Tribhuvan University

Institute of Science and Technology

Asian College of Higher Studies

Ekantakuna, Lalitpur, Nepal

An Internship Report

On

“DevOps Engineer “

At

F1Soft International Pvt. Ltd.

Submitted by

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An Internship Report Submitted in partial fulfillment of the requirement of Bachelor of Science in Computer Science & Information Technology (BSc.CSIT) 8th Semester of Tribhuvan University, Nepal

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ASIAN COLLEGE OF HIGHER STUDIES

ACHS

COLLEGE OF IT AND COMPUTER SCIENCE

(Affiliated to Tribhuvan University)

SUPERVISOR'S RECOMMENDATION

I hereby recommend that this report has been prepared under my supervision by Saurab Tharu entitled **……** is accepted as fulfilling in partial requirements for the degree of Bachelor of Science in Computer Science and Information Technology.

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ACKNOWLEDGEMENT

ABSTRACT

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

Chapter 1: Introduction

1.1. Introduction

Over the course of my internship at F1Soft International, I had the chance to fully embrace their DevOps culture and see how it has been used effectively in bridging the gap between software development and IT operations. F1Soft International is one of the most well-known names in innovative financial solutions, offering a wide array of innovative and advanced solutions to commercial banks, development banks, financial institutions, and several other large enterprises. The company is committed to using advanced technology with the view of enhancing financial inclusion and making digital experience seamless. My primary responsibility, as a member of their DevOps team, has been to learn how to streamline and enhance the development and operational processes, so that the resulting systems could be robust, efficient, and reliable.

My main duty included understanding implementation of DevOps practices to automate and simplify different parts of the software delivery process. This entailed creation as well as optimization of Continuous Integration/Continuous Deployment (CI/CD) pipelines which automate integration of code changes frequently and reliably should be deployed; they are important in reducing time-to-market while increasing overall development team's productivity.

Additionally, I also got a chance to look into how corporations utilize automation for handling repetitive tasks in their environments. Automation not only saves time but also lowers human error thus increasing reliability; it should therefore yield consistent results always too. During this period, I got practical experience on automating routine operations, configuring infrastructures easily without any challenges faced and managing applications seamlessly deployed across different systems or platforms.

This paper serves as a documentation of my internship experience showing what projects I worked on, where difficulties arose and how they were solved. It also indicates the skills gained and knowledge acquired which contributed immensely to shaping me into becoming an expert DevOps professional.

I got real world experience with DevOps apart from the theoretical knowledge that I had. I also understood better how collaborative and iterative DevOps is. F1Soft has been able to produce quality software faster because they focus on continuous improvement, automation as well as ensuring effective communication among development and operations teams. These skills and ideas will help me handle any other challenges that come my way in this area hence becoming an even better engineer.

1.2. Problem Statement

F1Soft International, like many tech-driven organizations, faced challenges related to the manual processes in software deployment, the scalability of their infrastructure, and the efficiency of their operational workflows. The primary issues included:

i) **Manual Deployment Processes**:
The existing deployment processes were largely manual, leading to inconsistencies, longer deployment times, and higher risk of errors.

ii) **Infrastructure Scalability**:
With a growing user base, the need for scalable infrastructure became critical. The current setup struggled to efficiently handle the increased load, affecting performance and user experience.

iii) **Operational Efficiency**:
The lack of automated workflows resulted in slower response times to incidents and less efficient use of resources.

Addressing these problems was crucial for maintaining F1Soft's competitive edge, ensuring customer satisfaction, and supporting the company's growth objectives.

1.3. Objectives

The primary objectives of my internship at F1Soft International were:

i) **Gain Professional Experience**:
Work in a real-world corporate environment to understand team dynamics, project management, and effective communication within a professional setting.

ii) **Develop Problem-Solving Skills**:
Tackle real-world challenges and develop solutions, enhancing critical thinking and problem-solving abilities.

iii) **Automate Deployment Processes**:
Implement CI/CD pipelines to automate the build, test, and deployment processes, reducing deployment time and errors.

iv) **Improve Operational Efficiency**:
Develop and integrate automated monitoring and alerting systems to enhance incident response times and operational efficiency.

