



Course: SWE-Computer Network Practical							
Instructor	Dr. Asad Raza Malik		Practical/Lab No.	01			
Date	22-07-2024		CLOs	03			
Student's Roll no:			Point Scored:				
Date of Conduct:	24-07-2024		Teacher's Signature:				
LAB PERFORMANCE INDICATOR	Subject Knowledge	Data Analysis and Interpretation	Ability to Conduct Experiment	Presentation	Calculation and Coding	Observation/Result	Score

Topic	To Work with cable specification, installation, and troubleshooting
Objective	<ul style="list-style-type: none">To become familiar with cable specification, installation, and troubleshooting commandsUnderstand different types of network cables and their specifications.Learn the proper installation techniques for network cables.Develop skills in troubleshooting network cable issues.
Materials Required:	<ul style="list-style-type: none">Ethernet cables (Cat5, Cat53, Cat6, Cat6a)Coaxial cablesFiber optic cablesRJ45 connectorsCrimping toolsNetwork switch or hubComputers with network interface cards (NICs)ScrewdriversWire StrippersMultimeter

Lab Discussion: Theoretical concepts and Procedural steps

Theory:

What is Network Cabling?

Network cabling is the infrastructure used to connect and transfer data between computers, servers, and other network devices within local area networks (LANs) or wider area networks (WANs). It forms the physical foundation of any network, enabling communication between different network Components. Here are the key aspects of network cabling:

Cable Types and Specifications:

1. Twisted Pair Cables

- Unshielded Twisted Pair (UTP):** Commonly used in Ethernet networks. It consists of pairs of wires twisted together to reduce electromagnetic interference.
- Categories:**
 - Cate5:** Supports up to 100 Mbps, 100 meters max.
 - Cat5e:** Support up to 1 Gbps, 100 meters max.

- **Cate6:** Supports up to 1 Gbps, 100 meters max.
- **Cate6a:** Supports up to 10 Gbps, 100 meters max.

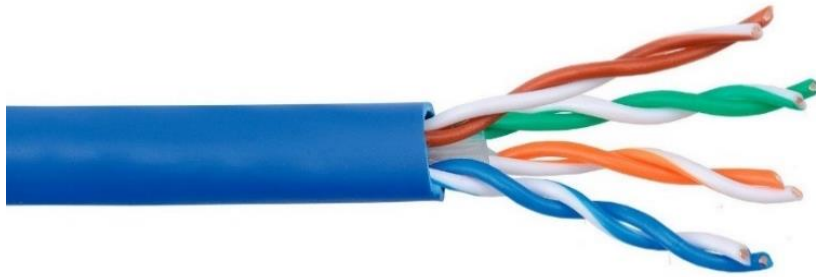


Fig.1. Unshielded twisted pair cable (UTP)

- **Shielded Twisted Pair (STP):** Like UTP but with additional shielding to further reduce electromagnetic interference.

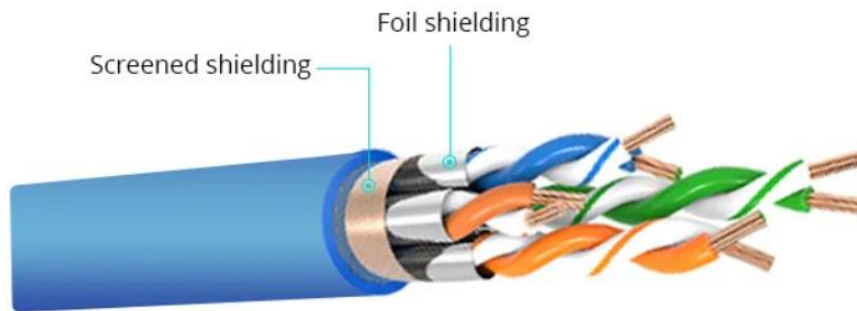


Fig.2. Shielded Twisted Pair (STP)

2. Coaxial Cables

Coaxial cable, commonly referred to as coax, is a type of electrical cable designed for transmitting radio frequency (RF) signals. It consists of a central conductor, usually made of copper, surrounded by an insulating layer, which is then encased in a concentric conductive shield. This shield is typically made of braided copper or aluminum, and the entire assembly is protected by an outer insulating jacket. The term "coaxial" refers to the geometric arrangement of the inner conductor and the outer shield, which share a common axis.

