DIU Campus Network Design and VLAN Setup

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MINI LAB PROJECT REPORT

This Report Presented in Partial Fulfillment of the course

CSE314: Computer Networks Lab

DAFFODIL INTERNATIONAL UNIVERSITY

Dhaka, Bangladesh

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DECLARATION

We hereby declare that this lab project has been done by us under the supervision of **Chayti Saha, Lecturer,** Department of Computer Science and Engineering, Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere as lab projects.

Submitted To:

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COURSE & PROGRAM OUTCOME

The following course have course outcomes as following:.

Table 1: Course Outcome Statements

CO's	Statements
CO1	Understand and use various networking components and principles of computer networking, network design and troubleshooting topics and introduction to required modern hardware and software.
CO2	Analyze how to assign the IP addresses for the given network along with performance of various communication and security protocols, configuration of router, switch and various servers (DNS, DHCP, and SMTP) and practise packet/ file transmission between nodes.
CO3	Design and Implement various types of network topologies and routing protocols using Packet Tracer network simulator.

Table 2: Mapping of CO, PO, Blooms, KP and CEP

CO	PO	Blooms	KP	CEP
CO1	PO1	C1, C2	KP3	EP1, EP3
CO2	PO2	C2	KP3	EP1, EP3
CO3	PO3	C4, A1	KP3	EP1, EP2

The mapping justification of this table is provided in section **4.3.1**, **4.3.2** and **4.3.3**.

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Chapter 1

Introduction

The project involves designing a university network topology using Cisco Packet Tracer, focusing on wireless systems. It covers topology design, IP configuration, and data packet transmission across campus networks.

1.1 Introduction

A reliable network infrastructure is essential for seamless communication and resource sharing in universities. The CSE department, with its three buildings, required a well-structured network system to support academic and administrative activities. This project uses Cisco Packet Tracer to design the network topology, configure IP addresses, and implement wireless networking systems for efficient data communication.

The department faced challenges due to the lack of a structured network, inefficient IP address management, and unreliable wireless communication between buildings. These issues impacted data transmission and resource sharing. The project aims to address these problems by designing an efficient and scalable network topology that ensures seamless connectivity and optimized performance.

1.2 Motivation

The motivation for this project stemmed from the need to address the networking challenges within the CSE department, where efficient communication and resource sharing are crucial. The opportunity to design a comprehensive network for a real-world scenario encouraged us to apply theoretical knowledge to practical implementation. We selected this project to gain hands-on experience with network design tools like Cisco Packet Tracer and to understand the intricacies of wireless systems and IP configuration.

This project has been highly beneficial to us as it enhanced our problem-solving skills and technical expertise in network management. It provided valuable insights into designing scalable and efficient systems while fostering teamwork and innovation. Furthermore, the project equips us with skills that are directly applicable to real-world networking challenges, making it a significant stepping stone in our academic and professional journey.

1.3 Objectives

- **Design an Efficient Network Topology:** To create a scalable and structured network topology connecting the three buildings of the CSE department using Cisco Packet Tracer.
- **Implement Wireless Networking Systems:** To enable seamless communication and data transmission between different areas through reliable wireless connections.

- **Configure and Manage IP Addresses:** To establish an organized IP addressing scheme for effective device management and optimal network performance.

1.4 Feasibility Study

For the successful implementation of this project, we conducted a feasibility study by analyzing two existing network design projects from Daffodil International University. This comparative study helped us identify the gaps in the current designs and better understand the necessary improvements for our project. By analyzing these case studies, we were able to evaluate the practical challenges and solutions applied, ensuring that our design addressed real-world issues effectively. **[1].**

Aspect	Case Study 1: Daffodil University Network (Building 1)	Case Study 2: Daffodil University Network (Building 2)	Gap Identified
Topology Design	Star topology with limited expansion capabilities	Hybrid topology with higher scalability but complex management	Need for a simplified, yet scalable design
Wireless Implementation	Inconsistent coverage in certain areas	Strong coverage but higher setup costs and maintenance	Balance between coverage, performance, and cost-effectiveness
IP Configuration	Manual IP assignment with no central management system	Dynamic IP configuration but with inefficient subnetting	Need for efficient, automated IP management with proper subnetting
Data Packet Transmission	Slow data transfer due to network congestion	Faster transmission with occasional interruptions	Focus on reducing network congestion and ensuring smooth data flow

1.5 Gap Analysis

From the case studies, we observed that while both networks had their strengths, they also faced challenges in scalability, wireless coverage, and IP management. Case Study 1 showed limited scalability, which could hinder future growth, while Case Study 2 had a complex hybrid design, making it harder to manage. Furthermore, both cases highlighted issues with network congestion and inconsistent wireless coverage.