1.4. Scope and Limitation

1.4.1. Scope

The scope of my internship included the following key areas:

i) **CI/CD Pipeline Implementation**:
   Setting up automated pipelines for continuous integration and deployment on bare-metal servers.

ii) **Bare-Metal Infrastructure Management**:
   Designing and deploying scalable solutions using physical servers.

iii) **Monitoring and Alerting**:
   Implementing tools like Prometheus and Grafana for monitoring and setting up alerting mechanisms.

iv) **Security Enhancements**:
   Adding security checks within the CI/CD pipeline and ensuring infrastructure compliance with security standards.

1.4.2. Limitations

Despite the comprehensive scope, there were some limitations during my internship:

i) **Time Constraints**:
   The duration of the internship was limited, which restricted the depth of exploration and implementation of certain advanced DevOps practices and tools.

ii) **Resource Availability**:
   Access to certain hardware and software resources was limited, which occasionally hindered the implementation and testing of specific solutions on a larger scale.

iii) **Learning Curve**:
   The complexity of some tools and technologies, especially those I was unfamiliar with, required significant time to learn, reducing the time available for hands-on application.

iv) **Assigned Task Scope**:
   The tasks assigned were predetermined, leaving limited room to explore additional areas of personal or emerging interest within the DevOps field.

1.5. Report Organization

This report is structured into four main chapters, each detailing different aspects of my internship experience at F1Soft International. Here is a brief overview of each chapter:

i) **Chapter 1: Introduction**
   This chapter introduces the work completed during my internship. It outlines the problem statement, the objectives of the internship, the scope and limitations of the project, and provides an overview of the report's organization.

ii) **Chapter 2: Organization Details and Literature Review**
   In this chapter, I provide a comprehensive introduction to F1Soft International. This includes an overview of the organization, its hierarchy, the various domains in which it operates, and a detailed description of the department or unit where I interned. Additionally, this chapter in-

cludes a literature review or related study, highlighting relevant theories and frameworks that underpin the work I performed during the internship.

iii) **Chapter 3: Internship Activities**

This chapter delves into the specifics of my internship activities. It outlines my roles and responsibilities, provides a weekly log of the technical activities I performed, describes the projects I was involved in, and details the technical tasks and activities I completed. This section offers an in-depth look at the hands-on experience I gained and the contributions I made to the organization.

iv) **Chapter 4: Conclusion and Learning Outcomes**

A brief overview of the experience gained during the internship is also stated in this last part, as well as the main conclusions. It mentions my skills and knowledge, challenges I faced and how I dealt with them. Additionally, the section talks about what the future holds in terms of career development after such an opportunity.

Chapter 2: Background Study and Literature Review

2.1. Introduction to Organization

F1Soft International leading financial technology company Nepal. Established 2004, it focuses on providing advanced digital financial solutions to various customers such as banks, financial institutions, and businesses within the country. F1Soft aims at changing the banking sector by using modern technology to promote financial inclusion and offer seamless online services for its clients. Its products range from mobile banking systems, payment gateways, digital wallets and enterprise solutions all designed around the needs of today's financial world. Besides, this firm is credited with introducing mobile banking as well as mobile financial services in Nepal.

The company's mobile banking and internet banking platforms which were developed are used by more than 90% of banks currently operational in Nepal thus serving >19M people. These systems account for nearly 80% total digital payments recorded so far in this landlocked nation. Moreover, F1Soft has won different accolades in recognition of its contribution towards fintech innovation both locally and internationally including but not limited to: Bronze Stevie Award Winner 2014 International Business Awards; 2013 FNCCI Service Excellence Award Winner; 3rd – Red Herring Top 100 Asia Award Winner 2012 among others. Additionally, in 2017 it was awarded 'Nepal Highest Tax Payer IT Sector' by Government of Nepal Revenue Department. Furthermore, there is an ongoing collaboration between F1Soft International Pvt Ltd and Government of Nepal/other agencies aimed at identifying and developing digital financial solutions that will benefit unbanked or underbanked populations across different regions of Nepal.

