

Research Proposal

Working Title:

Design and Implementation of a Secure Network Architecture
for a Small Company Using Cisco Packet Tracer and
Comparative Analysis of Switch and Routers

10/21/2026

Ibrahim Yahia Mohamed

COMPUTER NETWORKS AND CYBERSECURITY

Research Work Title:

Design and Implementation of a Secure Network
Architecture for a Small Company Using Cisco Packet
Tracer and Comparative Analysis of Switch and Routers

Contents

Introduction.....	2
Background to the Research	2
Literature Review.....	2
Research Problem Statement	3
Aim	4
Objectives	4
Research Methodology	4
Research Design.....	5
Resources Materials	5
Project Planning	10
Knowledge and understanding of subject	11
Analysis.....	11
Practical Application and Deployment	11
Skills for professional Practice	11
Conclusion	12
Bibliography	12

Introduction

[1]Computer networks are basic and they play a vital role in the modern society. They facilitate supporting communication, information sharing and access to global digital resources across organisation [2]. As technology use grows, secure and reliable networks are critical to protect information and prevent disruptions to resources and minimize security risks via well designed networks and control of access. [3]

Enterprise network architecture is a methodical way to design secure and efficient network infrastructures. Implementing network segmentation, dynamic routing protocols, automated address allocation and access control mechanisms can improve the performance of their networks and the security of their information. [4]

The project is to design and evaluate secure enterprise network using Cisco Packet Tracer. VLANs, OSPF, DHCP, ACLs and NAT are used in the network for security, performance and scalability. [5]

Background to the Research

Small businesses companies require secure and reliable networks to support communication and data sharing for daily operations. This project design and tests a secure network using Cisco Packet Tracer roles routers and switches in improving network security.

Literature Review

An Enterprise network allows employees and departments to share resources and information. But since building and managing a reliable enterprise network is no easy task, so many organisations are turning to enterprise network service providers.

[6]

Virtual Local Network (VLAN) improve network segmentation, while Open Shortest Path First (OSPF) enable dynamic routing. Dynamic Host Configuration Protocol (DHCP) assign automatically IP address allocation, reducing administrative effort and configuration errors. [7]

Access Control Lists (ACLs) restrict unauthorised traffic, while Network Address Translation (NAT) allows internal devices to share public IP address. [8]

This project uses Cisco Packet Tracer to design and evaluates an enterprise network integrating VLANs, OSPF, DHCP, ACLs, and NAT to improve security, scalability, and performance.

Research Problem Statement

Many small businesses lack secure and efficient networks. This project designs a secure network using Cisco Packet Tracer and evaluates the role of routers and switches.

By dividing the company network into segments, security can be improved since users will have access only to the resources they need. The attack surface is thus reduced, and security breaches can be contained, even though network connectivity and availability are maintained. [9]

Aim

To design, implement, and evaluate a secure enterprise network architecture using Cisco Packet Tracer and industry standard networking technologies.

Objectives

- ❖ Design a secure enterprise network topology for a multi-department organisation.
- ❖ Configure routers and switches
- ❖ Implement VLANs for network segmentation
- ❖ Configure OSPF for dynamic routing
- ❖ To deploy DHCP services for automated IP addressing
- ❖ To implement ACLs for traffic filtering and access control
- ❖ Analyses the roles of routers and switches.
- ❖ To test and evaluate network security and performance
- ❖ To produce technical documentation of the network design and configurations

Research Methodology

Design and test a secure network using Cisco Packet Tracer. It provides hands on experience in network design, configuration, testing and troubleshooting, while also meeting the networking requirements of a small business and will follow the following phases:

Phases1: Requirements Analysis

Phases 2: Network Design

Phases 3: Implementation

Phases 4: Testing and Evaluation

Phases 5: Documentation

Research Design

A practical simulation-based study to implement and evaluate routers, switches and network security. [10]