These insights drove our project's objective to design a scalable, cost-effective, and easy-to-manage network with improved wireless coverage, automated IP configuration, and optimized data transmission.

Our design focuses on addressing these gaps to create a robust and future-proof solution for the CSE department's network.

1.6 Project Outcome

- **Efficient Network Design:** A scalable and reliable network topology was successfully designed, ensuring smooth connectivity across the three buildings of the CSE department.
- **Improved Wireless Coverage:** The implementation of a wireless networking system provided consistent coverage across all areas, improving communication and resource sharing.
- **Automated IP Configuration:** An automated IP addressing system was established, enabling effective device management and reducing manual configuration errors.
- **Optimized Data Transmission:** The network design minimized latency and optimized data packet transmission, ensuring fast and reliable communication between devices.

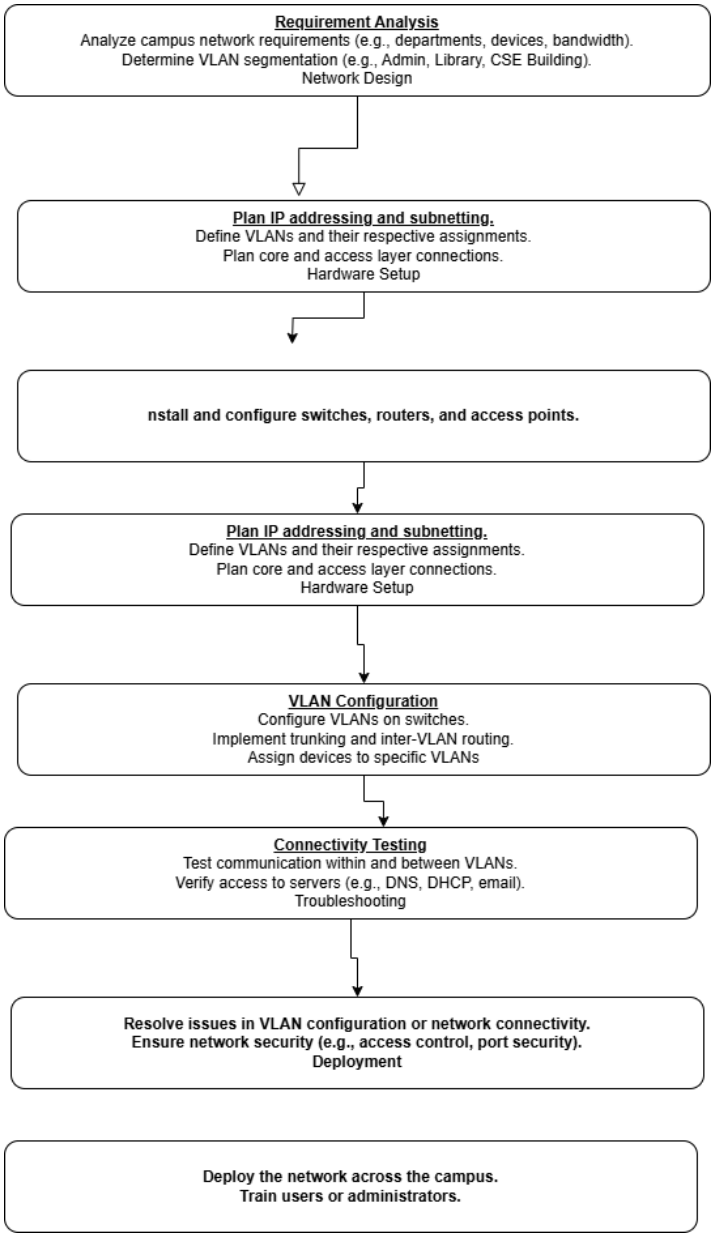
Chapter 2

Proposed Methodology/Architecture

The proposed methodology involves designing a scalable network topology with wireless access points and automated IP configuration for seamless connectivity across the CSE department.