F1Soft is the market leader in the fintech industry due to its unwavering dedication to perfection, constant forward thinking and focus on the client. Financial inclusion for millions is being championed by F1Soft with its strong infrastructure and smart team that yearns to see this achieved through providing safe trustworthy easy to use financial solutions.

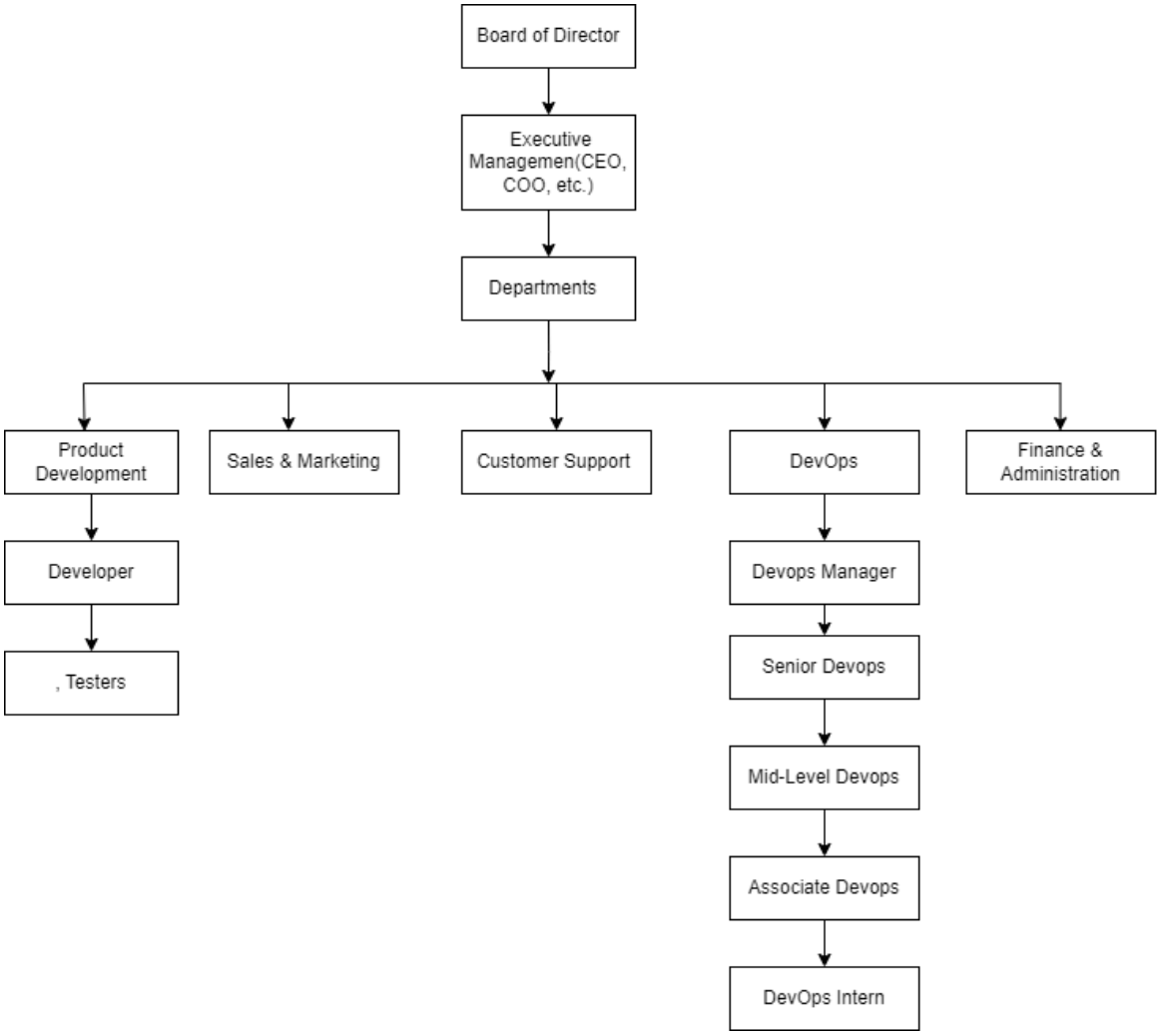
Table 2.1 : Company Details

Official name	F1Soft
Type of business	Fintech
Location	Pulchowk, lalitpur
Year of establishment	2004
Key service areas	Digital Payment Solutions, Banking Solutions
Staff size	600

