University of Global Village (UGV)
Barishal, Bangladesh

Lectures On:

Networking Cables

Lectures By

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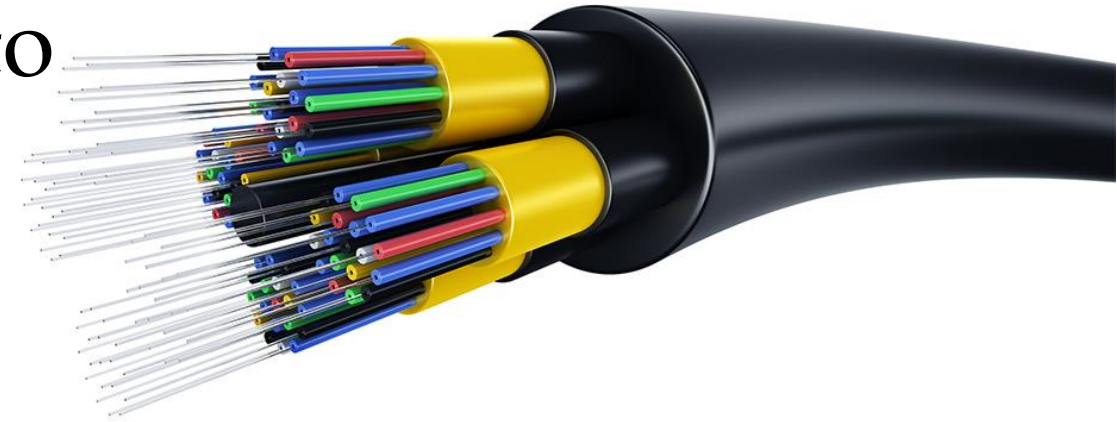
Networking Cable

Networking cable is a **piece of networking hardware** used to connect one network device to other network devices or to connect two or more computers.



Common Networking Cable Types

Different types of network cables, such as:

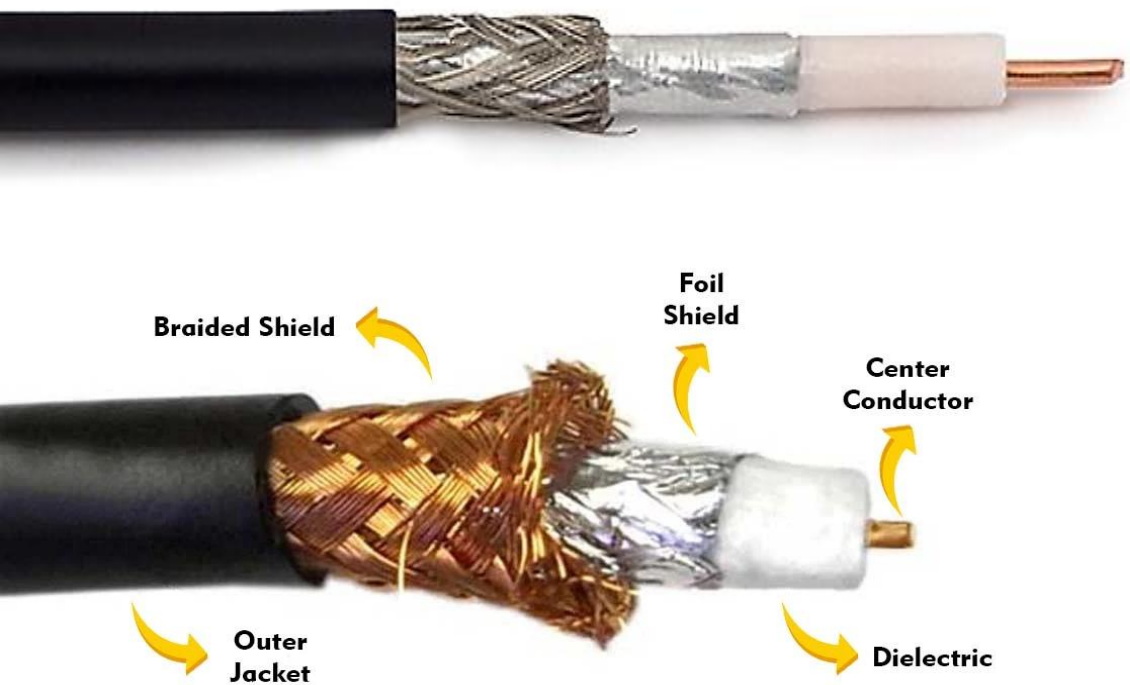
1. Coaxial Cable
2. Optical Fiber Cable
3. Twisted Pair Cables

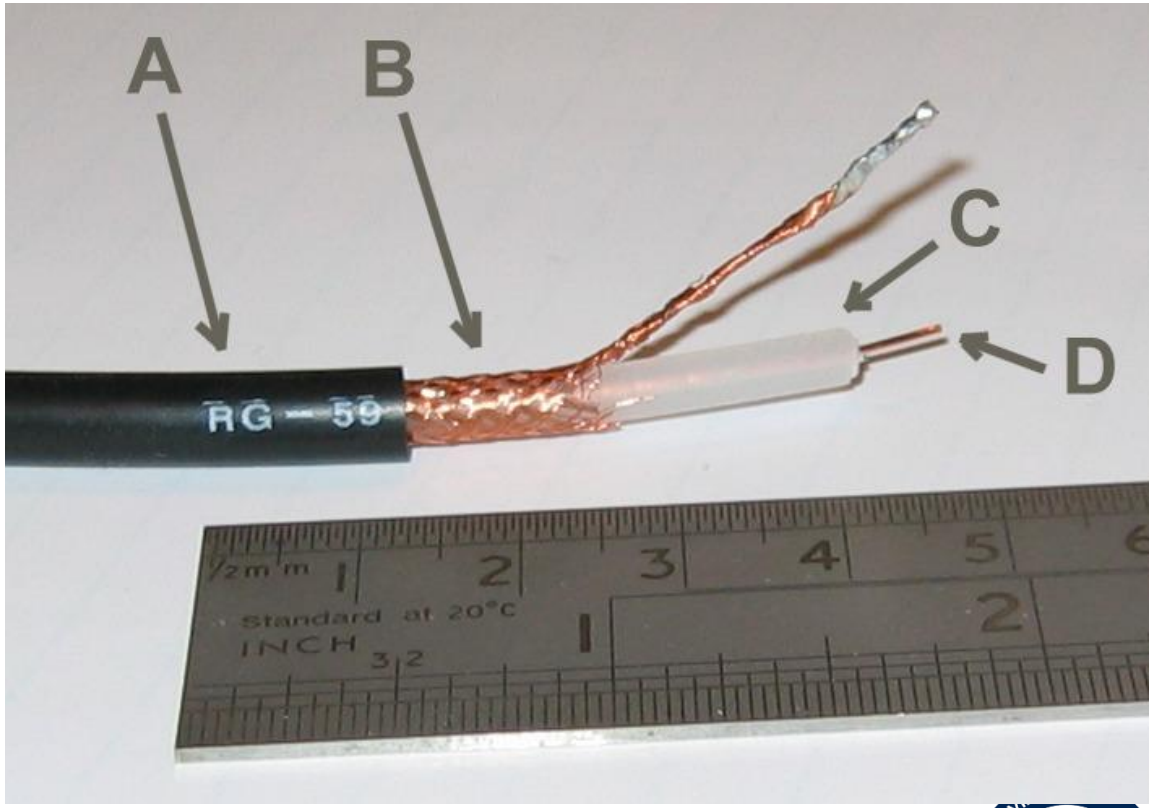
Which are used depending on the network's topology, protocol, and size.

Coaxial Cable

Coaxial cable is a **type of copper cable specially built with a metal shield and other components** engineered to block signal interference.

Coaxial Cable





Coaxial Cable

Coaxial cable is commonly used by:

- Cable Operators
- Telephone Companies
- And Internet Providers

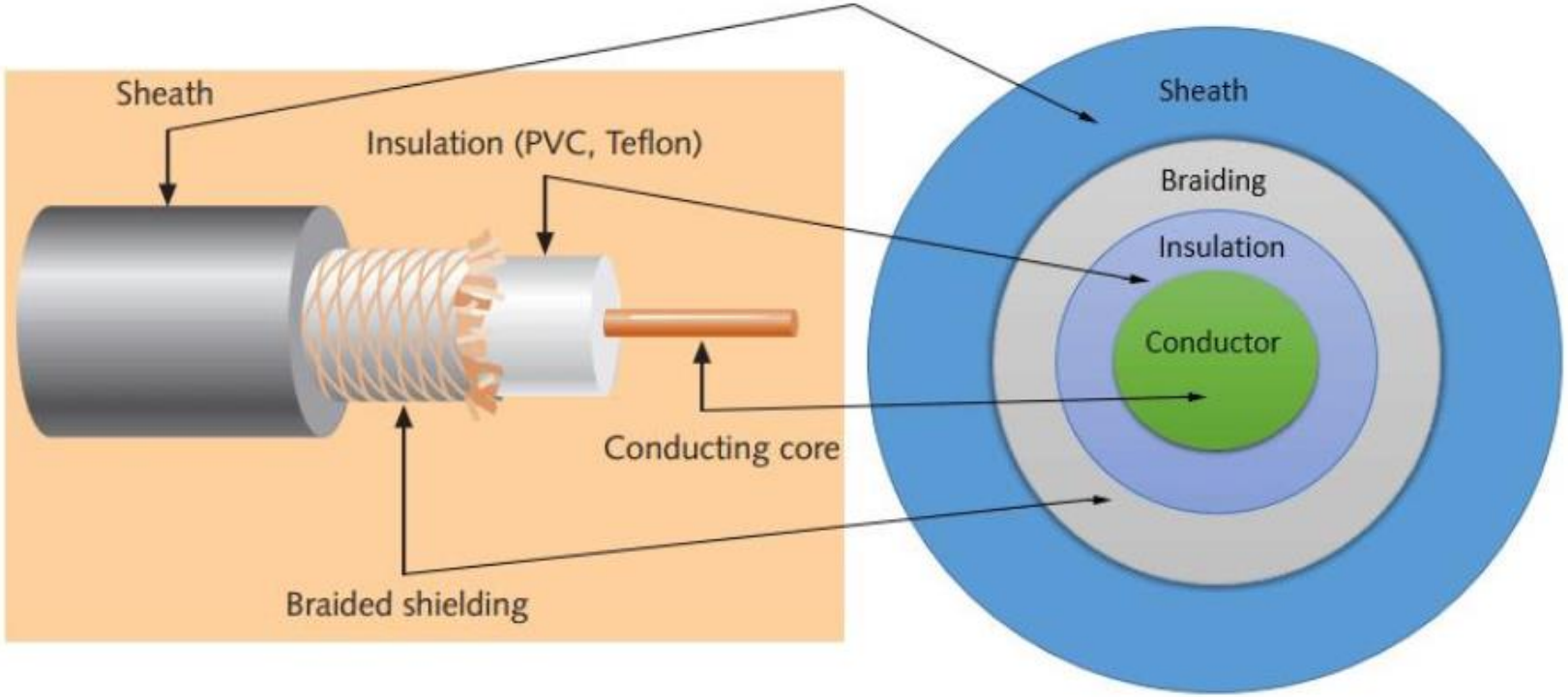
Worldwide to convey data, video, and voice communications to customers. It has also been used extensively within homes.

Coaxial Cable

Coaxial cable has been around for a long time as a technology (since the early 20th century) and has many singular advantages for reliable, accurate transmission

It also has limitations that will cause it to be replaced in some cases by **fiber optic cable**, category cable or, sometimes, by wireless signals.

Coaxial Cable



Optical Fiber Cable

- A **fiber-optic cable**, also known as an **optical-fiber cable**, is an assembly similar to an electrical cable but **containing one or more optical fibers** that are used to carry light.
- The optical fiber elements are typically individually coated with **plastic layers** and contained in a protective tube suitable for the environment where the cable is used.

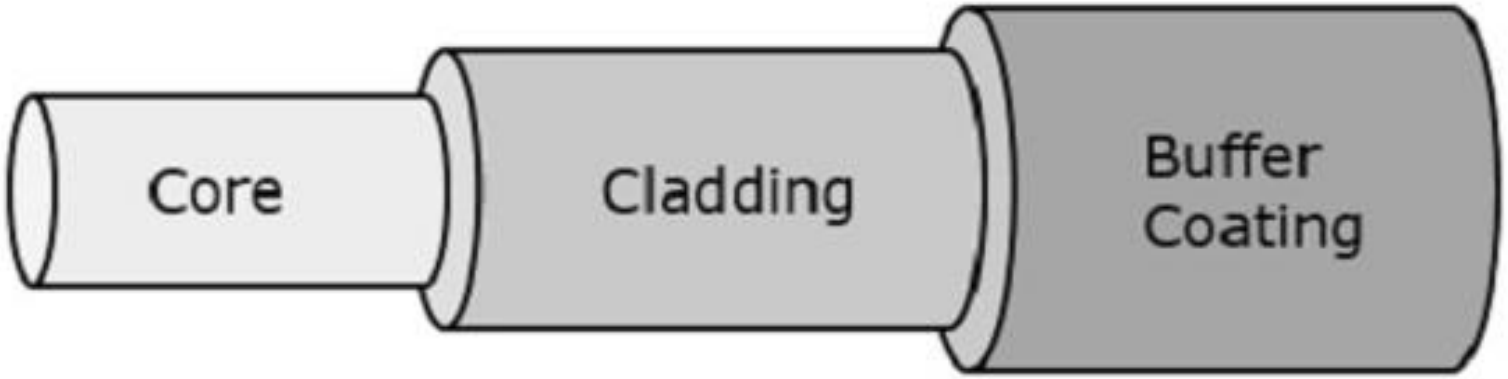
What is Fiber Optics?

- Fiber optics refers to the technology and method of transmitting information as light pulses along a **glass or plastic** strand or fiber.
- Fiber optic cables are used for **long-distance** and high-performance data networking.
- They are capable of transmitting data over longer distances and at higher bandwidths (data rates) than electrical cables, making them a critical component in modern telecommunications, internet, and computer networking.

Main Elements of Fiber Optics

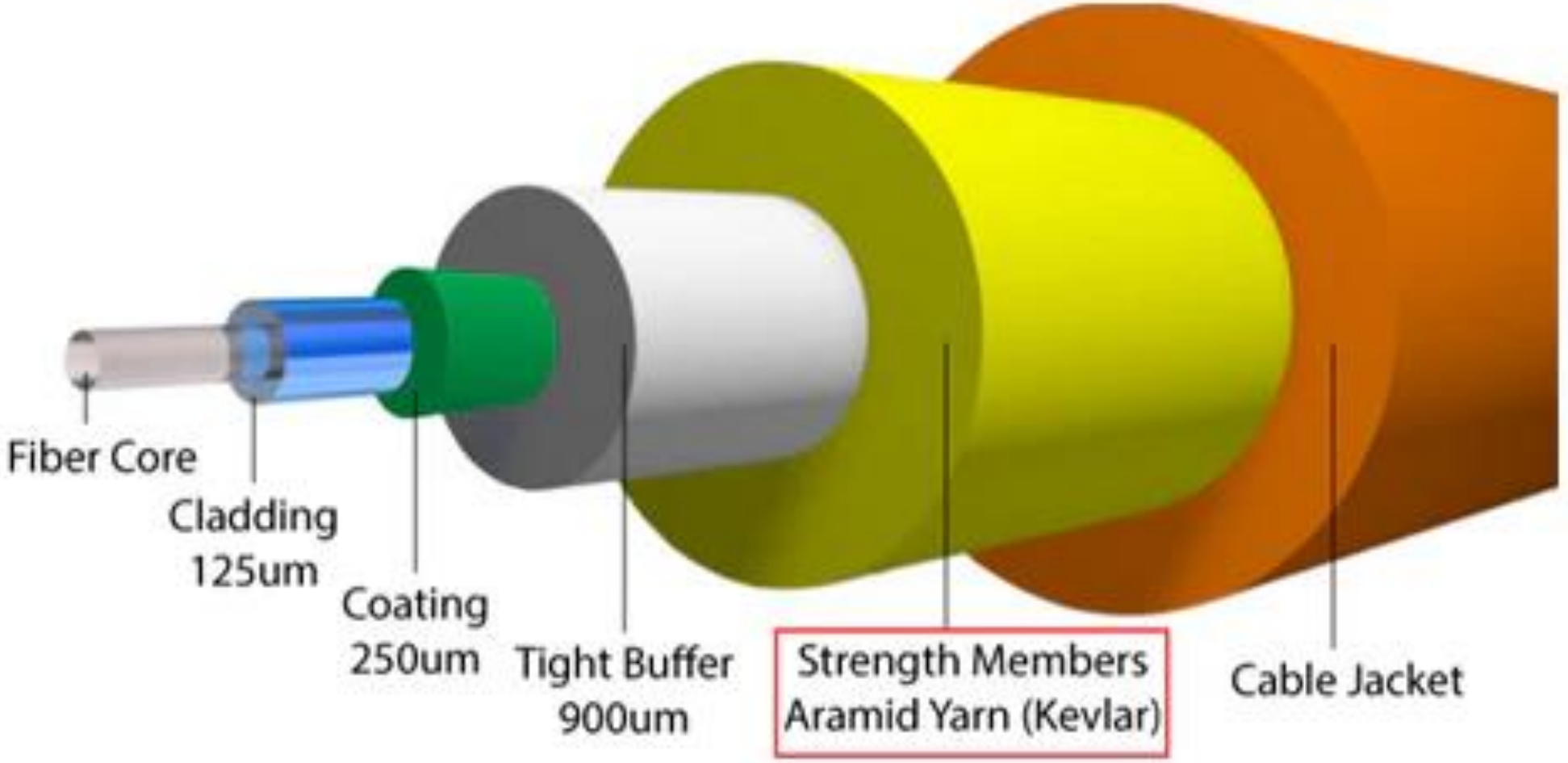
- **Core:** It is the central tube of very thin size made of optically transparent dielectric medium and carries the light transmitter to receiver and the core diameter may vary from about 5um to 100 um.
- **Cladding:** It is an outer optical material surrounding the core having a reflecting index lower than the core and cladding helps to keep the light within the core throughout the phenomena of total internal reflection.
- **Buffer Coating:** It is a plastic coating that protects the fiber made of silicon rubber. The typical diameter of the fiber after the coating is 250-300 um.

