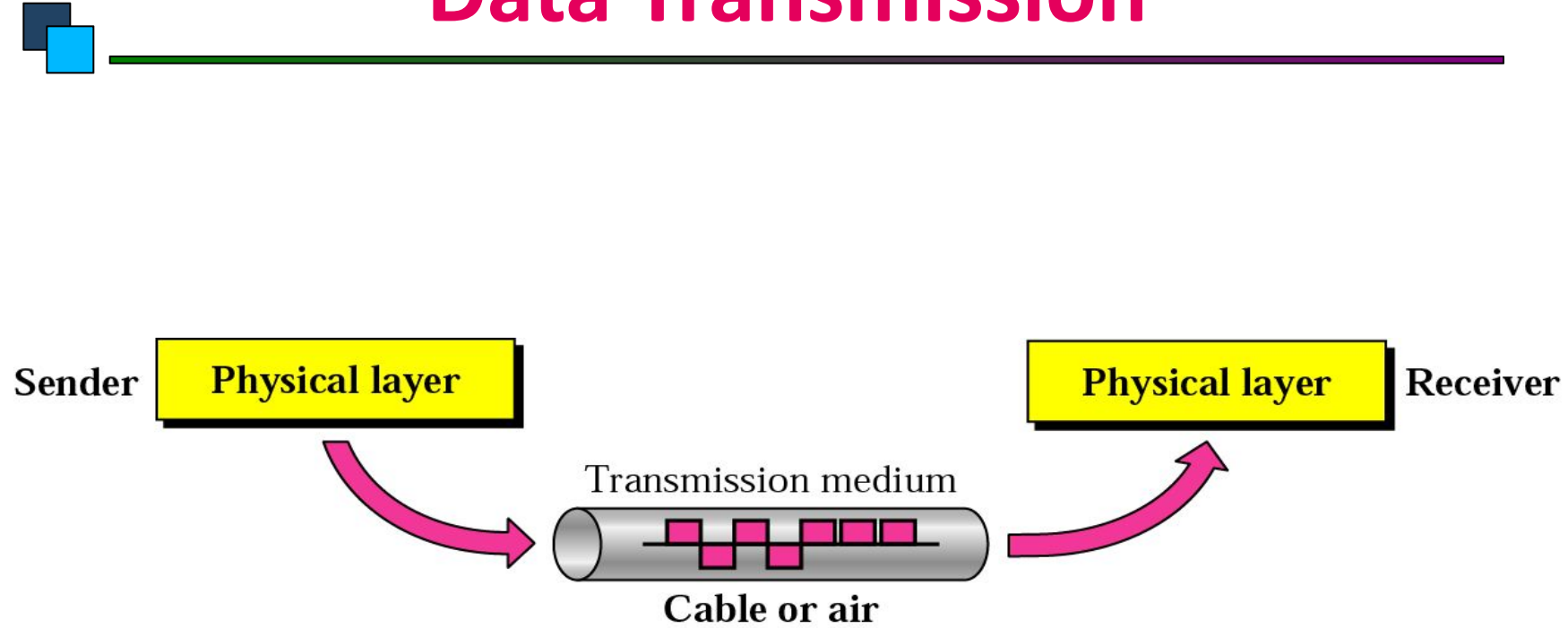


Network Cabling

Making connections with Cat6



Data Transmission



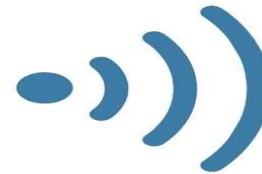
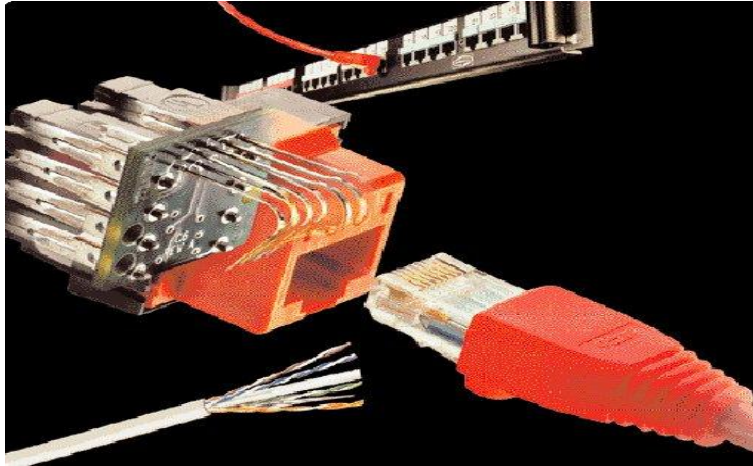
Network interface cards (NIC)



- ❑ The NIC provides the physical connection between the network and the computer workstation.
- ❑ The NIC contains the electronic circuitry required to communicate using a wired connection (e.g., Ethernet) or a wireless connection (e.g., WiFi).
- ❑ Also known as network interface controller, network adapter, or Local Area Network (LAN) adapter.



Transmission MEDIA



Media



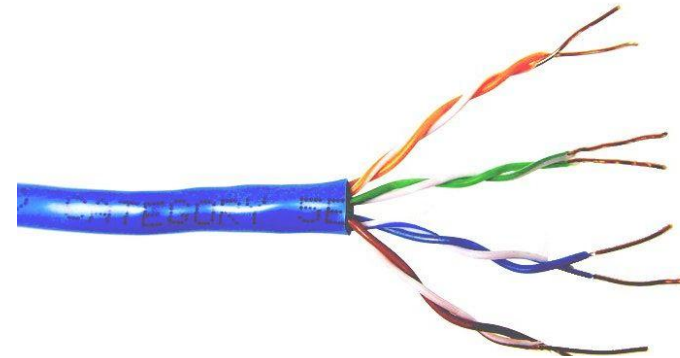
- **Copper**
 - Coaxial Cable - Thick or Thin
 - Unshielded Twisted Pair - CAT 3,4,5,5e&6
 - **Optical Fiber**
 - Multimode – multiple rays
 - Singlemode – a single ray
 - **Wireless**
 - Short Range
 - Medium Range (Line of Sight)
 - Satellite
- 

Common types of cable used in Wired Medium

- Coaxial cable



- Unshielded twisted pair

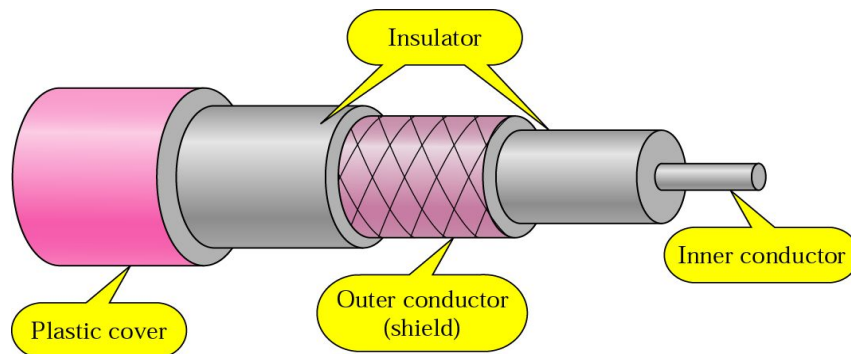


- Fiber optic



Copper Media: Coaxial Cable

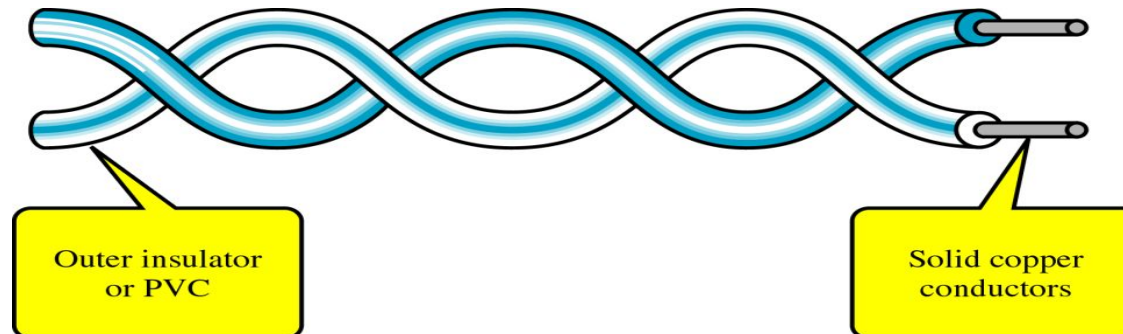
- Coaxial cable is a copper-cored cable surrounded by heavy shielding and is used to connect computers in a network.
- Outer conductor shields the inner conductor from picking up a stray signal from the air.
- High bandwidth but a lossy channel.
- **Repeater** is used to regenerate the weakened signals.



