Automated IP Planning System

Author

Capt Zubair

Maj Waleed

Maj Ihtesham

Capt Nasir

Supervisor

Maj Khawir Mahmood

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CERTIFICATE OF CORRECTIONS & APPROVAL

Certified that work contained in this thesis titled "**Automated IP Planning System**" carried out by **Maj Waleed, Capt Zubair ,Maj Ihtesham , Capt Nasir** under the supervision of **Maj Khawir Mahmood** for partial fulfillment of Degree of Bachelors of Software Engineering, in Military College of Signals, National University of Sciences and Technology, Islamabad during the academic year 2019-2020 is correct and approved. The material that has been used from other sources it has been properly acknowledged / referred.

Approved by
Brig Dr Adnan Ahmad Khan

Supervisor
Maj Khawir
Department of CSE, MCS

DECLARATION

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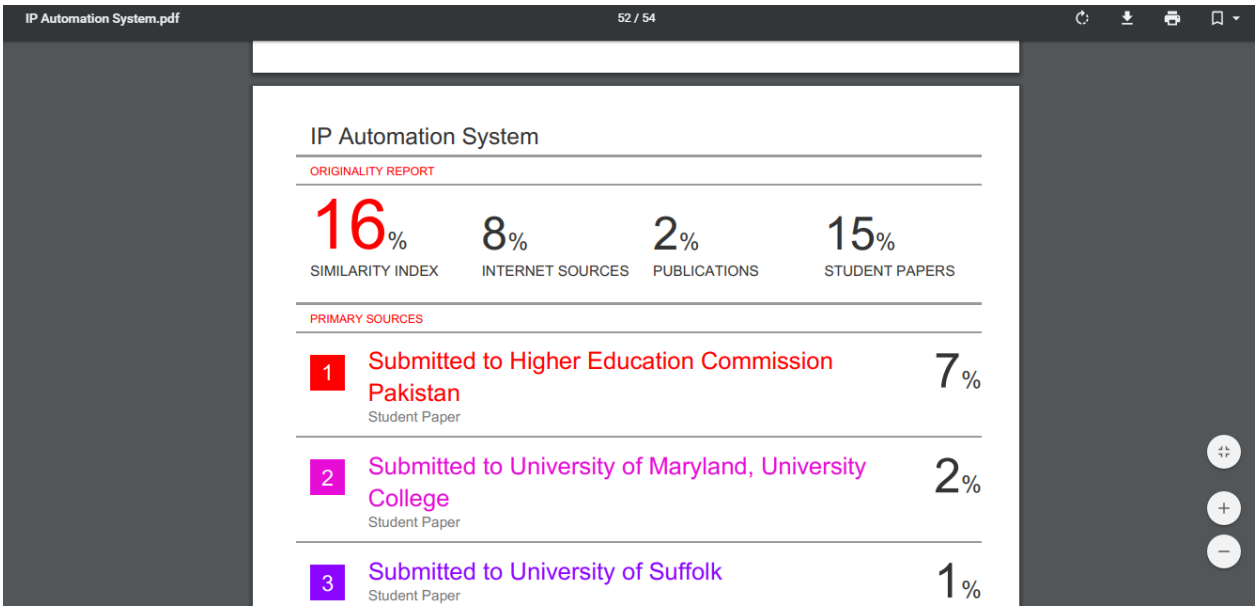

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Abstract

Networking of the army's equipment at the Corps as well as the Division level has been an issue. This process takes a lot of time if done manually and is very much prone to errors. Also, the accuracy of the manual process has to be checked at individual level which is also a very cumbersome process and is subject to the domain knowledge of the operator. Our proposed system solves that problem in an automated fashion. The operator is now only needed to input the equipment, which requires the IP allocation, and our system automatically generates the IP pool and assigns the subnets to that equipment. Our system will not only reduce the time required to complete the task but it will also remove the probability of errors in the output.

After induction of IP based NG PATCOMs(Next Generation Pakistan Army Tactical Communication Equipment System) initially IP planning has received many setbacks because of lack of experience of officers/soldiers and new technology. The aim behind the creation of this software is to bridge that gap and help in easy and flexible implementation of the communication plans of the IP based equipment. Up till now no centralized software is in use that can automate the IP planning activities.