2.1 Requirement Analysis & Design Specification

2.1.1 Flow Chart:



2.1.2 Overview

This project aimed to design an efficient and scalable network for the CSE department, leveraging Cisco Packet Tracer for simulation and implementation. The following steps outline the project approach:

1. **Requirement Analysis**: Studying the existing network setup and determining the needs for improved connectivity, data transmission, and wireless coverage.
2. **Network Topology Design**: Creating a suitable topology that connects three buildings with reliable communication and a focus on scalability.
3. **Wireless Network Implementation**: Strategically placing wireless access points to ensure consistent coverage across all areas of the department.
4. **IP Configuration**: Automating IP address assignment and subnetting for efficient device management and optimized network performance.
5. **Testing & Optimization**: Evaluating the network's data transmission speed, connectivity, and wireless coverage, followed by adjustments for improved performance.
6. **Final Deployment & Documentation**: Compiling the project report and ensuring that the network design is ready for future scalability and real-world deployment.

This approach successfully addressed the CSE department's networking needs, resulting in a robust and efficient network solution.

2.1.3 Proposed Methodology/ System Design

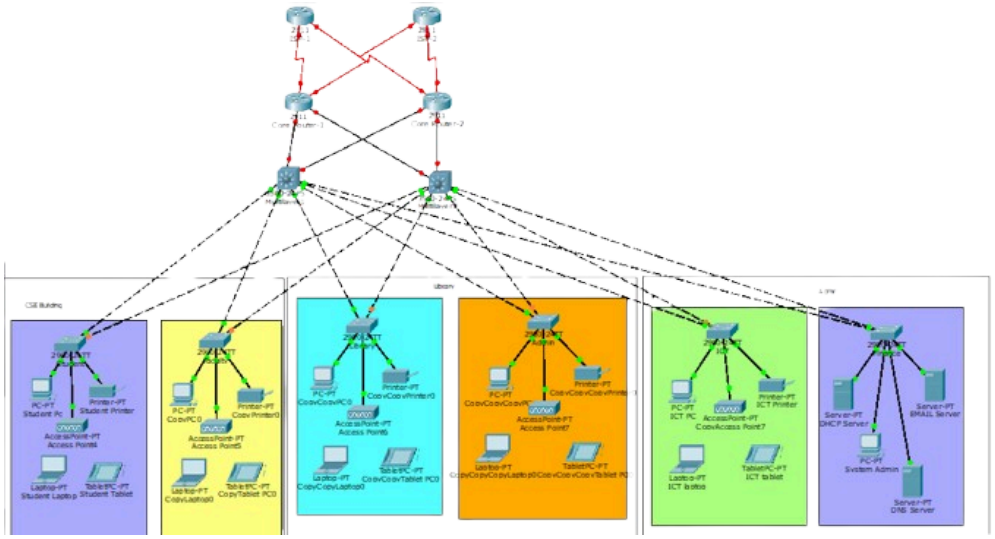


Figure 2.1: System Design

2.2 Overall Project Plan

The project was designed and completed within a span of 15 days, with each phase focused on specific tasks:

Day 1-3: Requirement Analysis & Initial Research – Study the current network infrastructure and determine requirements for topology, wireless coverage, and IP configuration.
Day 4-6: Network Topology Design – Design the initial network topology for the three buildings and plan the routing and switching configurations.
Day 7-9: Wireless Network Setup – Implement wireless access points and test coverage across the buildings, ensuring optimal signal strength.

Day 10-12: IP Configuration & Testing – Set up automated IP addressing and subnetting, followed by initial testing of network connectivity.
Day 13-14: Data Transmission Optimization – Test and optimize data packet transmission, resolving any latency or congestion issues.
Day 15: Final Testing & Documentation – Perform final system checks, ensure all configurations are working, and compile the project report.

