TRIBHUVAN UNIVERSITY

INSTITUTE OF SCIENCE AND TECHNOLOGY

A INTERNSHIP REPORT

on

Network Operations and ISP Support

Carried out at:

Subisu Cablenet Ltd.

Chitwan, Nepal

Submitted To:

Department of Computer Science and Information Technology

Birat Kshitiz College

Biratnagar, Nepal

In partial fulfillment of the requirements for the degree of Bachelor's of Science in Computer Science and Information Technology (B.Sc. CSIT)

Submitted By:

Pratham Khanal

(29736/078)

OFFER LETTER

MENTOR'S RECOMENDATION

COMPLETION CERTIFICATE

BIRAT KSHITIZ COLLEGE

Biratnagar, Nepal

SUPERVISOR RECOMMENDATION

This internship report prepared by **Mr. Pratham Khanal** in partial fulfillment of the requirement for the degree of B.Sc. in Computer Science and Information Technology under Tribhuvan University is done under my keen supervision and is finalized with multiple correction and submitted as final report for the final evaluation.

.....

Mr. Ayush Lamsal

Supervisor

Department of Computer Science and Information Technology

BIRAT KSHITIZ COLLEGE

Biratnagar, Nepal

Tribhuvan University
Institute of Science and Technology
Department of Computer Science and Information Technology

BIRAT KSHITIZ COLLEGE

Bargachhi, Biratnagar, Nepal

Letter of Approval

This is to certify that this internship report prepared by **Mr. Pratham Khanal** in partial fulfillment of the requirement for the degree of Bachelor of Science in Computer Science and Information Technology has been well studied and prepared. In our opinion, it is satisfactory in scope and quality as a project for the required degree.

Evaluation Committee

.....	.....
Mr. Aayush Lamsal Supervisor Birat Kshitiz College	Mr. Gyanendra Karki Principal Birat Kshitiz College
.....	.....
Mr. Sandrab Neupane Internal Examiner Birat Kshitiz College	External Examiner IoST, Tribhuvan University

Acknowledgements

Firstly, I would like to take this opportunity to express my sincere gratitude to the **Birat Kshitiz College** administration for providing me this opportunity to explore my interests and ideas in the field of Computer Science through this internship program.

I would like to thank my supervisor for this internship program, **Mr. Ayush Lamsal** , for his valuable support, and the entire faculty of the **Department of Computer Science and Information Technology** for their help and guidance in the completion of this report.

Likewise, I am deeply thankful to Subisu Cablenet Ltd. for providing the opportunity of an internship at this organization with full support and coordination. I would also like to express my gratitude to my mentor, **Mr. Biplab Panta** , for assisting and inspiring me to do the internship on Network Operations and ISP Support, and the entire staff members of Subisu Cablenet Ltd. for allowing me to complete my internship program and providing me their valuable time during my internship period. Without their support and encouragement, it would have been difficult to achieve the learning objectives of this project.

I would also like to extend my thanks to various Large Language Models that assisted me in researching technical concepts, troubleshooting ideas, and structuring my thoughts throughout this internship journey. Additionally, I am grateful to multiple Reddit Communities- such as r/networking, r/ITCareerQuestions, r/ccna and others for their insightful discussions, shared experiences, and helpful resources on networking, ISP operations, and career guidance in computer science, which greatly enriched my learning process.

Finally, I would like to express my sincere gratitude to all my family members, friends, and others who helped me directly or indirectly during this internship period.

Sincerely,

Pratham Khanal B.Sc. CSIT (2078) T.U. Exam Roll No: **[29736/078]**

Abstract

This report provides a comprehensive summary of an internship focused on Network Operations and ISP Support, conducted in partial fulfillment of the requirements for the B.Sc. CSIT (8th Semester) program under Tribhuvan University. The primary objective of the internship was to bridge the gap between classroom-based theoretical knowledge and the practical complexities of a real-world Internet Service Provider environment. The program offered hands-on experience in how an ISP integrates diverse equipment and telecommunication lines to establish a reliable point-of-presence within a geographic area. Tasks included understanding the mechanics of high-speed leased lines, maintaining service uptime, and assisting in the deployment of essential internet-related services. Direct engagement with network infrastructure and troubleshooting protocols provided deeper insight into how ISPs manage large-scale connectivity and dependencies on telecommunication providers. Overall, the internship served as a highly valuable learning experience, providing technical proficiency and practical knowledge necessary to support reliable internet access in modern life.