Main Elements of Fiber Optics

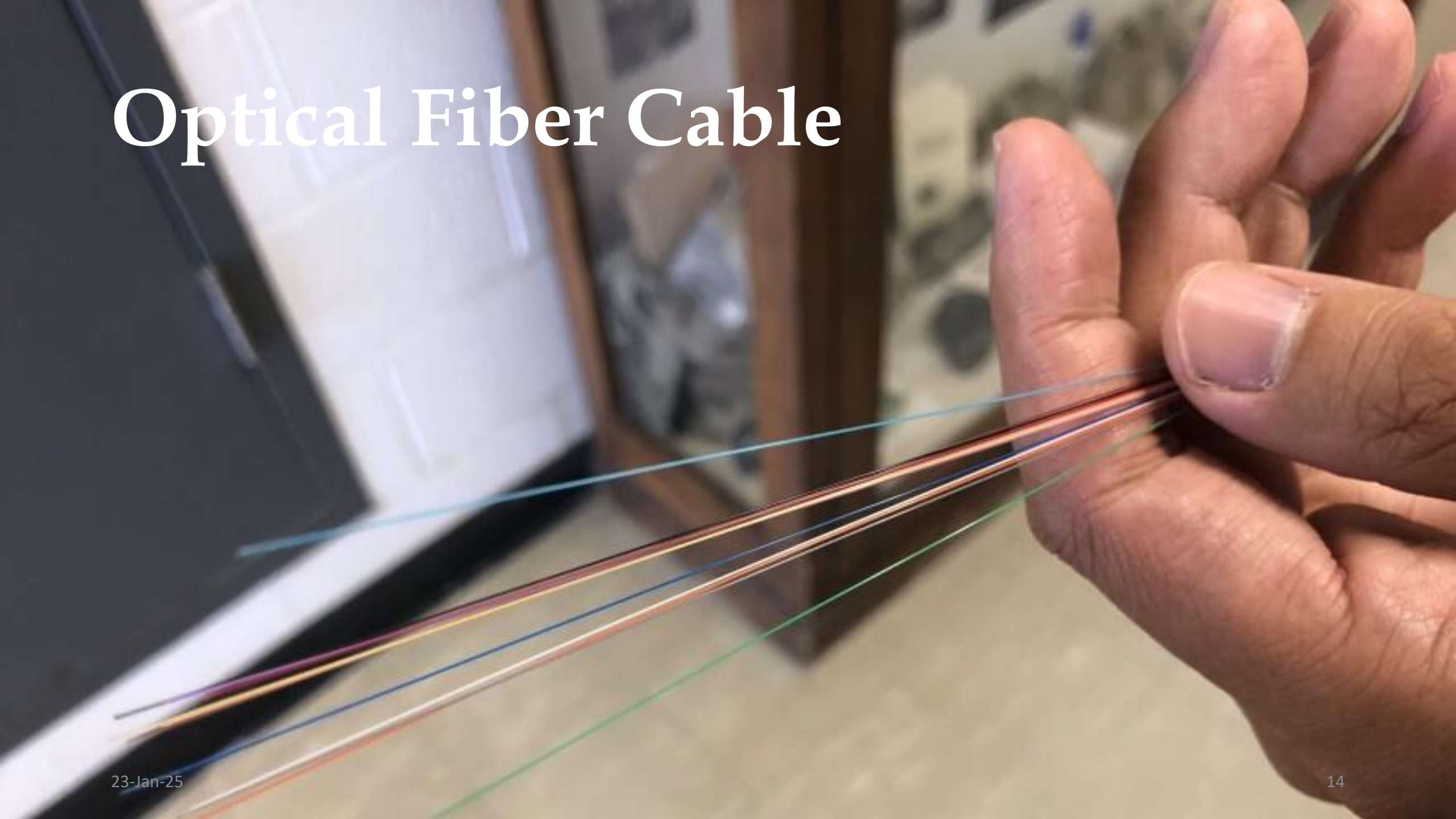


Parts of an Optical fiber

Main Elements of Fiber Optics

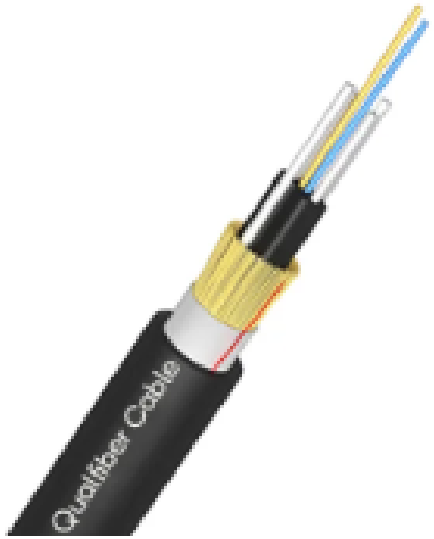


Optical Fiber Cable



Optical Fiber Cable

Optical Fiber Cable



Types of Fiber Optical Cable

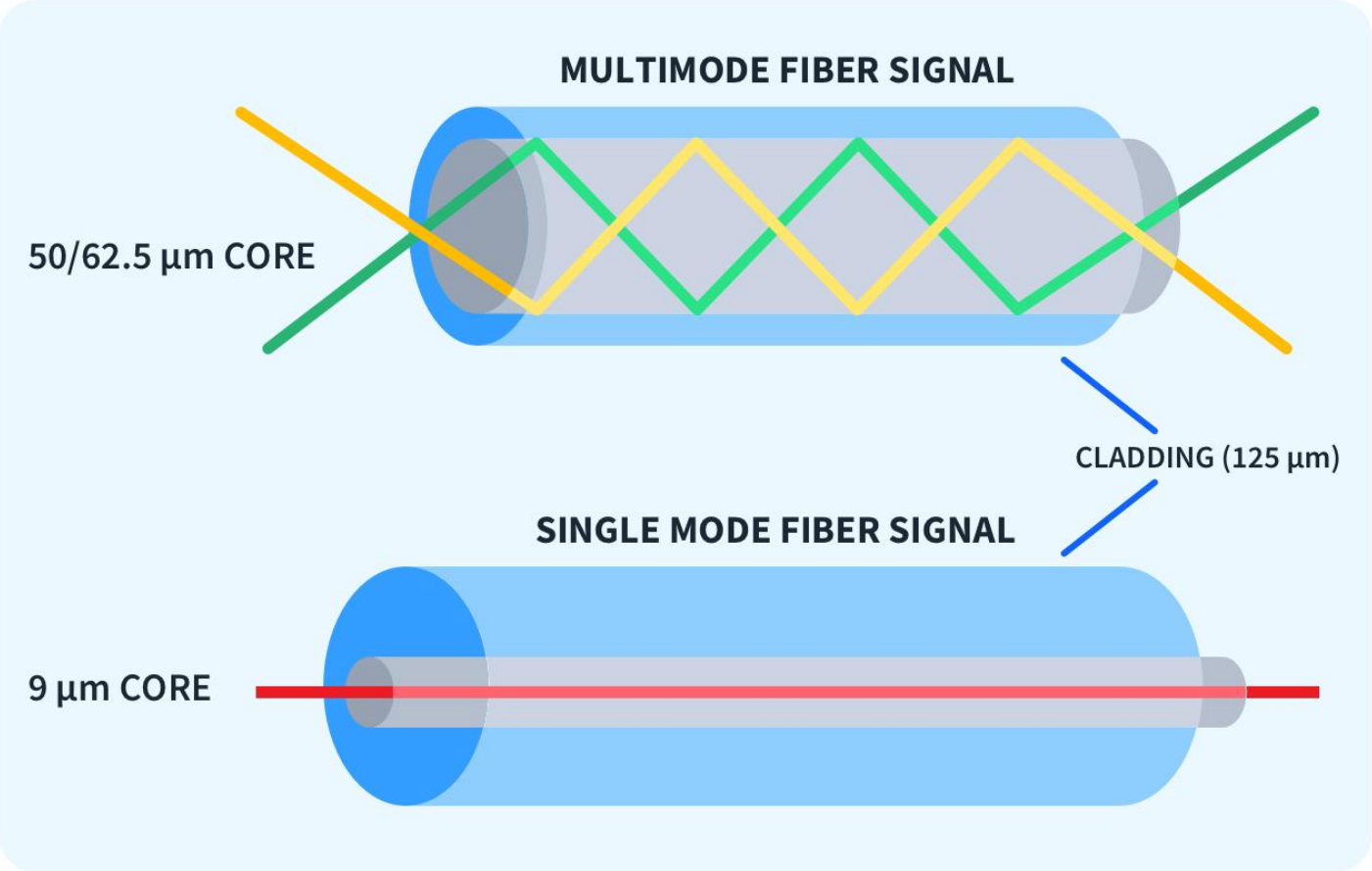
Based on the Number of Modes

- **Single-mode fiber:** In single-mode fiber, only one type of ray of light can propagate through the fiber. This type of fiber has a small core diameter (5um) and high cladding diameter (70um) and the difference between the refractive index of core and cladding is very small. There is no dispersion i.e. no degradation of the signal during traveling through the fiber. The light is passed through it through a laser diode.
- Single Mode Fiber
- **Multi-mode fiber:** Multimode fiber allows many modes for the light rays traveling through it. The core diameter is generally (40um) and that of cladding is (70um). The relative refractive index difference is also greater than single-mode fiber. There is signal degradation due to multimode dispersion. It is not suitable for long-distance communication due to the large dispersion and attenuation of the signal. There are two categories based on Multi-mode fiber i.e. Step Index Fiber and Graded Index Fiber. These are categories under the types of optical fiber based on the Refractive Index

Types of Fiber Optical Cable

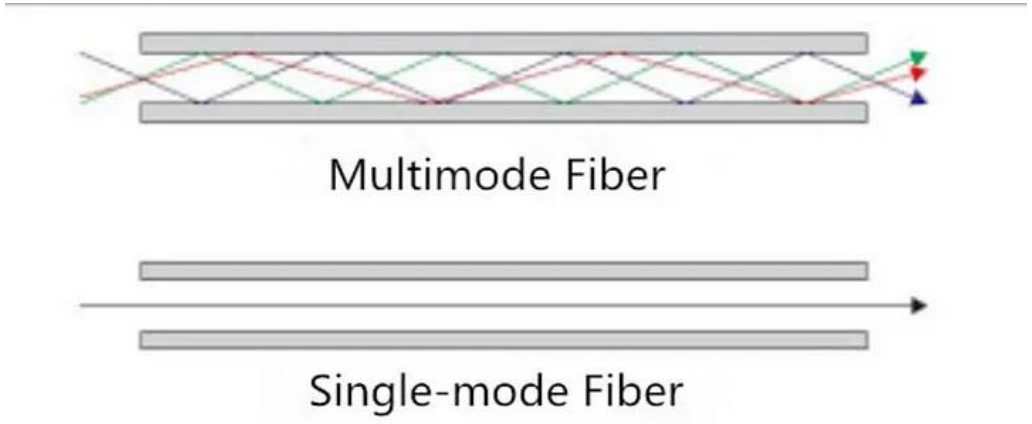
Feature	Single-Mode Fiber	Multimode Fiber
Core diameter	Small (typically 9 µm)	Large (typically 50 or 62.5 µm)
Propagation method	Only one mode of light travels through the fiber	Multiple modes of light travel through the fiber
Light source	Laser	LED or laser
Bandwidth	Higher bandwidth, typically in the gigahertz range	Lower bandwidth, typically in the megahertz range
Distance	Longer distance, typically up to tens of kilometers	Shorter distance, typically up to a few kilometers
Dispersion	Lower dispersion, resulting in less signal distortion	Higher dispersion, resulting in more signal distortion
Attenuation	Lower attenuation, resulting in less signal loss	Higher attenuation, resulting in more signal loss
System Cost	Higher cost due to more precise manufacturing requirements	Lower cost due to less precise manufacturing requirements
Applications	Long-haul telecommunications, high-speed data transmission	Local area networks, multimedia, and video applications

Single Mode Fiber Vs Multimode Fiber



Single Path Vs. Multiple Paths

SMF uses laser light which usually follows a single path through the fiber. MMF takes multiple paths, which may result in a differential mode delay. Each type of fiber can be applied for different equipment. It's important to know which application is more suitable for practical use. Otherwise, it will not operate at optimal levels.

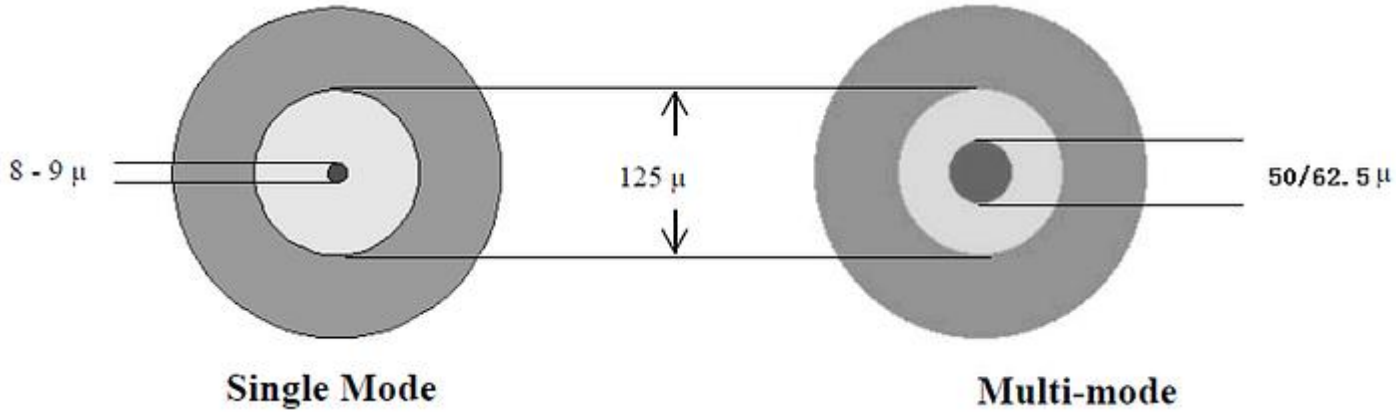


Short Distances Vs. Long Distances

SMF is used for long distance communication, and MMF is used for distances of 500m or less. Each type is equally as effective when chosen for the proper communication device. Make sure to check the ratings to determine which type is best for your application. The distances should be clearly marked.

Thick Core Size Vs. Thin Core Size

SMF typically has a smaller core size of 8.3 to 10 microns in diameter which is more precise for signal transmission in long distance, while the core size of MMF is much larger than SMF from 50 to100 microns in diameter which is more suitable for short distance transmission owing to the signal distortion. With a thinner core size, SMF is only allowed to carry a single light-wave along a single path, while the thick core size makes MMF able to carry different light-waves along numerous paths without modal dispersion limitation.



Low Cost Vs. High Cost

- MMF is typically a lower cost solution than SMF. Limited budget may prompt designers to seek solutions with MMF fiber optic cables. The equipment that's used for communications over MMF is usually less expensive than SMF. But the typical transmission speed and distance of MMF have limitations of 100 Mbit/s for distances up to 2 km.

Color Differences

- MMF and SMF cables can also be distinguished by color. Usually, yellow is used for SMF cable color and orange or aqua is used for MMF cables. It is much easier to distinguish them just by their appearance color.

SMF

MMF

MMF

Classified based on the number of cores

- Optical fibers can be classified based on the number of cores they have. Here's a brief overview of the classification depending on the number of cores:

1. Single-Core Optical Fiber

Single-Core (1 Core): The most common type of optical fiber, consisting of a single core. Used extensively in telecommunications and data transmission.

Classification of Multi-Core Optical Fibers

- **Dual-Core Optical Fiber (2 Cores)**
  - **Description**: Contains two cores within a single cladding.
  - **Applications**: Used in telecommunications for redundant paths and increased reliability. Also found in sensor applications and medical devices.
- **Quad-Core Optical Fiber (4 Cores)**
  - **Description**: Contains four cores within a single cladding.
  - **Applications**: High-capacity communication systems, data centers, and networking applications where increased data rates and redundancy are required.
- **Hexa-Core Optical Fiber (6 Cores)**
  - **Description**: Contains six cores within a single cladding.
  - **Applications**: Advanced telecommunications, high-speed internet services, and applications requiring multiple data channels.

Classification of Multi-Core Optical Fibers

- **Twelve-Core Optical Fiber (12 Cores)**
  - **Description**: Contains twelve cores within a single cladding.
  - **Applications**: Ultra-high capacity communication networks, extensive data centers, and applications that demand massive bandwidth and low latency.
- **Twenty-Four-Core Optical Fiber (24 Cores)**
  - **Description**: Contains twenty-four cores within a single cladding.
  - **Applications**: Extremely high-capacity data transmission environments such as major internet backbones, large-scale data centers, and metropolitan area networks.
- **Thirty-Two-Core Optical Fiber (32 Cores)**
  - **Description**: Contains thirty-two cores within a single cladding.
  - **Applications**: Specialized high-bandwidth applications, advanced research facilities, and scenarios where a very high number of independent data channels are required.

What is Fiber Optic Cable Splicing?

- Fiber Optic Cable is a form of modern network cable that has a far greater capacity than electrical communication connections. optical fibers are made comprised of exceedingly tiny strands of glass or plastic and these cables transfer information between two sites using completely optical (light-based) technology.

- Fiber Optic Cable Splicing is the method of joining two fiber optic cables together. Termination is the other, more frequent way of linking fibers. Fiber splicing is the preferred way when cable lines are too long for a single length of fiber or when combining two different types of cable.

Types of Optic Cable Splicing:

1. Fusion splicing
2. Mechanical splicing

- are two methods of fiber optic splicing. Both techniques have much lower insertion loss than fiber connections.

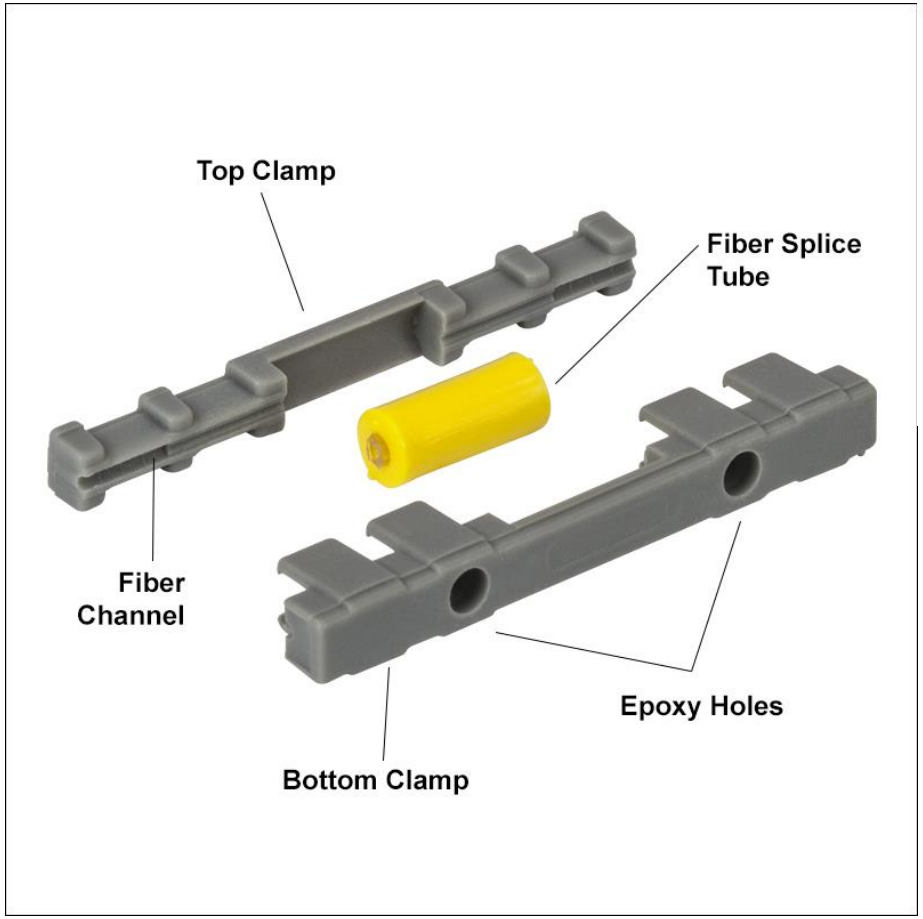
Mechanical Slicing:

Mechanical splicing is a type of splicing that does not use a fusion splicer. A mechanical splice is an optical fiber connection that is adjusted and maintained in place by an assembly that employs an indexing fluid to keep the fibers aligned. Mechanical splicing permanently connects the two optical fibers with a short mechanical splice approx. 6 cm long and 1 cm in diameter. This will mechanically join two bare strands after they have been properly aligned. Mechanical splices are simple alignment devices that keep the two ends of the fiber completely aligned and allow light to travel from one fiber to the other.

Steps to Perform Mechanical Splicing:

- **Step 1: Fiber Preparation**: Protective coatings, jackets, tubes, strength members, and other materials should all be removed, leaving only the naked fiber visible. The most important consideration is hygiene.
- **Step 2: Cleaving the fiber**: The process is comparable to fusion splicing cleaving, however, the accuracy of the cleave is less crucial.
- **Step 3: Joining fibers mechanically**: This approach does not utilize any heat. Simply place the fiber ends in the mechanical splice device and splice them together. Light coupling from one fiber end to the other will be aided by the index matching gel in the mechanical splice equipment. Rather than an index matching gel, epoxy will be used to hold the cores of earlier equipment together.

Mechanical Splicing:



Advantages vs Disadvantages of Mechanical Splicing:

Advantages of Mechanical Splicing:

- Mechanical splices do not require electricity.
- Other than a fiber stripper and a fiber splitter, many mechanical fiber splice designs require no additional equipment.
- Mechanical splicing is useful in cases where fusion splicing is not conceivable or practical. This makes them perfect for short-term connections.

Disadvantages of Mechanical Splicing:

- The insertion loss is much higher. The normal insertion loss of a mechanical splice is about 0.2 dB, which is much greater than the 0.02 dB loss of a standard fusion splice. Multimode fibers are usually spliced mechanically.
- Mechanical splices struggle to meet the alignment tolerances of single-mode fibers.
- Mechanical splices are only used under relatively safe conditions, such as in an office building.