Category	Impedance	Use
RG-59	75 Ω	Cable TV
RG-58	50 Ω	Thin Ethernet
RG-11	50 Ω	Thick Ethernet

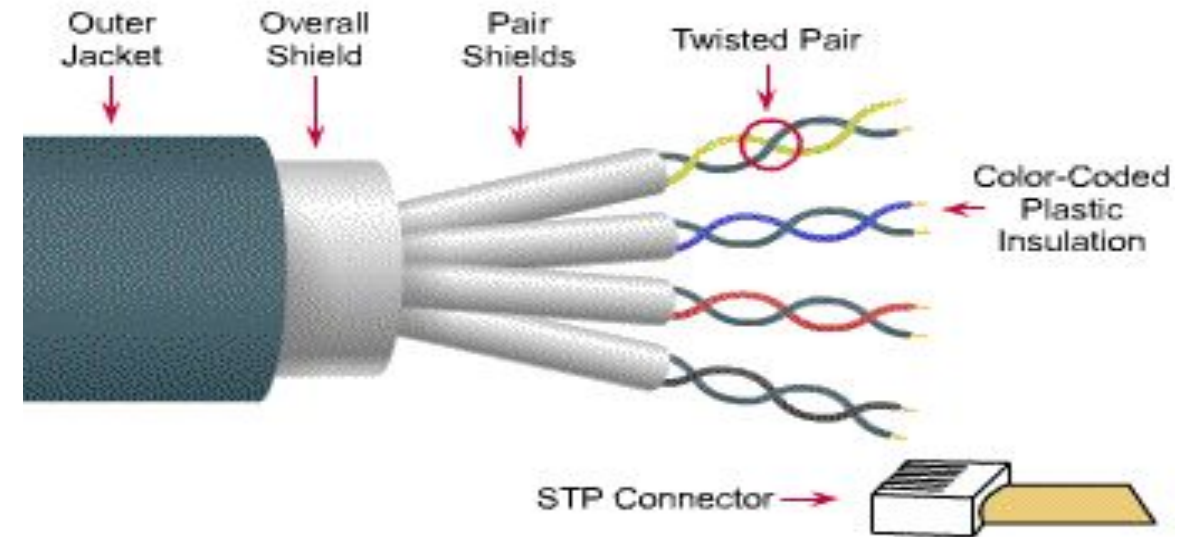
Copper Media: Twisted Pair

- Twisted-pair is a type of cabling that is used for telephone communications and most modern Ethernet networks.
- A pair of wires forms a circuit that can transmit data. The pairs are twisted to provide protection against crosstalk, the noise generated by adjacent pairs.
- There are two basic types, **shielded** twisted-pair (STP) and **unshielded** twisted-pair (UTP).



Shielded Twisted Pair (STP)

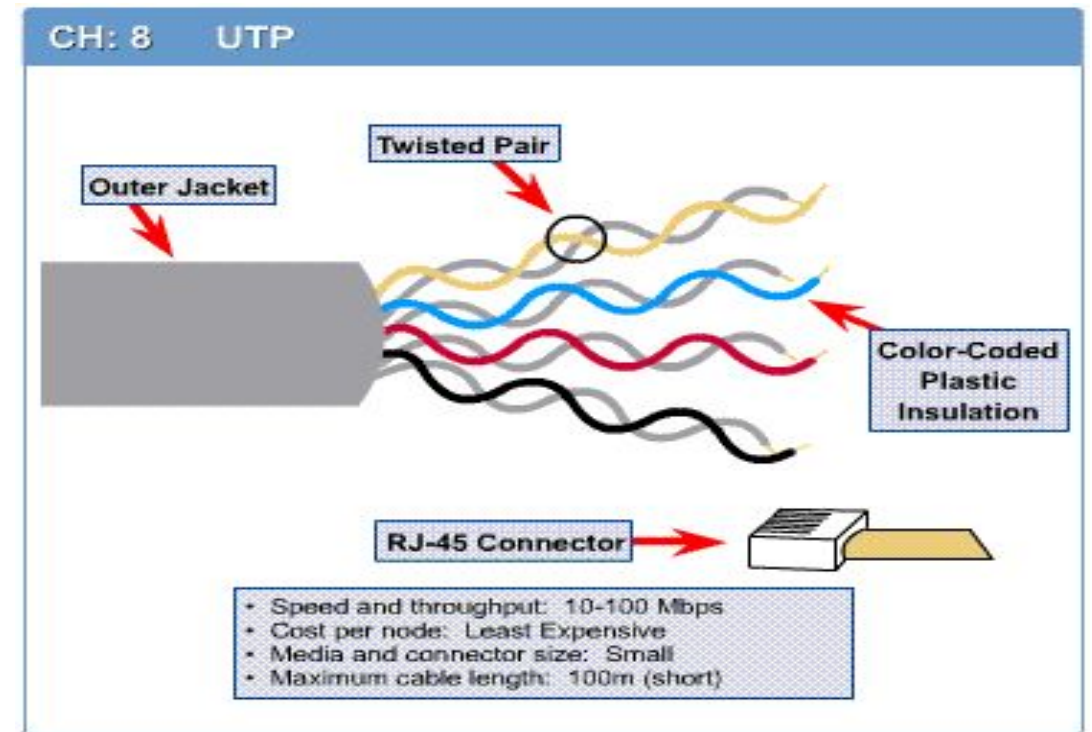
- ✓ Also known as **shielded twisted pair (STP) cable**.
- ✓ It features individual wire pairs wrapped in foil.
- ✓ These pairs are wrapped one more time to provide double protection.
- ✓ The shielding helps prevent electromagnetic interference (**EMI**) and other technical issues that may compromise signals' integrity.



- Speed and throughput: 10-100 Mbps
- Cost per node: Moderately expensive
- Media and connector size: Medium to Large
- Maximum cable length: 100m (short)

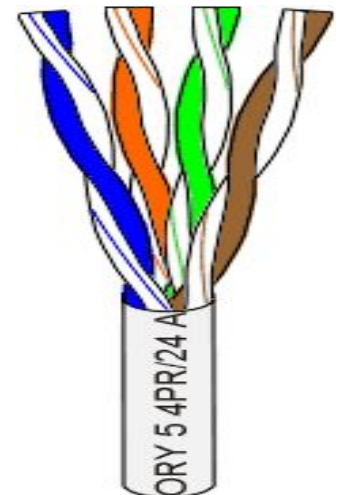
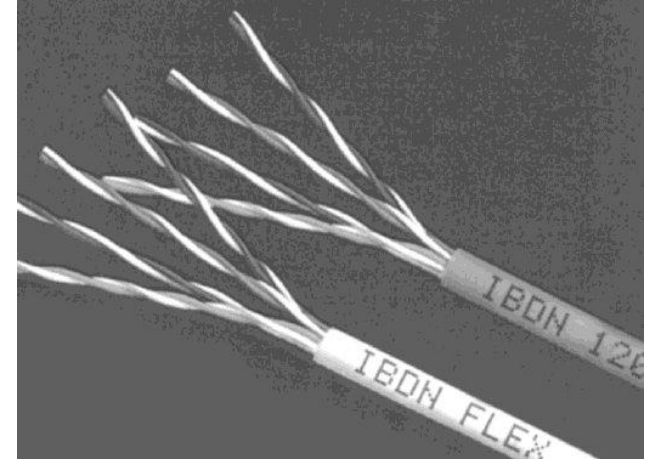
Unshielded Twisted Pair (UTP)

- ✓ UTP cable is a 100-ohm copper cable.
- ✓ Consists of 2 to 1800 unshielded twisted pairs surrounded by an outer jacket.
- ✓ They have no metallic shield.
- ✓ This makes the cable small in diameter but unprotected against electromagnetic interference (EMI).



Unshielded Twisted Pair (UTP)

- Consists of 4 pairs (8 wires) of insulated copper wires typically about 1 mm thick.
- The wires are twisted together in a helical form.
- Twisting reduces the interference between pairs of wires.
- High bandwidth and High attenuation channel.
- Flexible and cheap cable.
- Category rating based on the **number of twists per inch** and the material used.
- CAT 3, CAT 4, CAT 5, Enhanced CAT 5, and now CAT 6.



Categories of UTP

- UTP comes in several categories that are based on the number of twists in the wires, the **diameter** of the wires, and the **material** used in the wires.
- Category 3 is the wiring used primarily for **telephone** connections.
- Category 5e and Category 6 are currently the most common **Ethernet** cables used.