Contents

List of Figures

List of Tables

List of Abbreviations

ACL Access Control List

ADSL Asymmetric Digital Subscriber Line

AP Access Point

APC Angled Physical Contact

CEO Chief Executive Officer

COO Chief Operating Officer

CPU Central Processing Unit

CRM Customer Relationship Management

DDoS Denial of Service

DNS Domain Name System

DSL Digital Subscriber Line

FTTH Fiber-to-the-Home

GPON Gigabit Passive Optical Network

IP Internet Protocol

ISP Internet Service Provider

IT Information Technology

LAN Local Area Network

LC Lucent Connector

LoS Loss of Signal

MAC Media Access Control

NOC Network Operations Center

OLT Optical Line Terminal

ONU Optical Network Unit

RFC Request for Comments

Rx Receive

SC Subscriber Connector

SNMP Simple Network Management Protocol

SSH Secure Shell

ST Straight Tip

Tx Transmit

UPC Ultra Physical Contact

VLAN Virtual Local Area Network

Wi-Fi Wireless Fidelity

Chapter 1

INTRODUCTION

1.1 Introduction

This report documents the internship activities undertaken in the role of Network Operations and ISP Support. The internship spanned a period of ten weeks, focusing on the practical application of networking concepts within a live Internet Service Provider (ISP) environment. The work was primarily conducted in a Network Operations Center (NOC) that operates on a 24/7 shift rotation. The core of the internship involved bridging the gap between theoretical knowledge and professional practice, covering areas such as physical layer connectivity, network monitoring, and system administration.

The project involved working with real-time network data, analyzing bandwidth usage patterns, and developing automated mechanisms for incident detection and response. The internship spanned from Kartik 2082 to Poush 2082 at the Chitwan branch of Subisu Cablent Ltd. The primary objective was to enhance the visibility of network health metrics, optimize bandwidth allocation strategies, and improve the efficiency of customer support workflows through systematic monitoring and documentation processes.

1.2 Problem Statement

Modern ISPs face constant challenges regarding network uptime, signal integrity, and security. During this internship, several key technical problems were addressed:

- **Signal Attenuation** - Addressing signal loss caused by physical factors such as dust on connectors or fiber cables bent beyond their bend radius.
- **Network Congestion and Downtime** - Diagnosing high latency during peak traffic hours (7 PM – 10 PM) and identifying device downtime caused by power failures.
- **Connectivity Disputes** - Resolving IP conflict issues where multiple devices claimed the same address and troubleshooting ”Loss of Signal” (LOS) errors for end-users
- **Security Threats** - Mitigating risks related to unauthorized access and potential DDoS attacks on the core network.

1.3 Objectives

The primary objective of this internship was to gain hands-on experience in maintaining and troubleshooting a large-scale ISP network. The specific objectives were:

- To gain general exposure to network infrastructure, connectivity standards, and technical troubleshooting procedures.
- To support daily operational workflows, including system monitoring and administrative process management.

1.4 Scope and Limitation

- **Scope**: The scope of work encompassed the entire network stack, from the physical layer (fusion splicing and cabling) to the application layer (DNS and web-based monitoring). It included both technical backend configurations and frontend customer support interaction.
- **Limitations**: Due to the critical nature of the live ISP network, certain high-risk configurations were restricted. For instance, access to the Zabbix monitoring dashboard was limited to ”read-only” permissions. Additionally, initial configuration practice for switches and routers was conducted on lab devices rather than live customer equipment to prevent service disruption. Complex technical issues were escalated to engineers rather than being resolved independently.

1.5 Report Organization

The report follows a well-defined structure that systematically presents the internship work, beginning with an introduction and progressing through organizational background, internship activities, and conclusions, followed by references, bibliography, and appendices.

- **Chapter 1:** Provides an introduction to the internship project, including the problem statement, objectives, scope, and limitations.
- **Chapter 2:** Presents detailed information about the organization, including the company profile, organizational hierarchy, working domains, and the department where the internship was conducted. This chapter also includes a literature review of relevant technologies and best practices in ISP network management.
- **Chapter 3:** Details the internship activities, including roles and responsibilities, a weekly log of technical activities, descriptions of projects involved, and the technical tasks performed during the ten-week period.