2.1 Structure and Functionality

The construction of coaxial cable allows it to effectively transmit signals while minimizing interference. The central conductor carries the electrical signal, while the insulating layer maintains the necessary spacing and prevents short circuits. The outer shield serves to block external electromagnetic interference (EMI), ensuring that the signal remains clear and undistorted. This design is particularly beneficial for high-frequency applications, as it allows for low-loss transmission over considerable distances.

2.2 Key Components

1. **Inner Conductor:** Typically a solid or stranded copper wire that transmits the signal.
2. **Dielectric Insulator:** A non-conductive material that separates the inner conductor from the outer shield.
3. **Outer Shield:** Made of braided copper or aluminum, it protects against EMI and provides grounding.
4. **Outer Jacket:** A protective layer that shields the internal components from physical damage.

2.3 Applications

- Coaxial cables are widely used in various applications, including:
- Cable Television: Connecting cable service providers to homes and businesses.
- Internet: Used by broadband providers for data transmission.
- Telephone Systems: Connecting central offices to local telephone poles.
- Radio Frequency Transmission: Linking transmitters and receivers to antennas.
- Computer Networking: Historically used in Ethernet connections, though largely supplanted by twisted pair cables and fiber optics in modern networks.

2.4 Types of Coaxial Cables

There are several types of coaxial cables, each suited for different applications:

- **RG-6:** Commonly used for cable television and internet connections, effective for shorter distances.
- **RG-11:** Used for longer runs due to its superior performance over greater distances.
- **Hard-line Coaxial:** Utilizes a solid copper tube for high-power applications, often in commercial broadcasting.
- **Triaxial Cable:** Features an additional layer of shielding for enhanced protection against interference.

Coaxial cables provide a reliable method for transmitting data, video, and voice communications, making them a staple in both residential and commercial settings. Despite the rise of optical fiber technology, coaxial cables remain prevalent due to their effectiveness and ease of installation.

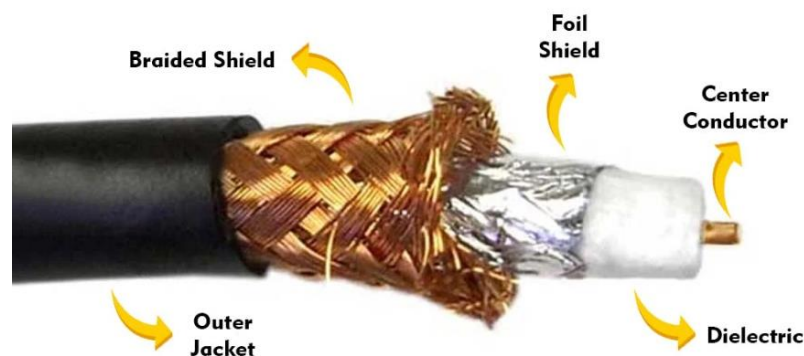


Fig.3. Coaxial Cables

3. Fiber Optic Cables

Fiber optic cables are advanced transmission mediums that utilize thin strands of glass or plastic fibers to transmit data as light pulses. This technology has transformed communication by enabling high-speed data transfer over long distances with minimal loss.

3.1 Structure and Components

A typical fiber optic cable consists of three main components:

1. **Core:** The innermost part where the light travels. It is made of glass or plastic and is designed to carry light signals.
2. **Cladding:** Surrounding the core, this layer has a lower refractive index, which allows for total internal reflection of light, keeping the light confined within the core.
3. **Buffer Coating:** This protective layer surrounds the cladding, providing additional protection against physical damage.
4. **Outer Jacket:** The outermost layer that shields the entire assembly from environmental factors.

3.2 Working Principle

Fiber optic cables transmit data by sending light signals through the core. The light reflects off the core-cladding boundary in a zig-zag manner due to the principle of total internal reflection. This allows the signals to travel long distances without significant degradation. The speed of light in fiber optics is approximately 30% slower than in a vacuum, typically around 180,000 to 200,000 km/s.

3.3 Advantages

Fiber optic cables offer several benefits over traditional copper cables:

- **Higher Bandwidth:** They can support significantly higher data rates, making them suitable for high-performance networking.
- **Long-Distance Transmission:** Fiber optics can transmit data over much longer distances without the need for signal boosting.
- **Immunity to Electromagnetic Interference:** Unlike copper cables, fiber optics are not affected by electromagnetic interference, ensuring clearer signals.
- **Durability and Lightweight:** Fiber optic cables are thinner and lighter than copper wires, making them easier to install and manage.

