AeroLink Network Matrix

Submitted By

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MINI LAB PROJECT REPORT

This Report Presented in Partial Fulfillment of the course **CSE_314: Computer Networks Lab in the Computer Science and Engineering Department**

DAFFODIL INTERNATIONAL UNIVERSITY

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DECLARATION

We hereby declare that this lab project has been done by us under the supervision of **Mr. Md. Mezbaul**, **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.

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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 different types of networks, the organization of computer networks, proper placement of different layers of OSI model and factors influencing network development
CO2	Analyze the conceptual and implementation aspects of network applications and its use in most of the application layer protocols such as HTTP, SMTP and FTP and Data Link Layer protocols. Reliable and unreliable protocol and their problems.
CO3	Apply the knowledge of basic binary system to solve subnetting and supernetting problems and can identify and make evaluation on the underlying principles of routing algorithms and its related protocols being applied to the Internet.
CO4	Demonstrate the components, services, principle and protocol provided in Wireless network and can be categorized between different wireless securities systems.

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
CO4	PO3	C3, C6, A3, P3	KP4	EP1, EP3

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

This chapter contains a brief introduction to the project AeroLink Network Matrix, objectives, motivation, feasibility study, GAP analysis & outcomes in the aspect of Computer Networks Lab.

1.1 Introduction

In the modern world where the internet has become a basic necessity, cybersecurity has become an essential part of any personal or commercial institution. The project AeroLink Network Matrix is a Cisco simulation project based on a possible network topology of Bangladesh Airways. The project ensures that the interconnection among two airports of Bangladesh & their central control hub are connected using a secure and strong network. The idea was generated by teammates as a technical solution to the problematic and over-complex network system of Bangladesh Airways. In the primary stage, the project might look too simple as a solution but a simple, yet reliable solution is the main concept of engineering. Use of additional security devices (ex: Firewall) has ensured the security of the internal network from the outside of the virtual world while staying connected with it. AeroLink Matrix Network is designed to ensure a simple, secure & reliable network system for Bangladesh Airways.

1.2 Motivation

The pressing need to address inefficiencies and vulnerabilities within the airline's current network infrastructure has motivated this project. Its primary objective is to provide a practical solution that will facilitate enhanced operational efficiency and bolster data security measures. The motivation behind this project includes:

Addressing Network Complexities: The current network is overly complicated, which affects efficiency and reliability.

Protecting Sensitive Data: Ensuring the safety and privacy of critical data within Bangladesh Airways' operations.

Optimizing Airline Operations: A more efficient network will enable smoother operations, enhancing overall performance.

Future-Proofing: The desire to build a network that can easily scale as the airline grows and technology advances.

Real-World Solution: Providing a practical solution to an existing problem that directly impacts day-to-day airline operations.

1.3 Objectives

The AeroLink Network Matrix project aims to create a top-notch, secure, and speedy network for Bangladesh Airways. This will make sure that all the airports and the central control hub can talk to each other without any hiccups. We'll also fix any problems with the existing network. The key objective are:

Simplified Management: To replace the overly complex network with a more streamlined and user-friendly system.

Enhanced Security: To protect sensitive data and operations from cyber threats through robust security measures.

Improved Reliability: To ensure consistent and uninterrupted communication between airports and the central hub.

Operational Efficiency: To support faster and more efficient data transmission for smoother airline operations.

Scalability: To create a network that can be modified and adapted to future needs and expansions.

1.4 Feasibility Study

After reviewing the article from [1] and conducting additional research, the feasibility study of the AeroLink Network Matrix project suggests that it is both technically feasible and cost-effective. The project offers clear benefits in terms of enhanced security, improved efficiency, and scalability. Nevertheless, transitioning to a physical network setup and implementing additional security features will necessitate further investment.

Technical Feasibility:

Current Challenges: The current network infrastructure of Bangladesh Airways is characterized by complexity, inefficiency, and vulnerability. It is plagued by extended downtime, fragmented systems, and insufficient cybersecurity protocols.

Proposed Solutions: The AeroLink Network Matrix simplifies the architecture by securely connecting two airports and a central control hub. Key components include firewalls, robust routing, and simplified communication pathways to address the inefficiencies.

Technical Viability: Cisco simulation tools ensure the feasibility of the design. Modern technologies such as VLANs, firewalls, and secure routing protocols can seamlessly integrate into the AeroLink framework. These technologies have been successfully deployed in real-world scenarios.