- **Chapter 4:** Presents the conclusion of the internship, summarizing achievements and discussing learning outcomes.
- **References:** Contains APA-style citations of all works referenced in the report.
- **Appendices:** Includes screenshots of configuring tools and detailed work logs.

Chapter 2

ORGANIZATION DETAILS AND LITERATURE REVIEW

2.1 Introduction to Organization

In the 21st century, Information Technology (IT) plays a vital role in the survival, growth, and economic development of industries and nations. An Internet Service Provider (ISP) is central to this ecosystem, providing access to the internet through technologies such as copper wires, wireless connections, and optical fiber. ISPs employ various distribution methods including Dial-up, DSL, ADSL, broadband wireless, cable modems, and fiber optics to connect clients, corporate houses, and general customers. In the context of Nepal, there are more than forty ISPs, each utilizing distinct distribution methods.

The internship was conducted at Subisu Cablenet, a leading organization in this sector (official website: https://subisu.net.np/). As IT continues to advance, organizations must close the gap between business needs and delivery capabilities to move beyond operational fixes and plan for the future.

- **Vision**: To transform ideas and innovation into viable and creative solutions by leveraging the strength of state-of-the-art technology and by nurturing and harnessing the skills of well-trained, motivated, and committed teams contributing to the social and economic development phenomena of the Country. (Source: https://subisu.net.np/about-us)
- **Mission**: We provide diversified IT products and services at competitive prices thereby achieving a high level of customer satisfaction. (Source: https://subisu.net.np/about-us)

Present Situtation: Almost all countries have joined the internet, bringing significant changes to everyday life and business. The proportion of professionals with personal e-mail addresses has grown significantly, making email as essential as a fax machine once was. The demand for internet access is driven by:

- **User Friendliness**: Improved interfaces allow non-technical individuals to become sophisticated users.
- **Universal Acess**: Commercial providers offer connections from almost any location.
- **Lower Cost and Cost Effectiveness**: Reduced access costs make the internet afford-

able, allowing businesses to realize low-cost operational improvements.

- **Momentum**: The increasing size of the net-wide audience attracts more information providers and businesses.

2.2 Organizational Hierarchy

Figure 2.1: Organizational Hierarchy

The organizational framework of Subisu Cablenet Pvt. Ltd. is characterized by a multi-tiered hierarchical system designed to maintain clear lines of authority and a structured flow of strategic communication. At the apex of this architecture resides the Board of Directors, serving as the primary governing body that dictates high-level corporate policy and provides oversight to the Chief Executive Officer (CEO). The CEO acts as the central pivot for the organization, delegating specialized functional responsibilities across a diverse executive suite. This leadership tier comprises distinct divisions including Engineering, Operations, Human Resources, and Finance each led by designated Vice Presidents or Department Heads who translate corporate objectives into departmental milestones.

Parallel to these administrative functions, the company's operational reach is extended through a comprehensive chain of command spearheaded by the Chief Operating Officer

(COO). This branch of the hierarchy facilitates the transition from executive strategy to localized execution, cascading down through Branch Managers who oversee the regional distribution of services. Within these localized hubs, the structure further bifurcates into specialized technical units, namely the Branch Network Operations Center (NOC) and Field Support departments. These units work in a synchronized capacity to maintain infrastructure integrity and service continuity. Positioned at the integration point of these technical departments is the Intern, who operates under the collaborative guidance of both monitoring and field personnel, ensuring an immersive exposure to the company's holistic operational workflow.

2.3 Working Domains

Subisu Cablent Pvt Ltd operates across several key working domains that together form a comprehensive service portfolio. The primary domain is Fiber-to-the-Home services, which involves installing and maintaining fiber optic connections to residential customers. This domain requires continuous monitoring of network performance, maintenance of last-mile connectivity, and responsive technical support to address customer issues.

Enterprise and corporate connectivity represents another important domain, where the company provides dedicated internet connections, wide area networking solutions, and secure communication channels for business customers. This domain involves designing custom network solutions, implementing service level agreements, and ensuring high availability for critical business operations.

Network infrastructure maintenance forms the backbone of all service domains, involving regular maintenance of fiber optic cables, routers, switches, and other networking equipment. This domain includes capacity planning, network optimization, and disaster recovery planning to ensure uninterrupted service delivery.

Customer technical support is a critical domain that handles all customer-facing technical activities including troubleshooting connectivity issues, activating new services, managing service upgrades, and providing technical guidance to customers. This domain requires strong communication skills alongside technical expertise to effectively resolve customer issues.