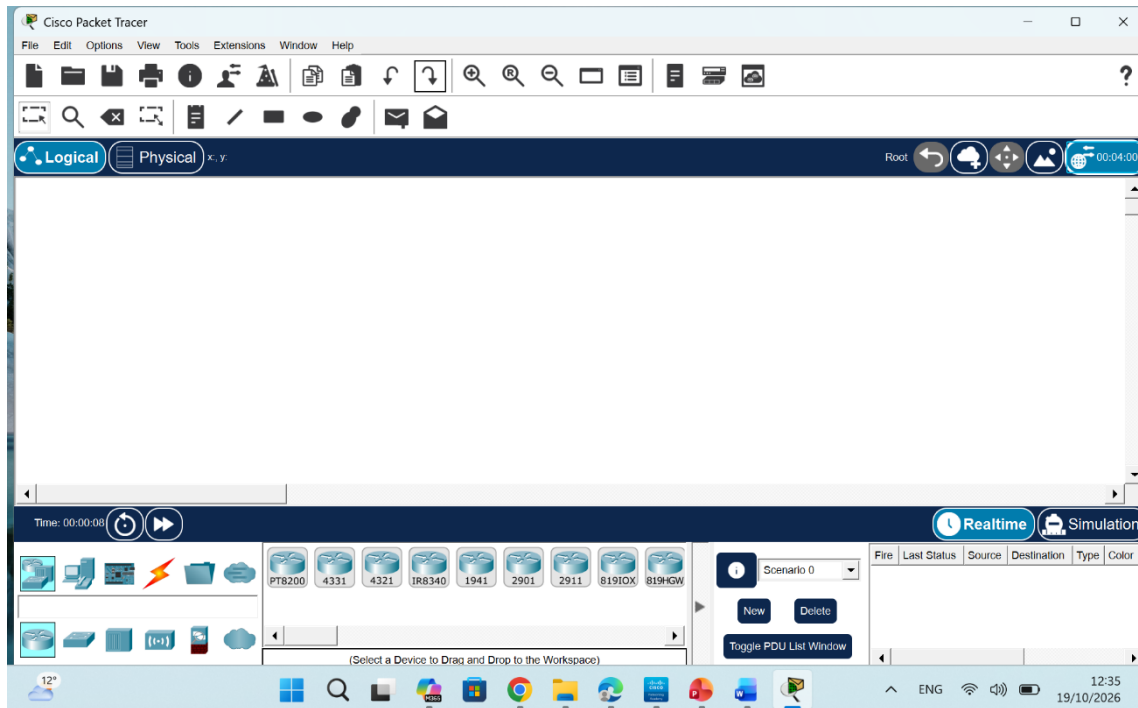
Resources Materials

Software:

- ❖ Cisco Packet Tracer
[11]

Below is the figure of Cisco Packet Tracer is a network simulation tool used to design and test a secure enterprise network using VLAN, OSPF, DHCP, AND SSH to improve connectivity, security, and network management.

Figure 1 Cisco Packet Tracer



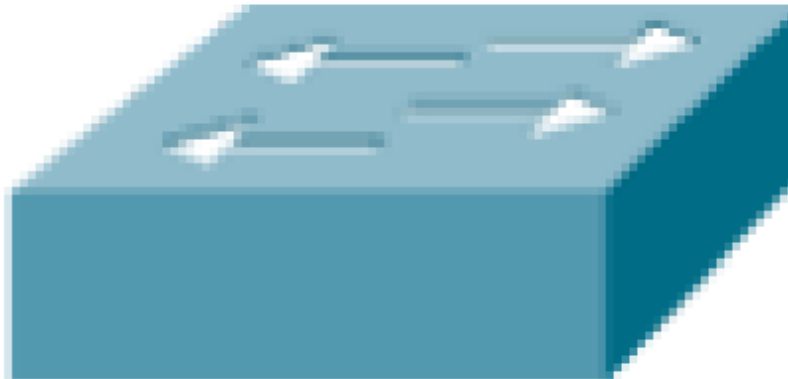
Network Devices

Figure [12]2 Routers



Above figure is the Router that connect different networks and direct data to the correct destination. In this project, routers use Open Shortest Path First (OSPF) to find suitable routers for data transmission. This helps maintain communication between departments and allow different network segments to connect efficiently.

❖ Switches



❖ Security Appliances

❖ End Devices: PCs, Laptop

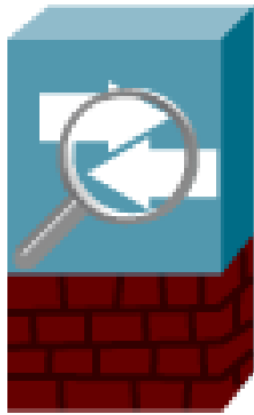


Laptop-PT

The PCs and Laptops are allowing employees to access network resources, share information, and communicate with other users.

Security firewall

A firewall protects the network by checking incoming and outgoing traffic against configured security rules. It helps block unauthorised connections and allows only permitted traffic to pass through.