'Automated IP Planning System' is an application designed to help troops/officers of Pakistan Army peculiar to Corps of Signals in their operational activities to be able to plan and implement the IP based communication systems in the field within a short period of emergency. In case of Escalation/Field exercise, this software will assist the communicators in groundwork efficiently. The software also strives to ease the minor matters related to allotment of IP addresses to communication equipment within the formations.

Key Words: *Corps, Division , NG PATCOMs, IP Planning , Equipment*

PREFACE

This thesis will present the detail study, design and implementation and testing of the project “IP Automation System” For ease of scenarios we have divided it into Six chapters

Chapter One: This chapter describes the introduction, objectives and scope of system

Chapter two: The purpose of this chapter is to get detailed analysis of the project management plan and give overview of the life cycle plan , risk analysis ,standards followed etc.

Chapter Three: The purpose of requirement analysis is to obtain requirements and information from the stakeholders and users for developing software. This chapter contains scope, objective, functional and non functional requirements of the system

Chapter Four: This chapter discusses the detailed architecture of the software product and helps the user ascertain different aspects of the architecture involved.

Chapter Five: This chapter contains the detailed user design specifications and all the information necessary for design of this product.

Chapter Six: This chapter contains the details & images of the software GUI which helps in better understanding of the SW.

Table of Contents

Chapter I : Introduction

1.1 Purpose and Scope

This document describes the architecture as well as the system design of the "Automated IP Planning System". It is intended to convey the practical aspect of how the system will be developed.

Networking of the army's equipment at the Corps as well as the Division level has been an issue. This process takes a lot of time if done manually and is very much prone to errors. Also, the correctness of the manual process has to be checked manually which is also a very cumbersome process and is subject to the domain knowledge of the operator. Our proposed system solves that problem in an automated fashion. The operator is now only needed to input the equipment which requires the IP allocation, and our system automatically generates the IP pool and assigns the subnets to that equipment. Our system will not only reduce the time required to complete the task but it will also remove the probability of errors in the output.

1.2 Overview

After induction of IP based NG PATCOMs (Next Generation Pakistan Army Tactical Communication Equipment System) initially IP planning has received many setbacks because of lack of experience of officers/soldiers and new technology. The aim behind the creation of this software is to bridge that gap and help in easy and flexible implementation of the

communication plans of the IP based equipment. Up till now no centralized software is in use that can automate the IP planning activities.

'Automated IP Planning System' is an application designed to help troops/officers of Pakistan Army peculiar to Corps of Signals in their operational activities to be able to plan and implement the IP based communication systems in the field within a short period of emergency. In case of Escalation/Field exercise, this software will assist the communicators in groundwork efficiently. The software also strives to ease the minor matters related to allotment of IP addresses to communication equipment within the formations.

1.3 Structure of the Document

In the first section, this document presents the introduction of the system being developed. Later, in the second section this document presents the overview of the system being developed followed by the architecture of the system. The data design including the data flow is described in the "Data Design" section.

1.4 Definitions and Acronyms

This document makes use of the following system specific jargon:

Acronyms	
MVC	Model View Controller
API	Application Programming Interface
JSON	JavaScript Object Notation
NIST	National Institute of Standards & Technology
Definitions	
Corps	The highest hierarchy level of army being used in the system.
Auxiliary Corps	The secondary corps that help function the primary Corps properly.
Div	Short form of "division". A hierarchy level in a Corps.

1.5 Introduction to the Software

This new automation technology will help Pakistan Army in overcoming the time and space constraints within its planning parameters whenever there is an escalation or a war scenario. Up till now the IP allotment process has been done on manual basis which had been prone to human error and delays due to impromptu situations which will now be overcome by automating this hectic process. This new software will be built keeping in view the user requirement of a easy to learn and use software that will ease the planning parameters for our officers in the field.