Economic Feasibility:

The AeroLink Network Matrix involves initial costs for hardware such as firewalls, routers, and switches, alongside software licenses and simulation tools. Additional expenses include training IT staff to manage the network effectively and ongoing maintenance for equipment and upgrades. However, these costs are offset by significant benefits, including reduced operational expenses through a streamlined network, improved productivity due to lower downtime, and scalability that minimizes future costs by enabling easy system expansion as the airline's needs evolve.

Operational Feasibility:

Usability and Simplicity: The simplified network design simplifies the complexity, thereby facilitating easier management and troubleshooting for IT staff. Automation features, including backups and security policy enforcement, further augment operational feasibility.

Scalability: AeroLink Network Matrix is built to grow with Bangladesh Airways. As they add more airports or upgrade their tech, this network can handle it all!

Compatibility: The solution fits right in with current IT setup (like Active Directory for user login and firewalls for security).

Environmental Feasibility:

Energy Efficiency: Utilizes energy-efficient hardware and virtualized environments to minimize carbon footprint.

Reduced Waste: Streamlined architecture eliminates redundant resource allocation for sustainability.

1.5 Gap Analysis

Current State:

Limited Scope: The project is confined to a simulation environment using Cisco tools, restricting its ability to replicate real-world complexities fully.

Focus on Connectivity: The design focuses on connecting two airports and a central control hub securely, but it does not address larger network expansions or integration with third-party systems.

Simulation-Based Testing: Testing is limited to Cisco Packet Tracer and similar tools, which provide a virtual environment but lack the depth of physical implementation and performance benchmarks.

Basic Security Measures: Security is addressed through firewalls and VLANs, but advanced features like intrusion prevention systems (IPS) or AI-based threat detection are not included.

Desired State:

Real-World Applicability: Expand the project scope to include real-world implementation scenarios, integrating physical hardware with the simulated environment.

Scalable and Modular Design: Develop a more flexible network that can seamlessly incorporate future expansions, such as additional airports or external connections like global airline networks.

Advanced Security Features: Include robust cybersecurity measures such as intrusion prevention systems (IPS), encrypted VPNs, and endpoint protection for better threat mitigation.

Comprehensive Testing: Conduct testing beyond simulations, involving real-world environments to validate network reliability, efficiency, and performance under load.

Gaps Identified:

Simulation vs. Real-World: The project lacks physical implementation, limiting its ability to address real-world challenges like hardware failures, latency, or environmental factors.

Limited Security Scope: The current security measures are basic and may not fully address sophisticated cyber threats faced by modern networks.

Scalability Constraints: The design focuses on immediate needs but lacks provisions for seamless scalability as the network grows.

Operational Readiness: IT staff training is not emphasized in the current scope, which might hinder efficient deployment and management in a real-world setup.

1.6 Project Outcome

The AeroLink Network Matrix project illustrates fundamental networking principles, such as the OSI model application layer, subnetting, routing, and protocol selection. These concepts are applied to construct a secure and efficient network for Bangladesh Airways. Additionally, the project delves into wireless networking principles and security measures, ensuring scalability and reliable communication.

Network Types, OSI Model, and Organization: The project demonstrates network types (LAN, WAN) and the correct placement of OSI model layers, ensuring proper communication and organization across airports and hubs.

Network Applications and Protocols: It explores application layer protocols (HTTP, SMTP) and data link layer protocols (Ethernet), showing their use in network communication for the airline.

Subnetting and Routing Protocols: The project applies subnetting for efficient IP addressing and uses routing protocols like OSPF to ensure optimal data transfer across the network.

Reliable and Unreliable Protocols: It distinguishes between reliable (TCP) and unreliable (UDP) protocols, selecting the appropriate ones for different network needs like secure communication and fast transfers.

Wireless Networks and Security: While primarily focused on wired networks, the project incorporates wireless principles and security measures like WPA2 for future scalability and secure communication.

Chapter 2

Proposed Methodology/Architecture

The AeroLink Network Matrix uses Cisco simulation tools to design a secure, efficient, and scalable network by addressing existing complexities, implementing DHCP, routing protocols, and firewalls, ensuring streamlined communication and management.

2.1 Requirement Analysis & Design Specification

2.1.1 Overview

The project AeroLink Network Matrix uses simple yet reliable devices and protocols to build and run the network securely and efficiently. Key components of the project includes:

1. **Cisco Packet Tracer:**

   For simulation and overall project prototype buildup.