3.4 Applications

Fiber optic cables are widely used across various industries, including:

- **Telecommunications:** Providing internet, television, and telephone services with high-speed connections.
- **Medical:** Used in imaging devices, endoscopes, and surgical instruments due to their ability to transmit light without interference.
- **Military and Aerospace:** For secure communications and data transfer in challenging environments.

- **Undersea Communications:** Fiber optic cables are essential for global internet connectivity, as they can be laid on the ocean floor.

Overall, fiber optic technology continues to play a crucial role in modern communication systems, enabling faster and more reliable connectivity across various sectors.

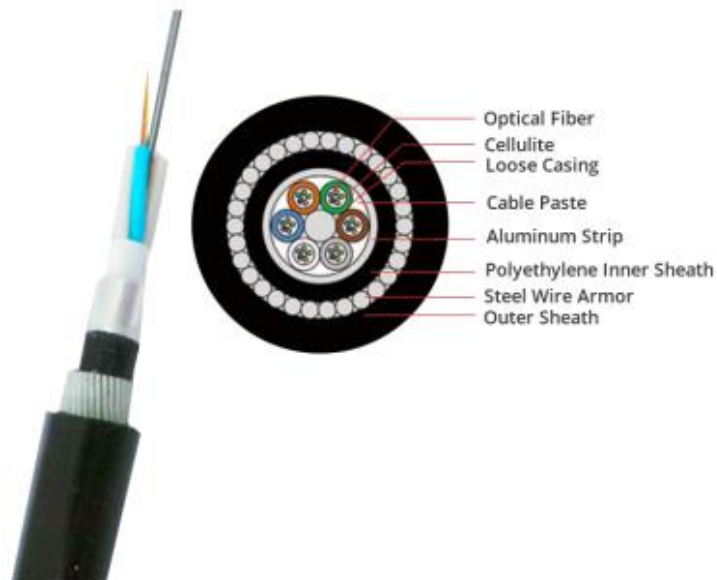


Fig.4. Fiber Optic Cables

4. Network cable connectors

Network cable connectors are devices that establish a physical connection between network cables and networking devices, such as computers, routers, and switches. They are crucial for enabling the transfer of data across various types of networks. Different types of connectors are designed to work with specific cable types and networking standards.

4.1 Common Types of Network Cable Connectors

1.RJ-45 Connector:

- The most widely used connector for Ethernet cables.
- It has eight pins and is used for connecting devices in Local Area Networks (LANs).



Fig.4. RJ-45 Connector

2. BNC Connector:

- Commonly used with coaxial cables in older networking technologies.
- Suitable for applications such as CCTV systems.



Fig.5. BNC Connector

3. Fiber Optic Connectors:

- Includes types like Square Connector (SC) 2.5, Lucent Connector (LC) 1.25 mm, and Straight Tip (ST) 2.5mm connectors.
- Used for connecting fiber optic cables, which transmit data using light signals.



Fig.6. Fiber Optic Connector

4. USB Connector:

- Primarily used for connecting peripherals but can also facilitate networking, such as connecting a computer to a modem or router.