Categories of UTP: CAT 3

- Bandwidth 16 Mhz
- Contains 4 pairs of wires and can carry up to 10Mbps
- Used in voice applications and 10baseT (10Mbps) Ethernet

Categories of UTP: CAT 4

- 20 MHz Bandwidth
- contains 4 pairs of wires and can carry up to 16Mbps
- Used in 10baseT (10Mbps) Ethernet

Categories of UTP: CAT 5

- 100 MHz Bandwidth
- Contains 4 pairs of wires and can carry up to 100Mbps
- Used in 10BaseT (10 Mbps) Ethernet & Fast Ethernet (100 Mbps)

Categories of UTP: CAT 5e

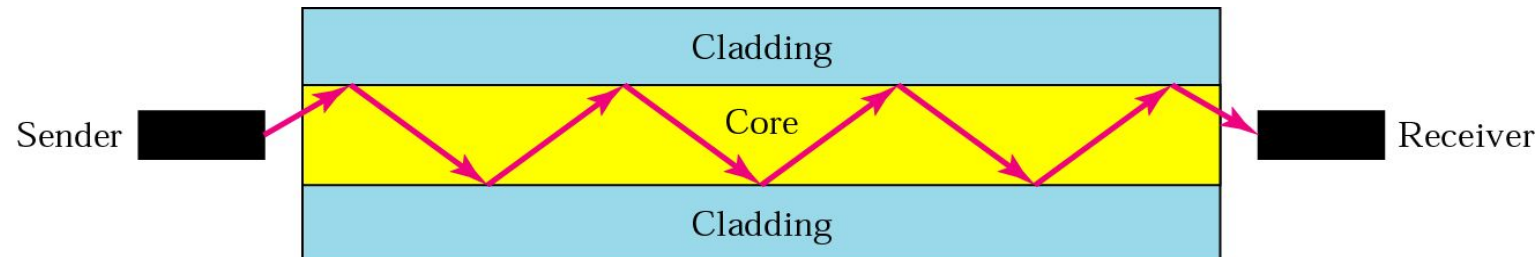
- 150 MHz Bandwidth
- a higher grade of CAT5 that contains high-quality copper
- Used in Fast Ethernet (100 Mbps), Gigabit Ethernet (1000 Mbps)

Categories of UTP: CAT 6

- 250 MHz Bandwidth
- a twisted pair cable that contains 4 wire pairs each wrapped in foil insulation
- Transmits high-speed data
- Used in Gigabit Ethernet (1000 Mbps) & 10 Gig Ethernet (10000 Mbps)

Fiber Media

- Optical fibers use **light** to send information through the optical medium.
- It uses the principle of total internal reflection.
- Modulated light transmissions are used to transmit the signal.



Cabling Standards

- ❑ Cabling is an integral part of building any network.
- ❑ When installing cable, it is important to follow cabling standards, which have been developed to ensure data networks operate to agreed levels of performance.
- ❑ Cabling standards are a set of specifications for the installation and testing of cables.

White/Orange	
Orange	
White/Green	
Blue	
White/Blue	
Green	
White/Brown	
Brown	

Twisted Pair Cables

- ❑ Twisted pair cable is most commonly used in network installations.
- ❑ The TIA/EIA organization defines two different patterns, or wiring schemes, called **T568A** and **T568B**.
- ❑ Each wiring scheme defines the pinout, or order of wire connections, on the end of the cable.
- ❑ The two schemes are similar **except two of the four pairs** are reversed in the termination order.

TIA (Telecommunications Industry Association)

EIA (Electronics Industries Alliance)

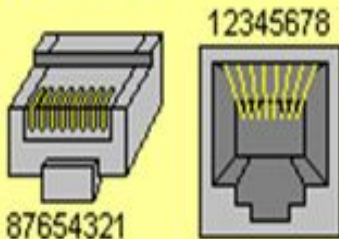
Twisted Pair Cables

Networking – Cable Configuration

Network Cabling and Signal Identification for Ethernet LAN Standards

**Note: GigaBit Ethernet
Requires All 4 Pairs.**

RJ45 3D View



Front
View

Rear
View

RJ45 - Pinout, Wire Pair Color Coding, and Signal Identification

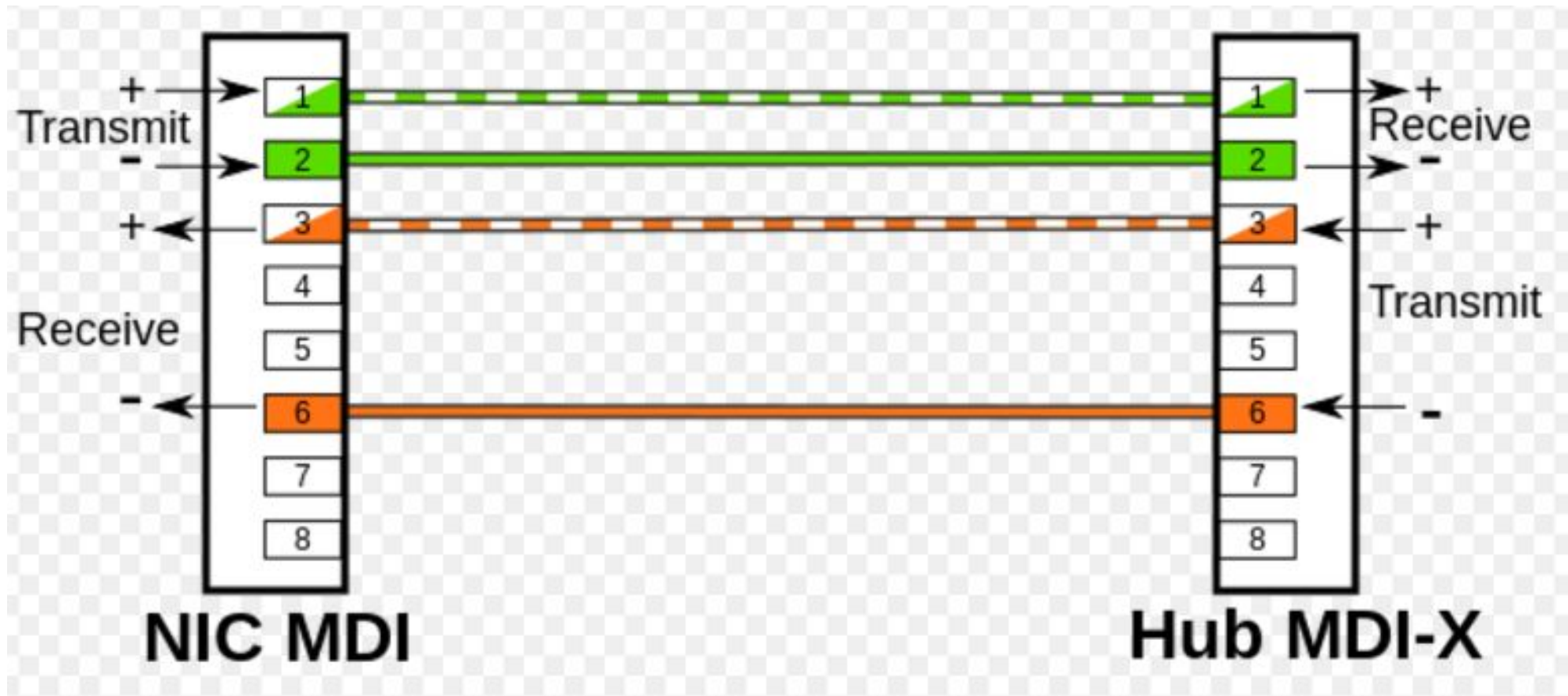
Pin	T568A	T568B	Signal 10/100BaseTx	Signal 1000BaseT
1	Wht/Grn	Wht/Org	Tx+	TP1+
2	Grn	Org	Tx-	TP1-
3	Wht/Org	Wht/Grn	Rx+	TP2+
4	Blu	Blu	Unused	TP3-
5	Wht/Blu	Wht/Blu	Unused	TP3+
6	Org	Grn	Rx-	TP2-
7	Wht/Brn	Wht/Brn	Unused	TP4+
8	Brn	Brn	Unused	TP4-

What does +(plus) and -(minus) sign mean in cable pairs for RJ45

The positive and negative connectors in the cabling mentioned, form a balanced pair for signals. They typically carry identical signals of opposite polarity, i.e. a HIGH bit may be +5 Volts on the + conductor, and -5 Volts on the - conductor. The corresponding LOW bit would then be -5 Volts on the + conductor, and +5 Volts on the - conductor.

Having such signals of opposite polarity in a twisted pair of wires helps in reducing susceptibility to common-mode noise / EMI. Because the voltage difference between the two conductors for any valid bit is twice the actual signaling voltage, this has the effect of doubling the strength and hence the detection of the signal at the receiving end.

Specific to the cabling / protocol involved, various signaling schemes may be used for transmitting the actual bits down the line, from the simple Gray Code, to more complex non-return-to-zero (NRZ) or other coding.