5505 ASA0

- Protocols and Standards
[13]

❖ TCP/IP

IP handles packet delivery, while TCP ensures data arrives safely and in the correct order.

❖ DHCP

Automatically assigns IP addresses and network settings to devices, preventing manual configuration errors. [14]

❖ OSPF

Layer 3 Routing finds the fastest, most reliable paths to send data across routers and automatically reroutes traffic if a link fails. Calculates the fastest paths between routes and instantly fixes broken routes. [15]

❖ VLAN

Divides the physical network into isolated virtual zones to stop threats from spreading sideways. [16]

❖ SSH

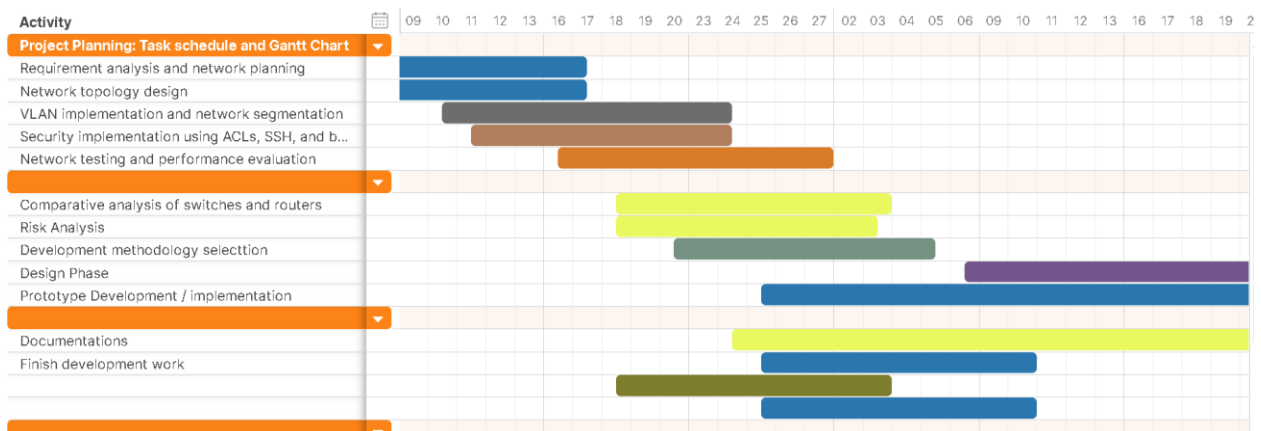
Secure Access provides encrypted remote control for administrators to manage network hardware safely without exposing passwords. [17]

Project Planning

1. Requirement analysis and network planning
2. Network topology design
3. VLAN implementation and network segmentation
4. Routing configuration using OSPF
5. Security implementation using ACLs, SSH, and basic Firewall rules
6. Network testing and performance evaluation
7. Comparative analysis of switches and routers
8. Documentations

Figure 3 Project Gantt Chart

[18]



Knowledge and understanding of subject

- ❖ Secure network design principles
- ❖ Dynamic routing protocols (OSPF)
- ❖ VLAN
- ❖ Roles and functions of routers and switches in modern networks [19]

Analysis

- ❖ Identifying potential vulnerabilities
- ❖ Evaluating network connectivity and performance
- ❖ Comparing router and switch operations, advantages, and limitation [20]

Practical Application and Deployment

- ❖ Department based VLANs
- ❖ Dynamic routing using OSPF
- ❖ DHCP for automatic IP assignment
- ❖ Secure remote administration through SSH
- ❖ Basic network testing

Skills for professional Practice

- ❖ Network design and planning
- ❖ Cisco device configuration
- ❖ Troubleshooting and testing
- ❖ Problem solving and analysis
- ❖ Project management and deployment planning [21]

Access practical terminal setup strategies, operational commands, and command line configurations inside the Cisco CL Networking Solutions Guide. [22]

Conclusion

The project is to design and implement a secure enterprise network with the key technologies by integrating such as Virtual Local Area Network (VLAN), Open Shortest Path First (OSPF), Dynamic Host Configuration Protocol (DHCP), Secure Shell (SSH), improve network and help create secure, reliable, and easy to manage network by separating users, connecting networks, assigning IP address automatically, and allowing secure remote access management, creating an efficient and secure enterprise network. [23]

The core finding that a secure reliable enterprise network needs a single multi layered protocol ecosystem to eliminate single points of failure.