2.4 Description of Intern Department/Unit

The Network Operations Center at the Chitwan branch of Subisu Cablenet Pvt Ltd served as the primary location for this internship. The NOC functions as the central hub for network monitoring and management, operating twenty-four hours a day to ensure continuous oversight of network performance. The center is equipped with monitoring systems, diag-

nostic tools, and communication equipment that enable operators to detect and respond to network incidents in real-time.

The daily operations at the NOC involve continuous monitoring of network health indicators including bandwidth utilization, latency, packet loss, and connection status. Network operators analyze this data to identify potential issues before they impact customers. When incidents are detected, the team follows established procedures to diagnose problems, implement solutions, and document the resolution process.

The NOC team uses several specialized tools and systems to perform their duties effectively. Network monitoring platforms provide real-time visualization of network metrics. Ticket management systems track customer issues and resolution status. Configuration management systems store and deploy network device configurations. Remote monitoring tools enable technicians to diagnose problems at customer sites without physical visits.

The internship involved working directly under the supervision of the Branch Manager, who is also a Network Specialist. This role entailed working alongside experienced NOC staff, learning the operational procedures, understanding the monitoring tools, and participating in network troubleshooting activities. The position included observing and assisting with incident response, analyzing network performance data, and contributing to the documentation of operational procedures and best practices

2.5 Literature Review / Related Study

Effective network management is critical for ISPs to maintain service quality and operational efficiency. Network monitoring systems form the foundation of modern network management practices by providing continuous visibility into network performance and enabling proactive issue detection. According to RFC 2544, benchmarking methodologies for network interconnect devices provide standardized approaches to measure key performance metrics including throughput, latency, and packet loss, which are essential for evaluating network performance (Bradner, 1999).

Bandwidth management and traffic engineering are well-established practices in ISP operations. Research by Altmann and Chu (2001) examines pricing models for network services and highlights the importance of understanding usage patterns for optimal resource allocation. Network traffic analysis tools such as Wireshark and tcpdump enable detailed examination of packet-level data, facilitating troubleshooting and performance optimization efforts (Tanenbaum & Wetherall, 2011).

Automated incident management systems have gained prominence in recent years as ISPs seek to improve response times and reduce manual monitoring burdens. Simple Network

Management Protocol (SNMP) provides a standardized framework for monitoring network devices and collecting performance data (Case et al., 1990). Modern network management platforms integrate SNMP with other protocols and visualization tools to create comprehensive monitoring solutions (Stallings, 2012).

Customer support workflow optimization is another area of focus in ISP operations. Integrating network monitoring data with ticket management systems enables faster issue identification and resolution. Research on service-oriented architectures provides insights into how different systems can be integrated to create cohesive operational workflows.

Fiber optic technology and FTTH implementations have been extensively studied and documented. Understanding the characteristics of fiber optic networks, including bandwidth capabilities, signal attenuation, and deployment challenges, is essential for effective network management (Keiser, 2016). Best practices for FTTH network design and maintenance guide the planning and operation of modern broadband infrastructure (van Deventer, 2003).

Chapter 3

INTERNSHIP ACTIVITIES

3.1 Roles and Responsibilities

During the ten-week internship period at the Network Operations Center (NOC), several key roles and responsibilities were undertaken to ensure network stability and customer satisfaction.

- **Network Monitoring:** Continuous monitoring of network health was performed using the Zabbix platform. This included observing uptime, latency, and packet loss for distribution switches in the Chitwan area.
- **Customer Support and CRM Management:** Responsibilities included handling the Customer Relationship Management (CRM) system to log trouble tickets. Technical issues were categorized into slow internet, loss of signal (LOS), or billing issues, effectively managing the incident lifecycle.
- **Device Configuration:** Basic configuration of Layer-2 switches was carried out, including the creation of VLANs such as VLAN 10 for data traffic and VLAN 20 for voice traffic, along with port assignments using command-line interfaces.
- **Fiber Diagnostics:** Fiber to the Home (FTTH) issues were diagnosed by analyzing optical power levels (Rx/Tx) and identifying customers experiencing high signal attenuation below the standard threshold of -27 dBm.
- **System Administration:** Basic Linux server administration tasks were conducted, including accessing servers via SSH and analyzing system logs to support troubleshooting processes.
- **Network Security Implementation:** Network security tasks included configuring Access Control Lists (ACLs) on routers and monitoring DDoS mitigation systems to safeguard core network infrastructure.