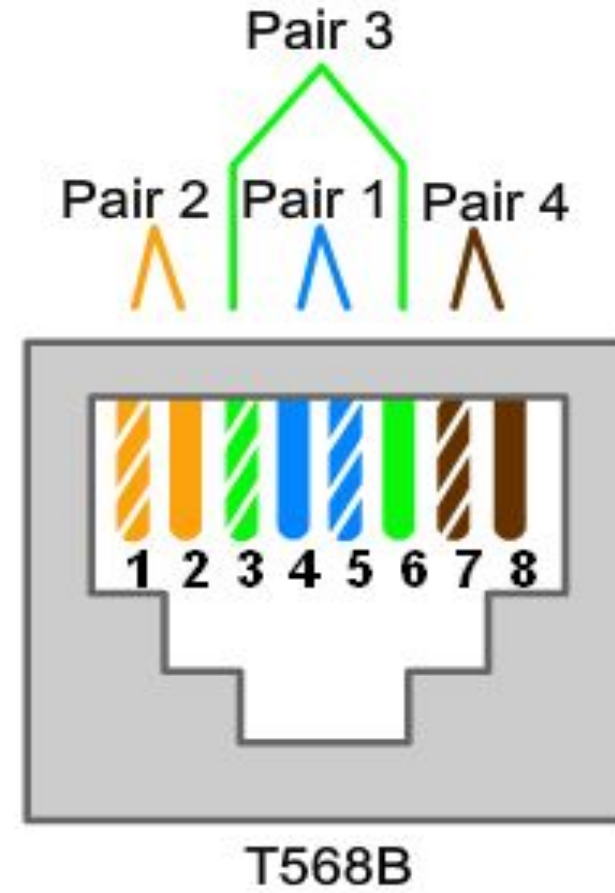
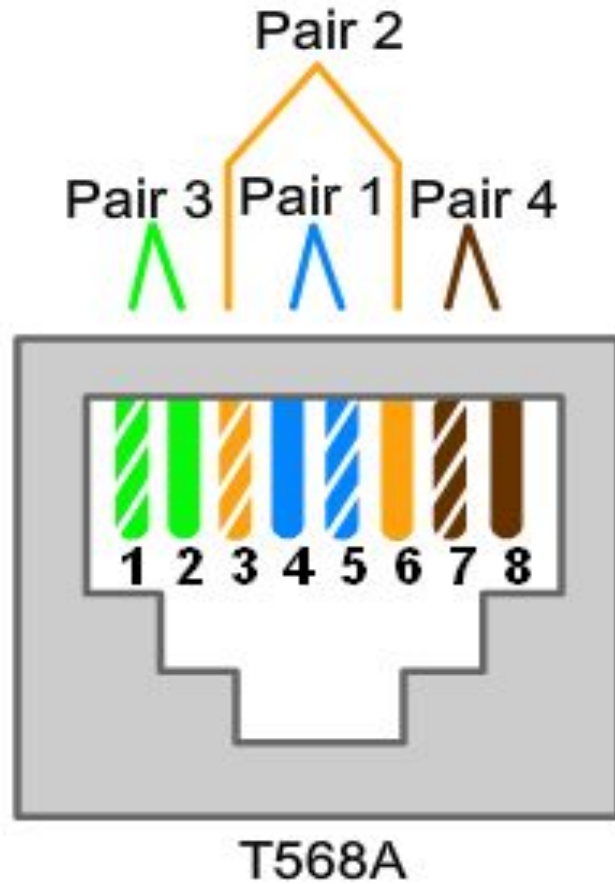


Twisted Pair Cables



- ❑ On a network installation, one of the two wiring schemes (T568A or T568B) should be chosen and followed.

Twisted Pair Cables



Twisted Pair Cables

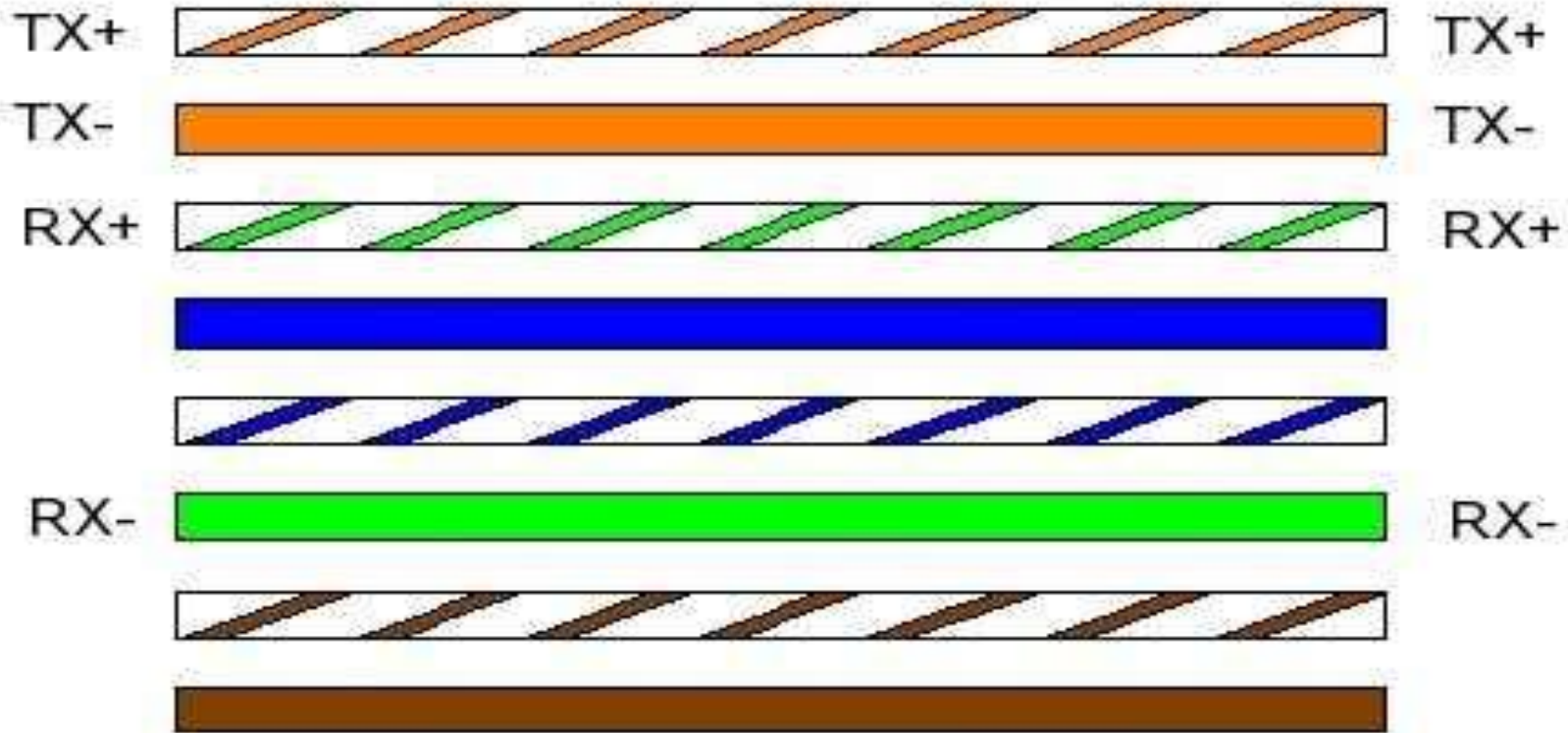
- Using the T568A and T568B wiring schemes, two types of cables can be created:
 - a straight-through cable
 - a crossover cable.
- These two types of cable are found in data installations.

Straight-through Cable

- A Straight-through cable is the most common cable type.
- It maps a wire to the same pins on both ends of the cable.
 - If T568A is on one end of the cable, T568A is also on the other.
 - If T568B is on one end of the cable, T568B is on the other.
 - This means that the order of connections (the pinout) for each color is the exact same on both ends.