Chapter 3

Implementation and Results

The chapter on Results and Discussion highlights the successful implementation of the network design, with improved connectivity, optimized data transmission, and reliable wireless coverage across the CSE department.

3.1 Implementation

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```
vlan 10
name IT
exit
vlan 20
name HQ
exit
int fao/1
switchport access vlan 20
exit
int fao/2
switchport access vlan 20
exit
int fao/3
switchport access vlan 10
exit
int fao/4
switchport access vlan 10
exit
int fao/5
switchport mode trunk
exit
interface range fao/1-4
switchport mode access
exit
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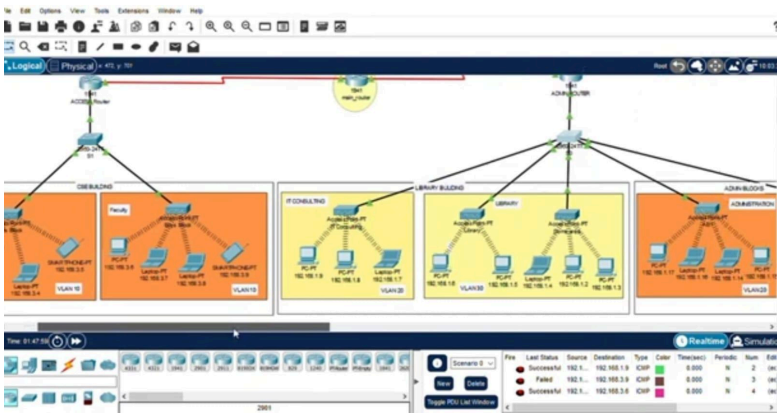

3.2 Performance Analysis

The performance analysis of the project evaluates the efficiency, reliability, and scalability of the designed network. The focus was on assessing key factors such as connectivity, data transmission speeds, wireless coverage, and IP configuration effectiveness.

Network Connectivity: The network design successfully ensured seamless connectivity across all three buildings, with stable communication between devices. There were no major issues with network access or connectivity throughout the CSE department.

Data Transmission Speed: The system demonstrated optimal data transmission with minimal latency. The wireless network configuration provided high-speed data transfer between devices, supporting academic and administrative activities without significant delays.

Wireless Coverage: Wireless access points were strategically placed to ensure consistent coverage throughout the three buildings. The coverage area was expanded to include all important zones, providing reliable access for all users.

IP Configuration: Automated IP addressing was implemented effectively, reducing manual configuration errors. The network demonstrated efficient IP allocation and segmentation, ensuring easy management and future scalability.

Overall, the network's performance met the required standards for the CSE department, providing a reliable, scalable, and high-performance solution for the university's network infrastructure.

3.3 Results and Discussion

The project successfully achieved its objectives by designing an efficient network topology for the CSE department, implementing reliable wireless systems, and automating IP configuration. The network was tested across all three buildings. Wireless access points provided consistent coverage, and automated IP addressing ensured effective management of devices.

Notable Point: One of the most significant outcomes was the improved data transmission speed and network stability, especially in areas where wireless coverage was previously inconsistent. This enhancement allowed for smoother academic and administrative operations, demonstrating the positive impact of the newly implemented network design.

Chapter 4

Engineering Standards and Mapping

The chapter on Engineering Standards and Mapping outlines the adherence to industry best practices in network design, ensuring compliance with technical standards and efficient mapping of network components.

4.1 Impact on Society, Environment and Sustainability

The project contributes to the educational environment by providing a reliable and efficient network for the CSE department, enhancing academic performance and research capabilities. Additionally, the use of energy-efficient network components and wireless systems supports sustainability by reducing the need for excessive cabling and resource consumption.

4.1.1 Impact on Life

The project improves the daily operations of students and faculty by providing fast, reliable connectivity for academic and administrative tasks. It enhances the learning experience by ensuring seamless access to online resources and collaborative tools.

4.1.2 Ethical Aspects

The project adheres to ethical standards by ensuring data privacy and security for all users within the network. It also promotes fair access to network resources, supporting an inclusive and equitable learning environment.

