Lab Manual

Computer Networks

Faculty of Software Engineering

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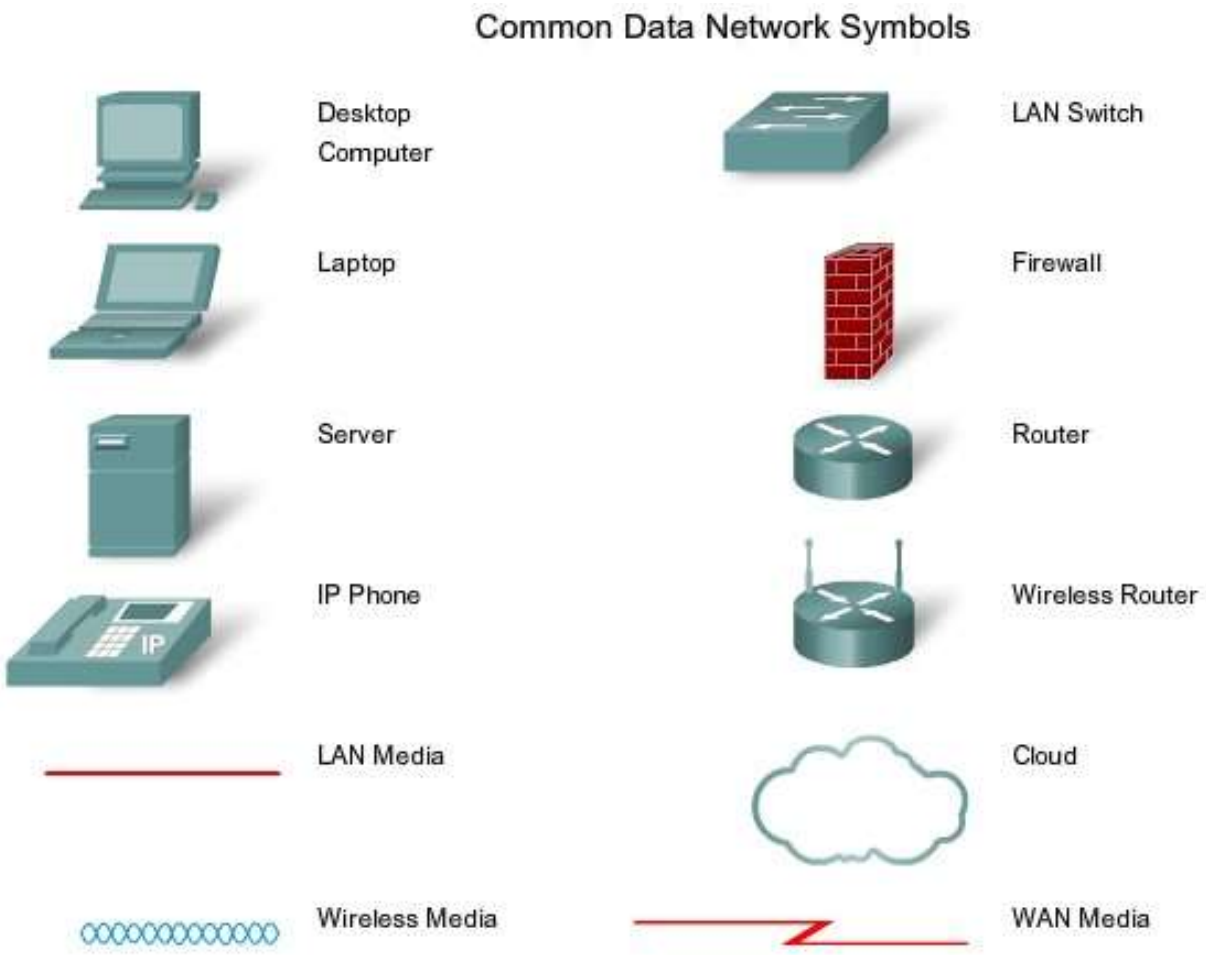
Lab 1

Introduction to Packet Tracer:

- Packet Tracer is a powerful router simulator created by Cisco Systems. It provides virtual interfaces to interact with physical environment.
- The purpose of Packet Tracer is to offer students and teachers a tool to learn the principles of networking as well as develop Cisco Technology specific skills.
- Packet Tracer is a simple Drag & Drop simulator that provides user-friendly environment.
- One of the biggest advantage of packet tracer is that when implementing a large scale of network in a physical environment it helps to establish the whole scenario in the simulator.
- Packet Tracer creates **.pkt & .pka** Extension when saving files.
- Packet Tracer **Include Routers, Switches, Hub, Servers, End Devices, Firewalls, And Multi user environment support**, so one can easily perform a large activity with its group members or partners on two computers. After completing of an activity both can merge a single Lab in one activity.