Straight-through Cable

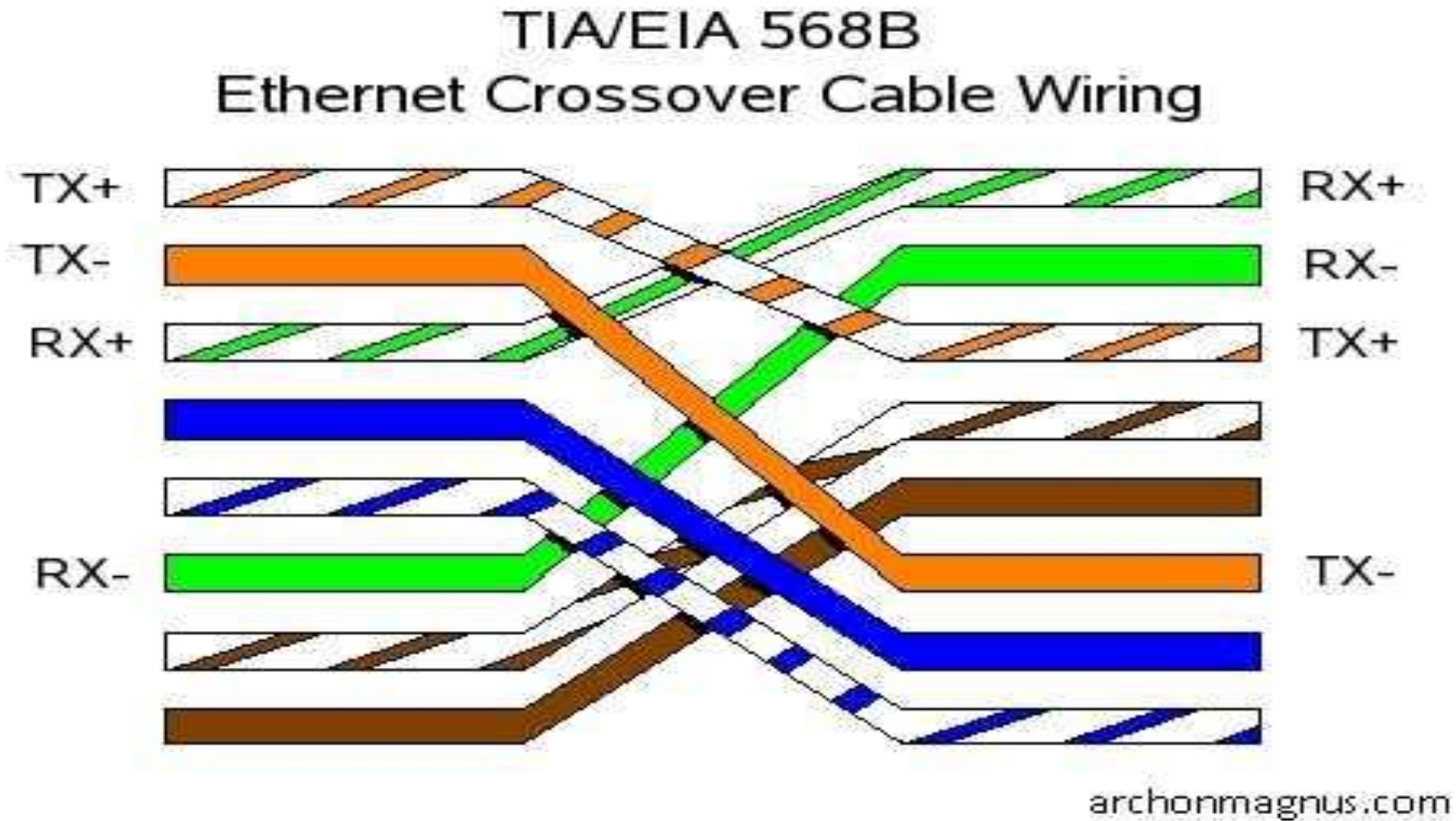
TIA/EIA 568B
Ethernet Cable Wiring



Crossover Cable

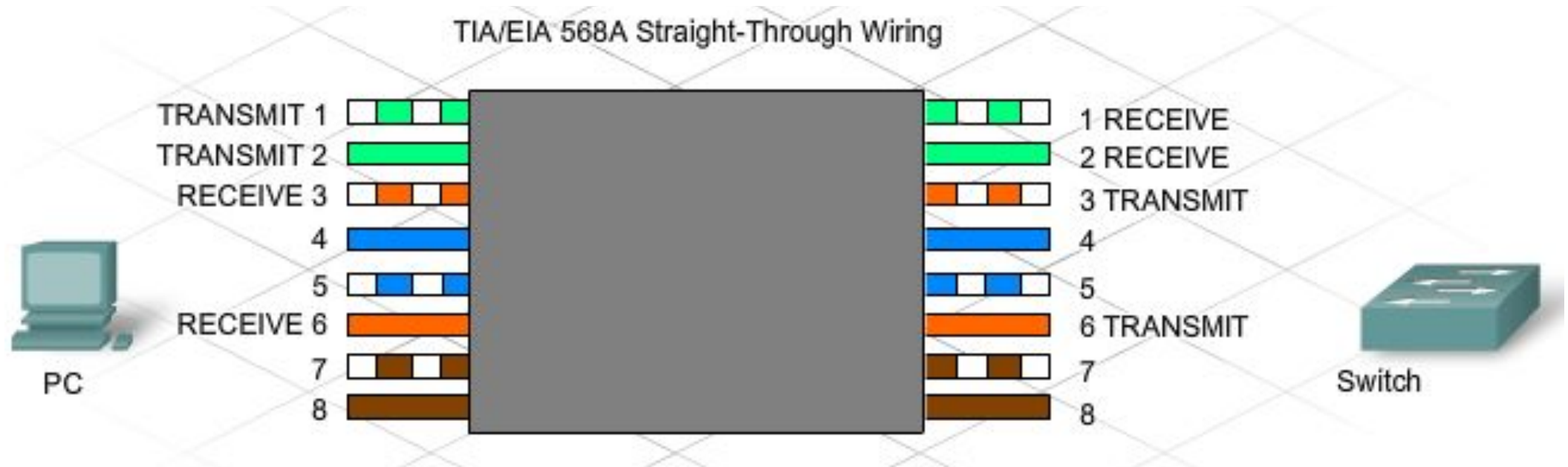
- A crossover cable uses both wiring schemes.
- T568A on one end of the cable and T568B on the other end of the same cable. This means that the order of connections on one end of the cable does not match the order of connections on the other.
- The straight-through and crossover cables each have a specific use on the network. The type of cable needed to connect two devices depends on which wire pairs the devices use to transmit and receive data.

Crossover Cable



Working with Twisted-Pair Cabling

- Specific pins on the connector are associated with a transmit function and a receive function. The transmit pin versus the receive pin is determined by the device being used.



Unlike and Like Devices

- Two devices directly connected and using **different pins** to transmit and receive are known as unlike devices. They require a **straight-through cable** to exchange data.
- Devices that are directly connected and use the **same pins** to transmit and receive, are known as like devices. They require the use of a **crossover cable** to exchange data.

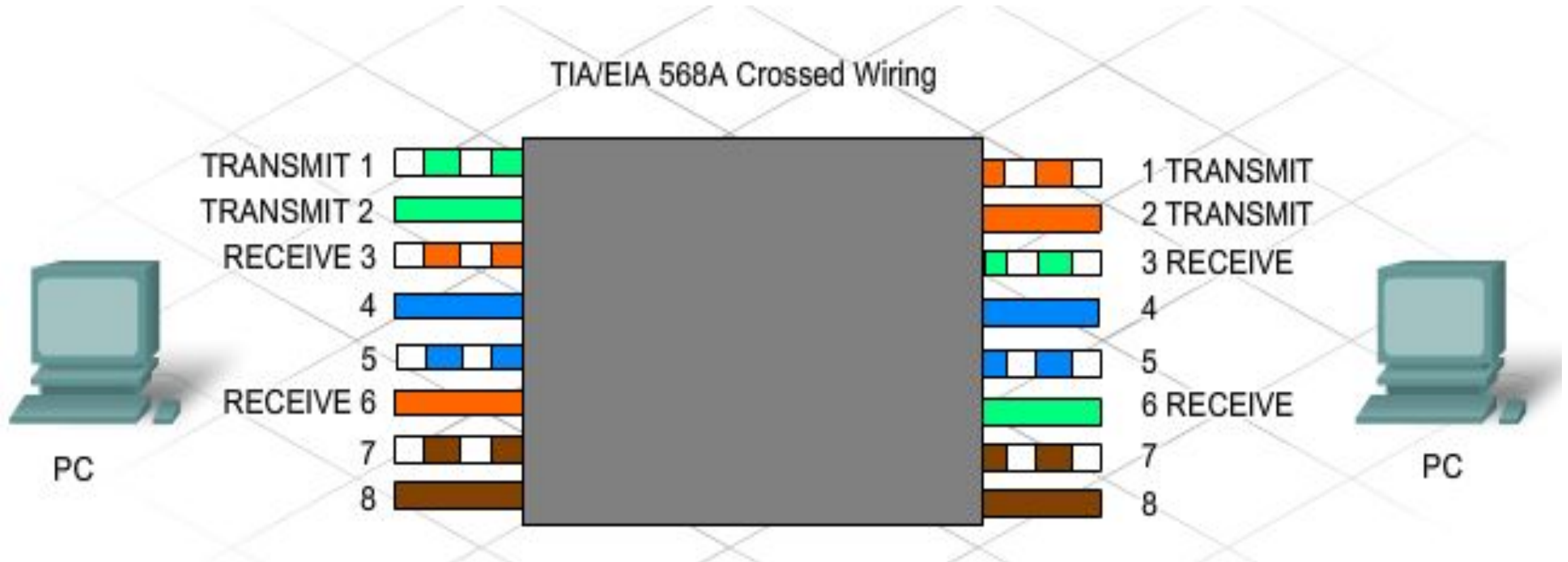
Unlike and Like Devices

- Examples of unlike devices that require a straight-through cable include:
 - Switch port to router port
 - Hub port to PC

Unlike and Like Devices

- If a PC is directly connected to another PC (like devices), pins 1 and 2 on both devices are transmit pins and pins 3 and 6 are receive pins.
- A crossover cable would ensure that the **green wire** connected to pins 1 and 2 (transmit pins) on one PC connect to pins 3 and 6 (receive pins) on the other PC.
- If a straight-through cable were used, the wire connected to pin 1, the transmit pin, on PC1 would be connected to pin 1, the transmit pin, on PC2. It is **not possible** to receive data on a transmit pin.

