Aim: To create and configure VLANs on switches and troubleshoot connectivity issues in Cisco Packet Tracer.

VLAN (Virtual Local Area Network):

- VLANs segment a physical network into logical groups.
- Devices in the same VLAN can communicate directly, while devices in different VLANs require a router for communication.

Benefits of VLANs:

1. Improved network performance by reducing broadcast domains.
2. Enhanced security by isolating sensitive data within specific VLANs.
3. Simplified network management.

Required Components

1. Cisco Packet Tracer software.
2. Devices:
   - Cisco Switches.
   - PCs (End Devices).
   - Router (for inter-VLAN routing, if required).
3. Ethernet cables.

Steps for VLAN Configuration

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1. Design the Network Topology

- Add a switch, a router (optional for inter-VLAN routing), and multiple PCs.
- Connect the PCs to the switch using Ethernet cables.
- Assign IP addresses to PCs in different subnets for different VLANs.

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2. VLAN Configuration on the Switch

1. **Access the Switch CLI**

```
bash
Copy code
Switch> enable
Switch# configure terminal
```

2. **Create VLANs**
   - Define VLANs with unique IDs and names:

     ```
     bash
     Copy code
     Switch(config)# vlan <VLAN-ID>
     Switch(config-vlan)# name <VLAN-Name>
     Switch(config-vlan)# exit
     ```

     Example:

     ```
     bash
     Copy code
     Switch(config)# vlan 10
     Switch(config-vlan)# name HR
     Switch(config)# vlan 20
     Switch(config-vlan)# name Finance
     ```

3. **Assign VLANs to Switch Ports**
   - Assign specific ports to VLANs:

     ```
     bash
     Copy code
     Switch(config)# interface <interface-id>
     Switch(config-if)# switchport mode access
     Switch(config-if)# switchport access vlan <VLAN-ID>
     Switch(config-if)# exit
     ```

     Example:

     ```
     bash
     Copy code
     Switch(config)# interface fa0/1
     Switch(config-if)# switchport mode access
     Switch(config-if)# switchport access vlan 10
     Switch(config-if)# exit
     ```

4. **Verify VLAN Configuration**

   ```
   bash
   Copy code
   Switch# show vlan brief
   ```

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3. Inter-VLAN Routing (Optional)

To enable communication between VLANs, configure a **router-on-a-stick**:

1. **Configure a Trunk Port on the Switch**
   - Set the port connected to the router as a trunk:

     ```
     bash
     Copy code
     Switch(config)# interface <interface-id>
     Switch(config-if)# switchport mode trunk
     ```

```
Switch(config-if)# exit
```

2. **Configure Sub-Interfaces on the Router**
   - Create sub-interfaces for each VLAN:

```
bash
Copy code
Router> enable
Router# configure terminal
Router(config)# interface <interface-id>.<subinterface-id>
Router(config-subif)# encapsulation dot1q <VLAN-ID>
Router(config-subif)# ip address <IP-address> <subnet-mask>
Router(config-subif)# exit
```

Example:

```
bash
Copy code
Router(config)# interface g0/0.10
Router(config-subif)# encapsulation dot1q 10
Router(config-subif)# ip address 192.168.10.1 255.255.255.0
```

3. **Verify Inter-VLAN Configuration**
   - Test connectivity between PCs in different VLANs using `ping`.

Verification

1. **VLAN Configuration on Switch**
   - Use the following command to verify VLANs:

```
bash
Copy code
Switch# show vlan brief
```

2. **Test Connectivity**
   - Ping between devices in the same VLAN:

```
bash
Copy code
PC> ping <IP-address>
```

3. **Test Inter-VLAN Routing**
   - Verify communication between devices in different VLANs (if a router is configured).

Troubleshooting Steps

1. **Device Cannot Ping Devices in the Same VLAN**
   - **Cause**: Incorrect VLAN assignment or access port configuration.

- **Solution**:
  - Verify the VLAN assigned to the port:

    ```
    bash
    Copy code
    Switch# show vlan brief
    ```

  - Reassign the port to the correct VLAN if needed.

2. **Devices in Different VLANs Cannot Communicate**
   - **Cause**: Inter-VLAN routing not configured or misconfigured.
   - **Solution**:
     - Check the router's sub-interfaces:

       ```
       bash
       Copy code
       Router# show ip interface brief
       ```

     - Verify encapsulation and IP addressing on the router.
3. **No Connectivity Across the Trunk Link**
   - **Cause**: Trunk port not configured or native VLAN mismatch.
   - **Solution**:
     - Verify trunk port configuration:

       ```
       bash
       Copy code
       Switch# show interface trunk
       ```

     - Ensure both ends of the trunk are configured correctly.
4. **Broadcast Storm**
   - **Cause**: Misconfigured trunk ports or loops.
   - **Solution**:
     - Use Spanning Tree Protocol (STP) to prevent loops:

       ```
       bash
       Copy code
       Switch# show spanning-tree
       ```