Fusion splicing

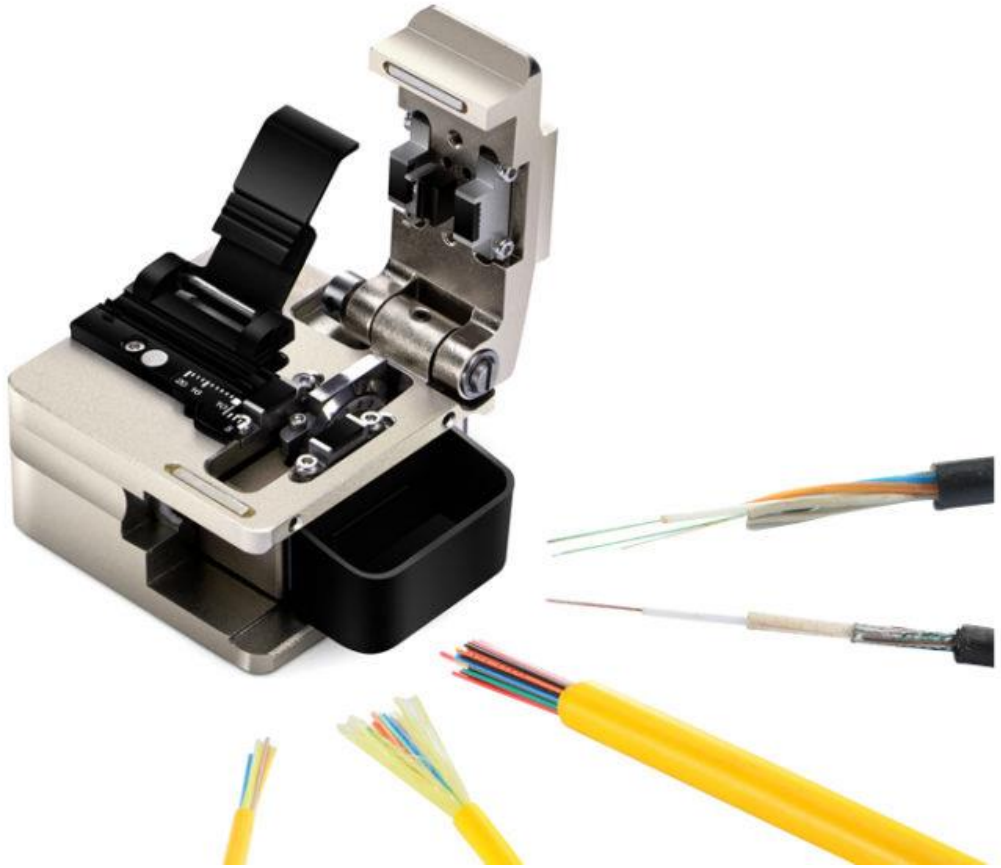
- Fusion splicing is more expensive than mechanical splicing, but it lasts longer. The fiber cores are fused together with reduced attenuation in the fusion process (insertion loss of less than 0.1 dB). Arc or another type of heat during fusion splicing. This leads to a clear, reflection-free, and continuous connection between the fibers, which enables very little light loss (average loss of 0.1 dB). Fusion splicing is a complex process that requires great care. Your fibers may not be connected properly and if not done correctly, your signal may degrade.

How To Join Optical Fiber Cable

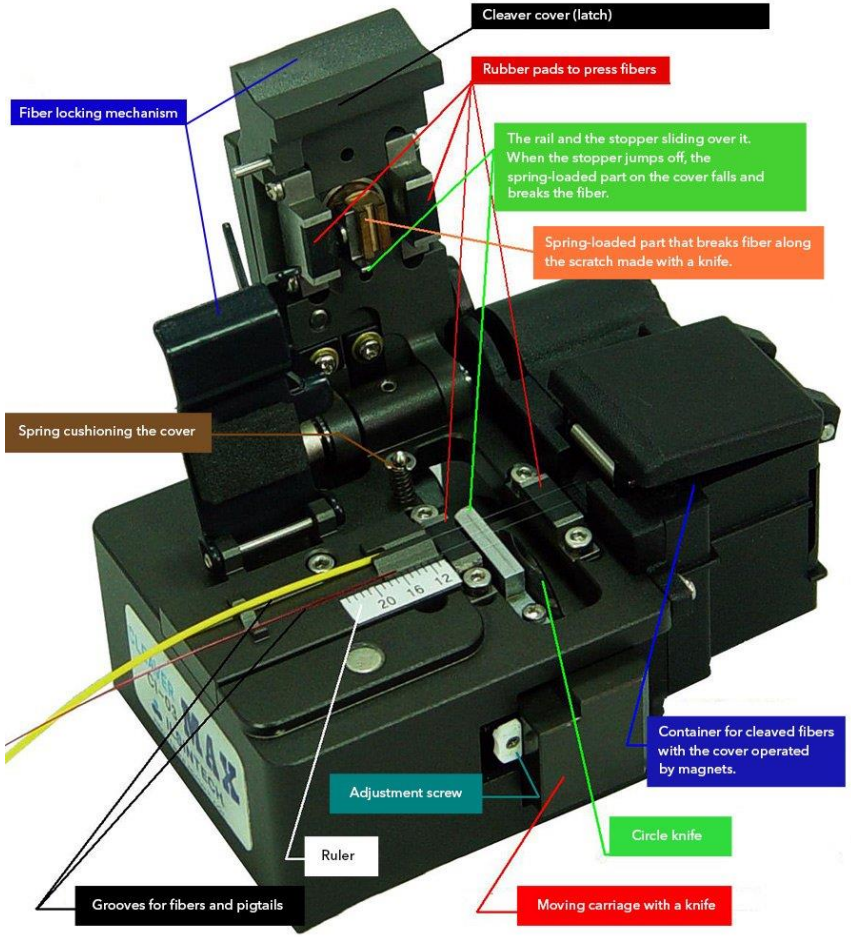
Some of the tools that you will need to utilize during this are:

- A Cleaver
- Strippers
- Alcohol Wipes
- Heat Shrink Wrap
- The Fiber Optic Cables
- The Fiber Optic Fusion Splicer Itself

A Cleaver



A Cleaver


Cleaver cover (latch)
Rubber pads to press fibers
Fiber locking mechanism
The rail and the stopper sliding over it. When the stopper jumps off, the spring-loaded part on the cover falls and breaks the fiber.
Spring-loaded part that breaks fiber along the scratch made with a knife.
Spring cushioning the cover
Container for cleaved fibers with the cover operated by magnets.
Adjustment screw
Circle knife
Ruler
Grooves for fibers and pigtails
Moving carriage with a knife

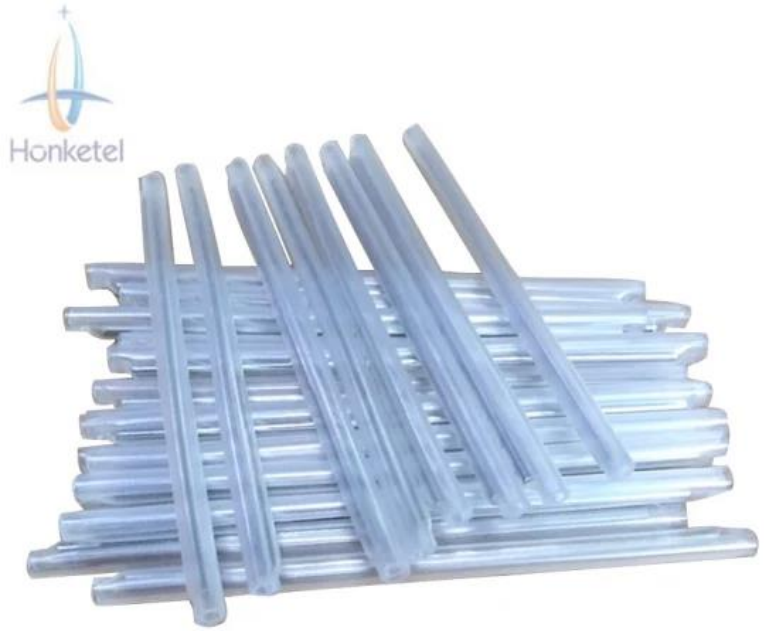
Strippers


1
2
3
JONARD
INDUSTRIES CORP.
www.jonard.com
JIC-375
1 2 3
600-900um
250um
125um

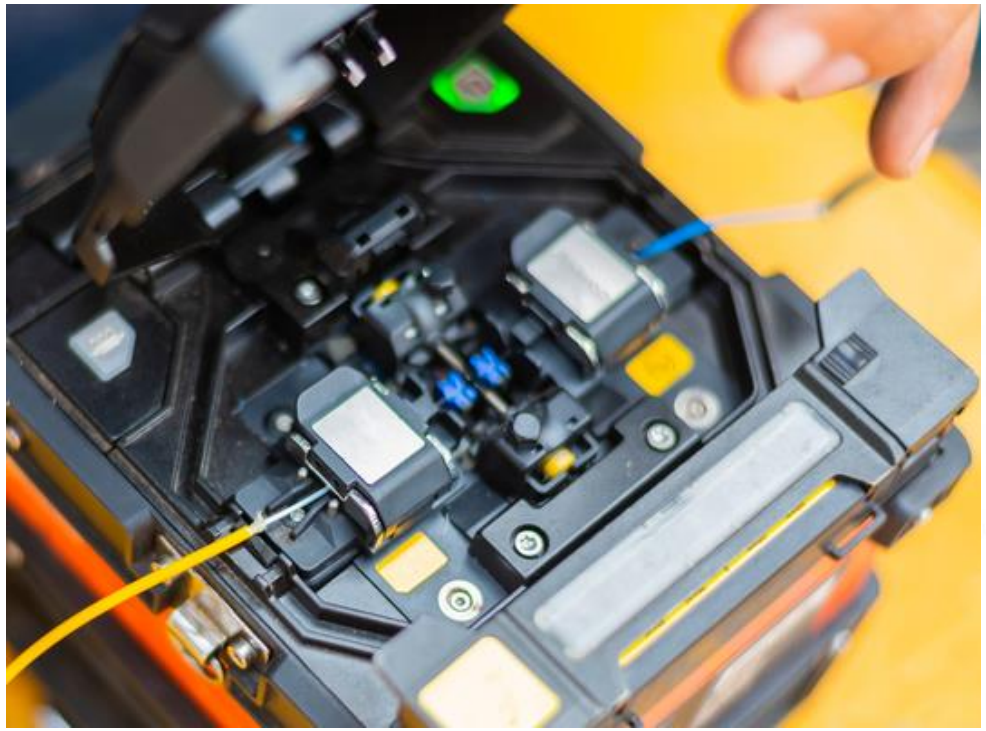

FIBEROPTIC STRIPPER
CFS-2

Alcohol Wipes

Heat Shrink Wrap



Optic Fusion Splicer or Splice Machine



Splice Machine Set

Step 1: Preparing to Use a Heat Shrink Wrap

- Before starting anything, be sure to slide your heat shrink wrap through one end of the fiber optic cable. This only needs to be done once the perfusion cycle and will be utilized later on in the fusion splicing cycle. You also want to do this step first so that you will not be damaging your fiber optic cable later on.

Step 2: Stripping the Fiber Optic Cable

- Go ahead and grab your go-to strippers for this step. The Bridge Cable team uses strippers that have 3 grooves. By utilizing the middle groove, carefully remove small sections of the outer jacket. If you attempt to take larger sections, you risk breaking the fiber optic cable and you'll lose any progress made. After removing the appropriate amount of the jacket, you the smallest groove to remove the clear coating on the fiber optic cable. It will resemble wax, just in case you don't know what it looks like. Keep in mind that if you don't take enough of the jacket off, you risk not being able to cleave it later on.


Network Cabling
Bridgecable.com
Network Cabling

Step 3: Cleaning the Fiber Optic Cable

- After the jacket and the clear coating are properly removed, the most important step is to clean the fiber optic cable. In our earlier referenced Tutorial Video, we are using both alcohol wipes and/or sprays. Whichever is your go-to cleaning method, gently wipe the glass consistently until you hear a prominent squeaking sound. If you attempt to cleave or fusion splice and fiber optic cable that isn't cleaned properly, you will have issues doing so.


Bridgecable.com
Network Cabling

Step 4: Cleaving Your Cleaned Fiber Optic Cable

- The Bridge Cable team has multiple different cleavers available on standby; most all are used in a similar way. Please be sure that you fully understand how your cleaver works prior to starting. Not only will this save you time when you are in the fusion splicing process but it will help prevent any errors or issues.
- Gently place your cleaned fiber optic cable into the cleaver. Be sure that the fiber is laid completely flat when it is inserted. This will help to ensure that it is not cleaved on an angle. When ready, in one smooth motion, pull down the lid and push in the cleaver button. **Be sure to properly dispose of all glass shavings carefully.
- *Repeat Steps 2-4 for the opposite side prior to continuing to use the Fusion Splicer.*


Bridgecable.com
Network Cabling

Step 5: Bring in the Fiber Optic Fusion Splicer

- Carefully insert each side of the fiber optic cable into its corresponding tray and get them both into position. While the fusion splice that you may be using has different prompts, the next step on ours is to close the lid and hit the “SET” button. During this time, the LCD screen will show you a live preview of the machine bringing both ends of the fiber cable together and lining them up. You will see a clearer picture of your cleaves and your cleaning result. At this point, if everything is not up to par, the machine will give you an error in regard to whether the fiber optic cable was too dirty, didn’t have a straight cleave, or if the dimensions are not alike. Assuming everything goes well, the LCD screen will continue to display the different tests showing how much dB loss you may or may not have. In addition, the system will also perform a tension test!


Bridgecable.com
Network Cabling
RESET
Splice Mode Menu: 2
AUTO

Step 6: Let's Get Back to the Heat Shrink Wrap

- After the fiber optic fusion splicer completes all of its tests, you can remove the newly formed cable and carefully slide the heat shrink wrap over to the center (remember this from step 1). Make sure that there is an even amount on both sides as this will later ensure an even amount of strength! Then move the heat shrink wrapped area to the heating element and carefully place it in. Our machine automatically triggers the door to close and lights up the heat lamp in red. When the red light goes off, carefully remove the cable and place it in the cooling tray. Be sure to wait at least 15-20 seconds before moving forward with the cable. However, please inspect the areas, if there are bubbles, this means that the heat shrink was overheated; if the ends are still turned up, this means that there wasn't enough heat.


Bridgecable.com
Network Cabling
RESET

The two types of splicing

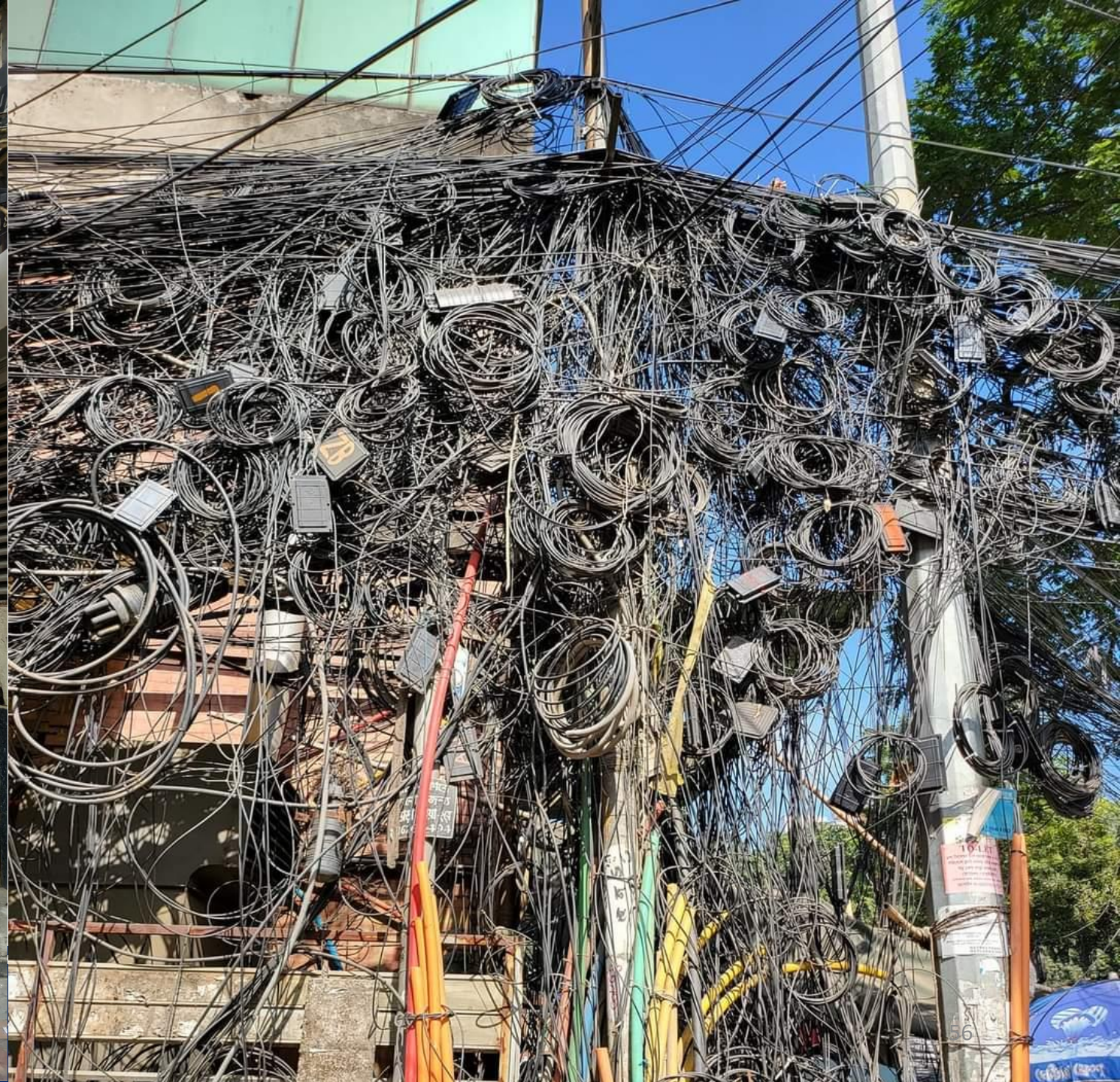
Fusion Splicing

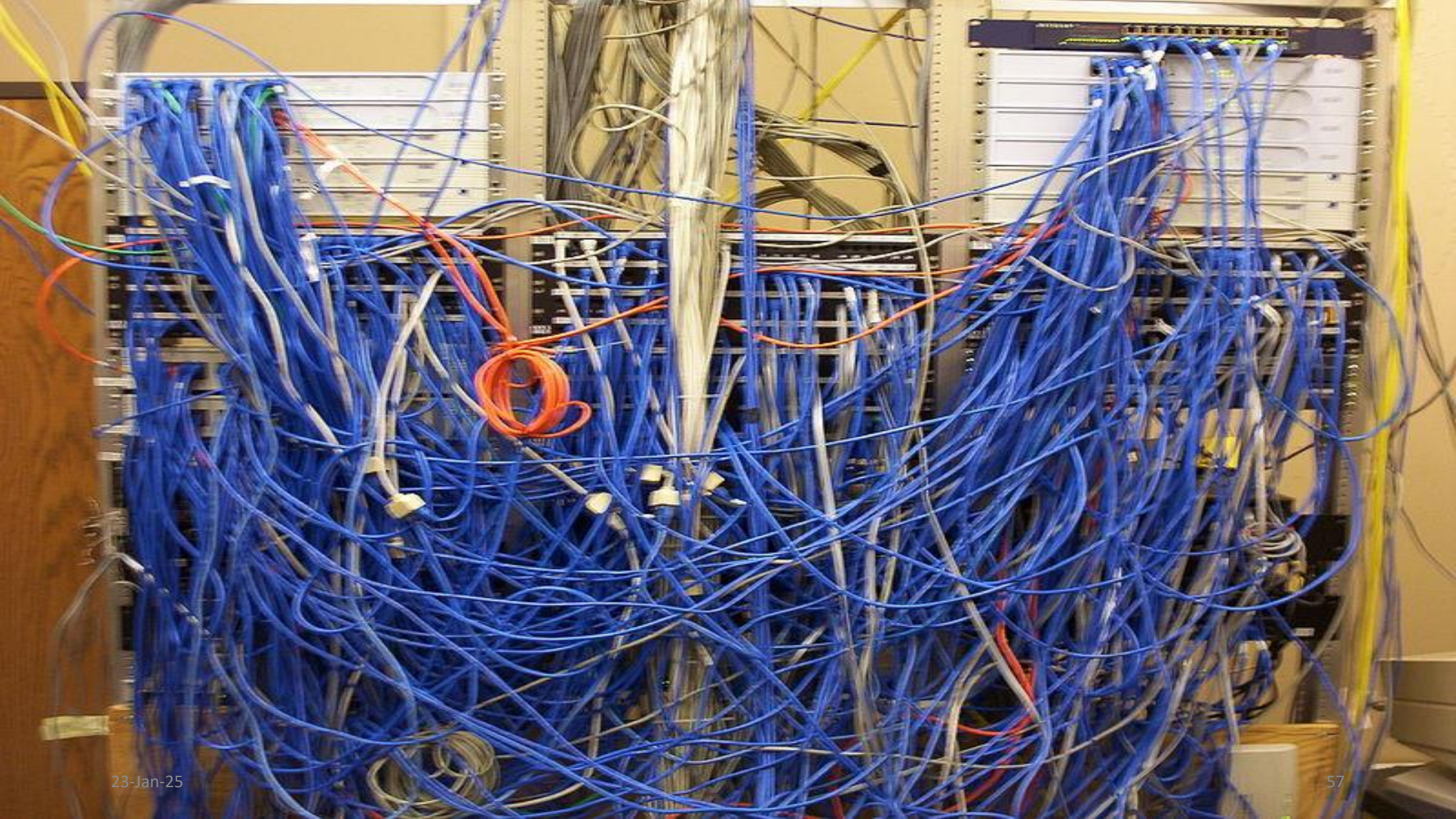
vs.