2. **Routers:**

   For connecting the Networks

3. **Switches:**

   To create sub-networks.

4. **PC's:**

   As end devices.

5. **Wireless Router:**

   To create a wireless network.

6. **Smartphones:**

   To demonstrate wireless connectivity.

7. **ASA 5506:**

   As a security device.

8. **Cloud connector**

   To connect the internal network to the global real-time internet.

9. **HTTP Server**

   To manage the HTTP / HTTPs requests and responses.

10. **DNS Server**

   To store and retrieve the domains of internal network and servers.

The main protocols or algorithms used are:

1. **Static IP Assign**

   To understand the static ip assignment.

2. **DHCP Pool**

   For efficient & easier IP assignment.

3. **RIP Dynamic routing:**

   For hasslefree routing.

4. **Static Routing:**

   To understand how routing works.

5. **Firewall:**

   To ensure security of the internal network from the outer real-time internet.

6. **NAT:**

   To connect the internal & external network while keeping the internal network isolated.

7. **VLAN:**

   To encapsulate the internal network.

The AeroLink Network Matrix, employing reliable devices and protocols, establishes a secure and efficient network for Bangladesh Airways. Key components include routers for network connections, switches for subnetworks, wireless routers and smartphones for wireless connectivity, an ASA 5506 for security, and a cloud connector to link the internal network to the internet, with PCs as end devices. Protocols such as Static IP Assignments and DHCP Pools manage IP allocation, while RIP Dynamic Routing and Static Routing ensure efficient data transmission. Additional measures such as NAT for secure external connectivity, firewalls for protection, and VLANs for network segmentation enhance the design's robustness, scalability, and security.

2.1.2 Proposed Methodology/ System Design

The AeroLink Network Matrix utilizes Cisco Packet Tracer to design a secure, efficient, and scalable network for Bangladesh Airways. The network integrates various components, including routers, switches, and firewalls, with protocols such as DHCP, NAT, and VLANs, to ensure seamless connectivity and robust security. The network comprises two airports and a central hub, effectively addressing operational complexities through a streamlined and reliable architecture. The architectural structure is given bellow:

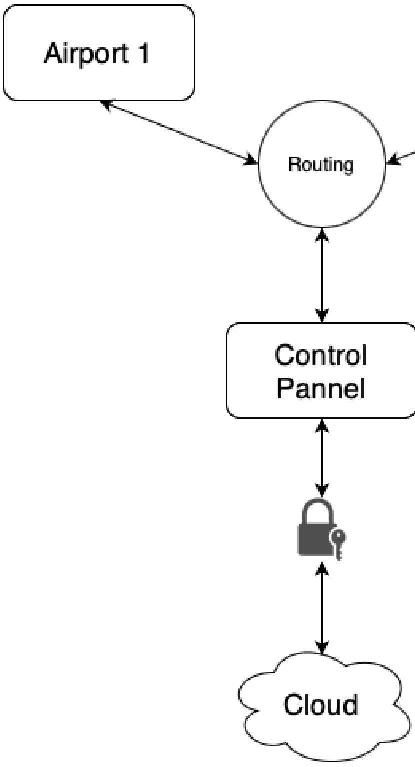

Figure 2.1: Architecture of Aerolink Network Matrix

2.1.3 UI Design

Being a simple and prototype project, the project doesn't really have a UI design part but the demo website of the Network system has been created keeping in mind the ease of use and fun to learn. The website's primary color is Navy Blue and secondary color is Sky Blue.
For more explanation and demonstration of the UI design, check the Implementation chapter.

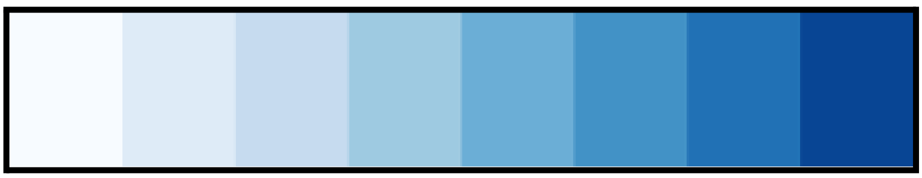

Figure 2.2: Color Palette of the websites

2.2 Overall Project Plan

Team Roles and Responsibilities:

Project Manager (Muid Hasan Maruf)

Coordinate team activities, track progress, and ensure deadlines are met, liaise with the team advisor or faculty for feedback and approvals, responsible for documentation and final presentation.