Number of current clients	
Location of clients	Nepal
Expertise in	Financial Software Development, Digital Payment Systems, Data Analytics
Noteworthy mentions	Innovation in Digital Payments,Core Banking Solutions

2.2. Organizational Hierarchy

F1Soft International prioritizes innovation through its structure. The Board sets direction, and Executive Management implements it. Specialized departments handle tasks: Product Development builds software, Sales & Marketing drives growth, Customer Support keeps users happy, DevOps streamlines processes, and Finance & Admin manages the company's well-being. This structure fosters collaboration towards F1Soft's goals.



2.3. Working Domains of Organization

F1Soft International Pvt. Ltd is among the top technology firms located in Nepal that mainly focuses on financial technology solutions (fintech). Since its establishment in 2004, F1Soft has revolutionized digital financial services thus changing Nepalese and regional financial sector landscape. The company operates principally in:

i) **Digital Payment Solutions** - F1Soft is popularly known for its inclusive digital payment systems which consist of mobile wallets and payment gateways. Notable products under this category are eSewa (Nepal's first & leading digital wallet) and Fonepay (a prominent payment gateway that facilitates secure online transactions).

ii) **Core Banking Solutions** – It offers strong core banking systems that are meant to improve the operational efficiency of banks. These solutions help in various banking operations like account management, transaction processing among others.

iii) **Mobile Banking** – Advanced mobile banking applications provided by F1Soft allow users to do multiple banking activities using their smartphones. These applications have features such as fund transfer, balance inquiry, bill payment etc., thus making it more convenient for the user.

iv) **Internet Banking** – Secure internet banking platforms provided by the company ensures that customers have a user-friendly online banking experience. This allows them to manage their finance transfer money pay bills from home comforts or while at work through different services available on these platforms.

v) **Send or transfer money**: F1Soft also has experience with money transfer systems. They make it easy to send funds between countries by streamlining the process for their clients who want to do so quickly and securely while saving on costs too!

vi) **For businesses**: F1Soft offers many other types of technology products besides just those related to finance such as app development tools etc., through its Enterprise Solutions arm catering for all different industries' needs ranging from software engineering through systems integration right up until consultancy service provision around Information Technology.

2.4. Description of Intern Department/Unit

During my internship at F1Soft International Pvt. Ltd., I was placed in the dynamic DevOps department, which plays a crucial role in the company's IT infrastructure and operations. The DevOps team is responsible for ensuring seamless integration and deployment processes, enabling continuous delivery and integration (CI/CD) of applications. This involves managing infrastructure automation, monitoring system performance, and enhancing deployment efficiency through streamlined processes and tools. Each team within the department is led by a dedicated team lead who oversees operations and delegates responsibilities to team members. Under the guidance of System Support and Deployment Department, the department fosters a collaborative and energetic environment that enables its teams to deliver exceptional results.

As a DevOps intern, I had the opportunity to work under the guidance of an assigned mentor who provided invaluable assistance throughout my tenure. My responsibilities included assisting in the setup and maintenance of CI/CD pipelines, working with tools like Docker, Kubernetes, and Ansible for infrastructure automation, and implementing monitoring tools to track system performance. Additionally, I wrote scripts to automate routine tasks, improving overall efficiency in deployment and maintenance processes. This hands-on experience in DevOps practices, coupled with the support and mentorship from my team, significantly enhanced my technical skills and prepared me for a future career in the DevOps field. The collaborative and energetic environment at F1Soft allowed me to develop professionally and contribute effectively to the team's objectives.