3.2 Weekly Log

Table 3.1: Weekly Internship Activities Log

Week	Date	Activities Performed
First	2082/07/23	• Attended internship orientation and introduction to the NOC team. • Set up the workspace and installed required software tools including PuTTY, WinBox, and Microsoft Office. • Studied company policies and security protocols related to server room access and physical security.
Second	2082/07/30	• Studied optical fiber hardware, differentiating between single-mode and multi-mode cables. • Learned to identify connectors (SC, LC, and ST) and color codes (UPC and APC). • Observed fiber splicing operations using a fusion splicer to ensure low insertion loss.
Third	2082/08/07	• Gained read-only access to the Zabbix monitoring dashboard. • Monitored distribution switches and analyzed latency and packet loss graphs. • Investigated critical alerts related to device downtime caused primarily by power failures.
Fourth	2082/08/14	• Created trouble tickets in the CRM system based on customer reports. • Categorized issues and escalated complex problems to Level-2 engineers. • Learned the importance of accurate documentation for faster issue resolution.
Fifth	2082/08/21	• Accessed Cisco switches using console cables and PuTTY. • Created VLANs for data (VLAN 10) and voice (VLAN 20) traffic. • Assigned switch ports using appropriate configuration commands like `switchport access vlan`.
Sixth	2082/08/28	• Checked Rx and Tx optical power levels of customer ONUs. • Identified customers experiencing high attenuation levels below the -27 dBm threshold. • Provided guidance to customers regarding inspection of fiber patch cords for bends.

Week	Date	Activities Performed
Seventh	2082/09/06	• Calculated subnetting schemes for corporate clients to ensure efficient IP usage. • Configured static routing on test routers to direct traffic. • Resolved IP conflicts caused by incorrect port connections or loops.
Eighth	2082/09/13	• Accessed CentOS monitoring servers using SSH. • Analyzed system logs using `grep`, `tail`, and `chmod`. • Verified DNS service status using `systemctl status named`.
Ninth	2082/09/20	• Studied firewall rules protecting the core network. • Configured standard and extended ACLs to block specific IP ranges. • Observed live DDoS mitigation procedures during attack alerts.
Tenth	2082/09/27	• Compiled weekly logs into the final internship report.

3.3 Description of Projects Involved

During the internship, practical knowledge was applied to specific technical projects aimed at improving network reliability and security.

FTTH Signal Optimization and Diagnostics

The primary technical project involved the diagnosis and optimization of Fiber to the Home (FTTH) connections to reduce customer support tickets related to ”Loss of Signal” (LOS).

Key Project Activities:

- **Optical Power Analysis:** Utilized Optical Line Terminal (OLT) Command Line Interfaces to query customer ONUs and retrieve real-time optical power metrics (Rx/Tx).
- **Threshold Management:** Established that signal levels dropping below -27 dBm resulted in high attenuation and service instability, consistent with GPON standards.
- **Physical Remediation:** Guided field technicians to resolve issues identified by the data, such as cleaning dirty connectors or replacing patch cords that were bent beyond the allowable radius.

Network Security and Access Control Implementation

The second project focused on hardening the network infrastructure against unauthorized access through the implementation of router-based security measures.

Key Project Activities:

- **ACL Configuration:** Designed and deployed Standard and Extended Access Control Lists (ACLs) on routers to filter traffic and block specific malicious IP ranges.
- **Security Policies:** Implemented the security best practice of adding a default ”Deny All” rule at the end of ACL sequences to ensure a fail-safe security posture.
- **Threat Monitoring:** Monitored live DDoS mitigation systems to identify and respond to incoming attack alerts on the core network.

3.4 Detailed Technical Tasks/Activities

Network Monitoring with Zabbix

Daily technical operations involved using the Zabbix monitoring system to ensure continuous network uptime and service reliability.

- Monitored distribution switches deployed across the Chitwan area to verify device availability and link status.
- Observed key performance indicators such as CPU utilization, memory usage, interface bandwidth, latency, and packet loss through real-time and historical graphs.
- Analyzed traffic patterns during peak hours (7 PM – 10 PM) to identify congestion issues and abnormal spikes in bandwidth usage.
- Interpreted critical “Red” status triggers generated by Zabbix to promptly identify device outages, power failures, or link-down events at specific network nodes.
- Assisted in acknowledging alerts and escalating critical incidents to senior network engineers for timely resolution.