Network Architect (Touhidul Islam Ayon)

Design the network topology, focusing on routing, subnetting, and VLANs, develop simulation environments using Cisco Packet Tracer, ensure scalability and security measures in the design.

Security Specialist (Md. Al Amin)

Configure firewalls, NAT, and other security measures (ASA 5506), identify potential vulnerabilities and propose countermeasures, test network resilience against simulated cyberattacks.

System Integrator (Md. Sheikh Sayem)

Implement devices such as routers, switches, PCs, and wireless networks, configure DHCP, static routing, and RIP dynamic routing, ensure proper communication between all network components.

Documentation and Testing Specialist (Arafat Rahman Shihab)

Document all configurations, protocols, and design specifications, perform thorough testing of the network (functionality, efficiency, and security), summarize outcomes, prepare the final report, and contribute to the presentation.

Project Phases and Timeline Overview:

Project divided into five phases: Planning, Design and Implementation, Configuration and Security, Testing and Optimization, and Documentation and Presentation.

Phase 1: Project Planning (Week 1)

1. Define project objectives, roles, and timelines.
2. Conduct research on Cisco Packet Tracer tools.

Phase 2: Network Design and Implementation (Weeks 2–3)

1. Design the network topology.
2. Implement subnetting, VLANs, and IP addressing.
3. Integrate devices in Cisco Packet Tracer.

Phase 3: Configuration and Security (Weeks 4–5)

1. Implement configurations for routing (DHCP, RIP, static).

2. Configure security features (ASA 5506, NAT).
3. Ensure cloud connectivity.

Phase 4: Testing and Optimization (Week 6)

1. Test network functionality.
2. Simulate attacks to verify security.
3. Optimize the network for efficiency and scalability.

Phase 5: Project Documentation and Presentation (Week 7)

1. Document the project.
2. Prepare the presentation.
3. Rehearse for delivery.

Chapter 3

Implementation and Results

The implementation of the AeroLink Network Matrix involves designing the network topology, configuring routing and security features, and optimizing performance. Testing and documentation follow to ensure functionality, scalability, and secure communication.

3.1 Implementation

The AeroLink Network Matrix implementation involves the configuration of essential devices and protocols to establish a secure, efficient, and scalable network connecting two airports and a central control hub.

Network Design and Topology:

- The network consists of four routers: Airport 1, Airport 2, Central Control Panel, and an intermediary router placed between the cloud and ASA for NAT.
- Three switches are used to create isolated networks for different segments (Airport 1, Airport 2, and Central Control Hub).
- The topology connects 1 DNS server, 1 HTTP server, and 17 PCs, simulating a realistic operational environment.

Server Configuration:

- The DNS and DHCP services are hosted on the DNS server, with an IP range of 192.168.100.0 to ensure proper address assignment for devices.
- The HTTP server is set up to handle web traffic across the network, supporting the overall communication needs.

Routing and NAT Configuration:

- RIP routing is implemented for dynamic route discovery between routers, optimizing communication across the network.
- NAT is configured on the ASA firewall to securely connect the internal network to the internet while maintaining isolation for sensitive devices.

Network Segmentation and Security:

- VLANs are used to segment the network into separate broadcast domains, ensuring optimal performance and security.
- The ASA firewall and NAT ensure protection from external threats, allowing only authorized traffic between internal and external networks.

Testing and Optimization:

- Thorough testing is conducted to validate the network’s functionality, performance, and security.
- Simulated attacks are performed to check the firewall's effectiveness, while the network is optimized for scalability, ensuring future expansion is seamless.

