Network Lab Project Documentation

The objective of this lab project was to design, configure, and interconnect multiple Local Area Networks (LANs) in a simulated environment using Cisco Packet Tracer. The scenario involved four separate LANs, each with two PCs and a switch, and a central router to manage inter-LAN communication. The purpose of the exercise was to develop a practical understanding of IP addressing, router and switch configurations, VLAN management, and inter-router connectivity.

This project provided hands-on experience in configuring network devices, troubleshooting interface limitations, and implementing solutions to enable seamless communication across multiple networks. It also reinforced key networking concepts, including IP subnetting, interface configuration, and routing.

Network Topology Design

The network was structured as follows:

- LAN 1: Two PCs connected to Switch1
- LAN 2: Two PCs connected to Switch2
- LAN 3: Two PCs connected to Switch3
- LAN 4: Two PCs connected to Switch4
- Central Router: Acts as the gateway for all LANs, enabling communication across networks

Each LAN was assigned its own subnet for organization and isolation:

LAN	IP Subnet	Default Gateway (Router)
LAN1	192.168.10.0/24	192.168.10.1
LAN2	192.168.20.0/24	192.168.20.1
LAN3	192.168.30.0/24	192.168.30.1
LAN4	192.168.40.0/24	192.168.40.1

Each PC in a LAN was configured with a static IP address, subnet mask, and the default gateway corresponding to the router interface.

Device Configuration

1. **Switch Configuration**

```
enable
configure terminal
hostname Switch1
enable secret cisco123
line console 0
 password console123
 login
exit
service password-encryption
banner motd # Authorized Access Only #
end
copy running-config startup-config
```

Each switch was configured with:

- A unique hostname to identify the LAN
- A console and enable password for secure access
- Service password encryption to ensure security
- A banner message to indicate authorized access

This configuration was repeated for Switch2, Switch3, and Switch4, with appropriate hostnames.

2. **Router Configuration**

A **Cisco 1941 router** was chosen for its sufficient number of Layer 3 interfaces, allowing each LAN to connect directly. Each router interface was configured with:

- A unique IP address corresponding to the connected LAN
- A description to document its purpose
- `no shutdown` command to activate the interface

```
enable
configure terminal

interface GigabitEthernet0/0
 description Connect to LAN1 Switch
 ip address 192.168.10.1 255.255.255.0
 no shutdown
exit

interface GigabitEthernet0/1
 description Connect to LAN2 Switch
 ip address 192.168.20.1 255.255.255.0
 no shutdown
exit

interface GigabitEthernet0/2
 description Connect to LAN3 Switch
 ip address 192.168.30.1 255.255.255.0
 no shutdown
exit

interface GigabitEthernet0/3
 description Connect to LAN4 Switch
 ip address 192.168.40.1 255.255.255.0
 no shutdown
exit

ip routing
end
copy running-config startup-config
```

All interfaces were verified using the command `show ip interface brief`, confirming they were correctly assigned and active.

3. **Inter-Router Connectivity**
   To enable full communication between LANs, the two routers were connected using a **GigabitEthernet crossover link**:
   - A small /30 subnet was assigned for the router-to-router link (e.g., 10.0.0.0/30)
   - IP addresses were configured on the connecting interfaces on each router

This setup allowed traffic to route between LAN1/LAN2 and LAN3/LAN4 seamlessly.

4. **Challenges and Solutions**
   During the project, several challenges were encountered:
   a. Interface limitations on certain router models:
      i. Some routers had insufficient routed interfaces for all four LANs.

   ii. **Solution:** A Cisco 1941 router with four Layer 3 GigabitEthernet ports was used to allow direct connection for each LAN
- **b.** Misunderstanding console port usage:
   i. Initially, the console port was considered for inter-router communication.
   ii. **Solution:** Corrected by connecting routers via GigabitEthernet ports using a crossover cable.
- **c.** Subinterface and VLAN configuration considerations:
   i. Attempting to configure IPs on switch-like Layer 2 ports failed.
   ii. **Solution:** Using a router with true routed interfaces avoided the need for VLAN trunking, simplifying the setup.

These challenges reinforced the importance of understanding **router hardware capabilities**, proper interface selection, and appropriate cabling.

5. **Testing and Verification**
   After configuration, connectivity was tested:
   - **a.** **Ping tests** between PCs on the same LAN confirmed local connectivity
   - **b.** **Ping tests** across LANs confirmed routing was successful.
   - **c.** `show ip route` and `show ip interface brief` verified the correct IP assignments and interface status.

All devices responded correctly, indicating a fully functional network.

This lab successfully demonstrated:

1. Designing and configuring multiple LANs in a simulated environment
2. Assigning unique IP addresses and configuring router interfaces
3. Configuring switches with hostnames, passwords, and banners
4. Connecting multiple routers and enabling inter-LAN communication

The project highlighted key concepts in network design, interface configuration, and problem-solving in real-world scenarios. By addressing interface limitations and cabling considerations, the final network provided reliable connectivity across all two LANs, reflecting best practices in network configuration and management.