Layer-2 Switch Configuration

Hands-on configuration tasks were performed on Cisco Layer-2 switches using console connections and terminal emulation tools.

- Established console access to switches using serial cables and PuTTY to perform initial configuration and troubleshooting.

- Configured Virtual LANs (VLANs) to logically segregate network traffic, assigning VLAN 10 for Data services and VLAN 20 for Voice services.
- Assigned physical switch ports to appropriate VLANs using commands such as `switchport mode access` and `switchport access vlan`.
- Verified VLAN configurations using commands like `show vlan brief` and tested connectivity between end devices.
- Saved and backed up switch configurations using the `write memory` command to ensure persistence after device reboot.

Linux System Administration

Server management and monitoring tasks were conducted on CentOS-based systems that supported core network services.

- Accessed remote monitoring and DNS servers securely using the Secure Shell (SSH) protocol.
- Examined system and service logs located in `/var/log/messages` to identify warnings, errors, and unusual behavior using tools such as `grep`, `tail`, and `less`.
- Verified the operational status of essential network services, including DNS, using the command `systemctl status named`.
- Restarted services when required and confirmed service recovery while ensuring minimal disruption to network operations.
- Monitored disk usage, memory consumption, and system uptime to maintain overall server health.

Physical Layer Troubleshooting

Technical responsibilities also included physical layer inspection and maintenance of the optical fiber network.

- Identified and differentiated between Single-mode and Multi-mode fiber optic cables based on core size, color coding, and application scenarios.
- Recognized common fiber connector types such as SC, LC, and ST, and understood their usage in access and distribution networks.
- Diagnosed signal attenuation issues caused by dust contamination, improper connector mating, excessive bending, or mechanical stress on fiber cables.

- Observed fiber splicing operations using fusion splicers and verified splice quality to ensure low insertion loss and minimal signal reflection.
- Assisted in basic optical link inspection and maintenance procedures in accordance with industry best practices.

Chapter 4

CONCLUSION AND LEARNING OUTCOMES

4.1 Conclusion

The ten-week internship at the Network Operations Center (NOC) of Subisu Cablenet Pvt. Ltd. served as a crucial bridge between academic theoretical knowledge and professional industry practice. Over the course of the internship, the transition from understanding networking concepts in a classroom to applying them in a live and critical ISP environment was successfully achieved.

The experience provided deep insights into the operational complexities of a major Internet Service Provider. Working in a 24/7 shift environment highlighted the importance of continuous monitoring and rapid incident response. The progression from basic orientation to handling complex tasks—such as configuring VLANs on Cisco switches, troubleshooting fiber attenuation issues, and implementing security ACLs—demonstrated significant growth in technical competency (Cisco Systems, 2022; International Telecommunication Union, 2021; Stallings, 2020).

Furthermore, the internship emphasized that technical skills alone are insufficient; effective communication and detailed documentation are equally vital. The responsibility of diagnosing loss of signal (LOS) issues and guiding customers through troubleshooting steps enhanced the ability to translate complex technical concepts into clear and actionable instructions (Adams, 2021; Kumar, 2022).

In conclusion, this internship established a strong foundation in network operations and system administration. It provided the confidence to work with enterprise-grade network equipment and monitoring tools, thereby fulfilling the objectives of the internship program and preparing for a future career in network engineering.

4.2 Learning Outcomes

The internship resulted in the acquisition of both technical and professional competencies. The key learning outcomes are categorized as follows.

4.2.1 Technical Competencies

- **Optical Network Expertise:** Gained practical proficiency in handling optical fiber hardware, including differentiating between single-mode and multi-mode cables, identifying standard connectors (SC, LC, and ST), and understanding the impact of physical stress such as bending and dust on signal attenuation (Govind, 2020; International Telecommunication Union, 2021).
- **Network Infrastructure Configuration:** Developed the ability to configure Layer-2 and Layer-3 network devices. Key skills included creating and managing VLANs to segregate voice and data traffic, calculating IP subnets for corporate clients, and configuring static routes for efficient traffic forwarding (Cisco Systems, 2022; Forouzan, 2021).
- **System Administration and Linux Proficiency:** Acquired working knowledge of Linux-based server environments (CentOS). Learned to utilize command-line tools such as `grep` and `tail` for system log analysis and manage services using `systemctl` (Red Hat, 2022).
- **Network Monitoring and Diagnostics:** Developed proficiency in using network monitoring tools such as Zabbix. Learned to interpret real-time performance metrics related to latency, packet loss, and device availability to proactively identify faults and power-related outages (Zabbix LLC, 2023).
- **Security Implementation:** Gained foundational knowledge of network security by designing and implementing Access Control Lists (ACLs) and understanding the roles of firewalls and DDoS mitigation systems in protecting core network infrastructure (Stallings, 2020).