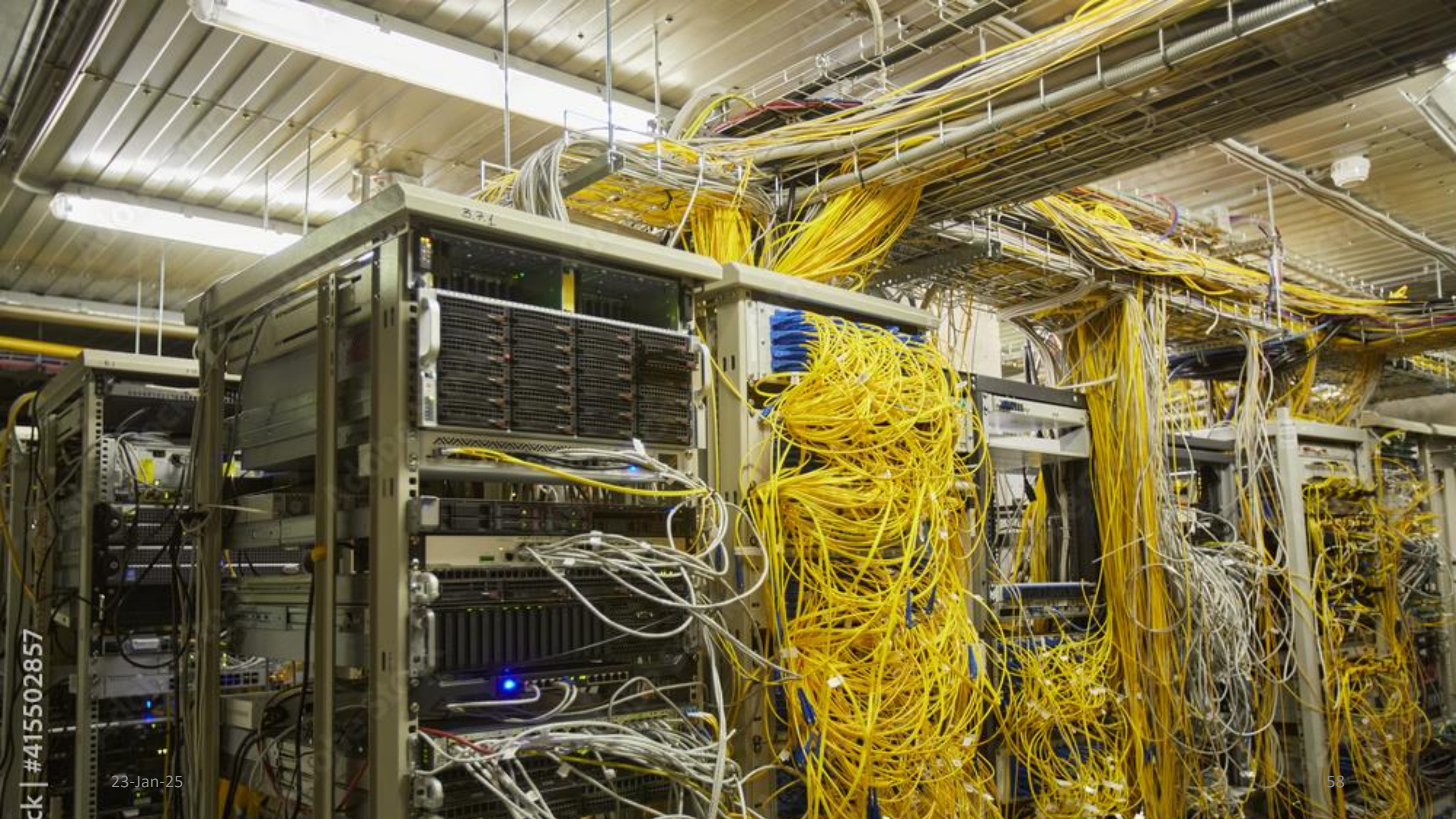
Mechanical Splicing


SynchroServe Global Solutions Pvt. Ltd.
Academic Information Board
DDU-GKY
Ministry of Rural Development, Government of India
DDU-GKY

23-Jan-25







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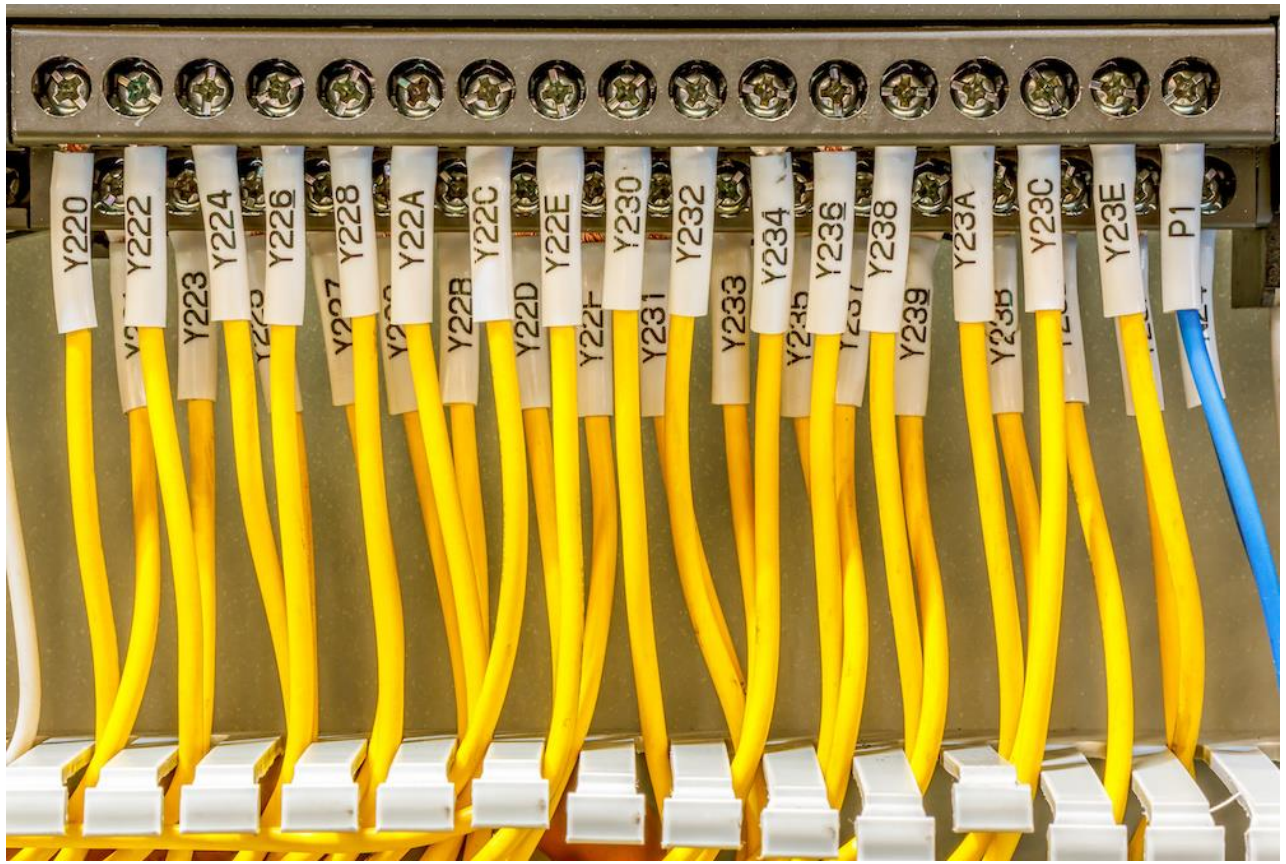
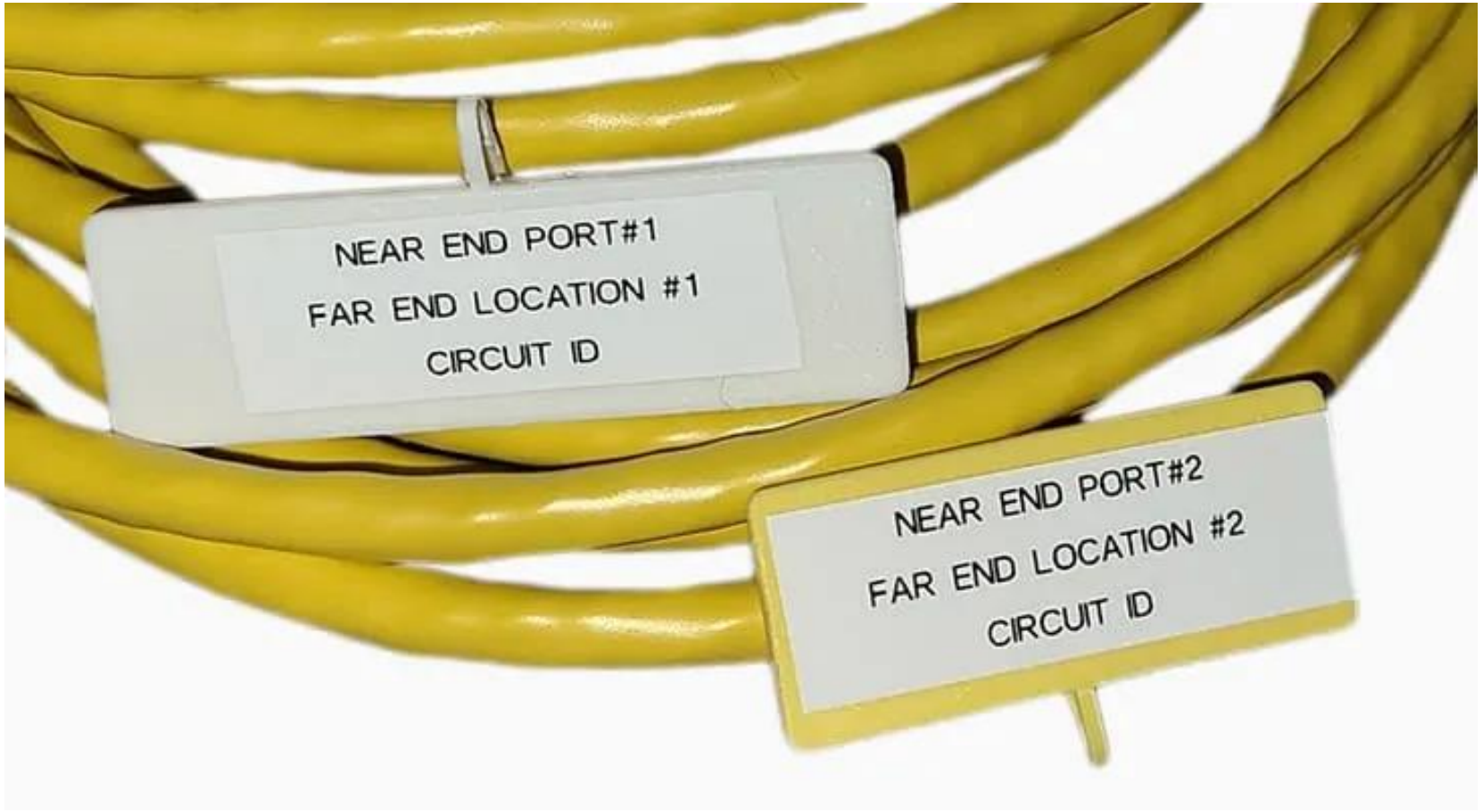
Cable ID

- Network cables usually do not come with unique IDs printed on them from the manufacturer. However, you can use the following methods to label and identify cables yourself:

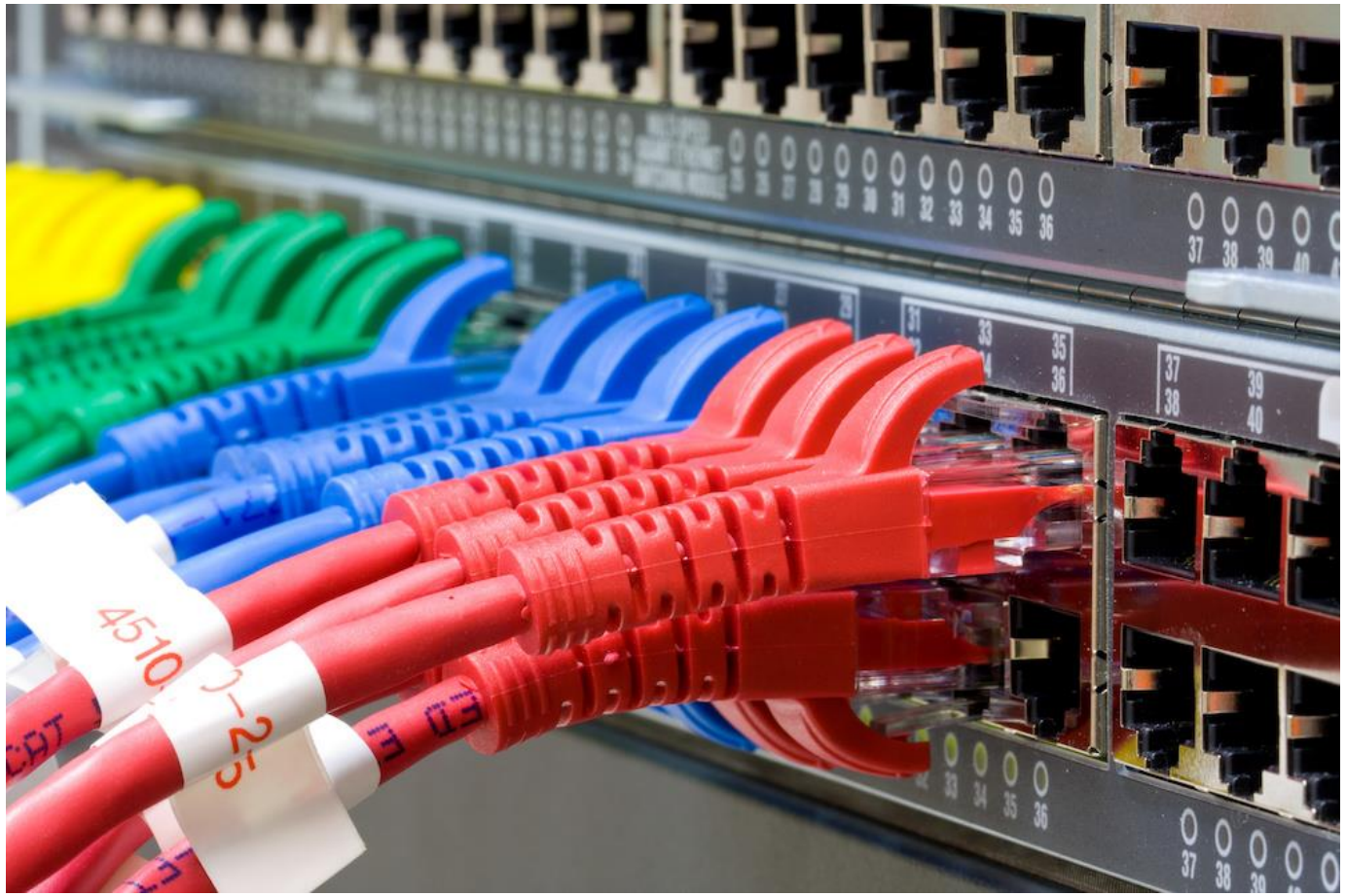
Method 1: Tags and Labels



Method 2: Direct Printing



Method 4: Color Identification



Cable ID Types:

https://www.youtube.com/watch?v=ngLAkzePxto&list=PLS8esD8HRZVEjQXmhQ5OmwQRU69Iw7dpS&index=1

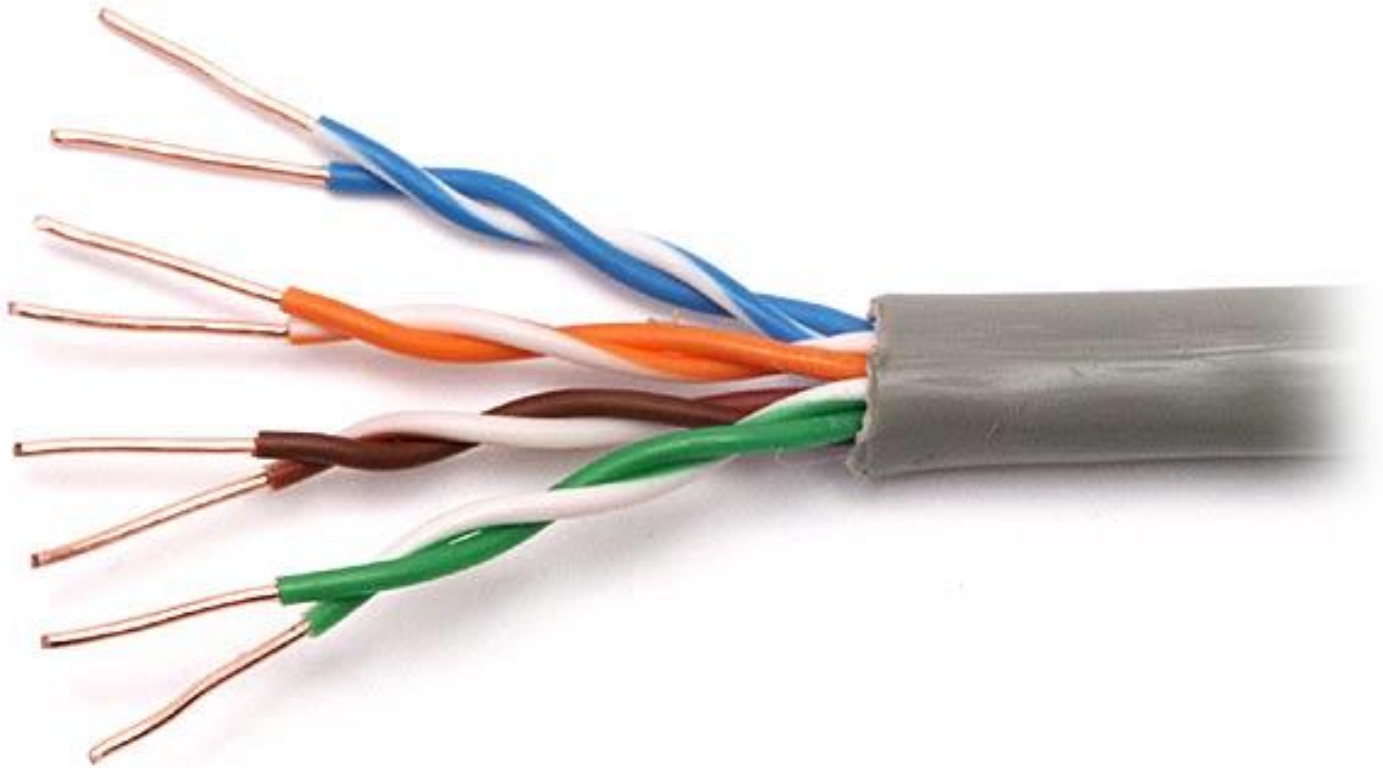
Click the Link


Why not using small label printer for labeling?

Cable Length

- Many network cables have length markers printed on them at regular intervals. These markers can be used to determine the length of the cable.

Twisted Pair Cables



Twisted-pair Cable

- These are a type of **guided media.**
- It was invented by **Alexander Graham Bell.**
- Twisted pair cables have two **conductors** that are generally made up of **copper** and each conductor has **insulation**.
- These **two conductors** are **twisted together**, thus giving the name twisted pair cables.

Twisted-pair Cable

- One of the conductors is used to **carry the signal** and the other is used as a **ground reference** only.
- The **noise or crosstalk** in the two parallel conductors is high but this is greatly reduced in twisted pair cables due to the twisting characteristic.
- The quality of signal in twisted pair cables greatly depends upon the **number of twists per unit** length of the cable.

Twisted-pair Cable

- **Electromagnetic interference (EMI)** is unwanted noise or interference in an electrical path or circuit caused by an outside source. It is also known as radio frequency interference
- **Crosstalk (Interference):** is a disturbance caused by the electric or magnetic fields of one telecommunication signal affecting a signal in an adjacent circuit. Essentially, every electrical signal has a varying electromagnetic field.