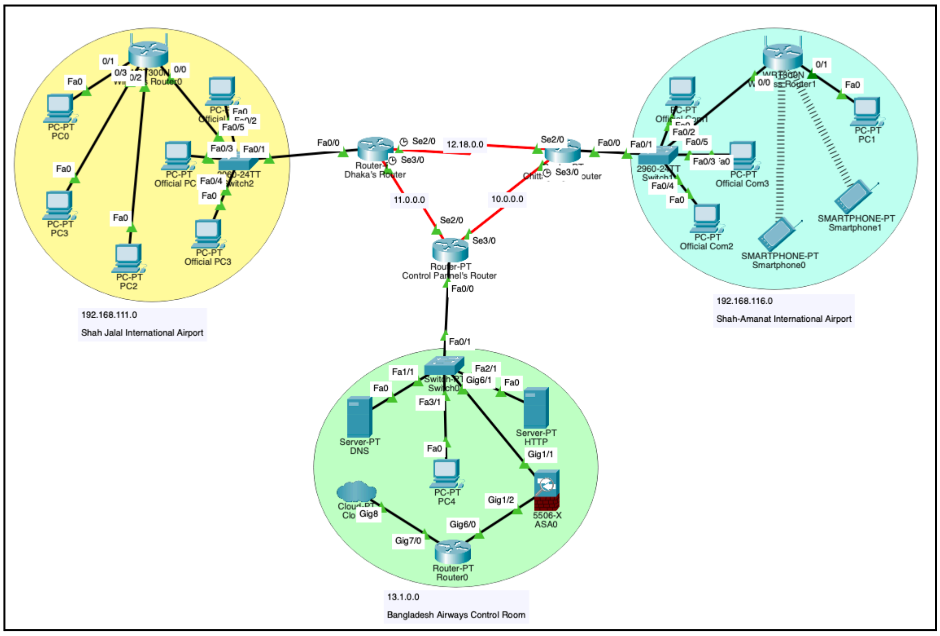

Figure 3.1: AeroLink Network Matrix (Logical View)

Figure 3.2: AeroLink Network Matrix (Physical View)

Figure 3.3: Websites for AeroLink Network Matrix

3.2 Performance Analysis

The AeroLink Network Matrix project has been successfully implemented in a simulated environment, and the results show that the network performs as expected. However, being a simulation, it does not account for real-world challenges such as hardware failures, latency issues, or environmental factors. Despite these limitations, the project demonstrates a strong, reliable, and scalable design that is expected to work seamlessly in real-world scenarios. Below is a detailed performance analysis based on the simulation results:

Network Stability and Reliability:

- The network maintained consistent connectivity between all routers, switches, and end devices. The use of **RIP routing** ensured dynamic communication, allowing the network to adapt to changes and optimize data paths effectively.
- **Static routing** for critical connections ensured a reliable flow of data, with no disruptions in communication between airports and the central control hub during tests.

Security Measures:

- The **ASA 5506 firewall** and **NAT** configuration successfully protected the internal network from external threats. The simulated attacks did not compromise the network's security, validating the effectiveness of the implemented security measures.
- The firewall successfully blocked unauthorized access while ensuring that legitimate traffic from internal devices was able to access external resources securely.

Scalability:

- The network was optimized for scalability, with the potential for future expansion. The architecture, including the use of **VLANs**, **RIP routing**, and **NAT**, allows for the easy addition of more devices or network segments without compromising performance.
- The simulation demonstrated smooth communication and resource allocation, and the network can be easily adapted to accommodate additional airports or devices.

Data Transmission and Efficiency:

- Data transmission was efficient, with minimal delays between devices across different segments of the network. **Dynamic routing protocols** like RIP optimized the path selection, reducing congestion and improving overall speed.
- **NAT** did not impact the network's performance, as it was able to manage internal and external traffic seamlessly, maintaining high-speed connectivity even with a moderate number of devices.

Operational Readiness:

- The simplified architecture and streamlined design ensured ease of management and troubleshooting. The use of **Cisco Packet Tracer** for simulation provided a detailed overview of potential network failures and required adjustments.
- Although real-world challenges such as hardware failures and network congestion were not simulated, the network's design is robust enough to handle such issues with appropriate tools and maintenance in place.

3.3 Results and Discussion

The performance analysis confirms that the AeroLink Network Matrix is a solid and reliable design that can function efficiently in a real-world setting. While the simulation does not fully replicate real-life conditions, the simplicity and strength of the network's design make it adaptable to various operational scenarios. Given the success of the simulation, the project is expected to seamlessly support Bangladesh Airways' operational needs once deployed in a real-world environment.

Chapter 4

Engineering Standards and Mapping

This chapter describes how engineering standards are applied, how the suggested network system affects society and the environment, and how program results are mapped to meet the issues that have been discovered. The project's connection with intricate engineering tasks and difficulties is also examined in this chapter.

4.1 Impact on Society, Environment and Sustainability

4.1.1 Impact on Life

The AeroLink Network Matrix, if implemented, could have a transformative impact on several key areas:

Operational Efficiency for Bangladesh Airways:

By streamlining communication between airports and the central control hub, the network will improve flight operations, reduce delays, and enhance coordination, ultimately providing a smoother and more efficient travel experience for passengers.

Data Security and Privacy:

With robust security measures like firewalls and NAT, sensitive operational and customer data will be protected from cyber threats, ensuring privacy and trust between Bangladesh Airways and its customers.