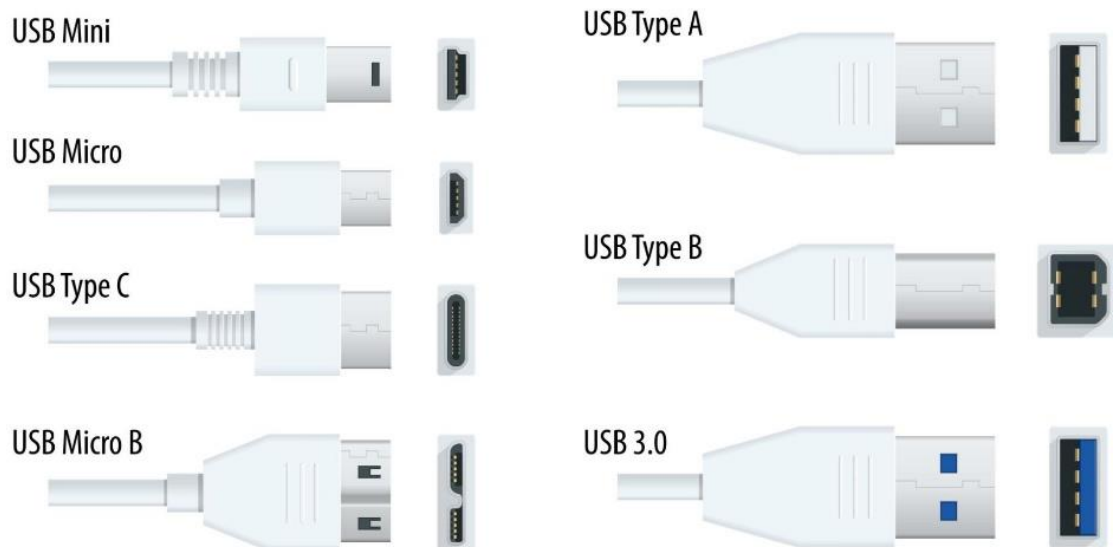


Fig.7. USB Connector

5. HDMI Connector:

- Used for high-definition multimedia interface connections, mainly for audio and video transmission.



Fig.7. HDMI Connector

6. Difference of Straight Through, Crossover, and Rollover Wiring

A Straight-through cable is a type of twisted pair cable commonly used in local area networks (LANs) to connect devices of different types. It is designed to facilitate the transmission of data between devices, such as connecting a computer to a network switch, router, or hub.

6.1 Characteristics of Straight-Through Cables

Wiring Standards: Straight-through cables are wired using either the T568A or T568B wiring standards, with both ends of the cable having the same pin arrangement. This means that the

pinouts on both ends are identical, allowing for a direct one-to-one connection of transmit and receive signals.

6.2 Common Uses: These cables are typically employed in scenarios where devices of different functions need to be connected. Examples include:

- Connecting a computer to a switch or hub.
- Linking a router's WAN port to a DSL or cable modem.
- Connect two different types of devices, such as a computer to a network printer.