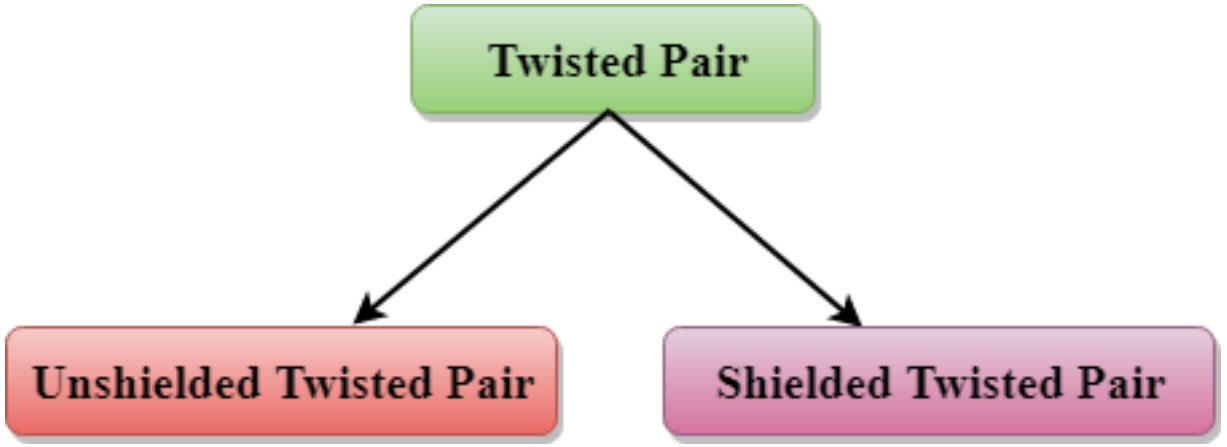
Applications of Twisted pair cables :

- Twisted Pair cables are used in telephone lines to provide data and voice channels.
- The DSL(Digital subscriber line) lines make use of these cables.
- Local Area Networks (LAN) also make use of twisted pair cables.
- They can be used for both analog and digital transmission.
- RJ-45 is a very common application of twisted pair cables.

Types of Twisted-pair Cable

Twisted Pair Cables are further of two types :

1. **Unshielded Twisted Pair Cables (UTP)**
2. **Shielded Twisted Pair Cables (STP)**



Unshielded Twisted Pair Cables (UTP)

- **UTP** cable has **four pairs** or **eight colour-coded** copper wires twisted together and covered with a **plastic sheath**.
- Their electromagnetic interference gets cancelled due to the twisting effect.
- UTP cables are primarily used in **LANs, telephone wires** and **ethernet cables**.

Unshielded Twisted Pair Cables (UTP)

Advantages –

- These cables are cost-effective and easy to install owing to their compact size.
- They are generally used for short-distance transmission of both voice and data.
- It is less costly as compared to other types of cables.

- **Disadvantages –**
  - The connection established using UTP is not secure.
  - They are efficient only for a distance up to 100 meters and have to be installed in pieces of up to 100 meters.
  - These cables have limited bandwidth.

Shielded twisted pair or STP:

- STP cable uses the techniques of wire twisting, shielding, and cancellation.
- Each wire pair is covered in a **metallic foil**.
- Then **four pairs** of wires are then covered by an external metallic braid.
- **STP cables** reduce crosstalk both within the cable with pair-to-pair coupling and from outside the cable.

Shielded Twisted Pair Cable (STP)

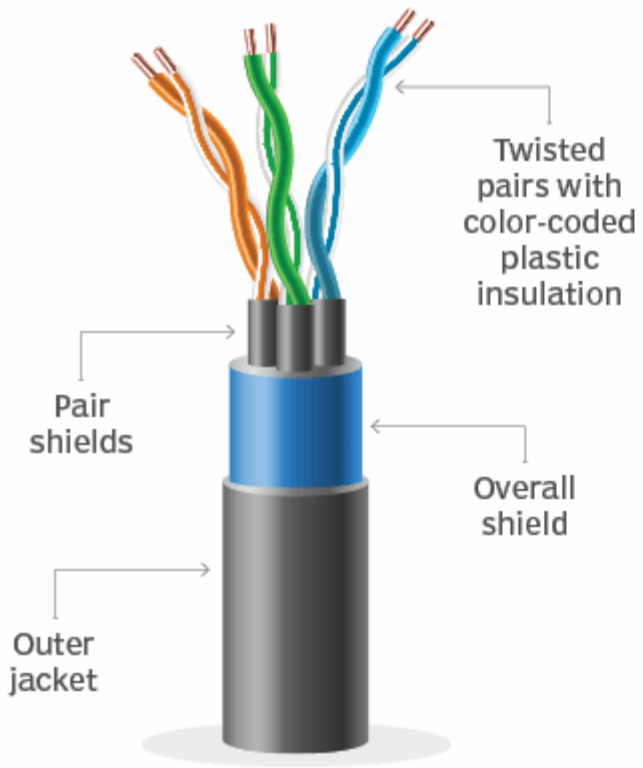
Advantages –

- They are generally used for long-distance communication and transmission and are installed underground.
- The protective shield prevents external electromagnetic noise penetration into the cable.
- They have a higher bandwidth as compared to UTP.

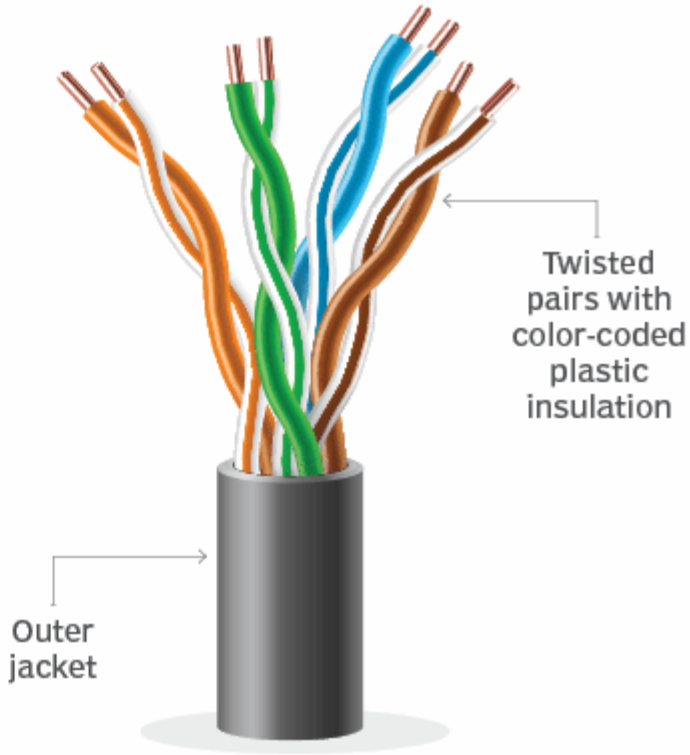
Disadvantages –

- These cables are very expensive.
- They require a lot of maintenance which increases the cost more.
- These can be installed underground only.
- The length of the segment is similar to UTP for these cables.

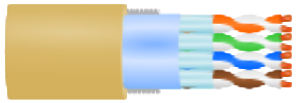
Types of Twisted-pair Cable



Shielded twisted pair

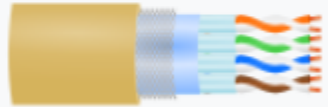


Unshielded twisted pair



U – unshielded
F – foil shielding
S – screened shielding (outer layer only)
TP – twisted pair
TQ – twisted pair, individual shielding in quads

Common industry nomenclature for cable construction types

Industry abbreviations	ISO/IEC 11801 designation[A]	Cable shielding	Pair shielding	Illustration
UTP, TP	U/UTP	None	None	
STP, ScTP, PiMF	U/FTP	None	Foil	
STP, ScTP	S/UTP	Braiding	None	
SSTP, SFTP, STP, STP PiMF	S/FTP	Braiding	Foil	
SSTP, SFTP, STP	SF/FTP	Braiding and Foil	Foil	
SFTP, S-FTP, STP	SF/UTP	Braiding and Foil	None	
FTP, STP, ScTP	F/UTP	Foil	None	
FFTP, STP	F/FTP	Foil	Foil	

What are the categories of twisted pair cables?

- **Category 1 or Cat 1** – UTP cables with data rate < 0.1 Mbps, used in telephone lines
- **Category 2 or Cat 2** – UTP cables with a data rate of 2 Mbps, used in transmission lines
- **Category 3 or Cat 3** – UTP cables with a data rate of 10 Mbps, used in LANs or 10baseT Ethernet
- **Category 4 or Cat 4**– UTP cables with a data rate of 20 Mbps, used in token ring networks
- **Category 5 or Cat 5** – UTP cables with a data rate of 100 Mbps, used in LANs or 100baseT Ethernet
- **Category 5e or Cat 5e** – 1000baseT Ethernet with a data rate of 1000 Mbps
- **Category 6 or Cat 6** – UTP cables with a data rate of 200 Mbps, used in high-speed LANs
- **Category 7 or Cat 7** – STP used in super high-speed Gigabit Ethernet.

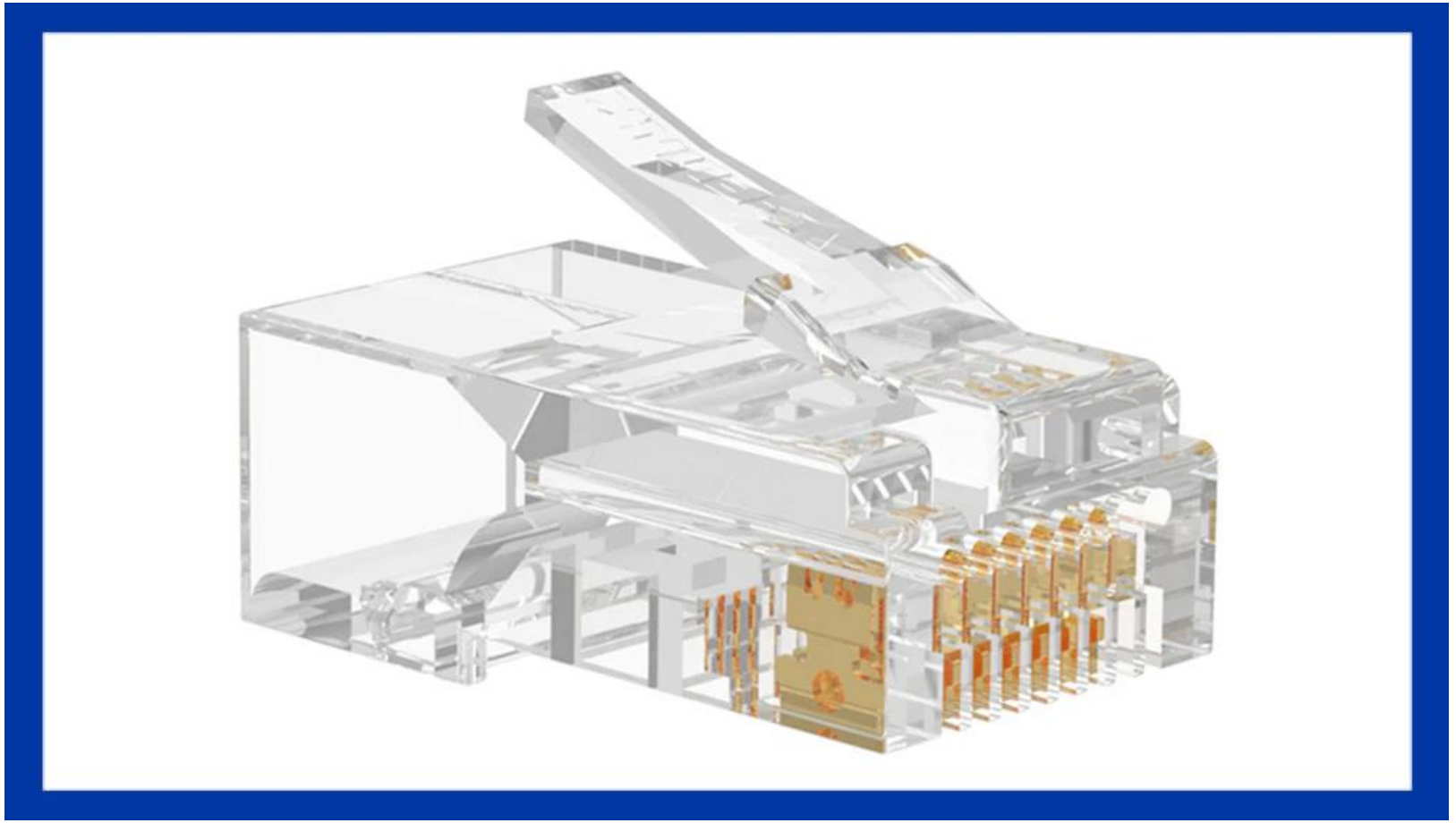
What is "RJ45"?

- "RJ" is the abbreviation of **"registered jack"**, which originally means a standardized telecoms network interface for voice and data devices connection.
- It was first defined in the USCO (Universal Service Ordering Code) of Bell System and in the 1970s, it was licensed by FCC (Federal Communications Commission) to maintain the compatibility between customer devices and telephone service provider equipment.
- "45" means the listing number of networking interface standards.

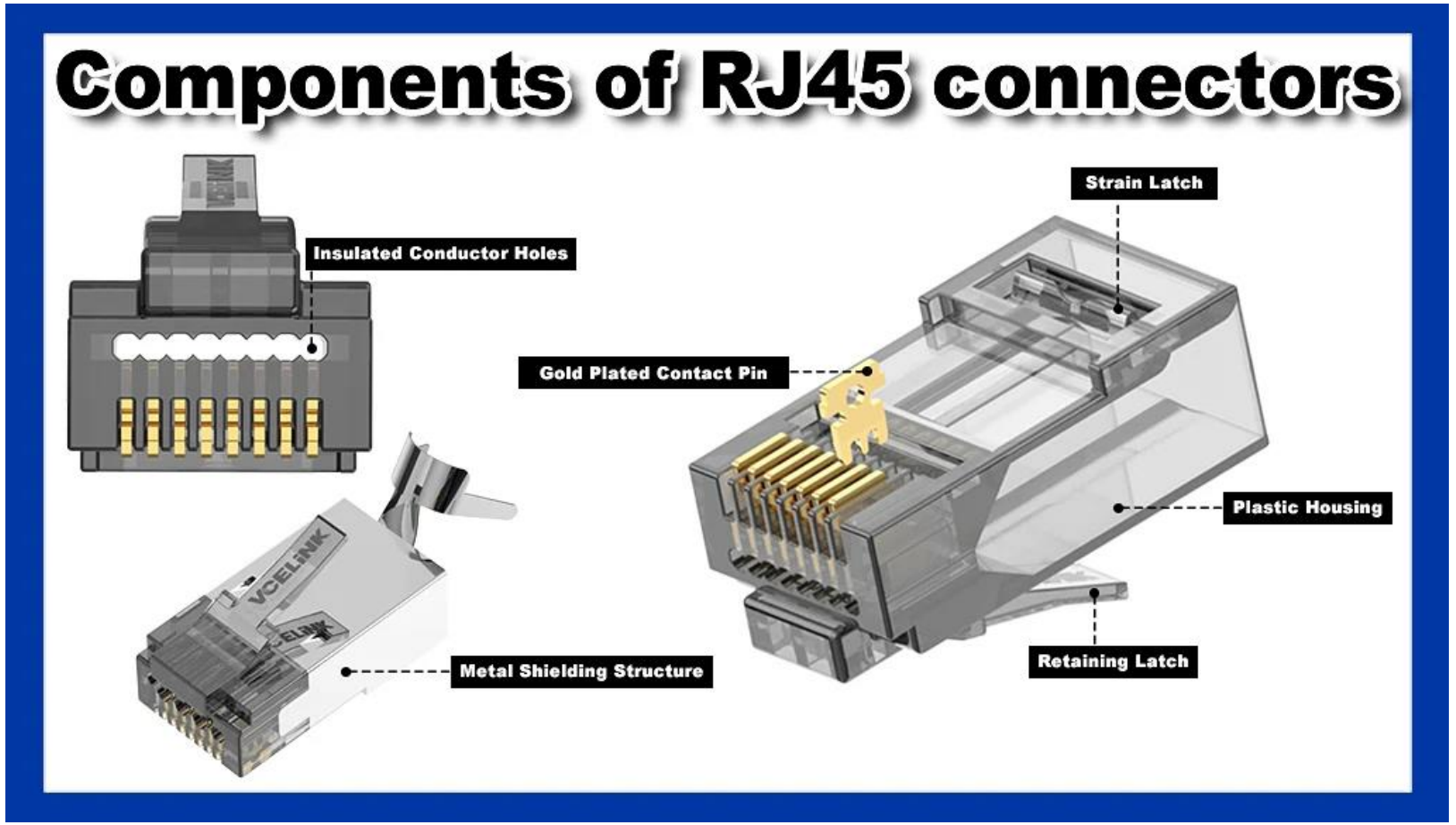
What is an RJ45 Connector? RJ45 vs. 8P8C?

- There are different types of modular connectors for telephone and network applications and the RJ45 is one kind of modular plug used in the network.
- In fact, the RJ45 connector is a **technically incorrect term**, and the correct way to call it is **"8P8C modular plug".**
- "8P8C" refers to "8 Positions and 8 Contacts", which is often used at the end of Ethernet cables.
- A **network patch** cable is usually made of an Ethernet cable and two RJ45 connectors on both ends.