Difference Between End & Intermediate devices:

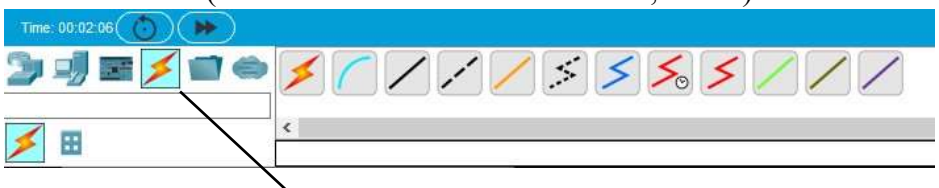
Intermediary devices:

A device that connects directly to end user devices or provides end user routing to other networks. For instance, a router is an example of intermediary devices Intermediary devices connect the individual hosts to the network and can connect multiple individual networks to form an internet-work.

End Devices

The network devices that people are most familiar with are called end devices. These devices form the interface between the human network and the underlying communication network. Some examples of end devices are: • Computers (work stations, laptops, file servers, web servers)

- Network printers
- VoIP phones
- Security cameras
- Mobile handheld devices (such as wireless barcode scanners, PDAs)



Selecting Connection Type

Difference between Twisted Pair & Unshielded Twisted Pair:

Twisted pair: Twisted pair cabling is a type of wiring in which two conductors (the forward and return conductors of a single circuit) are twisted together for the purposes of canceling out electromagnetic interference (EMI) from external sources.

UTP: is a four –pair medium used in verity of networks. UTP does not require te fixed spacing connection that is necessary with coaxile type connection. UTP is also finding increasing use in video applications, primarily in security cameras. Many middle to high-end cameras include a UTP output with setscrew terminals. This is made possible by the fact that UTP cable bandwidth has improved to match the baseband of television signals

Symbols of Cable Type:


Console Cable (used to connect with a router)


Straight Through Cable (Used to Connect Different Devices


Copper Crossover cable (Used to connect with the same devices)


Fiber (used in WAN environment)


Phone (used in VOIP Phone)


Coaxial cable (used in WAN emulation)


Serial DCE Cable (Used in WAN links where clock rate is required)


Serial DTE Cable (used in WAN link where clock rate is not required)

Lab 1 - Task

Task 1;

What is the difference between all the routers, and when to use them (mentioned in cisco packet tracer)

Ans:No:1:-

In Cisco Packet Tracer, there are several types of routers, each serving different purposes in networking. Here's an overview of the main routers available in Cisco Packet Tracer and when to use them:

1.Cisco 1841 Router:

Purpose: Small to medium-sized networks (like small businesses).

Features:

- Basic routing functionalities for smaller setups.
- Supports a few modules like serial, fast Ethernet, and WIC cards.
- Not as powerful as higher-end models.

When to use: Ideal for basic routing tasks like connecting a few LANs, WAN connections, or setting up a small business network.

2. Cisco 1941 Router:

Purpose: Medium-sized networks with additional security needs.

Features:

- Better processing power and modularity than the 1841.
- Integrated Service Router (ISR) supporting VPN, security, and mobility services.
- Can be used for more complex routing, including VLANs and ACLs (Access Control Lists).

When to use: Suitable for small to medium businesses requiring advanced routing, security, and WAN connectivity (like connecting multiple remote sites).

3. Cisco 2811/2821/2851 Routers (2800 Series):

Purpose: Medium to large networks with multi-service needs.

Features:

- More powerful than the 1900 series.
- Can handle voice, video, wireless, and security services along with routing.
- Greater modularity with more interface options (Ethernet, T1/E1, etc.).

When to use: Ideal for branch offices or medium-sized businesses that need a variety of services such as voice and VPN along with routing.

4. Cisco 2911/2921/2951 Routers (2900 Series)

Purpose: Larger enterprise networks requiring high scalability and performance.

Features:

- Provides more advanced security, mobility, and collaboration services.
- Higher processing power and more advanced modular options (faster Ethernet, enhanced VPN capabilities).

When to use: Best suited for large enterprise environments, branch offices with high traffic, and businesses requiring more sophisticated WAN features.

5. Cisco 4321/4331/4351 Routers (4000 Series)

Purpose: Advanced enterprise-class routers for large networks and demanding applications.

Features:

- Advanced security features like encryption, intrusion prevention, and application-aware networking.
- High bandwidth support with scalable performance for larger traffic loads.
- Designed for virtualized networks, cloud-based applications, and modern service delivery.