1.6 Context

1.6.1 Latest Technologies in Contemporary Armies

If we follow the trends of communication setup and planning in contemporary armies of the world then we will find that the western armies and our adversary the Indian army has shifted to Next Generation (NG) communication systems from their traditional communication means. Gone are the days when communication was established using analogue systems and rugged equipment like wiring and high frequency wireless sets. Now the world has moved on to automated processing for setting up their communication systems. Reliance on manpower has been reduced significantly and reliance has been shifted to machines to do the needful tasks. Right now US army and NATO armies are using Softwares dedicatedly developed for setting up communication equipment in the field, which reduces the time constraints. Our adversary has also increased his fighting capability by incorporating Russian made equipment, which automates the equipment setup mechanism

1.6.2 Relevance of this Project

This project will help boundlessly in getting a grasp of the latest technology in communication setup of military hardware. It will also help our army in improving its planning parameters and will pay off a titanic

amount when the day of decision comes. The pace of warfare is changing and so are the paradigms of planning. New technologies mean that the pace of warfare has increased manifolds which implies that rapid means of logistics and communication will have to utilized to match the ever increasing speed of the modern military machine

1.6.3 Relation To Other Scientific Works

It is based on the baselines of softwares/hardware's being used by other militaries however the structure of our project will be based on requirements of our own military keeping in view the security and advancements in cyber technology throughout the world. Our military has its own pace of operations therefore the structure of this project will be defined by the pace of our military operations

1.6.4 Research Questions Likely to be Answered

1.6.4.1 What technologies will we use?

Ans: We will be using simple software development tools for the main structure of the software however to implement a security structure we will be using encryption technology indigenously developed by Corps of Signals for the overall security of this project.

1.7 Research Details

1.7.1 What do we want to find out

We want to implement new automation technology for our military hardware in a cost effective and easy way. Since our army has inducted new equipment in the field we want that the soldiers and officers should not lag behind in its usage therefore we have planned to find a new automated method which will help them in setting it up and using it during field exercises , escalation and war.

1.7.2 What would the results of our Research be like

The end result of this research would be in the form of a software that would automate the equipment setup process and speed up our

Army's deployment mechanisms. It would ultimately help us in striking the Achilles heel of our adversary i.e. completion of deployment along the eastern border before his deployment of forces

1.8 Research Approach and Methods

1.8.1 Answer to Research Question

Refer to Section 2 , Sub Section D , Para 1

1.8.2 Which Theoretical Framework Shall Be Applied

Knowledge from different fields such as Computer Networks, Cryptography and Information Assurance will be used in the research and development of this project. The primary research will be in the Networks field. The security dimension will be covered by the Encryption field.

1.8.3 Data Gathering

The data for development of this software will be gathered from following sources

1.8.3 .1 Verbal Interviews

a) Commander Corps Signals
b) Commanding Officers Signal Units
c) Grade One Staff Officers ex Corps Signals Headquarters
d) Communication Officers ex Division Signal Battalions
e) Communication Officers ex Corps Signal Battalions

1.8.3.2 Documentation

a) Internal Exercise Documentation
b) Field Exercise Briefs
c) Exercise Debriefs
d) General Staff Publication: Signal Tactics
e) General Staff Publication: Next Generation Pakistan Army Communication System (NG PATCOMS)

1.8.3.3 Visits

a) General Headquarters: Signals Directorate

b) Headquarters Corps Signals
c) Divisional Signal Battalion
d) Field Areas
e) Forward Assembly Areas of specific Areas of Responsibility
f) Designated Security Zones along working boundary on Western border
g) Forward Communication Nodes under New Communication Doctrine

1.8.4 Data Analysing Methods

1) Abstraction of Documentation
2) Highlighting Problem Areas
3) Earmarking the User Requirements in the field
4) Brainstorming Workshops by Developers

1.9 Problems with Development

1.9.1 Technical

Since the technology is relatively new and automation of IP allotment hasn't been previously done by corps of signals it requires a great deal of initiative and intuitive decision making by the developers despite the risk of resource wastage in the form of developing the project in the wrong direction

1.9.2 Financial

Keeping in view the budget constraints of our military and the country it will be problematic for the developing team to maintain their pace of development on face of the lack of funds. New technologies and learning new content requires authorized sources from whom miscellaneous techniques will be learnt and then utilized in this project.