RJ45 Connector



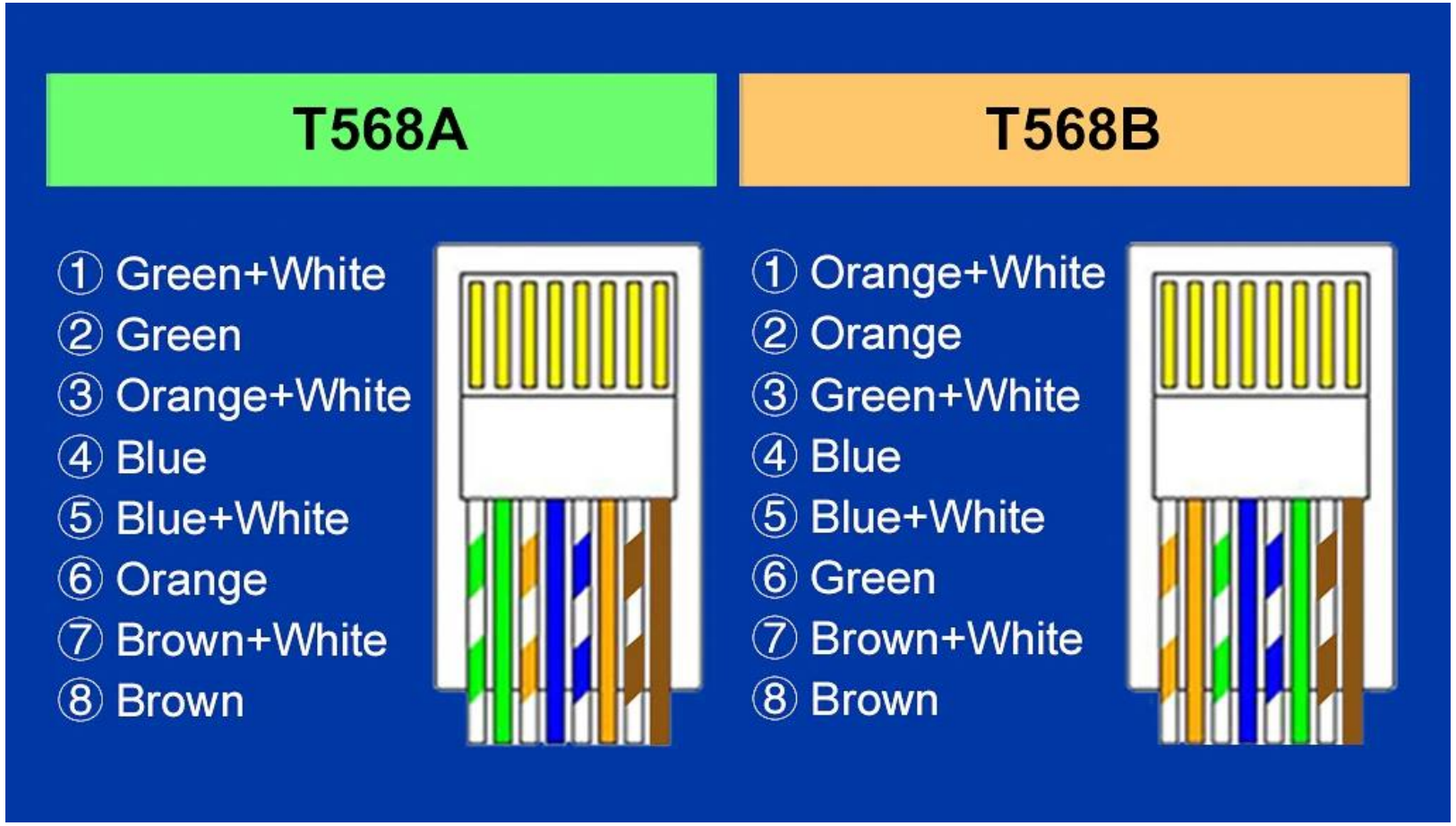
RJ45 Connector



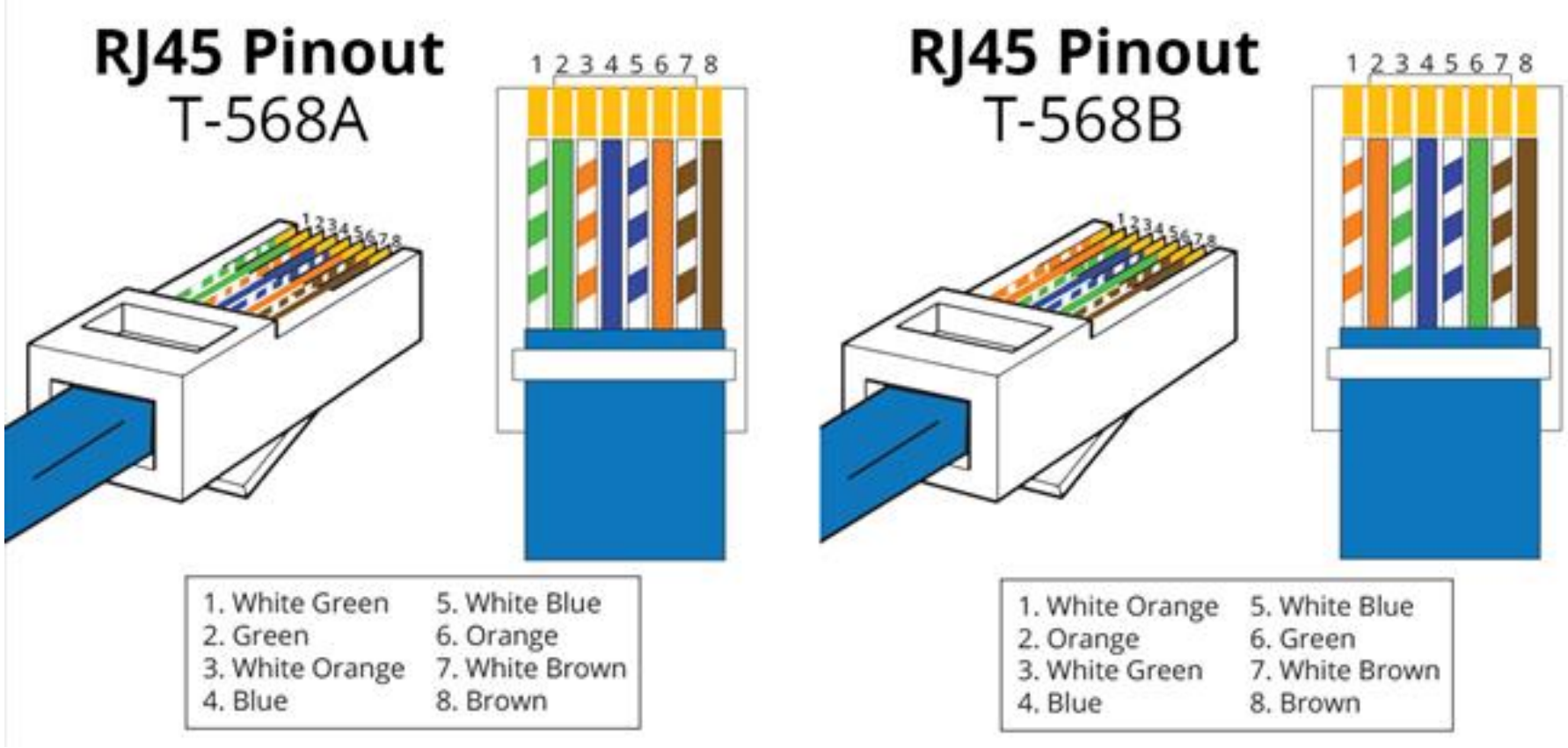
RJ45 Connector Pinout

- RJ45 connectors are made to connect Ethernet cables.
- There are two wiring standards for terminating network cables with RJ45 connectors: **T568A and T568B.**
- The main difference between these two color codes is the interchange of orange and green wires.
- T568B is more popular than T568A, but either one is OK according to your own requirement.
- All you need to do is to choose one wiring standard and then insist on it.

RJ45 Connector Pinout



RJ45 Connector Pinout

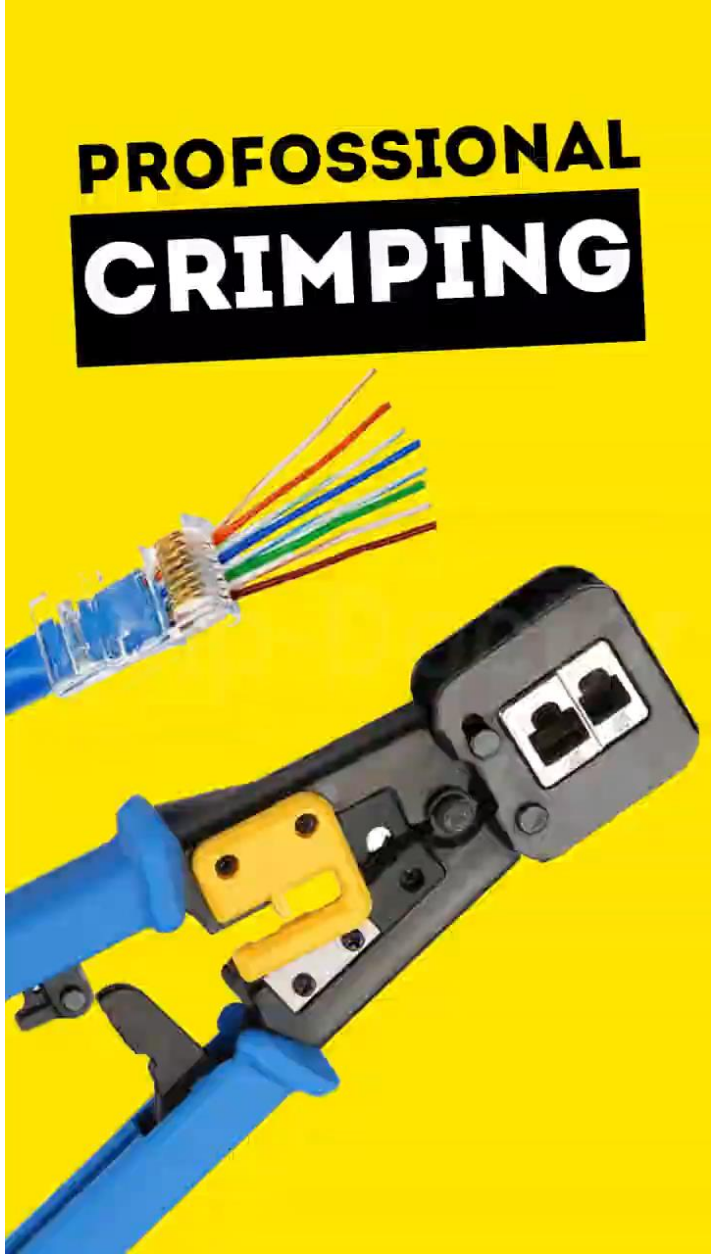


Types of RJ45

- **Standard RJ45 connectors** can also be named as non-pass-through RJ45 connectors, which are usually referred to as 8P8C modular plugs.
- **Pass-through RJ45** connectors allow the network cable wires to pass out of the connector body.
- Compared to standard RJ45 connectors, pass-through RJ45 connectors are easy to keep Ethernet cable wires aligned before terminating connectors.
- In addition, **pass-through RJ45 connectors are easier** to operate, ideal for novices or DIYers.
- Pass-through RJ45 connectors usually require a specific crimping tool.

Regular vs Pass-through RJ45 Connect

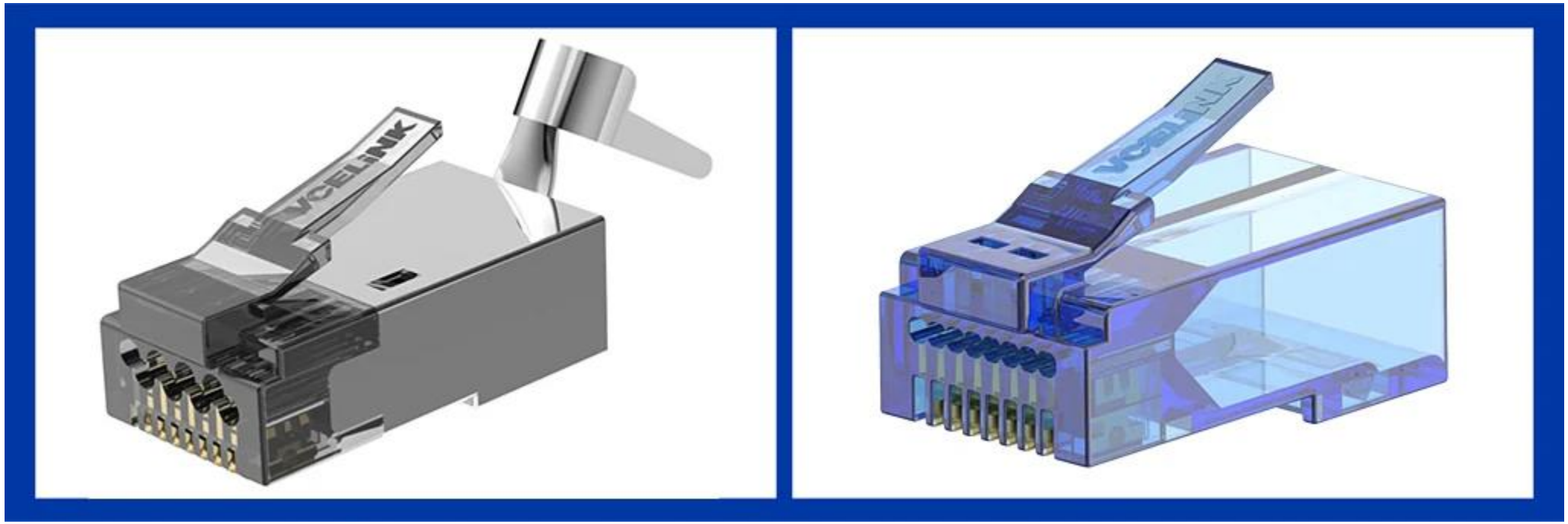
Pass-through RJ45 Connect



Shielded vs Unshielded RJ45 Connectors

- Unshielded RJ45 connectors have a plastic housing, while shielded RJ45 connectors usually feature a metal shield to avoid too much electromagnetic interference (EMI).
- The metal shielding structure is usually plated with nickel or gold. But nickel-plated shielding structure is more common on the market.
- Remember not to use a shielded RJ45 connector on an unshielded network cable as it may affect the connection.
- Shielded RJ45 connectors are often paired with shielded Ethernet cable for maximum performance. If you use an unshielded cable, choose an unshielded connector and if the cable is shielded, use the shielded RJ45 connector.

Shielded vs Unshielded RJ45 Connectors



Standard vs Toolless RJ45 Connectors

- **Standard RJ45** connectors usually require a professional tool - RJ45 crimping tool.
- **A toolless RJ45** connector or field termination plug can be easily terminated **without a crimping tool.**
- Toolless connectors can be used in **emergent situations** and field termination.
- For example, they are designed for quick connection in the field and **frequently moved cabling**.
- Toolless RJ45 connectors can also be **reused a few times** without affecting the data transmission.

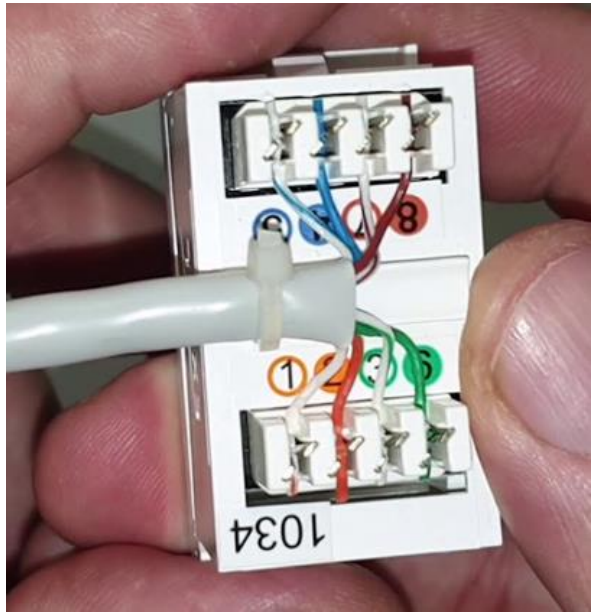
Standard vs Toolless RJ45 Connectors

Single-piece vs Two-piece RJ45 Connectors

Compared to **single-piece RJ45** connectors, **two-piece RJ45** connectors have an additional load bar, designed to help align eight wires for easy and quick wiring. In addition, the load bar can also improve RJ45 connectors' resistance to interference.

Female RJ45

- The sockets of the connectors are the recessed sockets into which a plug can be inserted.
- They are often called (female) RJ45 sockets or similar.
- They are usually in the housing of the device you want to connect.



Female RJ45 Socket

Female RJ45 Socket

Female RJ45 Connector

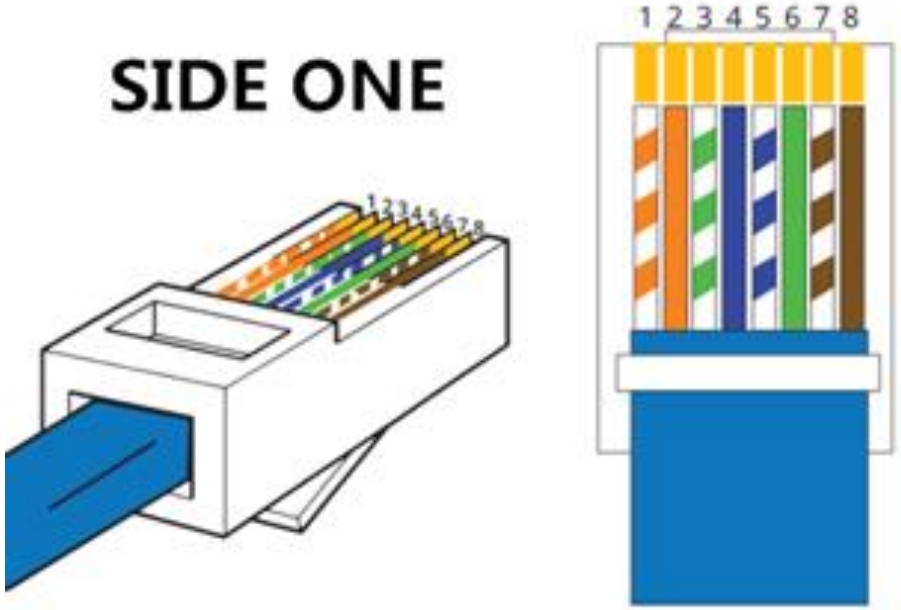
Straight Through and Crossover Cable

What Is Straight Through Cable?

- A straight through cable is a type of twisted pair cable that is used in local area networks to connect a computer to a network hub such as a router.
- This type of cable is also sometimes called a patch cable and is an alternative to wireless connections where one or more computers access a router through a wireless signal.
- On a straight through cable, the wired pins match. Straight through cable use one wiring standard: both ends use T568A wiring standard or both ends use T568B wiring standard.
- The following figure shows a straight through cable of which both ends are wired as the T568B standard.

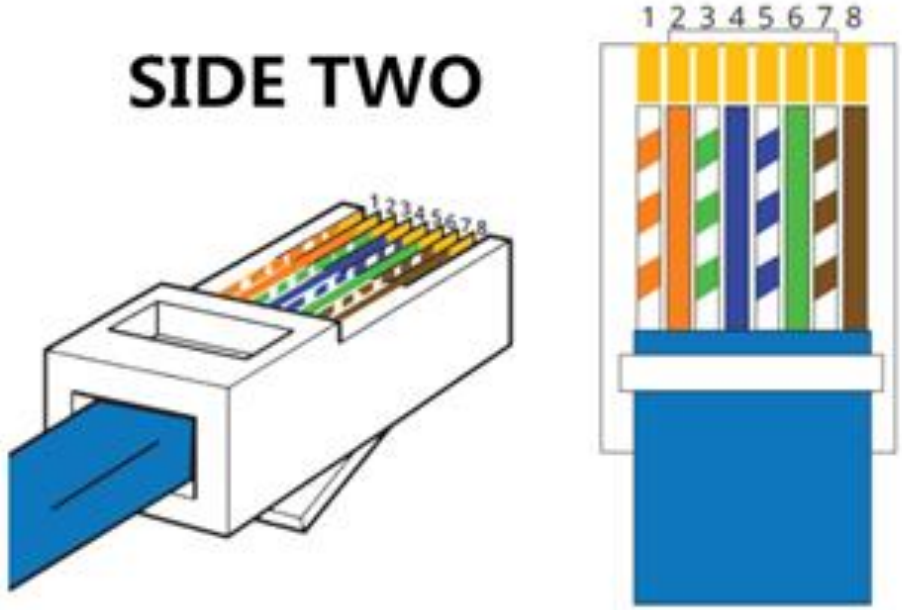
STRAIGHT-THROUGH

SIDE ONE



1. White Orange	5. White Blue
2. Orange	6. Green
3. White Green	7. White Brown
4. Blue	8. Brown

SIDE TWO



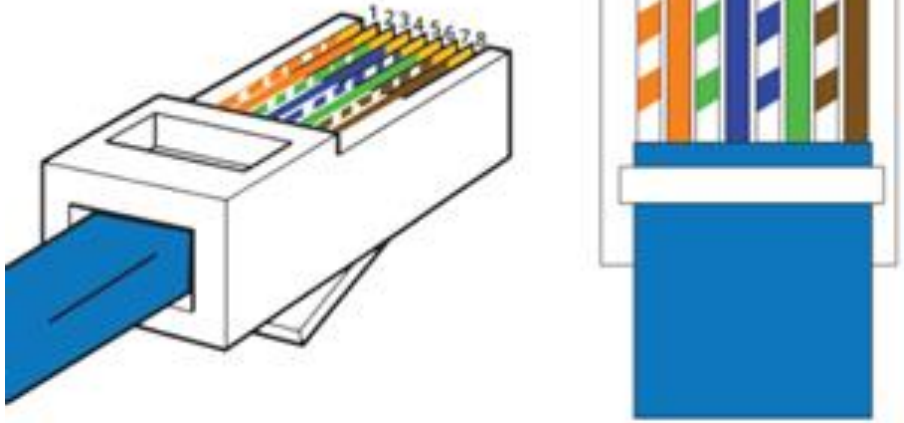
1. White Orange	5. White Blue
2. Orange	6. Green
3. White Green	7. White Brown
4. Blue	8. Brown

What Is Crossover Cable?

- A crossover Ethernet cable is a type of Ethernet cable used to connect computing devices together directly.
- Unlike straight through cable, the RJ45 crossover cable uses two different wiring standards: one end uses the T568A wiring standard, and the other end uses the T568B wiring standard.
- The internal wiring of Ethernet crossover cables reverses the transmit and receive signals.
- It is most often used to connect two devices of the same type: e.g. two computers (via network interface controller) or two switches to each other.

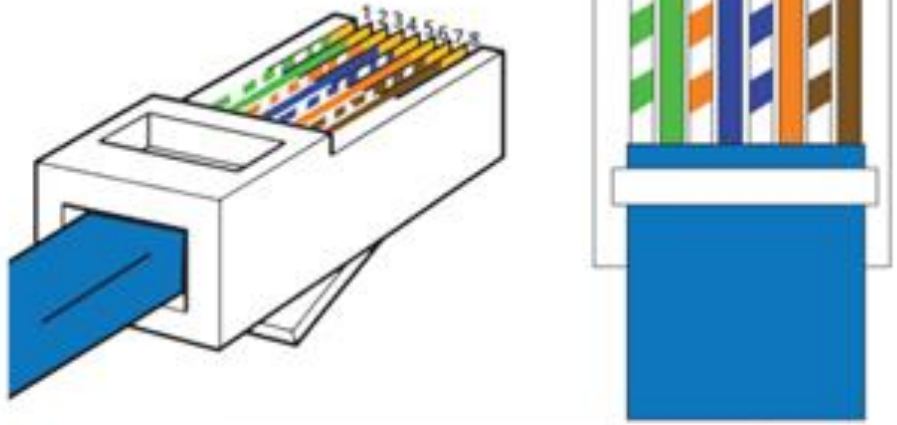
CROSSOVER

SIDE ONE



1. White Orange	5. White Blue
2. Orange	6. Green
3. White Green	7. White Brown
4. Blue	8. Brown

SIDE TWO



1. White Green	5. White Blue
2. Green	6. Orange
3. White Orange	7. White Brown
4. Blue	8. Brown

Straight Through vs Crossover Cable, which to choose?