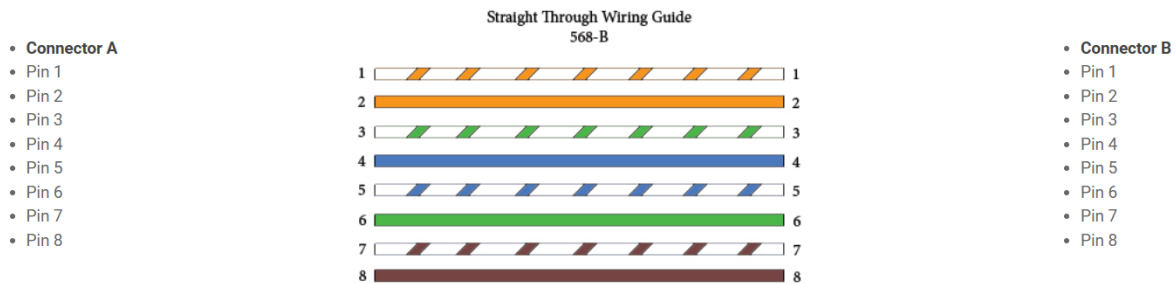


Fig.8. Straight Through Wiring Guide

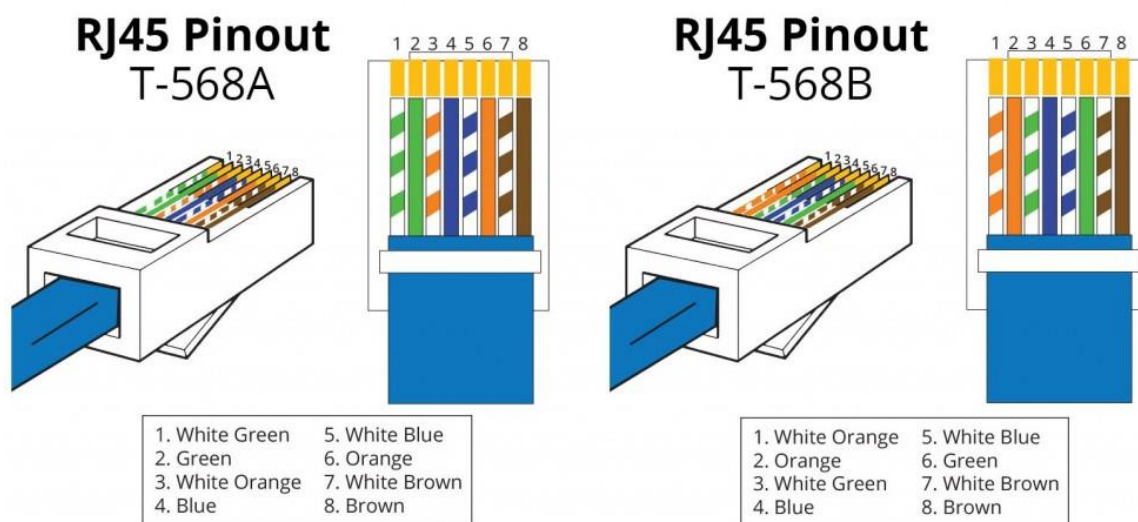


Fig.9. Straight Through Wiring Guide T-568A and T-568B

7. Crossover Cable

Crossover wired cables (commonly called crossover cables) are very much like straight-through cables with the exception that TX and RX lines are crossed (they are at opposite positions on either end of the cable). Using the 568-B standard as an example below, you will see that Pin 1 on connector A goes to Pin 3 on connector B. Pin 2 on connector A goes to Pin 6 on connector B, etc. Crossover cables are most commonly used to connect two hosts directly.

Examples would be connecting a computer directly to another computer, connecting a switch directly to another switch, or connecting a router to a router. Note: While in the past, when connecting two host devices directly, a crossover cable was required. Nowadays, most devices have auto-sensing technology that detects the cable and device and crosses pairs when needed.

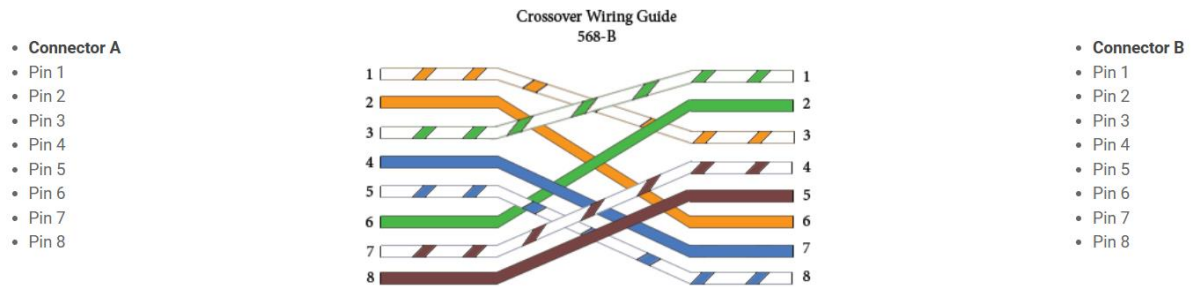


Fig.8. Crossover Wiring Guide

8. Rollover Wired Cables

Rollover wired cables, most commonly called rollover cables, have opposite Pin assignments on each end of the cable or, in other words, it is "rolled over." Pin 1 of connector A would be connected to Pin 8 of connector B. Pin 2 of connector A would be connected to Pin 7 of connector B and so on. Rollover cables, sometimes referred to as Yost cables are most commonly used to connect to a device's console port to make programming changes to the device. Unlike crossover and straight-wired cables, rollover cables are not intended to carry data but instead create an interface with the device.

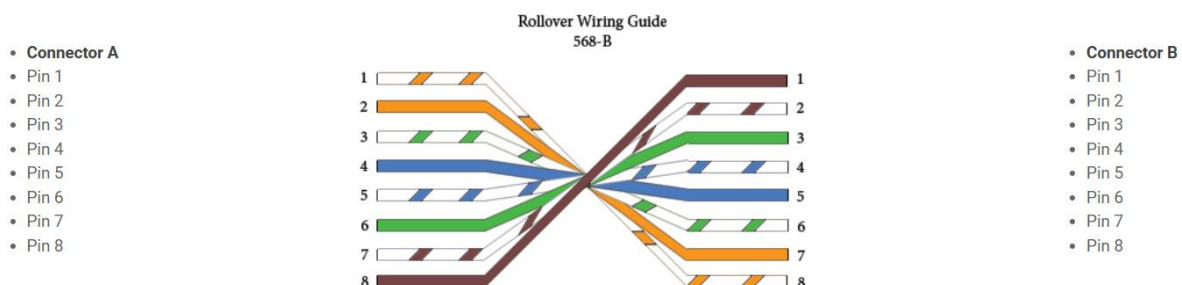


Fig.8. Rollover Wiring Guide

9. Network Cable installation mechanism

Network cable installation involves several key mechanisms and best practices to ensure efficient connectivity and performance. Here's an overview of the installation process and the components involved.