When to use: For large organizations needing high performance, cloud integration, and large-scale network security services.

6. Cisco 819/829 Routers (ISR 800 Series)

Purpose: Mobile and IoT applications.

Features:

- Designed for rugged, industrial applications, and mobile use cases.
- Supports cellular networks (LTE), Wi-Fi, and WAN interfaces.
- Lightweight and compact but capable of providing secure connections.

When to use: Suitable for mobile networks, IoT (Internet of Things) setups, or connecting remote locations using cellular networks.

7. Cisco 7200/7300 Series:

Purpose : High-performance service provider or large enterprise core routers.

Features:

- Extremely high capacity and throughput.
- Capable of handling vast amounts of traffic with advanced routing protocols.
- Highly modular and scalable, supporting a range of interfaces.

When to use: Best for core routing in large data centers or service provider environments where performance and scalability are crucial.

Key Differences:

1. Processing Power: Higher-end models like the 2900 and 4000 series have much more processing power and memory to handle complex tasks and high volumes of traffic.

2. Modularity: As you move up from the 1800 series to the 4000 series, routers offer more flexibility in terms of modular interfaces and service options (voice, security, VPN, etc.).

3. Features: Lower-end routers focus mainly on routing, while higher-end routers incorporate advanced features like encryption, deep packet inspection, and virtualization.

4. Scale: Smaller routers (e.g., 1841, 1941) are best for small networks or branch offices. Larger routers (e.g., 2900, 4000 series) are designed for large, enterprise-grade networks or service providers.

When to Use:

Small Business or Home Office: Cisco 1841 or 1941 routers are enough for basic connectivity.

Medium-Sized Business: The Cisco 2800 or 2900 series would offer more advanced features and flexibility.

Large Enterprise or Service Provider: Cisco 4000 or 7200 series routers are the best choice due to their high performance and scalability.

Each router type serves a specific range of applications depending on network size, complexity, and performance requirements. Let me know if you need details on a specific router's configuration!

Task 2;

What is the difference between all the switches, and when to use them (mentioned in cisco packet tracer)

Ans:No:2:-

In Cisco Packet Tracer, different types of switches are available to simulate various networking scenarios, ranging from simple home networks to complex enterprise setups. Each switch type has specific features and capabilities tailored for different network sizes and purposes. Here's an overview of the most commonly used switches in Cisco Packet Tracer and when to use them:

1. Cisco 2950 Switch

- **Purpose**: Basic Layer 2 switch for small networks.
- **Features**:
    - 24 Fast Ethernet (100 Mbps) ports.
    - Basic VLAN (Virtual LAN) support.
    - Spanning Tree Protocol (STP) for loop prevention.
    - Limited QoS (Quality of Service).
- **When to use**: Ideal for small networks that require simple Layer 2 switching with basic VLAN capabilities. It's good for labs or small businesses that don't need advanced routing or high throughput.

2. Cisco 2960 Switch

- **Purpose**: Enhanced Layer 2 switch with limited Layer 3 (routing) capabilities.
- **Features**:
    - Supports both Fast Ethernet (100 Mbps) and Gigabit Ethernet (1 Gbps) ports.
    - Basic Layer 3 features like static routing.
    - Enhanced VLAN support (private VLANs).

  - Improved security features like port security, ACLs, and 802.1x.
  - Spanning Tree Protocol (STP), RSTP (Rapid Spanning Tree), and basic QoS.
- **When to use**: Suitable for medium-sized networks that require more advanced VLAN support and light Layer 3 capabilities (static routing). Good for businesses with moderate traffic.

3. Cisco 3560 Switch

- **Purpose**: Layer 3 switch for routing and switching in small to medium enterprises.
- **Features**:
  - Gigabit Ethernet ports for high-speed data transfer.
  - Full Layer 3 capabilities (routing protocols like RIP, OSPF).
  - Advanced VLAN support, including inter-VLAN routing.
  - Security features such as ACLs, port security, and 802.1x.
  - QoS for traffic prioritization.
- **When to use**: Ideal for businesses that need both Layer 2 and Layer 3 capabilities. It’s great for networks that require routing between VLANs without needing a dedicated router.

4. Cisco 3650/3750 Switch

- **Purpose**: Advanced Layer 3 switch with high availability features.
- **Features**:
  - Gigabit Ethernet and some models have 10 Gigabit Ethernet ports.
  - Full Layer 3 routing capabilities (RIP, OSPF, EIGRP, BGP).
  - Stackable design for increased scalability and redundancy.
  - Advanced QoS and security features, such as deep packet inspection, policy-based routing, and security filtering.
- **When to use**: Perfect for mid-sized enterprises that require high-performance Layer 3 switching with redundancy and scalability (through switch stacking). It's also useful for data center access layers or distribution layers in enterprise networks.