The security integration, VLAN and ACLs segment departmental mistakes. Impact of project, Cisco Packet Tracer bridges the gap between networking theory and practical engineering. It guides to design a highly resilient and scalable infrastructure.

Bibliography

- [1] [Online]. Available: <https://www.cisco.com/site/us/en/learn/topics/networking/what-is-computer-networking.html#tabs-9da71fbd27-item-1288c79d71-tab>.
- [2] [Online]. Available: <https://www.netacad.com/courses/networking-basics/how-routers-work>. [Accessed 12 10 2026].
- [3] [Online]. Available: <https://www.cisco.com/site/us/en/learn/topics/networking/what-is-computer-networking.html#tabs-9da71fbd27-item-1288c79d71-tab>.
- [4] [Online]. Available: <https://www.pearson.com/en-gb/subject-catalog/p/network-security-essentials-applications-and-standards-global-edition/P200000005476/9781292555393>. [Accessed 12 10 2026].
- [5] 19 04 2024. [Online]. Available: <https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/26704-nat-faq-00.html>. [Accessed 12 10 2026].
- [6] [Online]. Available: <https://www.tatacommunications.com/knowledge-base/network/enterprise-network-fundamentals>.
- [7] [Online]. Available: <https://www.netacad.com/courses/networking-basics>. [Accessed 12 10 2026].
- [8] 11 04 2024. [Online]. Available: <https://www.cisco.com/c/en/us/support/docs/ip/network-address-translation-nat/26704-nat-faq-00.html>. [Accessed 12 10 2026].
- [9] [Online]. Available: <https://www.cisco.com/site/us/en/learn/topics/security/what-is-network-segmentation.html#tabs-35d568e0ff-item-4bd7dc8124-tab>. [Accessed 19 10 2026].
- [10] [Online]. Available: <https://www.learnCisco.net/courses/iins/common-security-threats/security-architecture-design-guidelines.html>. [Accessed 19 10 2026].
- [11] [Online]. Available: <https://www.netacad.com/cisco-packet-tracer>. [Accessed 19 10 2026].
- [12] [Online]. Available: <https://ptgmedia.pearsoncmg.com/images/9781587133183/samplepages/9781587133183.pdf>. [Accessed 19 10 2026].

- [13 [Online]. Available: <https://www.netacad.com/learning-collections/cisco-packet-tracer>. [Accessed 19 10 2026].
- [14 [Online]. Available:
] <https://www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html>. [Accessed 19 10 2026].
- [15 [Online]. Available:
] <https://www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html>. [Accessed 19 10 2026].
- [16 [Online]. Available: <https://standards.ieee.org/ieee/802.1Q/6844/>. [Accessed 19 10 2026].
- [17 globalknowledge, 17 06 2018. [Online]. Available:
] <https://www.globalknowledge.com/en-us/resources/articles/how-to-secure-cisco-routers-and-switches>. [Accessed 19 10 2026].
- [18 [Online]. Available: <https://plan.tomsplanner.com/#doc=AKFQzHSVqplyEKhmNUoe>.
] [Accessed 19 10 2026].
- [19 [Online]. Available: <https://www.learnCisco.net/courses/iins/common-security-threats/security-architecture-design-guidelines.html>. [Accessed 19 10 2026].
- [20 05 2015. [Online]. Available:
] <https://ptgmedia.pearsoncmg.com/images/9781587133183/samplepages/9781587133183.pdf>. [Accessed 19 10 2026].
- [21 04 05 2020. [Online]. Available:
] <https://www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html>. [Accessed 19 10 2026].
- [22 04 05 2020. [Online]. Available:
] <https://www.cisco.com/c/en/us/td/docs/solutions/CVD/Campus/cisco-campus-lan-wlan-design-guide.html>. [Accessed 19 10 2026].
- [23 [Online]. Available:
] <https://ptgmedia.pearsoncmg.com/images/9781587133183/samplepages/9781587133183.pdf>. [Accessed 19 10 2026].

[24 [Online]. Available: <https://www.netacad.com/courses/networking-basics/how-routers-work>. [Accessed 12 10 2026].

[25 [Online]. Available:

] https://www.cisco.com/c/en/us/td/docs/solutions/Enterprise/Education/SchoolsSRA-DG/SchoolsSRA-DG/SchoolsSRA_chap3.html?utm_source=chatgpt.com. [Accessed 11 10 2026].