2.5. Literature Review / Related Study (if any)

Chapter 3: Internship Activities

3.1. Roles and Responsibilities

While working as a DevOps Engineer intern for F1Soft International, my main focus was on bringing together software development and IT operations. I had the following tasks:

i) **CI/CD Pipeline Implementation**:
I automated software build, test, and deployment processes by setting up Jenkins CI/CD pipelines.

ii) **Infrastructure Management**:
I designed infrastructure solutions that could be scaled using physical servers.

iii) **Monitoring and Alerting**:
To ensure system reliability and performance, I implemented monitoring tools such as Grafana, Prometheus, Uptime Kuma as well as set up alerting systems.

iv) **Containerization**:
I utilized Kubernetes (K3s) for managing Docker containers which were orchestrated using Rancher.

v) **Automation and Scripting**:
My duties also involved writing Bash scripts that would automate routine tasks like deployment processes' execution or system checks for anomalies detection.

vi) **Documentation & Reporting**:
I kept records of every procedure undertaken along with their configurations before finally compiling performance reports at the end of each month.

vii) **Collaboration**:
Additionally, I worked hand in hand with developers, sysadmins and other team players so as to smoothen integration points between development and deployment workflows

viii) **Continuous learning**:
Staying updated with industry trends and applying new knowledge to improve existing systems.

DevOps skills development through practical experience gained while performing these duties.

3.2. Weekly log (Log should contain the list of technical activities performed)

Following table shows the weekly activities the intern performed throughout their internship period.

Table 3.1 : Weekly Log

Week	Activities

Week 1	
Week 2	
Week 3	
Week 4	
Week 5	
Week 6	
Week 7	
Week 8	
Week 9	
Week 10	
Week 11	
Week 12	

3.3. Description of the Project(s) Involved During Internship

3.4. Tasks / Activities Performed (Technical details of the activities done during the internship)

Chapter 4: Conclusion and Learning Outcomes

4.1. Conclusion

4.2. Learning Outcome

Throughout my internship at F1Soft International, I was exposed to a comprehensive range of DevOps practices and technologies, which significantly expanded my technical skill set and deepened my understanding of DevOps in a real-world fintech environment. Here are the key areas where I gained substantial knowledge and practical experience:

i. **Linux**:
   I extensively used Linux operating systems, mastering both basic and advanced functionalities such as file system management, user and group permissions, process management, and shell scripting. Proficiency in Linux was fundamental for server management and deployment processes, forming the backbone of my daily tasks.

ii. **Networking Concepts**:
   I developed a robust understanding of networking principles, including TCP/IP, DNS, DHCP, and subnetting. Additionally, I learned to configure and manage network interfaces and services, ensuring seamless communication and security within the infrastructure. This knowledge was essential for designing and maintaining reliable network setups.

iii. **Nginx Website Hosting**:
   I gained hands-on experience configuring and managing Nginx for web hosting. This involved setting up virtual hosts, configuring SSL certificates for HTTPS, and optimizing Nginx performance for handling high-traffic scenarios. These skills ensured that web applications were secure, accessible, and performant.

iv. **Tomcat Web Hosting**:
   I worked extensively with Apache Tomcat, deploying and managing Java web applications. This included configuring Tomcat servers, optimizing performance, and ensuring security. Understanding Tomcat's architecture and deployment processes was crucial for managing enterprise-level web applications.

v. **Load Balancing and Reverse Proxy with Nginx**:
   I implemented load balancing and reverse proxy solutions using Nginx, distributing incoming traffic across multiple backend servers to enhance reliability and scalability of web applications. This setup improved security and performance by offloading tasks from backend servers.

vi. **HAProxy and Keepalived for Load Balancing**:
   I used HAProxy and Keepalived to set up robust load balancing and failover solutions. HAProxy efficiently managed high traffic volumes, while Keepalived provided failover ca-

pabilities to ensure high availability. This combination was crucial for maintaining uninterrupted service.