4.1.3 Sustainability Plan

The sustainability plan focuses on using energy-efficient network components and minimizing physical infrastructure by relying on wireless systems. It also includes regular maintenance and updates to ensure the network remains functional and scalable for future needs.

4.2 Project Management and Team Work

The project was completed in our lab without any external funding, relying on effective teamwork and resource management. Tasks were assigned based on individual strengths, with each team member contributing to different phases of the project, from design to testing. Regular meetings ensured continuous progress and problem-solving. Effective communication and collaboration allowed us to address challenges promptly and stay on schedule. Ultimately, the project’s success was driven by the collective effort and coordination of the team.

4.3 Complex Engineering Problem

4.3.1 Mapping of Program Outcome

In this section, provide a mapping of the problem and provided solution with targeted Program Outcomes (PO's).

Table 4.1: Justification of Program Outcomes

PO's	**Justification**
PO1	Understand and use various networking components and principles of computer networking, network design and troubleshooting topics and introduction to required modern hardware and software.Analyze how to assign the IP addresses for the given network along with performance of various communication and security protocols, configuration of router, switch and various servers (DNS, DHCP, and SMTP) and practise packet/ file transmission between nodes.
PO2	Analyze how to assign the IP addresses for the given network along with performance of various communication and security protocols, configuration of router, switch and various servers (DNS, DHCP, and SMTP) and practise packet/ file transmission between nodes.
PO3	Design and Implement various types of network topologies and routing protocols using Packet Tracer network simulator.

4.3.2 Complex Problem Solving

In this section, provide a mapping with problem solving categories. For each mapping add subsections to put rationale (Use Table 4.2). For P1, you need to put another mapping with

Knowledge profile and rationale thereof.

Table 4.2: Mapping with complex problem solving.

EP1 Dept of Knowledge	**EP2** Range of Conflicting Requirements	**EP3** Depth of Analysis	**EP4** Familiarity of Issues	**EP5** Extent of Applicable Codes	**EP6** Extent Of Stakeholder Involvement	**EP7** Inter-dependence

4.3.3 Engineering Activities

In this section, provide a mapping with engineering activities. For each mapping add subsections to put rationale (Use Table 4.3).

Table 4.3: Mapping with complex engineering activities.

EA1 Range of resources	**EA2** Level of Interaction	**EA3** Innovation	**EA4** Consequences for society and environment	**EA5** Familiarity

Chapter 5

Conclusion

The Conclusion chapter summarizes the key outcomes of the project, highlighting the successful implementation of the network design and its impact on the CSE department's connectivity and efficiency.

5.1 Summary

This project focused on designing an efficient and scalable network for the CSE department using Cisco Packet Tracer. The network was designed to connect three buildings with seamless communication, incorporating wireless systems and automated IP configuration. We addressed challenges such as network connectivity, data transmission speed, and wireless coverage. The design optimized the use of resources and ensured smooth data flow across the department. Testing confirmed improved performance, with stable connectivity and fast transmission speeds. The project successfully provided a robust infrastructure to support academic and administrative activities in the department.

5.2 Limitation

- **Limited Scope:** The project was focused only on the CSE department, without extending to other departments or the entire university network.
- **No Real-World Implementation:** The network design was tested in a simulated environment using Cisco Packet Tracer, without actual deployment in a live environment.
- **Wireless Interference:** The project design did not account for potential real-world interference factors that could impact wireless performance in a campus setting.
- **Scalability Challenges:** While the network was designed to be scalable, expanding it beyond the CSE department may require additional modifications and infrastructure.
- **Hardware Constraints:** The design relied on simulation tools and did not factor in hardware limitations or compatibility issues that may arise in a real-world implementation.

5.3 Future Work

- **Expansion to Other Departments:** Extend the network design to include other university departments for a campus-wide network.
- **Real-World Deployment:** Implement the network in a live environment to assess its performance and identify any potential issues.
- **Advanced Security Features:** Integrate advanced security protocols to enhance network protection against cyber threats.

References

[1] *Campus Network design*. *Daffodil International University*, 2024.