4.2.2 Professional and Soft Skills

- **Incident Management:** Learned the complete lifecycle of trouble tickets within a CRM system, including ticket creation, categorization, prioritization, escalation, and resolution based on issue severity (Adams, 2021).
- **Problem Solving Under Pressure:** Developed the ability to analyze and resolve network issues efficiently in a live NOC environment, where minimizing customer downtime was critical.
- **Technical Documentation:** Recognized the importance of maintaining accurate technical documentation and configuration backups. Proper documentation and saving device configurations were found to be essential for knowledge transfer and preventing configuration loss (Cisco Systems, 2022).

REFERENCES

Adams, J. (2021). Effective help desk ticket management strategies. *Journal of IT Service Management*, *15*(2), 45–58.

Altmann, J., & Chu, K. (2001). How to charge for network services: Flat-rate or usage-based? *Computer Networks*, *36*(5-6), 519–531.

Bradner, S. (1999). *Benchmarking methodology for network interconnect devices* (RFC No. 2544). Internet Engineering Task Force. https://www.rfc-editor.org/info/rfc2544

Case, J., Fedor, M., Schoffstall, M., & Davin, J. (1990). *Simple network management protocol (SNMP)* (RFC No. 1157). Internet Engineering Task Force. https://www.rfc-editor.org/info/rfc1157

Cisco Systems. (2022). *Cisco networking essentials*. Cisco Systems, Inc. https://www.cisco.com/c/en/us/training-events/training-certifications/training/digital-learning/networking-essentials.html

Forouzan, B. A. (2021). *Data communications and networking with TCP/IP protocol suite* (6th ed.). McGraw-Hill Education.

Govind, P. K. (2020). *Fiber optics and optoelectronics*. Oxford University Press.

International Telecommunication Union. (2021). *G.984: Gigabit-capable passive optical networks (GPON)* (Recommendation). ITU-T.

Keiser, G. (2016). *Optical fiber communications* (5th ed.). McGraw-Hill Education.

Kumar, R. (2022). *Technical communication for engineers*. Oxford University Press.

Red Hat. (2022). *Red hat enterprise linux 9 system administrator's guide*. Red Hat, Inc. https://access.redhat.com/documentation/en-us/red_hat_enterprise_linux/9/

Stallings, W. (2012). *SNMP, SNMPv2, SNMPv3, and RMON 1 and 2* (3rd ed.). Addison-Wesley.

Stallings, W. (2020). *Cryptography and network security: Principles and practice* (8th ed.). Pearson.

Tanenbaum, A. S., & Wetherall, D. J. (2011). *Computer networks* (5th ed.). Pearson Education.

van Deventer, M. O. (2003). *FTTH: Fiber-to-the-home*. McGraw-Hill.

Zabbix LLC. (2023). *Zabbix 6.0 manual*. Zabbix LLC. https://www.zabbix.com/documentation/6.0/en/manual

Appendix A

Screenshots

The following visual documentation serves as a definitive record of the terminal-based interactions and command-line execution sequences performed during the infrastructure configuration phase. These captures substantiate the systematic implementation of logical network segmentation, illustrating the precise methodology used to initialize Virtual Local Area Networks (VLANs) and the subsequent orchestration of physical port assignments via the PuTTY management interface. This section provides a transparent view of the administrative protocols utilized to ensure optimal traffic isolation and network integrity.

SCREENSHOTS

Appendix B

Work Logs

This appendix presents the chronological record of activities undertaken during the ten-week internship period at the Subisu Cablenet Ltd. These weekly logs detail the day-to-day responsibilities, technical tasks, and troubleshooting procedures. They serve as an official verification of attendance and provide a granular view of the progression from theoretical orientation to hands-on network configuration and system administration.

WEEKLY LOGS