Scalability and Future Expansion:

The network's scalable design allows for future growth as Bangladesh Airways expands, whether through adding new airports, routes, or services. This ensures long-term operational continuity without major overhauls.

Cost-Effective Management:

By simplifying network management through VLANs, RIP routing, and NAT, the AeroLink system will reduce the complexity and cost of maintaining the network, allowing resources to be allocated to other critical areas of the business.

Improved Customer Experience:

Faster, more reliable communication can lead to improved customer service, as information on flights, bookings, and operations will be more accessible and accurate, directly benefiting passengers.

4.1.2 Impact on Society & Environment

The implementation of the AeroLink Network Matrix would not only enhance operational efficiency for Bangladesh Airways but could also have broader societal and environmental impacts:

Society:

Enhanced Communication:

The robust network infrastructure will improve real-time communication between airports, control hubs, and ground staff, ensuring smooth operations and better customer service, which directly benefits passengers.

Job Creation:

The implementation and maintenance of the advanced network system would create employment opportunities in IT, network management, cybersecurity, and technical support, benefiting local communities.

Social Connectivity:

By enhancing the efficiency of airline operations, the network could foster greater social mobility, connecting people from different regions, cultures, and backgrounds, which promotes social exchange and understanding.

Environment:

Energy Efficiency:

The use of energy-efficient devices and virtualized systems in the network design can help minimize the environmental impact by reducing electricity consumption and electronic waste.

Reduced Carbon Footprint:

A more efficient network reduces the need for physical infrastructure and travel, thus helping to decrease carbon emissions associated with airport operations and flights.

Sustainable Practices:

Streamlined network systems can minimize resource usage (e.g., less hardware required), supporting sustainability in the aviation industry by reducing waste and promoting more eco-friendly practices.

4.1.3 Ethical Aspects

The implementation of the AeroLink Network Matrix involves several ethical considerations that are crucial for its success and sustainability:

Data Privacy and Security:

Ensuring the protection of sensitive data is a top priority. The network must comply with data protection regulations, such as GDPR or similar local laws, to prevent unauthorized access, data breaches, and misuse of personal or operational data. Robust security measures like firewalls, NAT, and secure communication protocols must be strictly implemented to safeguard both employee and passenger data.

Equitable Access:

The network's design should ensure equitable access to services and information. It must not discriminate against any group based on factors such as geographical location, socioeconomic status, or technological literacy. Accessibility features, such as easy-to-use interfaces, should be considered for all stakeholders involved.

Transparency and Accountability:

The project team must ensure transparency in decision-making, particularly regarding the selection of network technologies and security measures. Accountability for maintaining the integrity and reliability of the network should be clearly defined, with clear procedures in place for handling any issues or failures that arise.

Sustainability:

The project should adhere to ethical sustainability principles, minimizing environmental impact through the use of energy-efficient technologies, responsible sourcing of equipment, and reducing the overall carbon footprint of the network's operation.

Job Ethics and Workforce Training:

As the project requires skilled workers for network management, ethical considerations related to fair labor practices, equal opportunities, and adequate training must be prioritized. Employees involved in the network's implementation and maintenance should be compensated fairly, and their work should be conducted in safe, healthy conditions.

4.1.4 Sustainability Plan

The AeroLink Network Matrix project emphasizes long-term sustainability by focusing on environmental, operational, and technological factors. The following sustainability plan ensures that the project can operate efficiently while minimizing its environmental and social impact:

Energy Efficiency:

- **Use of Energy-Efficient Equipment**:

  Select energy-efficient routers, switches, and other networking equipment to reduce electricity consumption. Virtualization technologies should be used wherever possible to reduce hardware requirements and energy usage.

- **Optimized Network Design**:

  The network's design should minimize data transfer distances and optimize routing to reduce energy consumption during data transmission. Low-power devices should be used for non-critical components of the network.

Environmental Impact:

- **Minimizing E-Waste:**

  Choose durable, long-lasting equipment that requires minimal maintenance and replacement. When upgrading equipment, ensure responsible disposal and recycling of older devices to reduce e-waste.

- **Carbon Footprint Reduction**:

  By improving network efficiency and streamlining operations, the project reduces the need for excessive infrastructure, helping to minimize carbon emissions from transportation, travel, and resource consumption.

