Network Configuration Project - Summarized Documentation

Student Name: Lokesh Bhatta

Executive Summary

This project demonstrates VLAN configuration, multi-router setup, DHCP implementation, and static IP allocation across a 3-site network topology using Cisco Packet Tracer. The network implements 5 VLANs (SALES, IT, SERVER, GUEST, Native) with proper subnetting, inter-VLAN routing, and comprehensive IP address management.

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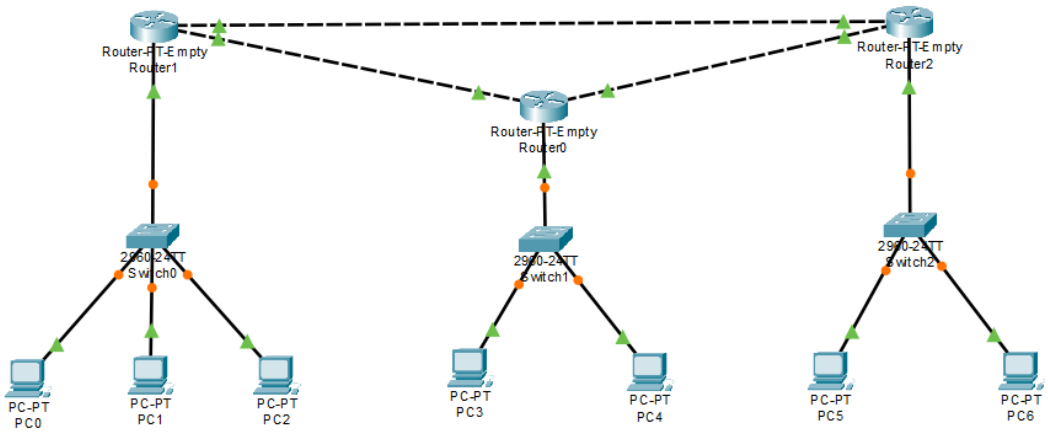
1. Network Overview

Topology Structure



- **3 Locations** with dedicated switches and routers
- **7 End-user PCs** distributed across locations
- **6 Core VLANs** for network segmentation
- **192.168.0.0/16** private address space

Key Components

Component	Count	Purpose
Cisco Switches	3	VLAN configuration, port management
Cisco Routers	3	Inter-VLAN routing, WAN connectivity
End Devices	7	User workstations across locations
VLANs	6	Network segmentation
Subnets	6	IP address allocation

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2. VLAN Design

VLAN Allocation

VLAN ID	Name	Purpose
1	Native-VLAN	Management/Default
10	SALES-VLAN	Sales Department
20	IT-VLAN	IT Department
30	SERVER-VLAN	Server Infrastructure
40	GUEST-VLAN	Guest Access

Benefits: Security isolation, broadcast containment, simplified management

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3. IP Address Planning

Subnetting Scheme (192.168.0.0/16)

Location	VLAN	Subnet	Gateway	DHCP Pool	Static Pool
Location 1	SALES	192.168.1.0/24	192.168.1.1	.50-.150	.2-.49
Location 1	IT	192.168.2.0/24	192.168.2.1	.100-.200	.2-.99
Location 2	SALES	192.168.3.0/24	192.168.3.1	.50-.150	.2-.49
Location 2	IT	192.168.4.0/24	192.168.4.1	.100-.200	.2-.99
Location 3	SALES	192.168.5.0/24	192.168.5.1	.50-.150	.2-.49
Location 3	IT	192.168.6.0/24	192.168.6.1	.100-.200	.2-.99

Subnetting Example (VLAN 10):

- Network: 192.168.1.0/24
- Subnet Mask: 255.255.255.0
- Gateway: 192.168.1.1
- DHCP Range: 192.168.1.50 - 192.168.1.150
- Usable Hosts: 254
- Broadcast: 192.168.1.255

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4. Switch Configuration

VLAN and Port Setup

- Create VLANs with IDs (10, 20, 30, 40)
- Assign access ports to specific VLANs
- Configure trunk ports for inter-switch/router connectivity
- Enable 802.1Q VLAN tagging on trunks
- Set native VLAN to 99 (unused) for security

Basic Commands

```
Switch# vlan 10
Switch# name SALES-VLAN

Switch# interface fastethernet 0/1
Switch# switchport mode access
Switch# switchport access vlan 10

Switch# interface gigabitEthernet 0/1
Switch# switchport mode trunk
Switch# switchport trunk encapsulation dot1q
Switch# switchport trunk allowed vlan 10,20,30
```