Straight through vs crossover cable, which one should I choose? Usually, straight through cables are primarily used for connecting unlike devices. And crossover cables are use for connecting alike devices.

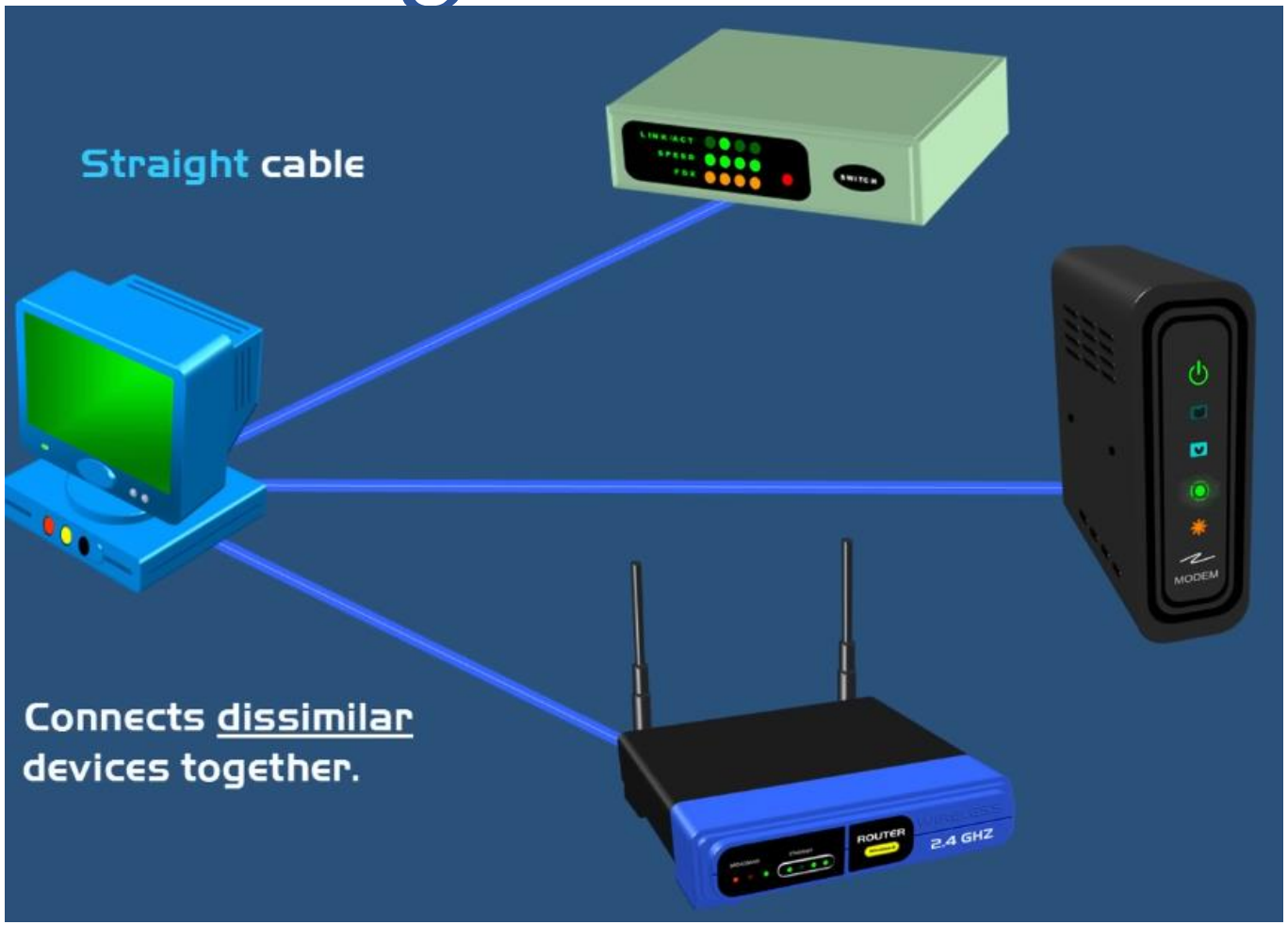
Use straight through Ethernet cable for the following cabling:

- Switch to router
- Switch to PC or server
- Hub to PC or server

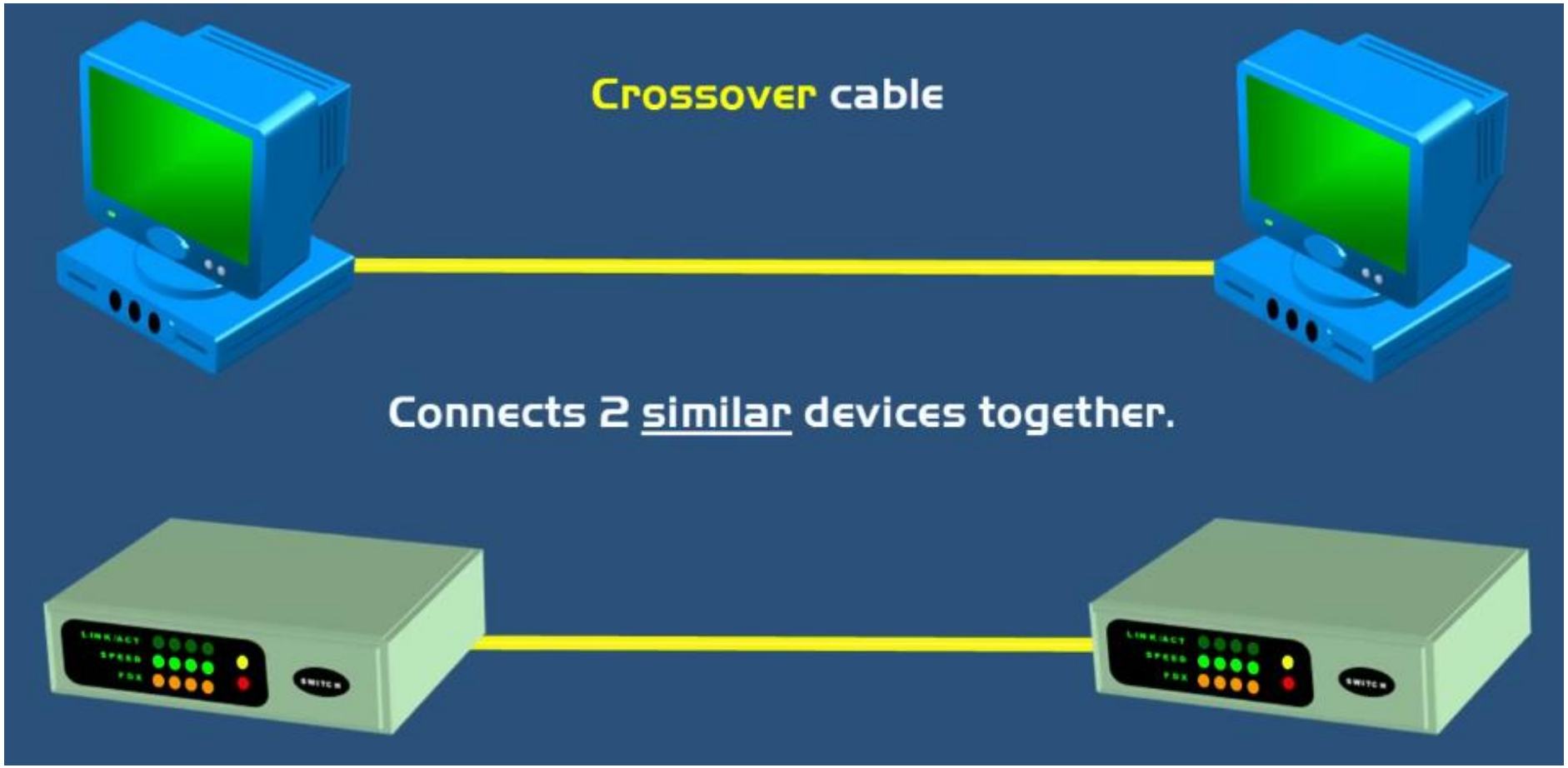
Use crossover cables for the following cabling:

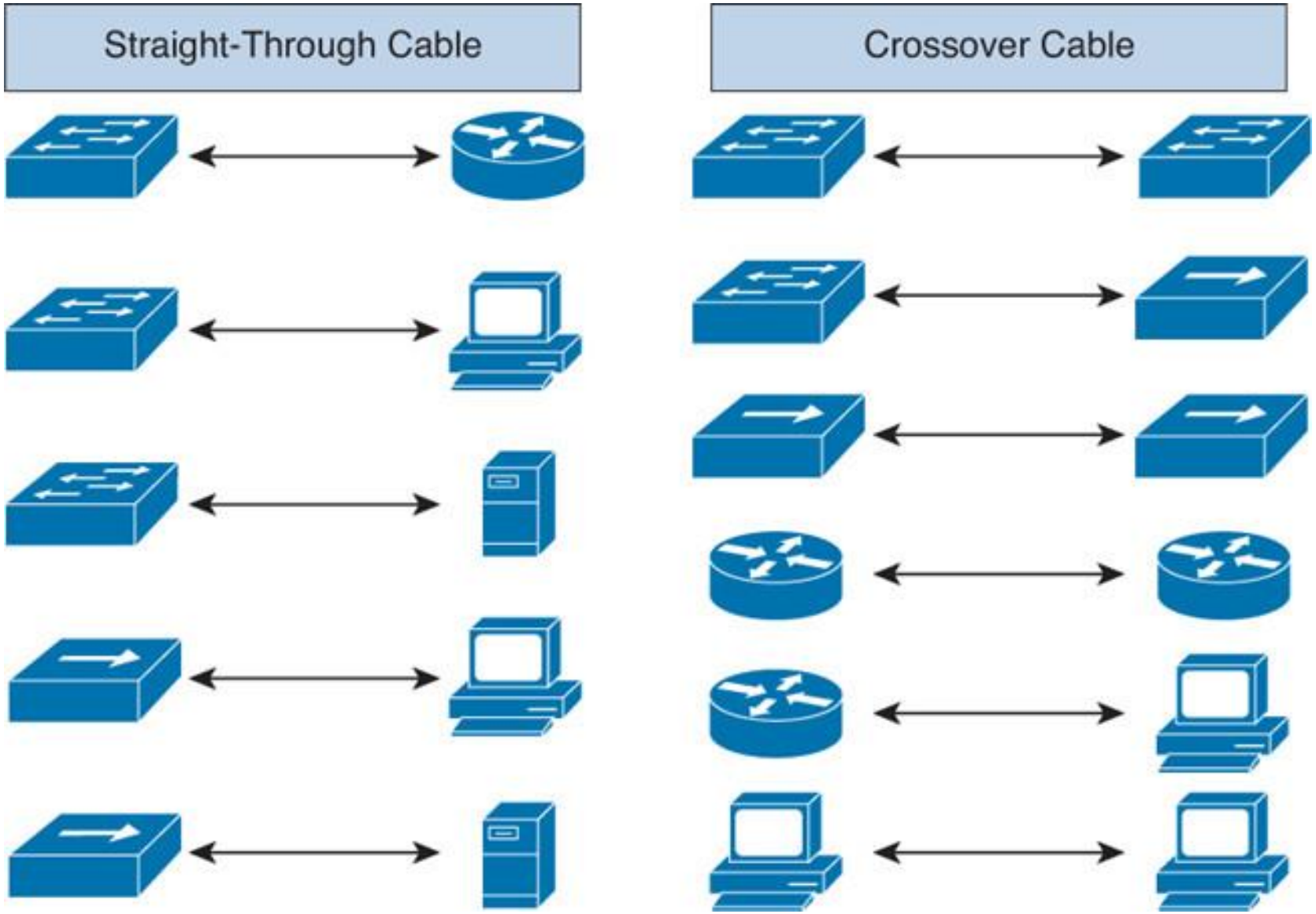
- Switch to switch
- Switch to hub
- Hub to hub
- Router to router
- Router Ethernet port to PC NIC
- PC to PC

Straight Through Cable



Crossover Cables



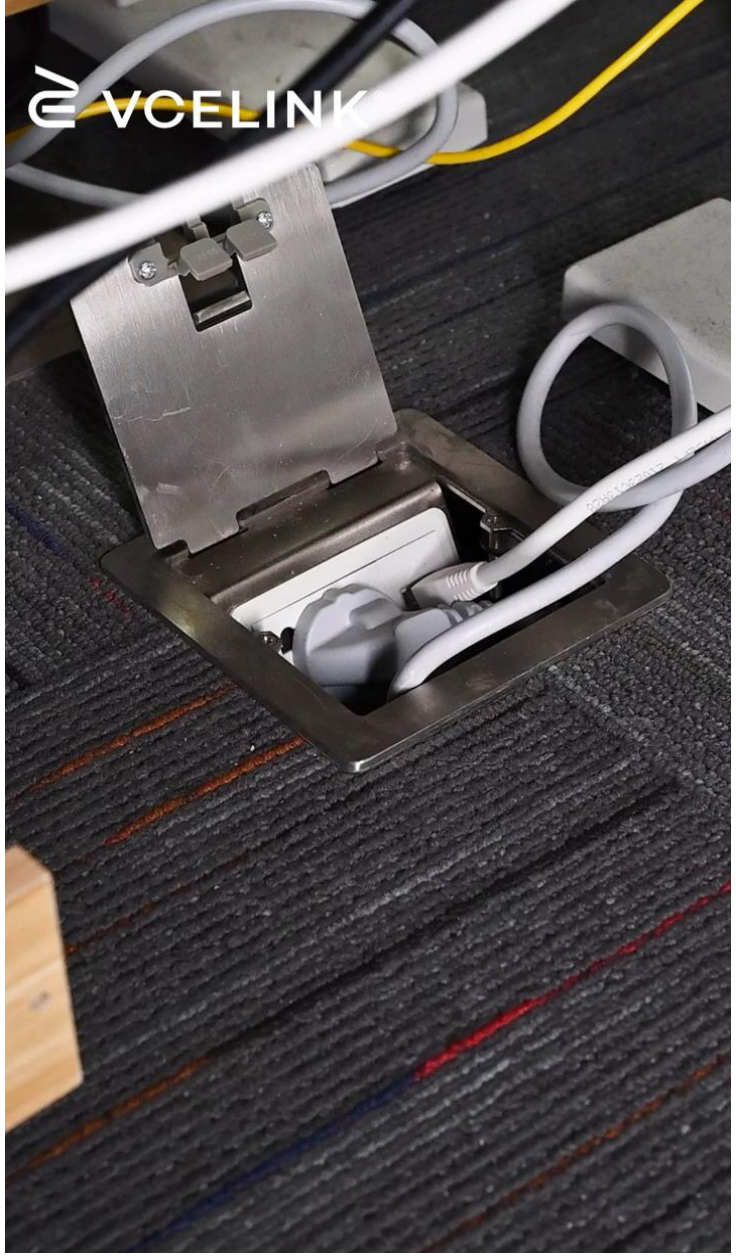

Straight-Through Cable
Crossover Cable

Ethernet Cable Tester

- A cable tester is an electronic device used to verify the electrical connections in a signal cable or other wired assembly.
- Basic cable testers are continuity testers that verify the existence of a conductive path between ends of the cable, and verify the correct wiring of connectors on the cable.

Ethernet Cable Tester

Ethernet Cable Tester



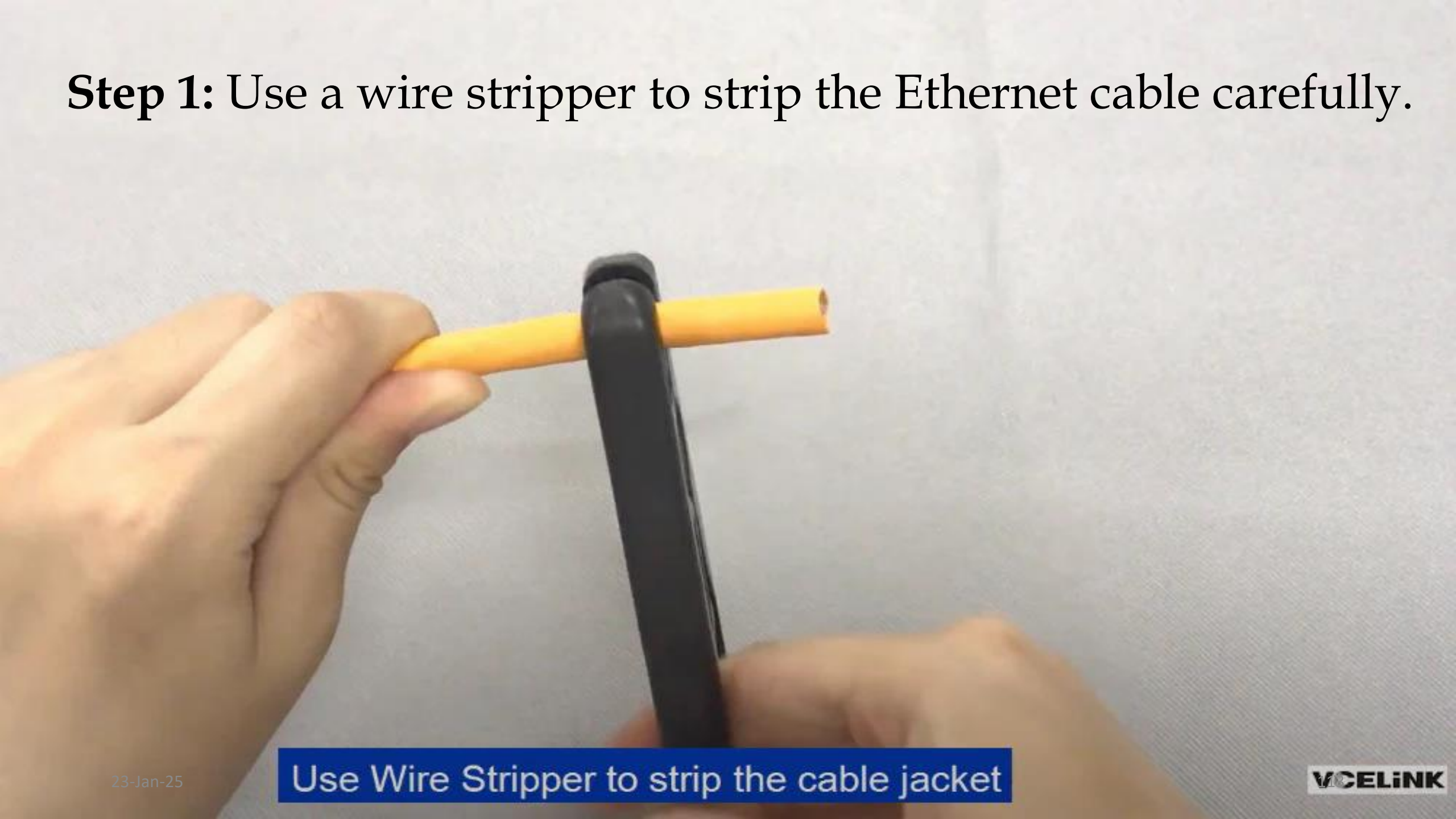
What is a Crimping Tool?

- A crimping tool is a device that is used to **make cold weld joints** between **wires and a connector** through deforming one or both of them to hold the other.
- A special connector is used to join metals together.
- The weld joint properties (mechanical and electrical) are strong as the parent materials when the tool works and offer some result, which is known as crimp.
- An instance of crimping is to affixing a connector to the end of a wire.
- For example, a crimping tool is used to create phone cable sand network cables to combine **RJ-11 and RJ-**45 connectors to both ends of the phone or Cat 5 cable.

What is a Crimping Tool?

How to: Assembly RJ45 Connector on CAT6A CAT7 Ethernet Cable?

Step 1: Use a wire stripper to strip the Ethernet cable carefully.