Scalability and Future Expansion:

- **Modular Network Design**:

  The network should be designed with scalability in mind, allowing for future expansion as the airline grows. This ensures that the network can be upgraded or expanded without significant resource consumption, helping the system adapt to future needs.

- **Cloud Integration**:

  By leveraging cloud-based services for data storage and backup, the need for physical servers and data centers can be reduced, cutting both energy usage and infrastructure costs.

Operational Efficiency:

- **Automation for Maintenance and Monitoring**:

  Automating network monitoring, backups, and maintenance tasks will reduce the manual workload and minimize the risk of human error, ensuring long-term operational stability.

- **Training and Development**:

  Provide continuous training for IT staff to keep them updated on the latest technologies and best practices for efficient network management. This will help reduce inefficiencies caused by outdated knowledge and ensure the network remains optimized.

Social and Economic Sustainability:

- **Community Engagement**:

  Engage local communities by providing employment opportunities and ensuring the network benefits the wider society through improved connectivity, access to services, and educational resources.

Security and Privacy:

- **Robust Security Measures**:

  The network must have built-in security protocols (firewalls, NAT, and encryption) to protect data and prevent unauthorized access, ensuring that the network remains secure and trustworthy for long-term use.

- **Data Privacy Compliance**:

  Adhere to international data privacy standards to protect sensitive user and organizational data from breaches, ensuring trust in the network system.

4.2 Project Management and Teamwork

Project Manager (Muid Hasan Maruf)

Coordinate team activities, track progress, and ensure deadlines are met, liaise with the team advisor or faculty for feedback and approvals, responsible for documentation and final presentation.

Network Architect (Touhidul Islam Ayon)

Design the network topology, focusing on routing, subnetting, and VLANs, develop simulation environments using Cisco Packet Tracer, ensure scalability and security measures in the design.

Security Specialist (Md. Al Amin)

Configure firewalls, NAT, and other security measures (ASA 5506), identify potential vulnerabilities and propose countermeasures, test network resilience against simulated cyberattacks.

System Integrator (Md. Sheikh Sayem)

Implement devices such as routers, switches, PCs, and wireless networks, configure DHCP, static routing, and RIP dynamic routing, ensure proper communication between all network components.

Documentation and Testing Specialist (Arafat Rahman Shihab)

Document all configurations, protocols, and design specifications, perform thorough testing of the network (functionality, efficiency, and security), summarize outcomes, prepare the final report, and contribute to the presentation.

Communication and Collaboration

Regular communication was maintained through team meetings, status updates, and progress reports

to ensure alignment across all project phases.

Weekly Meetings:

Held to review progress, discuss challenges, and adjust timelines if necessary.

Collaboration Tools:

Tools like Slack and Google Workspace were used for real-time communication, file sharing, and task management.

Documentation: All configurations, design decisions, and testing results were documented and shared with the team for future reference and troubleshooting.

4.3 Complex Engineering Problem

4.3.1 Mapping of Program Outcome

AeroLink Network Matrix project aligns with Program Outcomes, demonstrating engineering knowledge and problem-solving skills. It emphasizes ethical considerations, teamwork, and adaptability to new technologies.

Table 4.1: Justification of Program Outcomes

PO’s	Justification
PO1	Everyone appropriate tools (Packet Tracer, routers, and firewalls) to simulate and configure secure networks.
PO2	People analyze and solve engineering problems by evaluating network protocols and optimizing configurations
PO3	Students design and present network solutions, considering security, scalability, and societal implications

Justification of Program Outcomes

PO1: Modern Tool Usage
Justification:

The project utilizes advanced tools such as Cisco Packet Tracer for network simulation and Cisco ASA Firewalls for secure network configuration. These tools allow for the design, implementation, and validation of complex network systems, showcasing the integration of modern technology to solve practical engineering challenges.

PO2: Analysis of the Problem
Rationale:

The project requires thorough analysis of the current network setup, focusing on IP addressing, routing protocols, and security measures. The team identifies shortcomings related to scalability, security, and redundancy, and designs solutions based on simulation results to address these issues.

PO3: Design and Development of Solutions
Justification:

The project tasks students with designing a secure, scalable network infrastructure that includes redundancy and load balancing. This encourages them to apply their knowledge in creating practical and effective solutions to real-world networking problems.

4.3.2 Complex Problem Solving

AeroLink Network Matrix project tackles complex networking challenges, optimizing topology, ensuring security, and implementing scalability. Advanced problem-solving and innovative solutions are utilized to overcome real-world networking challenges.

