**AMERICAN UNIVERSITY OF SCIENCE & TECHNOLOGY**

Faculty of Engineering and Computer Science

Department of Computer Science



CSI345L – Computer Networks Lab

**Game Arena**

By

Zoulfikar Malak - 12220658

Submitted to

Dr. Nathalie Aouad

Achrafieh, Lebanon

May 27, 2025

Abstract

This project simulates a small enterprise network using Cisco Packet Tracer.

The goal of our project was to design a scalable, cost effective, and secure network

supporting basic services such as internet access, inter departmental communication, and remote connectivity. This network we created includes multiple routers, switches, PCs, wireless devices and uses routing protocols like OSPF. The design also integrates VLAN segmentation, DHCP, static and dynamic routing. Configurations were tested and verified through ping tests, simulation mode traffic, and packet analysis. The final topology demonstrated successful IP communication between all subnets and devices. This project highlights the importance of structured IP planning, access control, and reliable layer 2 and 3 setup.

Table of Contents

[Abstract i](#_Toc199212435)

[I. Introduction 1](#_Toc199212436)

[II. Objectives 1](#_Toc199212437)

[**1.** **To design a structured and efficient network topology using Cisco Packet Tracer** 1](#_Toc199212438)

[**2.** **To implement IP addressing and subnetting across multiple network segments** 1](#_Toc199212439)

[**3.** **To configure essential network services such as DHCP, DNS< and routing protocols** 2](#_Toc199212440)

[**4.** **To establish inter VLAN communication for segmented departments** 2](#_Toc199212441)

[**5.** **To ensure full connectivity between all devices through proper testing and troubleshooting** 2](#_Toc199212442)

[III. Background 2](#_Toc199212443)

[IV. Design and Procedure 3](#_Toc199212444)

[**1.** **Two routers:** 3](#_Toc199212445)

[**2.** **Three switches:** 3](#_Toc199212446)

[**3.** **PCs and laptops:** 3](#_Toc199212447)

[**4.** **A wireless access point:** 3](#_Toc199212448)

[**5.** **A DHCP server:** 3](#_Toc199212449)

[**6.** **A DNS server:** 4](#_Toc199212450)

[**7.** **VLANs:** 4](#_Toc199212451)

[**8.** **Router on a stick:** 4](#_Toc199212452)

[**9.** **Clous device:** 4](#_Toc199212453)

[**1.** **Planning and topology layout:** 4](#_Toc199212454)

[**2.** **VLAN Configurations:** 4](#_Toc199212455)

[**3.** **IP Addressing and Subnetting:** 5](#_Toc199212456)

[V. Problems Faced and Solutions 6](#_Toc199212457)

[**A.** **Inter VLAN Communication Failed** 6](#_Toc199212458)

[**B.** **DHCP Nor Assigning IPs** 6](#_Toc199212459)

[VI. Results and Conclusion 6](#_Toc199212460)

[Appendix 8](#_Toc199212461)

[**Pictures** 8](#_Toc199212462)

1. Introduction

This project we created simulates a small enterprise network using Cisco Packet Tracer to demonstrate essential networking concepts such as IP addressing, routing, VLANs and device configuration. The network includes routers, switches, PCs and wireless devices, designed to support a secure and efficient communication across different departments. Core services like DHCP and DNS are configured, and inter VLAN routing is implemented to ensure connectivity. Our project aims to apply knowledge in a practical setting, showcasing a functional and scalable network that meets real word requirements.

1. Objectives

## **To design a structured and efficient network topology using Cisco Packet Tracer**

* Create a realistic layout of routers, switches, end devices and wireless access point.
* Connect devices using appropriate cable types and ports.
* Label and organize the topology clearly for readability.

## **To implement IP addressing and subnetting across multiple network segments**

* Assign a static and dynamic IP address based on subnet planning.
* Use subnetting to divide the network logically (by department or function)
* Avoid IP conflicts and ensure efficient use of address space.

## **To configure essential network services such as DHCP, DNS< and routing protocols**

* Set up DHCP servers to automate IP address distribution.
* Configure DNS to resolve domain names to IP address.
* Use static routing or protocols like OSPF for inter network communication.

## **To establish inter VLAN communication for segmented departments**

* Create VLANs for different departments (Admin, Sales, IT).
* Configure trunk ports and router on a stick setup.
* Test connectivity between VLANs to ensure correct routing.

## **To ensure full connectivity between all devices through proper testing and troubleshooting**

* Use ping and traceroute to verify communication between hosts.
* Monitor packet flow in simulation mode to detect and resolve issues.
* Apply troubleshooting techniques to configure errors.