1.10 Preliminary Schedule

Date	Title	Remarks
31 Nov 2019 – 04 Jan 2020	Data Gathering, Visits	
05 Jan 2020 – 21 Mar 2020	Tutorials and Techniques	
20 Mar 2020 – 14 Apr 2020	Development of Baseline	
15 Apr 2020 – 11 May 2020	Development of Structure and Prototype	
12 May 2020 0 – 4 June 2020	Testing in the field	
5 Jun 2020 – User Feedback	Launch of Product	User feedback will be awaited to revise the initial version

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Chapter II : Project Management Plan

1.11 Project Organization

After collecting all the requirements, the project was divided into smaller components. Then those components were identified which could be worked on in parallel. Those smaller components were distributed among the team members.

1.12 Lifecycle Model Used

Incremental model was used. System's base with the bare minimum functionality was provided in the first increment. Later on next increments support for Report generation, import export of reports, Encryption and Decryption of reports were introduced in later increments.

1.13 Risk Analysis

Type of Risk	Impact	Probability of Occurrence	Significance (Impact*Probability)	Risk Level
Financial	20	0.1	2	Low
Technical	100	0.5	50	High
Design	60	0.2	20	Medium
Safety	0	0.0	0	Low
Legal & Regulatory	0	0.0	0	Low

Based on the data in the table above, the only significant risks worth considering are technical and design risks. The technical risks involve the correctness of the system and the technical skills required to maintain the project. Whereas, the design risks correspond to the capability of the system to support new equipment types of military and flexibility in design to run it on a newer level other than Corps/Division.

Note: The values of Impact and Probability of Occurrence are purely based on the estimate of main stakeholders of the system (Military personnel who understand the requirements of the system and the developers).

1.14 Hardware and Software Resource Requirements

Any Intel Pentium IV and above for hardware will be able to run the system.
For software, the system hosting the IP allocation tool must be running on Windows XP, Windows 7,8 or above.
The system can also be run on any Debian based Linux distribution.

1.15 Monitoring, Reporting and Controlling Mechanisms

Overall for project management, task tracking, issue tracking and reporting an opensource tool

Trello was used.

1.16 Professional Standards

Industry standard architecture and coding practices were followed. An MVC architecture was followed for the decoupling of front and backend services and their communication was done using REST APIs. Static code reviews were also done by peers.

For the cryptography module, industry standard and NIST recommended algorithm AES-256 was used.

1.17 Impact of Project on Individuals and Organizations

Military relocates place to place very frequently based on their need and training exercises. This project directly affects the efficiency of the military as it automates a manual, cumbersome and time intensive task of manual IP allocation to its equipment. This project will save a lot of time in allocation of IPs on the network to the equipment and it will be less prone to errors.

Chapter III : Requirement Specifications

Introduction

1.18 Purpose

The purpose of this project is to ease the use of IP allotment in the field army. Up till now IP planning is not done centrally and there is no set rules or mechanisms that are being followed. Implementation of this software will help in reducing the complexities and increasing the time and space mechanics for planning purpose of field army. The software's primary task is to provide a user friendly and efficient environment for the troops who are shy of technology.

1.19 Document Conventions

This section describes the standards followed while writing this document.

1.19.1 Headings

Headings are prioritized in a numbered fashion, the highest priority heading having a single digit and subsequent headings having more numbers, per their level.

1.2.2 Annexures

All reference letters are attached as Annexures for better understanding of the reader

1.20 Intended Audience and Reading Suggestions

1.3.1 Intended Audience

Intended Audience of this SRS includes:

- **Project supervisor**:

It will help the supervisor to supervise the project and guide the team in a better way. This document will be used by him to check whether all the requirements have been

understood and in the end whether the requirements have been properly implemented or not.

- **UG Project Evaluation team:**

It will help the evaluation team to evaluate the progress of FYP project. The document will provide the evaluators with the scope, requirements and details of the project to be built. It will also be used as basis for the evaluation of the implementation and final project.

1.3.2 Reading suggestions:

The SRS begins with the title and table of contents. All level 1, level 2 and level 3 headings are given in table of content but the lower sub headings are not included.. The entire interfaces are also described. The SRS ends with annexures.