Table 4.2: Mapping with complex problem solving.

EP1 Dept of Knowledge	**EP2** Range of Conflicting Requirements	**EP3** Depth of Analysis
Analysis of advanced networking concepts like VLAN, IPsec VPN, and hierarchical design.	Balancing cost efficiency with network performance, scalability, and security requirements.	Balance more secure and enhance the performance quickly using network type.

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	**EA4** Consequences for society and environment
Utilization of advanced tools and resources like Cisco Packet Tracer, ASA Firewalls, and DHCP configurations.	High levels of engagement between many stakeholders, including as instructors, students, and IT personnel	Design decisions consider societal and environmental impacts, including energy efficiency and secure access for all users.

EA1 (Range of Resources): The AeroLink Network Matrix project utilizes advanced tools and technologies, including firewalls, IPsec VPNs, and hierarchical design principles. These resources are essential for simulating, configuring, and validating the network systems, ensuring optimal efficiency, security, and reliability in the design.

EA2 (Level of Interaction): The project requires active collaboration with various stakeholders, including faculty, IT personnel, and students. Their input ensures that the network architecture meets operational requirements, user needs, and institutional objectives, fostering effective communication and solution development.

EA4 (Consequences for Society and the Environment): By implementing scalable and modular network designs, the project helps reduce electronic waste and promotes energy efficiency. The design also supports sustainability by providing secure and open access to the network, aligning with environmental and societal considerations for future growth.

Chapter 5

Conclusion

The AeroLink Network Matrix project simplifies Bangladesh Airways' network, ensuring efficient data transfer and secure communication. The project, utilizing Cisco simulation tools, creates a robust network connecting multiple airports and a central control hub, with scalability to accommodate future growth.

5.1 Summary

The AeroLink Network Matrix project successfully addresses the complexities of Bangladesh Airways current network by providing a simplified, secure, and scalable solution. Leveraging Cisco simulation tools, the project demonstrates the creation of a robust network connecting multiple airports and a central control hub, ensuring efficient data transfer and secure communication. The integration of firewalls and VLANs strengthens the security framework, safeguarding sensitive airline data. Furthermore, the project's emphasis on scalability ensures that the network can adapt to future growth. Overall, the AeroLink Network Matrix enhances operational efficiency, reduces network downtime, and establishes a future-proof, reliable network system for Bangladesh Airways.

5.2 Limitation

Simulation-Based Implementation: The project is confined to a simulated environment using Cisco tools, which cannot fully replicate real-world network challenges such as hardware failures, latency issues, or environmental factors.

Scalability Constraints: While the network is designed with future scalability in mind, the project's scope does not address large-scale integration or the addition of external systems beyond the current airports and central hub.

Basic Security Features: The security measures implemented, such as firewalls and VLANs, are fundamental but may not be sufficient to protect against more advanced cyber threats like AI-based attacks or zero-day vulnerabilities.

Lack of Physical Network Implementation: The absence of physical hardware testing limits the validation of network performance, reliability, and security under real-world conditions, such as physical cable connections and network traffic load.

5.3 Future Work

Future work for the AeroLink Network Matrix includes transitioning to a physical network setup, enhancing security features, and expanding scalability to support additional airports and global connections. The project will also integrate wireless technologies, improve network monitoring, and implement disaster recovery plans for greater reliability and continuity.

Transition to a Real-World Setup: Implement a physical network using hardware like routers, switches, and firewalls to evaluate network performance, reliability, and security under real-world conditions.

Enhance Security Measures: Integrate advanced security features such as Intrusion Prevention Systems (IPS), AI-based threat detection, and end-to-end encryption to safeguard the network against emerging cyber threats.

Scalability and Expansion: Extend the network to accommodate additional airports, third-party systems, and external connections, enabling a global network that can support the airline's future growth and operations.

Wireless Network Integration: Explore the integration of wireless technologies like Wi-Fi and LTE for areas where wired connections are impractical. Ensure robust security measures for wireless communication.

Network Monitoring and Automation: Implement network monitoring tools and automation frameworks to proactively detect and resolve issues, optimizing performance and reducing human intervention in day-to-day operations.

Disaster Recovery and Business Continuity Planning: Develop and test disaster recovery plans and redundant systems to ensure the network can quickly recover from outages or failures, minimizing downtime and maintaining business continuity.

User Training and Support: Provide ongoing training for IT staff and end-users to equip them with the necessary skills to manage, troubleshoot, and optimize the new network system effectively.

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