1. Background

In modern organizations, computer networks are essential for enabling communication, data sharing, and access to centralized services. To ensure secure and efficient operation, networks must be well designed and properly segmented.

Our project uses Cisco Packet Tracer to simulate a small to medium enterprise network, focusing on practical implementation of knowledge gained throughout the networks course. It includes the configuration of routers, switches, PCs, wireless devices, and servers. Important services such as DHCP (for dynamic IP routing), DNS (for name resolution), and VLANs (for logical separations) are incorporated to mirror real world scenarios.

By creating and configuring a functioning network in a simulated environment, our project provides hands on experience in network planning, device communication, and troubleshooting. It also highlights the importance of IP planning, secure design, and protocol configuration in establishing a reliable and scalable infrastructure.

1. Design and Procedure
2. System design

The network topology was designed using Cisco Packet Tracer to simulate a realistic enterprise setup. It consists of the following key components:

## **Two routers:**

To connect separate departments and provide inter network communication.

## **Three switches:**

For internal wired device connections across different departments (Admin, Sales, IT).

## **PCs and laptops:**

Configured with static or dynamic Ips for each department.

## **A wireless access point:**

Connected to one switch to simulate WIFI access for mobile users.

## **A DHCP server:**

To automate IP address allocation.

## **A DNS server:**

To resolve domain names to IP addresses.

## **VLANs:**

Created to separate departments, each assigned to specific switch ports.

## **Router on a stick:**

Configuration used to enable inter VLAN communication via a single trunk port.

## **Clous device:**

Configured to represent internet access (optional, if implemented).

The topology promotes security and organization through segmentation and structured addressing, while enabling all devices to communicate across the network through proper Layer 3 routing.

1. Step by Step Procedure

## **Planning and topology layout:**

* Open Cisco Packet Tracer and add routers, switches, end devices (PCs, laptops), access points, and servers.
* Physically connect devices using copper straight through or cross over cables as appropriate.
* Label each device and port clearly for clarity and maintenance.

## **VLAN Configurations:**

* Create VLANs on each switch (VLAN 10 for admin, VLAN 20 for sales, VLAN 30 for IT).
* Assign each switch port to the appropriate VLAN based

on the department.

* Configure trunk links between switched and routers.

## **IP Addressing and Subnetting:**

* Plan subnet ranges using appropriate subnet masks(/24or /27).
* Assign static Ips to routers and servers.
* Configure DHCP server with IP pools for each VLAN and assign IP addresses dynamically to end devices.

1. **Router Configuration:**

* Enable interfaces and assign IP addresses.
* Set up router sub interfaces for each VLAN (router on a stick method)
* Configure routing protocols (OSPF)if inter router communication is needed.

1. **DNS and SHCP Server Setup:**

* Configure the DHCP server with scope, default gateway, and DNS information for each VLAN.
* Configure DNS server to resolve internal hostnames.

1. **Wireless Network Configuration:**

* Connect the wireless router or access point to a switch.
* Set SSID, IP configuration, and security settings.
* Connect wireless laptops using matching SSID and password.

1. **Testing and Validation**

* Use the ping command to test connectivity between devices in the same and different VLANs.
* Use simulation mode to observe packet flow and detect misconfigurations.
* Validate DNS by pinging domain names.
* Confirm successful IP assignment via DHCP.

1. Problems Faced and Solutions

## **Inter VLAN Communication Failed**

* Issue: Devices in different VLANs couldn’t communicate.
* Fix: Router sub interfaces were corrected and trunk ports properly configured.

## **DHCP Nor Assigning IPs**

* Issue: PCs didn’t receive IP addresses.
* Fix: DHCP pools were properly set, and default gateways assigned.

1. **Routing Not working Between Routers**

* Issue: No communication between subnets on different routers.
* Fix: RIP routing was configured to advertise all networks.

1. **Wireless Connection issues**

* Issue: Laptops couldn’t connect to WIFI.
* Fix: SSID and security setting were corrected, DHCP enabled for wireless.

1. Results and Conclusion

* All devices successfully received IP addresses via DHCP.
* Inter VLAN communication was established using router on a stick.
* DNS resolutions was functional, allowing devices to reach servers by domain name.
* Wireless devices connected securely and obtained network access.
* Routing between different subnets worked as expected using RIP.
* Connectivity was verified using ping and simulation mode in Cisco Packet Tracer.

Conclusion:

This project demonstrated the practical implementation of core networking concepts using Cisco Packet Tracer. Through proper planning, VLAN configuration, IP addressing, and routing setup, a fully functional and scalable enterprise network was achieved. The simulation we created reinforced knowledge learnt in class and provided valuable hands on experience in designing, configuring, and troubleshooting an real world network.

Appendix

## **Pictures**