vii. **Using Firewalld**:
I configured and managed the built-in firewall (Firewalld) in Linux systems to enhance security. Setting up firewall rules to control network traffic was essential for protecting the infrastructure from unauthorized access and potential threats.

viii. **Containerization**:
I explored containerization technologies, focusing on Docker. This included creating, managing, and orchestrating containers to ensure consistent and efficient application deployment across different environments. Containerization streamlined the deployment process and ensured consistency.

ix. **Containerizing Tomcat Websites**:
I containerized Tomcat-based web applications, simplifying deployment and ensuring consistency across development, staging, and production environments. This involved creating Docker images for Tomcat applications, configuring Docker Compose, and managing container lifecycles.

x. **SSL for HTTPS**:
I implemented SSL certificates to secure web applications by enabling HTTPS, ensuring data integrity and security during transmission. Generating and managing SSL certificates and configuring web servers to use them were critical for secure communications.

xi. **Self-Hosting Git Services**:
I set up and managed self-hosted Git services like Gitea and Gogs. This included configuring repositories, managing user access, and ensuring the security and availability of version control systems. Self-hosted Git services provided greater control over source code management.

xii. **Using MinIO for Object Storage**:
I utilized MinIO, an open-source object storage solution, to set up and manage scalable and high-performance storage infrastructure. MinIO enabled secure and efficient storage of large amounts of unstructured data.

xiii. **Monitoring and Alerts with Monito**:
I configured monitoring tools like Monito to track system performance and send email notifications when specific triggers or thresholds were met. This proactive system management helped quickly identify and resolve issues, minimizing downtime and ensuring optimal performance.

xiv. **Bash Scripting**:
I developed proficiency in Bash scripting for automating repetitive tasks, streamlining workflows, and enhancing productivity. Automating complex tasks with Bash scripting reduced human error and saved time.

xv. **Network File System (NFS) for Synchronization**:
I implemented NFS to enable file sharing and synchronization across multiple servers, facilitating seamless data access and collaboration. NFS was crucial for environments requiring consistent and shared data access.

xvi. **Using Monitoring Tools (Uptime-Kuma, Grafana, Prometheus, Loki)**:
I deployed and configured monitoring tools to track system health, performance metrics, and log management. Uptime-Kuma provided uptime monitoring, Grafana offered data visualization, Prometheus handled time-series data, and Loki managed log aggregation. These tools provided comprehensive insights into system operations, aiding proactive maintenance and troubleshooting.

xvii. **MySQL Replication**:
I set up and managed MySQL replication to ensure data redundancy and high availability. Configuring master-slave replication, monitoring replication status, and managing failover scenarios were essential for maintaining data integrity and minimizing downtime in case of failures.

xviii. **Self-Hosted Docker Registry**:
I configured and managed a self-hosted Docker registry to securely store and distribute Docker images within the organization. This provided greater control over the deployment pipeline and ensured the availability of Docker images for various environments.

xix. **Cryptography and Public Key Infrastructure (PKI)**:
I gained knowledge in cryptography and PKI, including implementing encryption techniques, key management, and digital certificates to secure communications and data. Understanding cryptography was critical for protecting sensitive information and ensuring secure transactions.

xx. **K3s and Rancher for Kubernetes Management**:
I used K3s and Rancher to deploy, manage, and scale Kubernetes clusters. K3s provided a lightweight Kubernetes distribution, while Rancher offered a user-friendly interface for cluster management. These tools enabled efficient orchestration and management of containerized applications.

xxi. **Managing Linux LVM Partitions**:
I acquired skills in managing Logical Volume Manager (LVM) partitions on Linux systems, enabling flexible disk space management and storage optimization. LVM allowed for dynamic resizing of disk partitions, facilitating better resource utilization and storage management.

These experiences have significantly enhanced my technical skills and prepared me for future roles in the DevOps field. The comprehensive exposure to various tools, technologies, and

practices has equipped me with the knowledge and confidence to tackle complex DevOps challenges and contribute effectively to any technology-driven organization.

References

Appendices