Unlike and Like Devices



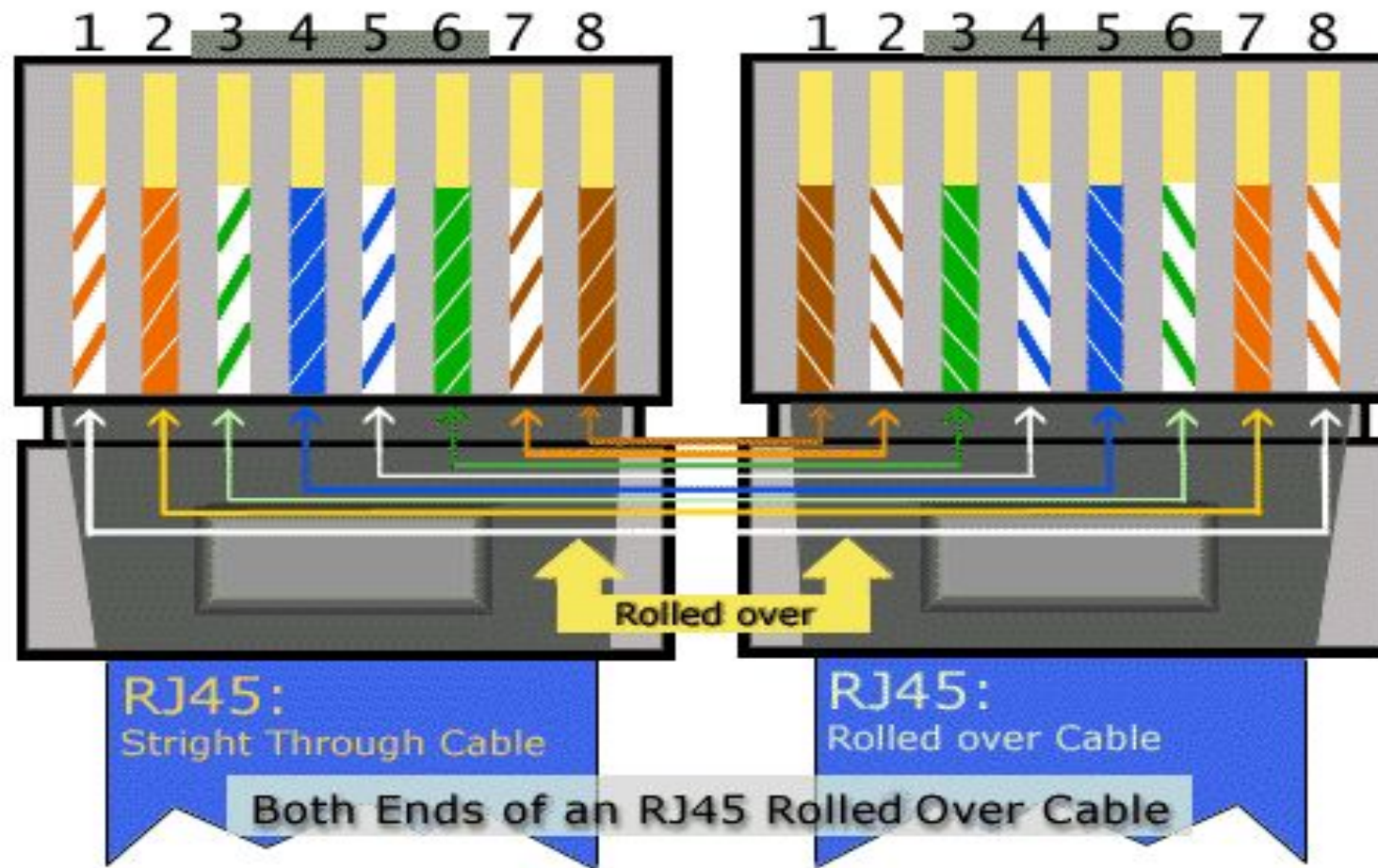
Unlike and Like Devices

- Other examples of like devices that require a crossover cable include:
 - Switch port to switch port
 - Switch port to hub port
 - Hub port to hub port
 - Router port to router port
 - PC to PC
- If the incorrect cable type is used, the connection between network devices will not function.
- Some devices can automatically sense which pins are used for transmit and receive and will adjust their internal connections accordingly.

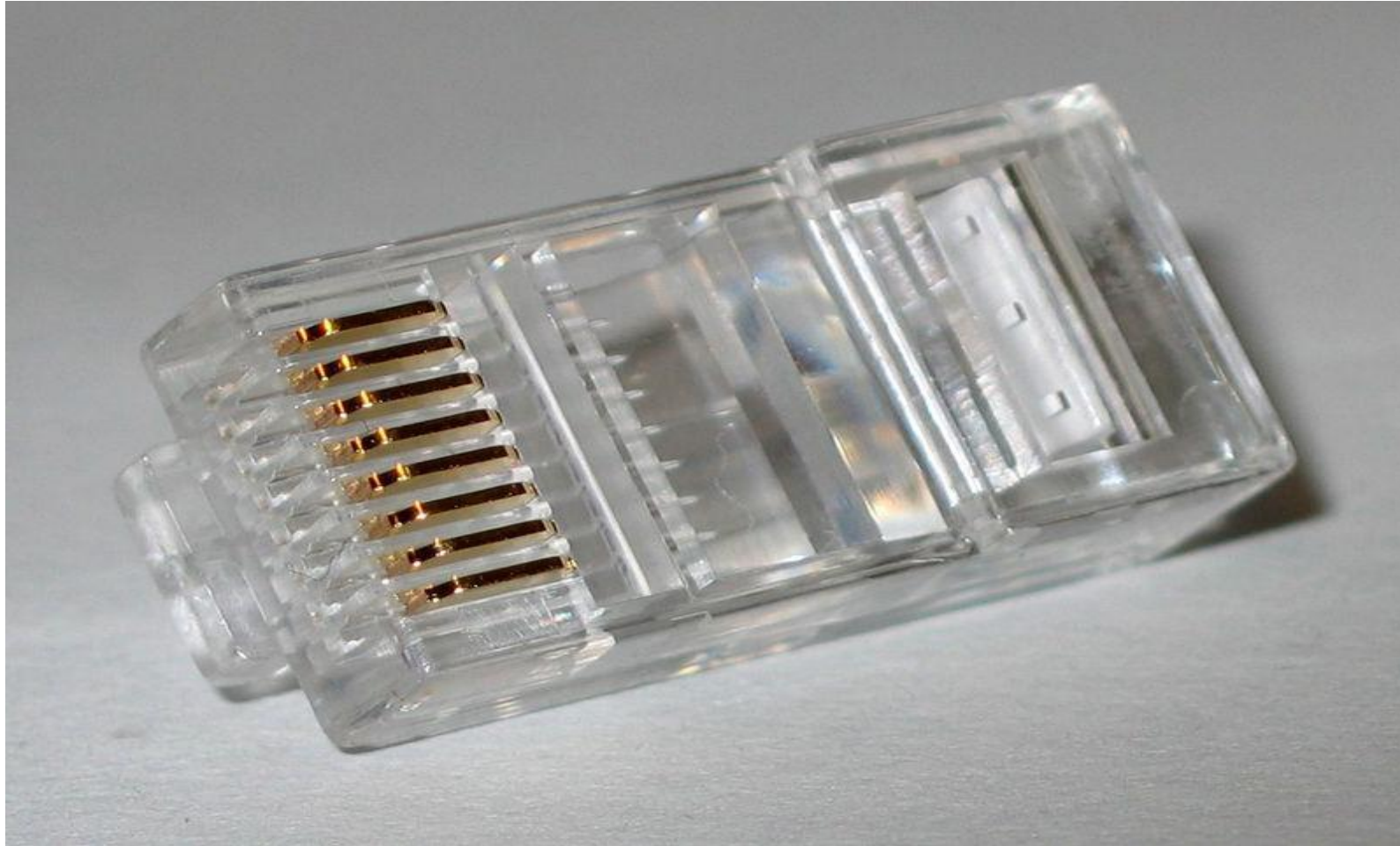
Rollover Cable

- Rollover cable (also known as Cisco console cable) is a type of null-modem cable that is most commonly used to connect a computer terminal to a router's console port.
 - Cisco routers and switches are normally configured over their console ports.
- This cable is typically flat and the colour is also different to help distinguish it from other types of network cabling.
- It gets the name rollover because the pinouts on one end are **reversed** from the other, as if the wire had been rolled over and you were viewing it from the other side.