Verification:

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5. Router Configuration

Inter-VLAN Routing Setup

Router uses sub-interfaces to route between VLANs:

```
Router# interface gigabitEthernet 0/0
Router# no shutdown

Router# interface gigabitEthernet 0/0.10
Router# encapsulation dot1Q 10
Router# ip address 192.168.1.1 255.255.255.0

Router# interface gigabitEthernet 0/0.20
Router# encapsulation dot1Q 20
Router# ip address 192.168.2.1 255.255.255.0

Router# interface serial 0/0/0
Router# ip address 10.0.0.1 255.255.255.0
Router# no shutdown
```

Routing Protocol (RIPv2):

```
Router# router rip
Router# version 2
Router# network 192.168.1.0
Router# network 192.168.2.0
Router# network 10.0.0.0
```

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6. DHCP Configuration

DHCP Pool Setup

```
Router# ip dhcp pool VLAN10-POOL
Router# network 192.168.1.0 255.255.255.0
Router# default-router 192.168.1.1
Router# dns-server 8.8.8.8 8.8.4.4
Router# lease 8

Router# ip dhcp excluded-address 192.168.1.1 192.168.1.49
Router# ip dhcp excluded-address 192.168.1.151 192.168.1.254
```

Verification:

```
Router# show ip dhcp binding
Router# show ip dhcp pool
Router# show ip dhcp statistics
```

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7. Static IP Configuration

Manual Server Assignment

Device	IP Address	Subnet Mask	Gateway	Purpose

Web-Server	192.168.7.10	255.255.255.0	192.168.7.1	HTTP/HTTPS
DNS-Server	192.168.7.20	255.255.255.0	192.168.7.1	DNS Services
Switch-Mgmt	192.168.1.50	255.255.255.0	192.168.1.1	Management

Windows Configuration:

Linux Configuration:

\begin{verbatim}
sudo nano /etc/netplan/00-installer-config.yaml

network:
version: 2
ethernets:
eth0:
dhcp4: no
addresses:
- 192.168.7.10/24
gateway4: 192.168.7.1
nameservers:
addresses: [8.8.8.8, 8.8.4.4]
\end{verbatim}

8. Network Testing

Connectivity Verification

Test 1: Same VLAN (Local Communication)

C:> ping 192.168.1.80
Reply from 192.168.1.80: bytes=32 time=1ms TTL=64

Test 2: Cross-VLAN (Router Forwarding)

C:> ping 192.168.2.100
Reply from 192.168.2.100: bytes=32 time=2ms TTL=63

Test 3: Inter-Location (WAN Link)

C:> ping 192.168.4.50
Reply from 192.168.4.50: bytes=32 time=5ms TTL=62

Verification Commands

Command	Purpose
`show vlan brief`	List all VLANs with ports
`show ip interface brief`	Display router interfaces and IPs

`show interfaces trunk`	Verify trunk configurations
`show ip dhcp binding`	List DHCP assignments
`show ip route`	Display routing table
`ping <IP>`	Test connectivity
`tracert <IP>`	Trace route to destination

9. Security Best Practices

10. Troubleshooting

Common Issues

Issue 1: DHCP Clients Not Receiving IP

Issue 2: Inter-VLAN Communication Fails

Issue 3: Same VLAN Devices Can't Communicate

Issue 4: Static IP Not Reachable

11. Summary

This Network Configuration Project successfully demonstrates:

✓ **VLAN Design:** 6 VLANs across 3 locations for logical segmentation
✓ **Subnetting:** Efficient IP planning using /24 subnets
✓ **Router Setup:** Inter-VLAN routing with RIPv2 protocol
✓ **DHCP Services:** Dynamic IP allocation with excluded ranges
✓ **Static IPs:** Manual configuration for servers and infrastructure
✓ **Network Connectivity:** Full communication across all locations
✓ **Security Implementation:** VLAN isolation and access control
✓ **Testing & Verification:** Comprehensive connectivity validation

Key Metrics

References

[1] Cisco Systems. (2024). VLAN Configuration Guide. https://www.cisco.com

[2] RFC 2131. (1997). Dynamic Host Configuration Protocol. IETF.

[3] IEEE 802.1Q. (2012). Virtual Bridged Local Area Networks Standard.

[4] Kurose, J. F., & Ross, K. W. (2020). *Computer Networking* (8th ed.). Pearson Education.

[5] Cisco Packet Tracer Documentation. (2024). Network Simulation Software Guide.