5. Cisco 3850 Switch

- **Purpose**: Unified wired and wireless access switch with Layer 3 capabilities.
- **Features**:
  - Gigabit Ethernet and optional 10 Gigabit Ethernet ports.
  - Unified wireless and wired access in one device.
  - Full Layer 3 routing (OSPF, EIGRP, BGP, etc.).
  - Stackable for scalability.

- Enhanced security features like TrustSec, MACsec, and advanced ACLs.

- **When to use**: Best for large enterprises that need to integrate both wired and wireless networks into a single infrastructure. It's highly scalable, making it suitable for growing organizations or campus networks.

6. Cisco 2960-L (Lite) Switch

- **Purpose**: Budget Layer 2 switch for small networks or access layers.
- **Features**:
  - Basic Layer 2 switch with 10/100/1000 Ethernet ports.
  - Simple VLAN support.
  - Limited QoS and security features.
  - Lacks Layer 3 routing capabilities.
- **When to use**: Suitable for small businesses or home networks that need basic switching with minimal features. It's cost-effective and works well in environments where complex configurations are not needed.

7. Multi-Layer Switch (MLS)

- **Purpose**: A general-purpose switch for more advanced Layer 3 routing and switching.
- **Features**:
  - Supports both Layer 2 and Layer 3 operations.
  - Advanced VLAN and inter-VLAN routing.
  - Supports multiple routing protocols (OSPF, EIGRP, etc.).
  - Advanced QoS and security features.
- **When to use**: Useful when you need a hybrid switch/router solution for small to medium networks. It's designed to handle both Layer 2 traffic (switching) and Layer 3 traffic (routing), reducing the need for a separate router in some cases.

Key Differences Between Switches:

1. **Layer 2 vs. Layer 3 Capabilities**:
   - **Layer 2 switches** (like Cisco 2950 and basic 2960) handle data at the data link layer, forwarding traffic based on MAC addresses.
   - **Layer 3 switches** (like Cisco 3560, 3650, and 3850) can perform routing between VLANs or subnets using IP addresses, reducing the need for a separate router.
2. **Speed (Port Types)**:
   - Basic switches like the 2950 support **Fast Ethernet (100 Mbps)**.

- More advanced switches (e.g., 2960, 3560) support **Gigabit Ethernet (1 Gbps)**, and some high-end models (e.g., 3850) even support **10 Gigabit Ethernet** for high-bandwidth environments.

3. **VLAN Support**:
   - All switches in Packet Tracer support basic VLANs.
   - Higher-end models like 3560, 3650, and 3850 offer advanced VLAN support, including **inter-VLAN routing** (Layer 3 functionality) and **private VLANs** for more segmented traffic control.
4. **Routing Protocols**:
   - Basic switches like 2950 and 2960 are primarily Layer 2 and cannot run advanced routing protocols.
   - Layer 3 switches (3560, 3650, 3850) support dynamic routing protocols like **RIP, OSPF, EIGRP, and BGP**.
5. **Stacking & Redundancy**:
   - Switches like the **3750 and 3850** support **stacking**, which allows multiple switches to be managed as a single unit, improving scalability and redundancy.
   - This feature is vital in larger networks where fault tolerance is critical.
6. **Unified Access**:
   - The **Cisco 3850** integrates both **wired and wireless** access, making it ideal for environments where wireless devices are prominent, and the network needs to be managed holistically.

When to Use Each Switch:

- **Small Networks/Home Networks**: Use a **Cisco 2950** or **2960** switch for simple Layer 2 switching needs with basic VLAN functionality.
- **Medium Networks**: If you need some Layer 3 routing, go with **Cisco 2960**, which supports static routing. For more dynamic routing and advanced Layer 2/3 features, use a **Cisco 3560** or **3650**.
- **Large Enterprise Networks**: Use **Cisco 3750** or **3850** switches when you need high-performance Layer 3 capabilities, routing between VLANs, advanced QoS, and security, or stacking for redundancy and scalability.
- **Unified Wired and Wireless Networks**: For environments where both wired and wireless networks need integration, the **Cisco 3850** is a great choice, providing a single platform for both network types.