Rollover Cable



RJ45 connector



Making connections - Tools

- Cat5e cable
- RJ45 connectors
- Cable stripper
- Scissors
- Crimping tool

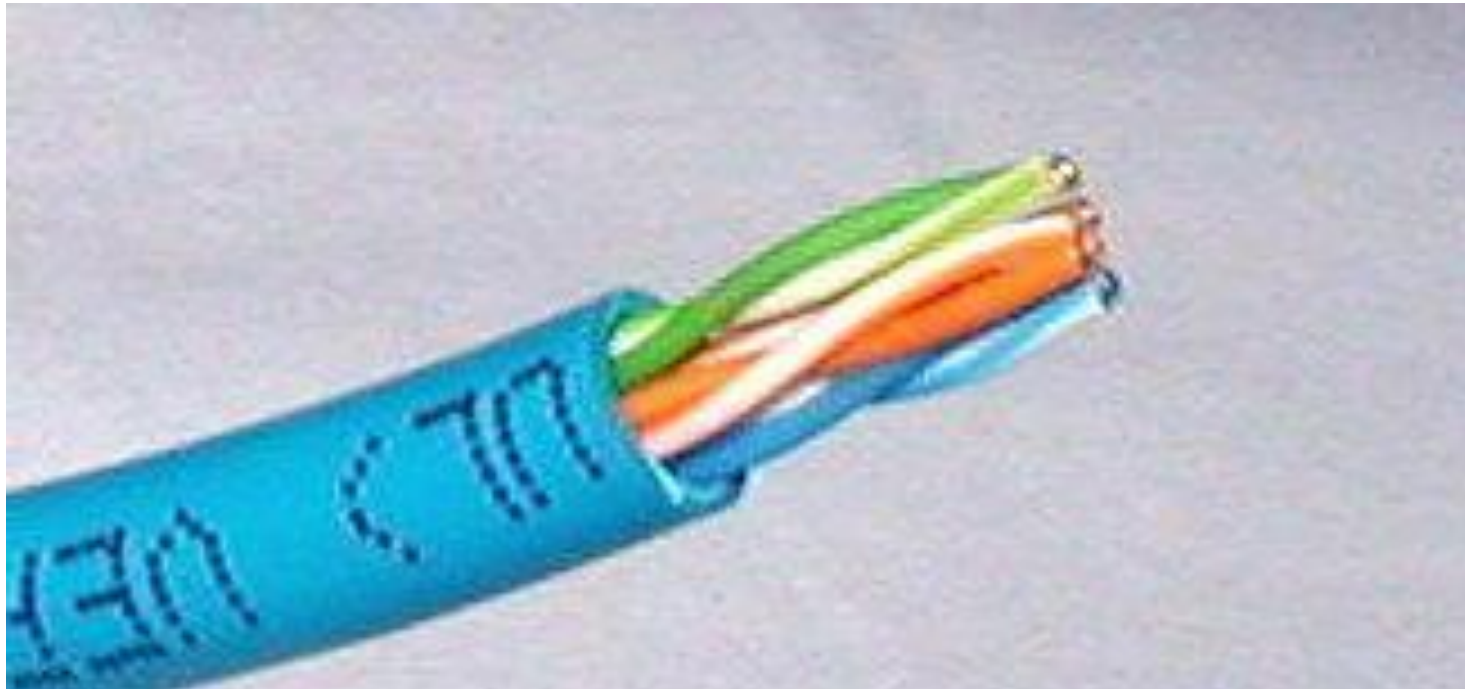


Making connections - Steps

1. Strip cable end
2. Untwist wire ends
3. Arrange wires
4. Trim wires to size
5. Attach connector
6. Check
7. Crimp
8. Test