1.21 Product Scope

'Automated IP Planning System' is an application designed to help troops/officers of Pakistan Army peculiar to Corps of Signals in their operational activities to be able to plan and implement the IP based communication systems in the field within a short period of emergency. In case of Escalation/Field exercise, this software will assist the communicators in groundwork efficiently. The software also strives to ease the minor matters related to allotment of IP addresses to communication equipment within the formations.

1.22 Extended Scope

- Develop a GUI that is easy to use
- Remove the complexities in IP planning
- To acquaint the troops with latest trends in NG PATCOM planning phase

Overall Description

1.23 Product Perspective

After induction of IP based NG PATCOMs(Next Generation Pakistan Army Tactical Communication Equipment System) initially IP planning has received many setbacks because of lack of experience of officers/soldiers and new technology. The aim behind the creation of this software is to bridge that gap and help in easy and flexible implementation of the communication plans of the IP based equipment. Up till now no centralized software is in use that can automate the IP planning activities.

1.24 Product Functions

The main features of '*Automated IP Planning System'* are highlighted below:

- A main page for login
- Hierarchical level of IP planning
- Efficient Processing
- Reliable Usage
- User friendly GUI
- Printing Facility
- File Import
- File Export
- User Security i.e. Login Authentication
- Data Security i.e. Encryption

1.25 User Classes and Characteristics

The following section describes the types of users of the application. There are explanations of the user followed by the interactions the user(s) shall be able to make with the software.

2.3.1 Headquarters Signals (Corps Communication Officers)

They will be responsible for allotment of IP during field exercises and escalation

2.3.2 Division Communication Officers

They will be responsible for allotment of IPs during routine training activities and Individual training Cycles.

1.26 Operating Environment

The product shall be operating in a Microsoft Windows environment. It shall be compatible with Windows XP and above.

2.4.1 Hardware

'Automated IP Planning System' operates, either directly or indirectly, with the following external hardware:

- Pentium IV and above.
- Keyboard
- Printer
- Mouse.

2.4.2 Software

- Python / C#
- Java

1.27 Design and Implementation Constraints

It will keep on working as long as the windows/application does not get corrupted or there is no power loss.

1.28 User Documentation

A user manual will be provided to the users in which separate instructions will be given according It will include the details of the software working. The project report will also be available for the users which will highlight the software's features,

working and procedures. Using this user documentation the new users will be able to easily get themselves acquainted with the new software.

1.29 Assumptions and Dependencies

- User knows the basic skills to operate a computer system
- The customer knows the language (English) used in the user interface to perform actions.
- User should have a basic know how of Pakistan Army's ORBAT(Order of Battle)

External Interface Requirements

1.30 User Interfaces

- Main menu for access will be used.
- Interface will be user friendly and the standard English-US will be used
- Menu Bar will be displayed at the top of the software window.

1.31 Hardware Interfaces

- A working monitor
- A Mouse
- A Keyboard
- Minimum 2 Gb RAM

System Features

This section describes in detail the system features of the 'Automated IP Planning System'.

1.32 Use Cases

1.32.1

ID:	**1**
Title:	Login
Description:	User will be prompted to login his authorized credentials
Primary Actor:	Authorized Communication Officer
Preconditions:	The Software is started
Postconditions:	The user is given access to the main menu
Main Success Scenario:	1. The user will enter his details 2. He will be given access to the main menu
Extensions:	**Error** **1.** The software will deny access **2.** User will be asked to enter his details again **Exception** **1.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Always
Status:	N/A
Priority:	High

1.32.2

ID:	**2**
Title:	New Project
Description:	User clicks the New Project Button on the main menu

Primary Actor:	Authorized Communication Officer
Preconditions:	The Software is started and login is successful
Postconditions:	The user is given access to the requirement selection menu
Main Success Scenario:	1. After login the user selects New Project Option 2. User will be given access to the requirement selection page 3. User will fill the requirements form 4. User will input the IP block 5. Software will generate a table based on the requirements and IP block
Extensions:	**Error** **1.** The user inputs wrong data **2.** IP block generated by software is not correct based on wrong data entry **Exception** **1.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Mostly
Status:	N/A
Priority:	Medium

1.32.3

ID:	**3**
Title:	Import Project
Description:	User clicks the Import Project Button on the main menu
Primary Actor:	Authorized Communication Officer