9.1 Overview of Network Cabling

Network cabling is the method of connecting devices to facilitate data transfer. It can be categorized into wired and wireless systems, with wired connections often preferred for their reliability and speed, especially in business environments

9.2 Installation Mechanism

Components of Structured Cabling

Structured cabling is a standardized approach that integrates various media types (voice, data, video) into a cohesive system. It consists of several key subsystems:

1. **Demarcation Point:** This is where the service provider's network connects to the customer's network.
2. **Equipment Rooms:** These are designated areas for housing cables and networking equipment, serving as consolidation points.
3. **Vertical Cabling:** This involves connections within the equipment rooms, typically running vertically between floors.
4. **Horizontal Cabling:** Wires that connect telecommunications rooms to individual workstations, usually routed through ceilings or walls.
5. **Work Area Components:** These connect end-user devices to the horizontal cabling systems.

10. Straight Through vs Crossover Cable, which to choose?

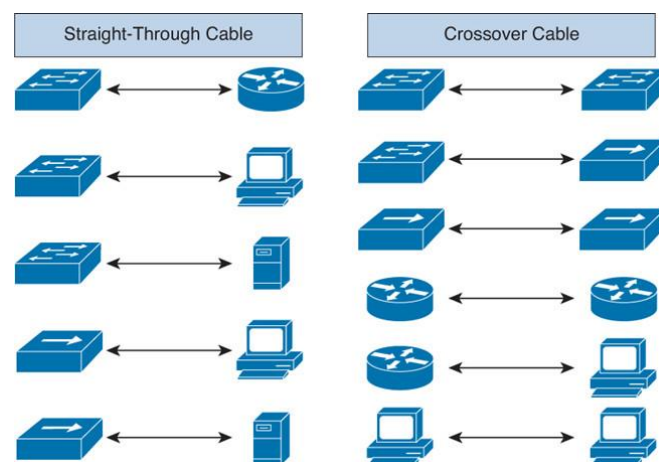
Straight through vs crossover cable, which one should I choose? Usually, straight-through cables are primarily used for connecting unlike devices. And crossover cables are used for connecting alike devices.

Use straight-through Ethernet cables 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



Installation Steps

1. **Planning:** Assess the network requirements, including the number of devices, types of services (data, voice), and future scalability.
2. **Design:** Create a layout that includes the placement of cables, equipment rooms, and workstations, ensuring compliance with local codes and standards.
3. **Cable Installation:** Install the chosen cables according to the design. This includes running cables through walls, ceilings, and floors, ensuring proper support and avoiding interference.
4. **Termination:** Connect the cables to jacks and patch panels. This step requires careful handling to maintain signal integrity.
5. **Testing:** Conduct tests to verify that the installation meets performance standards. This includes checking for continuity, signal strength, and any potential interference.
6. **Documentation:** Maintain records of the installation, including cable types, lengths, and test results, for future reference and troubleshooting. The installation of network cabling is a critical process that requires careful planning and execution. By following structured cabling principles and best practices, organizations can ensure a robust and efficient network infrastructure that meets current and future communication needs.