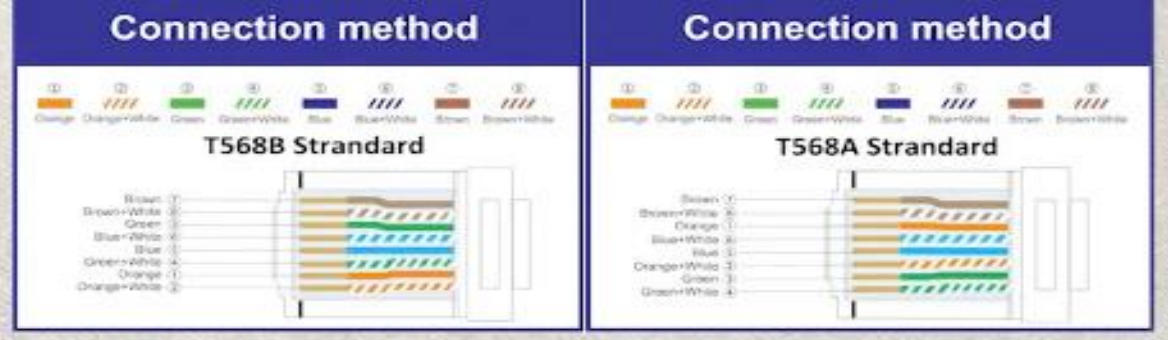


Step 2: Use the cable jacket to straighten eight wires.

Straighten out the wires

迷你播放器 (i)

Step 3: Arrange the wires according to T568A or T568B wiring standard. Either is OK and you can choose one based on your needs.

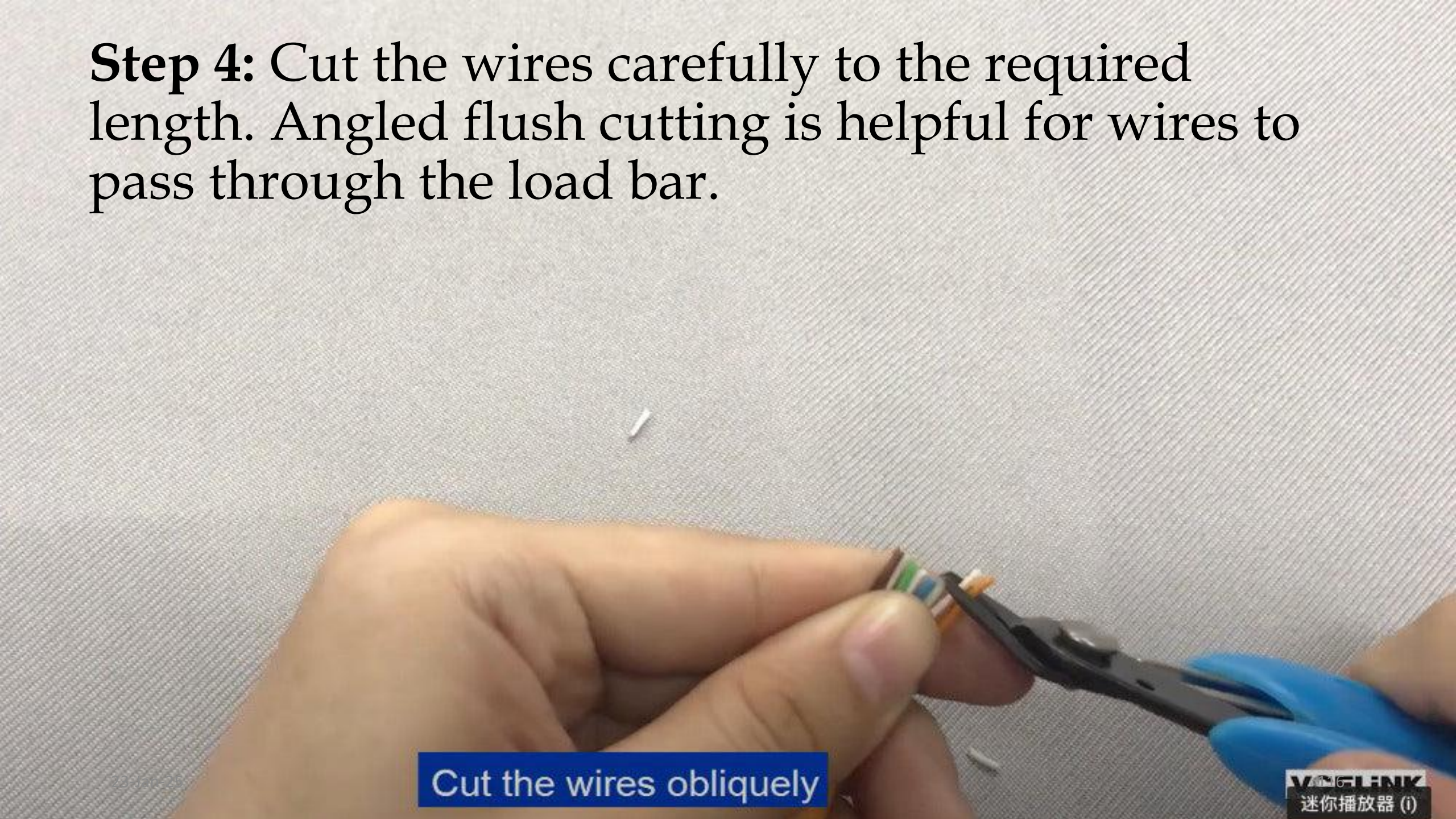


The connection method in the video is T568B, please choose T568A or T568B wire sequence according to your needs

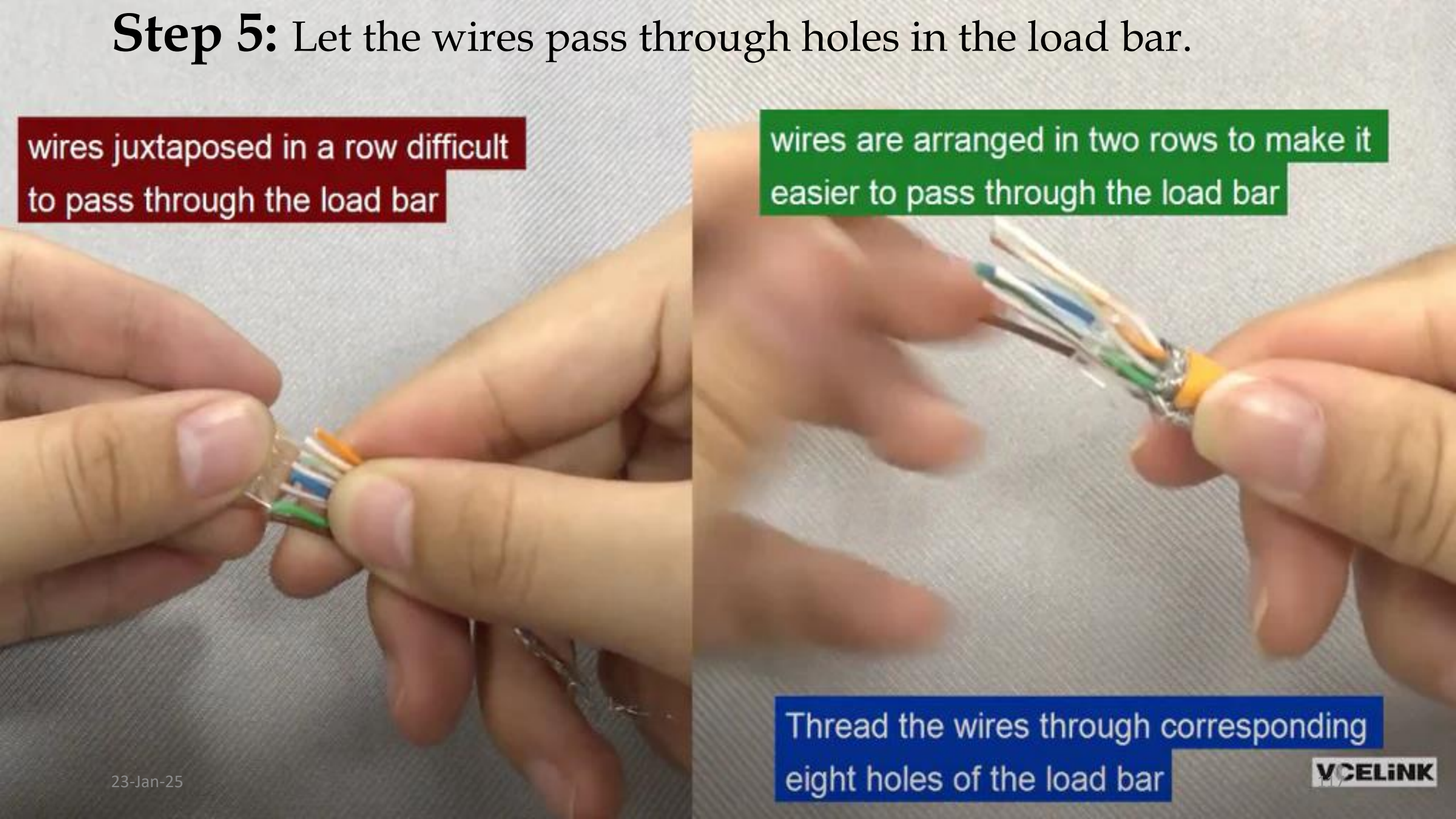
Arrange the wires according to the T568B wire order

VCELiNK

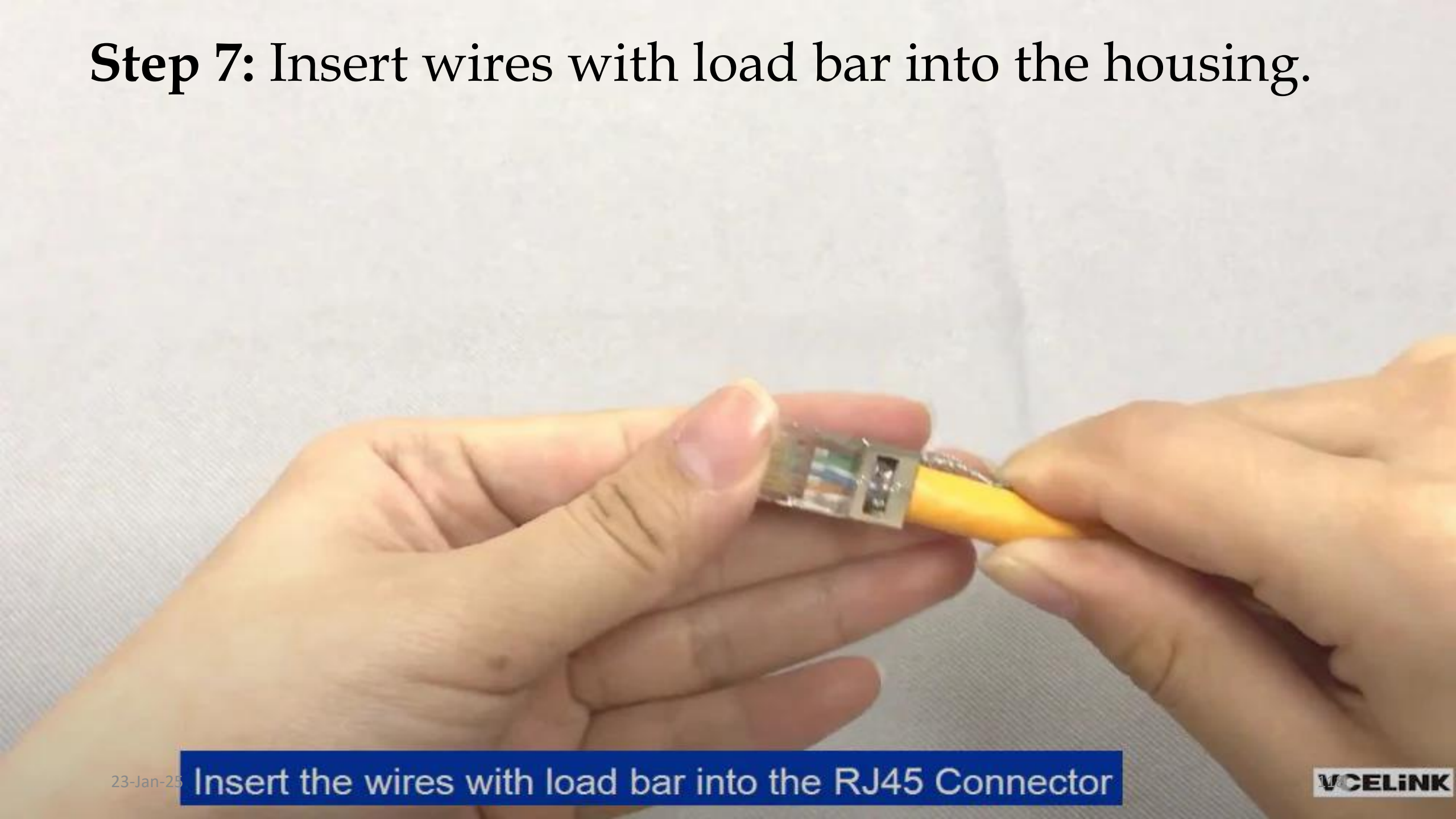
Step 4: Cut the wires carefully to the required length. Angled flush cutting is helpful for wires to pass through the load bar.



Step 5: Let the wires pass through holes in the load bar.

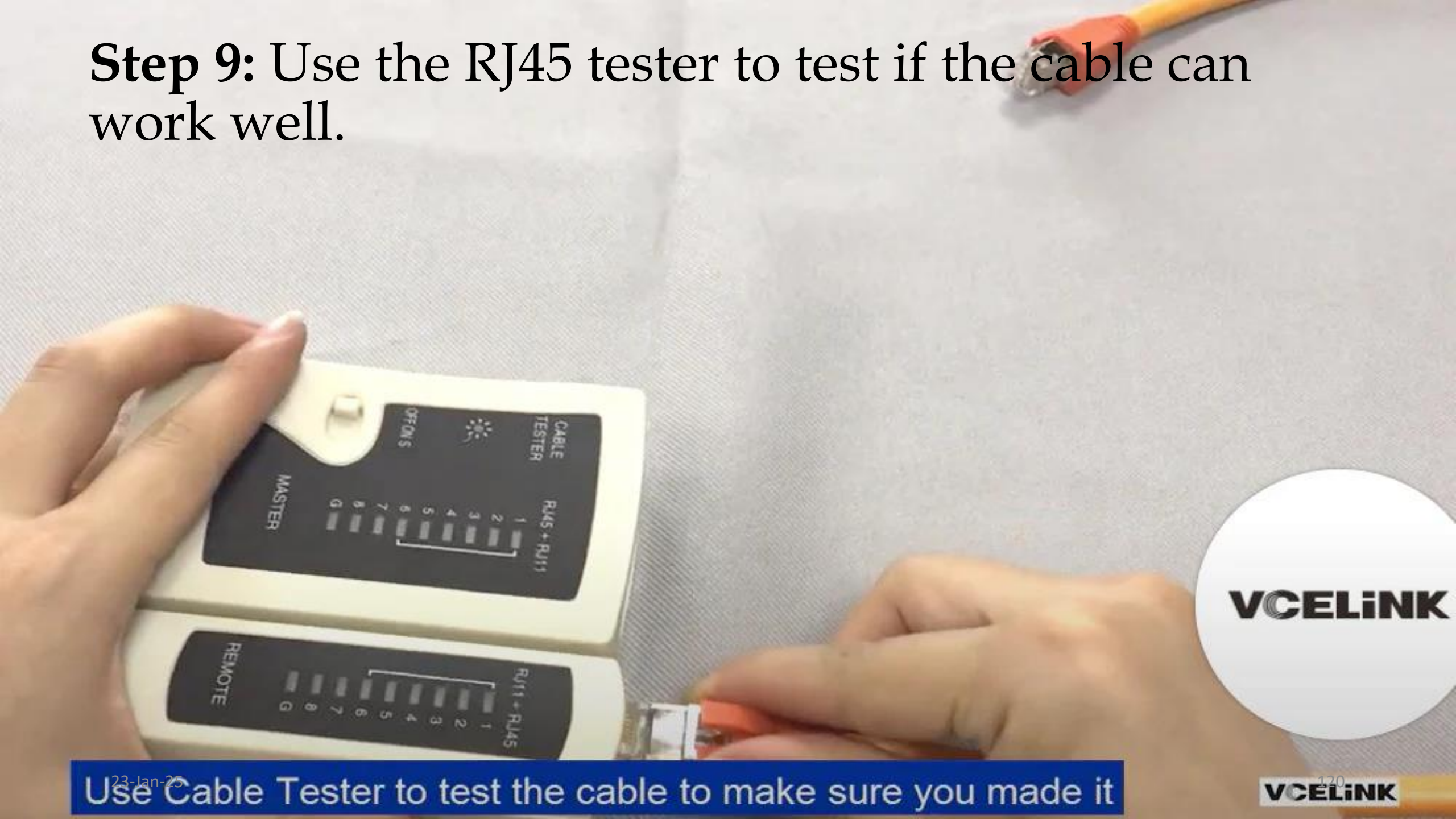


Step 7: Insert wires with load bar into the housing.

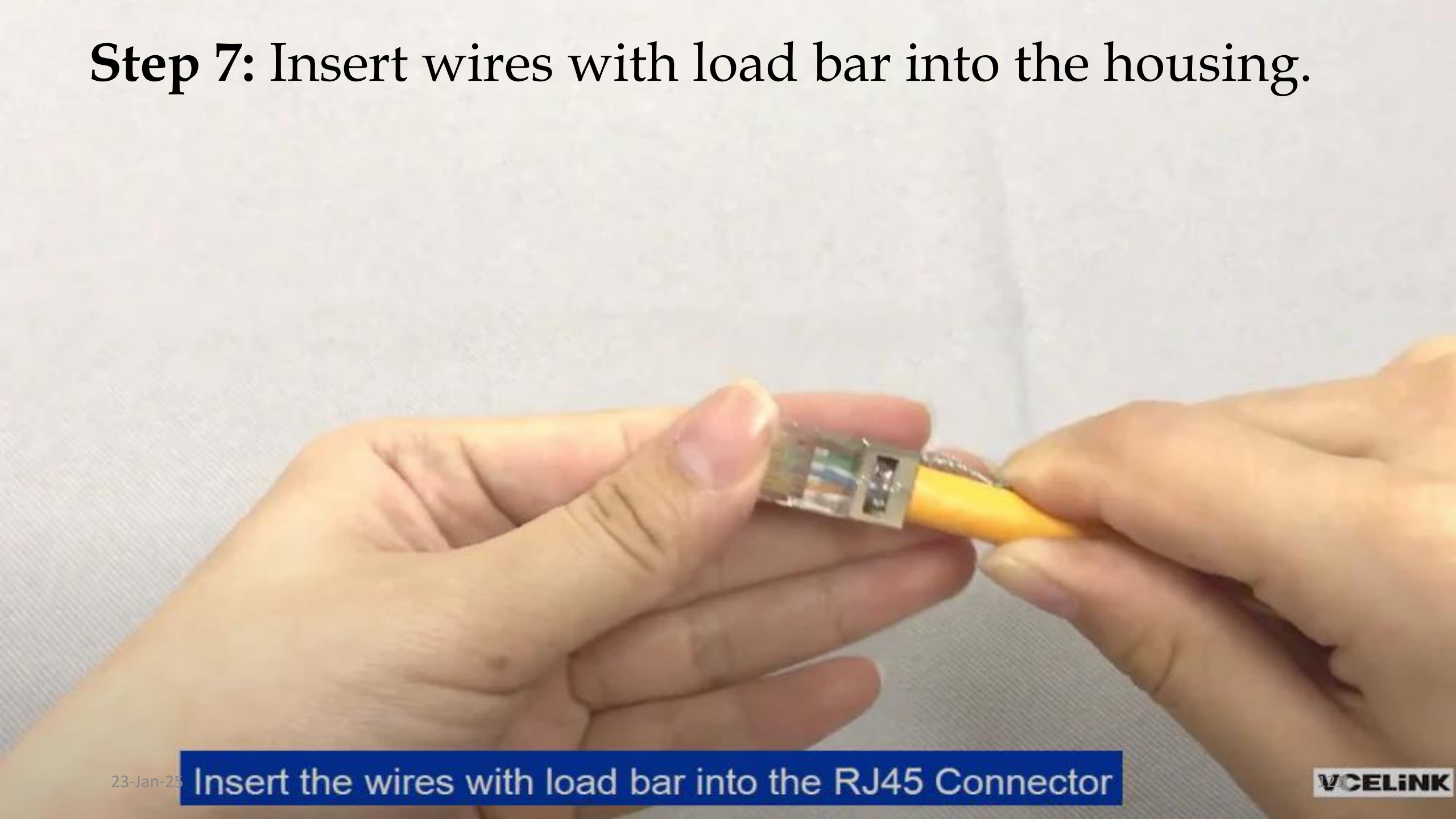


Step 8: Use the professional crimping tool to crimp the RJ45 connector.

Step 9: Use the RJ45 tester to test if the cable can work well.



Step 7: Insert wires with load bar into the housing.



Lectures By Md. Tariqul Islam, Lecturer & Coordinator, Dept. of CSE, UGV, Email: tariq.ugv@gmail.com, Web: www.tariqul.ugv.edu.bd

Assembly RJ45 Connector