Computer Networks **Rasikh Ali**

Task 3;

What is the difference between all the connection wires, and when to use them (mentioned in cisco packet tracer)

In **Cisco Packet Tracer**, various connection wires (cables) are available to simulate the different types of connections in a network. Each type of cable has a specific purpose depending on the devices being connected. Here's an overview of the connection wires and when to use each:

1. Copper Straight-Through Cable

- **Color**: Solid black
- **Purpose**: Connects different types of devices.
- **Used for**:
  - **PC to switch**.
  - **PC to router**.
  - **Switch to router**.
- **When to use**: Use a straight-through cable when connecting devices that operate on different layers of the OSI model, such as a PC to a switch, or a switch to a router. It follows a standard pin configuration for communication (like 1-1, 2-2, etc.).

2. Copper Crossover Cable

- **Color**: Red
- **Purpose**: Connects similar devices.
- **Used for**:
  - **PC to PC**.
  - **Switch to switch**.
  - **Router to router**.
  - **PC to router (without an intermediary switch)**.
- **When to use**: A crossover cable swaps the sending and receiving pairs (1-3, 2-6, etc.), and is used to connect devices of the same type, such as two PCs, two switches, or two routers. This allows for direct communication between them without intermediary devices.

3. Fiber Optic Cable

- **Color**: Light blue
- **Purpose**: High-speed connections over long distances.
- **Used for**:
  - **Switch to switch** (especially if both switches support fiber ports).
  - **Switch to router** (if using fiber interfaces).
  - **WAN links**.
- **When to use**: Fiber optic cables are used in scenarios where you need to transfer data over long distances or at very high speeds (Gigabit or 10 Gigabit Ethernet). In modern data centers or large networks, fiber optic connections are often used between switches and routers.

4. Serial Cable (DCE & DTE)

- **Color**: Light blue (with ends that look like a DB-60 connector)
- **Purpose**: Used for WAN connections between routers.
- **Used for**:
  - **Router to router (serial interfaces)**.
  - **WAN links (simulated serial link)**.
- **When to use**: Serial cables are used to connect routers in a Wide Area Network (WAN) configuration. One side is connected as a **DCE (Data Communications Equipment)**, which provides clocking, and the other as **DTE (Data Terminal Equipment)**. You'll use these to simulate point-to-point WAN connections between routers in Packet Tracer.

5. Coaxial Cable

- **Color**: Black (but thicker and used with coaxial devices)
- **Purpose**: Used in older or specialized network setups.
- **Used for**:
  - **Connecting legacy devices**.
  - **Cable modems**.
- **When to use**: Coaxial cables are rarely used in modern networking, but they appear in specialized networks, such as connecting to older cable modem infrastructure.

6. Console Cable (Roll-Over Cable)

- **Color**: Light blue (flat cable)
- **Purpose**: Connects a PC to a router or switch for configuration purposes.
- **Used for**:
  - **PC to switch console port**.
  - **PC to router console port**.
- **When to use**: Console cables are used to connect a PC to the console port of a switch or router for configuration. It's essential when you need to configure a new device or recover a device when network access is unavailable. You typically use software like PuTTY or Tera Term to interact with the device's command-line interface (CLI) through this connection.

7. Automatic Cable (Auto-Detect)

- **Color**: Gold
- **Purpose**: Automatically selects the appropriate type of cable.
- **Used for**:
  - **Any device connection** (Packet Tracer automatically picks the correct cable type based on the devices being connected).
- **When to use**: When you're not sure which cable to use, this option automatically selects the correct cable (straight-through, crossover, or fiber) based on the devices you are connecting.

8. Wireless Connection (No Wire)

- **Color**: No physical cable, used in wireless setups.
- **Purpose**: Connects devices wirelessly using wireless protocols.
- **Used for**:
  - **PC to wireless router**.
  - **Wireless router to access point**.
- **When to use**: Use this when simulating wireless communication between devices. This can be used for Wi-Fi connections where no physical cable is required, such as connecting PCs or mobile devices to a wireless router.

Summary of When to Use Each Cable:

- **Copper Straight-Through**: For connecting different types of devices (e.g., PC to switch, switch to router).
- **Copper Crossover**: For connecting similar devices (e.g., PC to PC, switch to switch, router to router).
- **Fiber Optic**: For long-distance, high-speed connections between devices (e.g., switch to switch, WAN connections).
- **Serial Cable**: For WAN connections between routers (e.g., connecting routers over a serial interface).
- **Coaxial Cable**: Rarely used; for connecting older network devices or specialized connections like cable modems.
- **Console Cable**: For configuring network devices through their console port (PC to switch/router for CLI configuration).
- **Automatic Cable**: When you're not sure which cable to use, this automatically selects the correct one.
- **Wireless**: For wireless communication between devices (e.g., PC to wireless router).