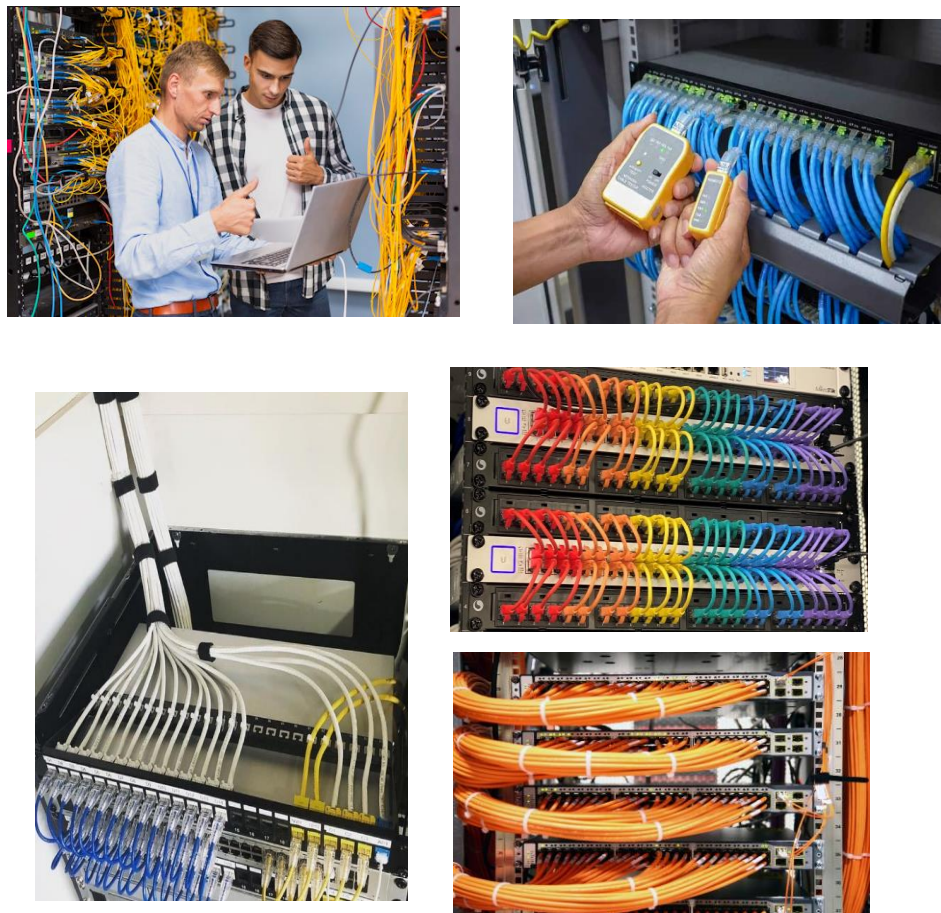


Fig.9. Overview of Network Cabling Installation Mechanism

Lab Activities

Activity 1: Understanding Cable Specifications

Step 1: Identify Different Types of Cables

- **Cat5e:** Enhanced Category 5, supports up to 1 Gbps over 100 meters.
- **Cat6:** Category 6 supports up to 10 Gbps over 55 meters.
- **Cat6a:** Augmented Category 6, supports up to 10 Gbps over 100 meters.

Step 2: Read and Record Specifications

- Use datasheets or online resources to find and record the specifications for each type of cable.

Step 3: Examine Physical Differences

- Observe the physical differences in cable thickness, shielding, and twists per inch.

Worksheet For Lab Task:

1. List the specifications (speed, maximum distance, shielding) for Cat5e, Cat6, and Cat6a.

Answer:

2. Draw and label the internal structure of each cable type.

Answer:

Activity 2: Cable Installation

Step 1: Prepare the Cables

- Cut the cable to the desired length.
- Strip the outer jacket using a wire stripper.

Step 2: Attach RJ45 Connectors

- Untwist the wire pairs and arrange them according to the T568A or T568B wiring standards.
- Insert the wires into the RJ45 connector and use the crimping tool to secure them.

Step 3: Test the Cable

- Use a cable tester to ensure all connections are correct.

Worksheet For Lab Task:

1. Describe the steps for attaching an RJ45 connector.
 2. Draw the pin configuration for both T568A and T568B standards.
-

Activity 3: Setting Up a Basic Network

Step 1: Connect the Devices

- Use the prepared cables to connect PCs or laptops to a network switch or router.

Step 2: Configure Network Settings

- Assign IP addresses to each device and ensure they are on the same subnet.

Step 3: Test Connectivity

- Use the `ping` command to test connectivity between devices.

Worksheet For Lab Task:

1. List the steps to configure IP addresses on a PC.
 2. Record the results of your connectivity tests.
-

Activity 4: Troubleshooting Network Cables

Step 1: Simulate Common Issues

- Create common network issues such as a loose connection, improper pin configuration, or a damaged cable.

Step 2: Diagnose the Issues

- Use a cable tester to diagnose the problems.
- Check the network connection status on the PCs.

Step 3: Fix the Issues

- Re-crimp connectors, and replace damaged cables.

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