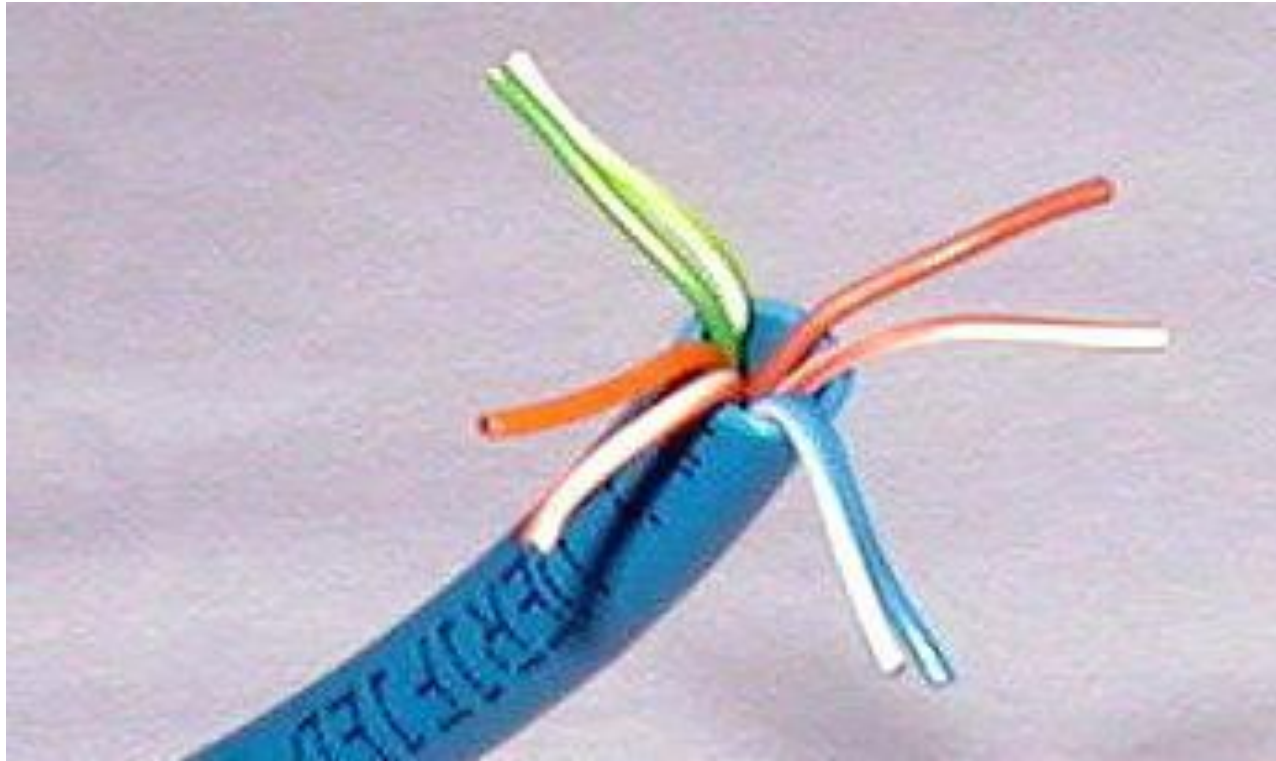
Step 1 – Strip cable end

- Strip 1 – 1½” of insulating sheath
- Avoid cutting into conductor insulation



Step 2 – Untwist wire ends

- Sort wires by insulation colors



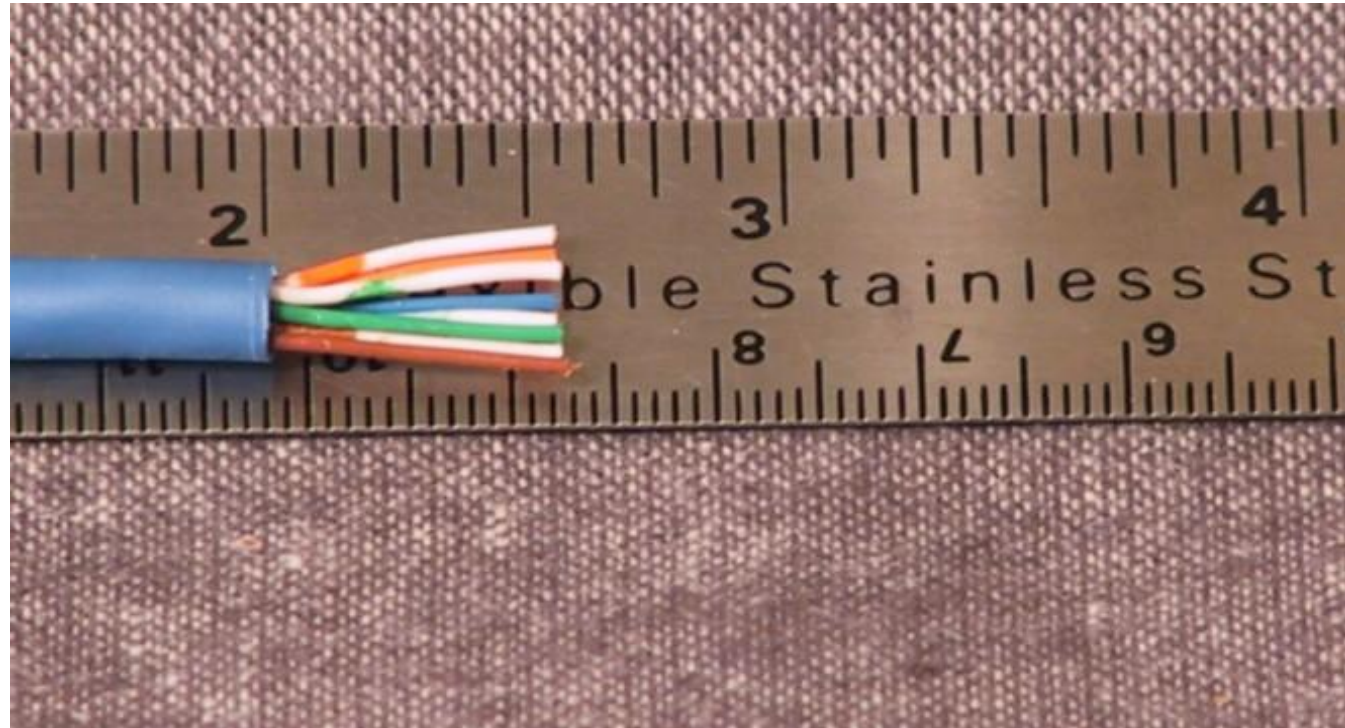
Step 3 – Arrange wires

- TIA/EIA 568A: GW-G OW-BI BIW-O BrW-Br
- TIA/EIA 568B: OW-O GW-BI BIW-G BrW-Br



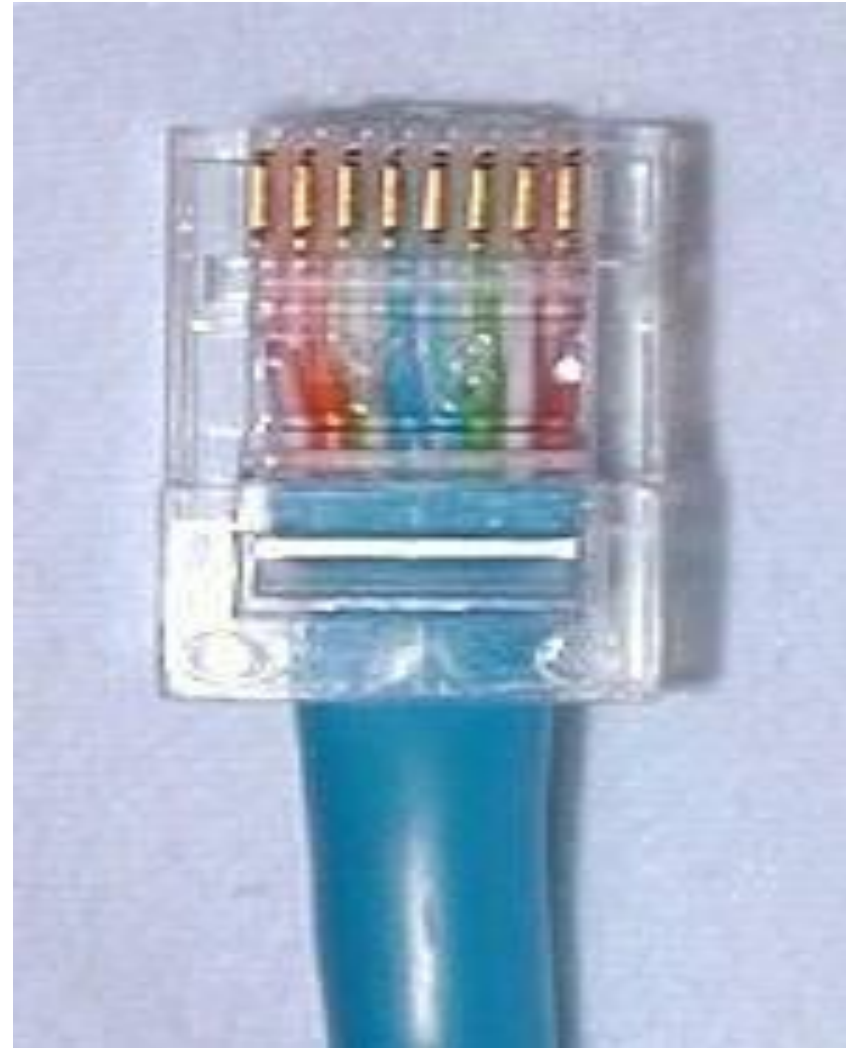
Step 4 – Trim wires to size

- Trim all wires evenly
- Leave about $\frac{1}{2}$ " of wires exposed



Step 5 – Attach connector

- Maintain wire order, left-to-right, with RJ45 tab facing downward



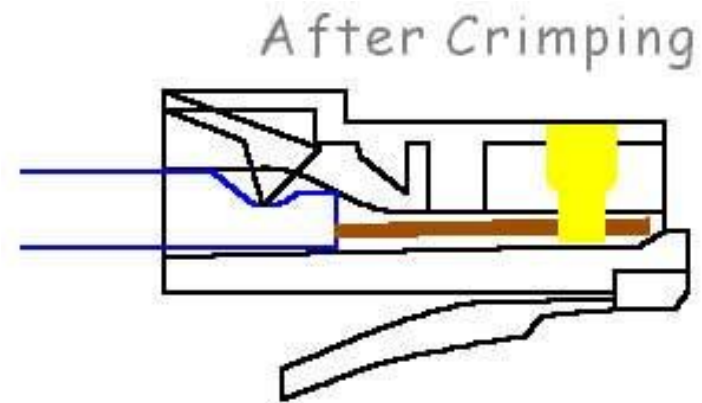
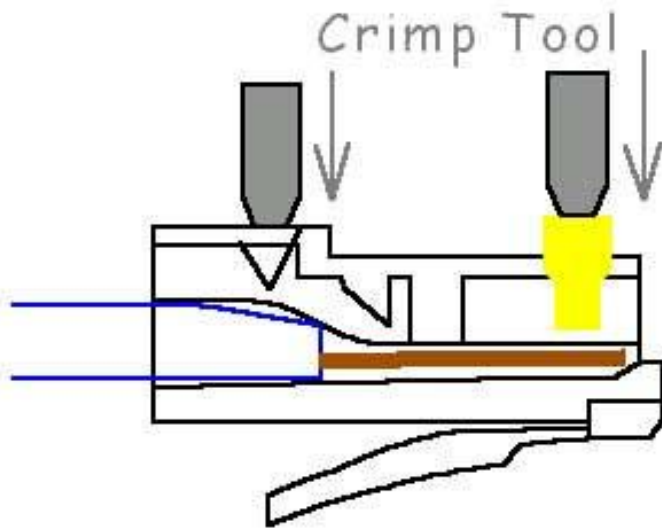
Step 6 - Check

- Do all wires extend to end?
- Is sheath well inside connector?



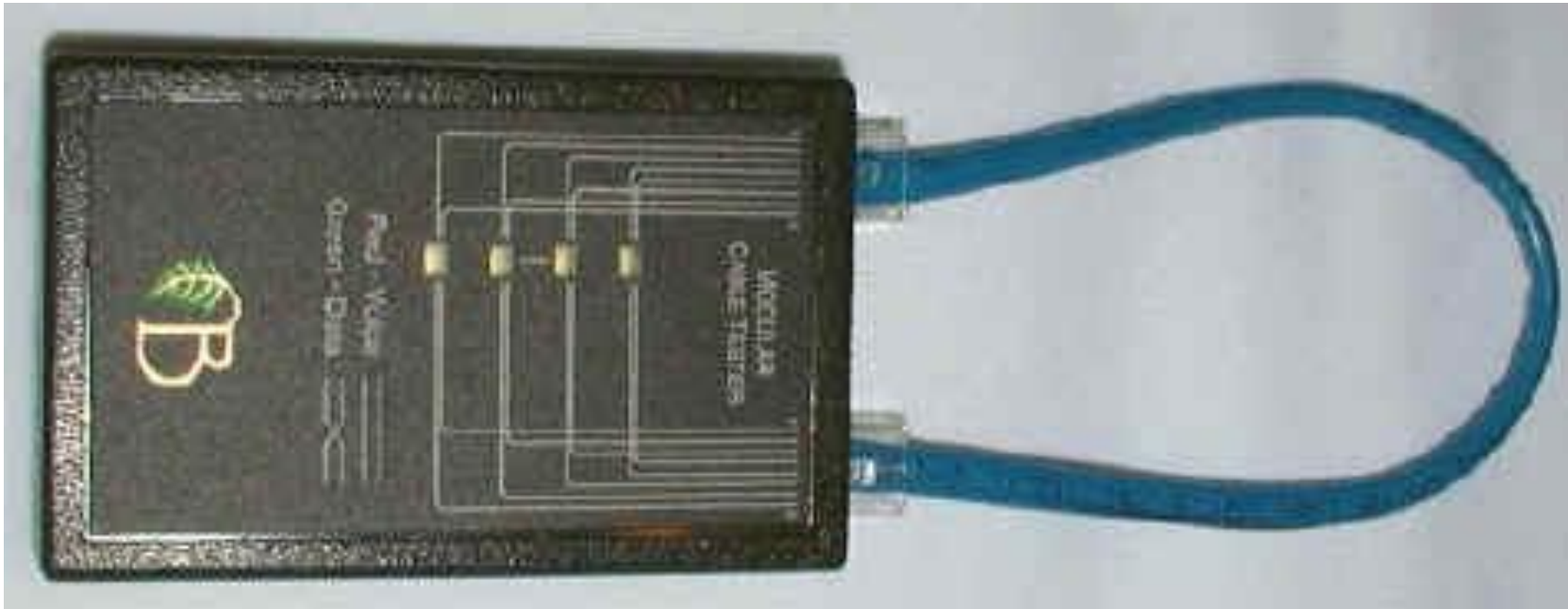
Step 7 - Crimp

- Squeeze firmly to crimp connector onto cable end (8P)



Step 8 – Test

- Does the cable work?



Marks

- ☐ 10/10 = a successful cable that is prepped, crimped, and connects properly.
- ☐ 05/10 = a cable that does not work but is set-up reasonably well and has a detailed typed response as to possible solutions or reasons as to why the cable does not work.
- ☐ 0/10 = cable does not work and no explanation as to why.

LET'S GET STARTED!!



Let's go to work!