Preconditions:	The Software is started and login is successful
Post conditions:	The user is given access to the browser tab from where he will select the file to be imported
Main Success Scenario:	1. After login the user selects Import Project Option 2. User will be given access to the browser tab 3. User will select the file to be imported 4. The user will input the key to decrypt the file 5. Software will open the imported file
Extensions:	**Error** **1.** The user inputs wrong key **2.** The user selects wrong file to open **Exception** **1.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Mostly
Status:	N/A
Priority:	Medium

1.32.4

ID:	**4**
Title:	Change Password
Description:	User clicks the Change Password on the main menu
Primary Actor:	Authorized Communication Officer
Preconditions:	The Software is started and login is successful
Post conditions:	The user is given access to the change password tab where he can change the existing password of the software

Main Success Scenario:	1. The user selects the change password tab from main menu 2. User inputs the current password 3. User is prompted to enter the new password
Extensions:	**Error** **1.** The user inputs wrong current password **Exception** **1.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Mostly
Status:	N/A
Priority:	Medium

1.32.5

ID:	**5**
Title:	Export
Description:	User clicks the Export Button on the generated table page (**From ID 2**)
Primary Actor:	Authorized Communication Officer
Preconditions:	User has inputted the correct required data and IP block after which he will select this option
Post conditions:	User will be able to save the file after encrypting with key
Main Success Scenario:	1. The user will enter the key for encryption 2. User will be prompted to select save location from browser tab 3. User will save the file
Extensions:	**Error** **1.** Key inputted by user does not fulfill the requirements

	Exception **1.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Mostly
Status:	N/A
Priority:	Medium

1.32.6

ID:	**6**
Title:	Print
Description:	User clicks the Print Button on the generated table page (**From ID 2**)
Primary Actor:	Authorized Communication Officer
Preconditions:	User has inputted the correct required data and IP block after which he will select this option
Post conditions:	User will be able to print the file
Main Success Scenario:	1. The user will select the print option after successful generation of tables
Extensions:	**Error** **1.** Printer is not connected properly **2.** Printer is faulty **Exception** **2.** Error in Operating System , the software will hang up/ close
Frequency of Use:	Mostly
Status:	N/A

Priority:	Medium

1.33.1 Description and priority

After starting the application the user will be prompted to enter his login information. Once the main menu is accessible the user will be able to select between Corps/Division level of planning. After that user will enter the primary details required to process the IP automation i.e. number of brigades in case of a division communication officer , total number of IPs required etc.

1.33.2 Stimulus/Response Sequence

1. Open the application.

2. Access the main menu.

1.33.3Functional requirements

REQ-1: Application shall be properly installed on the operating system

REQ-2: The different options available shall be

- Import/ Export Options
- Print Option
- Login Option
- Exit

REQ-3: At any time user shall be able to exit the application when required.

Other Nonfunctional Requirements

1.34 Security Requirements

Application running on the operating system shall not need any additional or personal information except the security credentials. There are no connections to other devices or severs so no data will be sent or received or used in any way. All types of network security will be ensured by keeping the device off the internet.

Security is one of the most vital requirements of military data another feature of this system is the provision of data security in the form of encryption which shall

be performed when the user saves the file. This encryption will ensure a state of the art safety and security of the data.

1.35 Performance Requirement

Like other militaries our army is using windows XP in majority of its operating systems. Therefore due to performance constraints it is the need of the hour that a high end performing software is developed. The application's response should be fast and rapid, so that user shall not wait for a long time(not more than 15 seconds) before proceeding to next step or test. Incase application crashes it shall recover in less than 1 minute after restarting the application. The aim of this improvement in performance is to ensure a smooth and easy experience for the users.

Software Quality Attributes

Usability

1. The graphical user interface of application is to be designed with usability as the first priority. The application will be presented and organized in a manner that is both visually appealing and easy for the user to navigate keeping in view the reluctance of relatively new users.

Reliability

2. Application shall provide reliability to the user. The product will run stably with all the features mentioned above available and executing perfectly. It shall be tested and debugged completely. All exceptions shall be well handled.

Efficiency

3. Time and Space is the most important constraint of military planning. Apropos to the above mentioned problem this software will help in relieving the troops in field of the hectic and time tolling process of communication

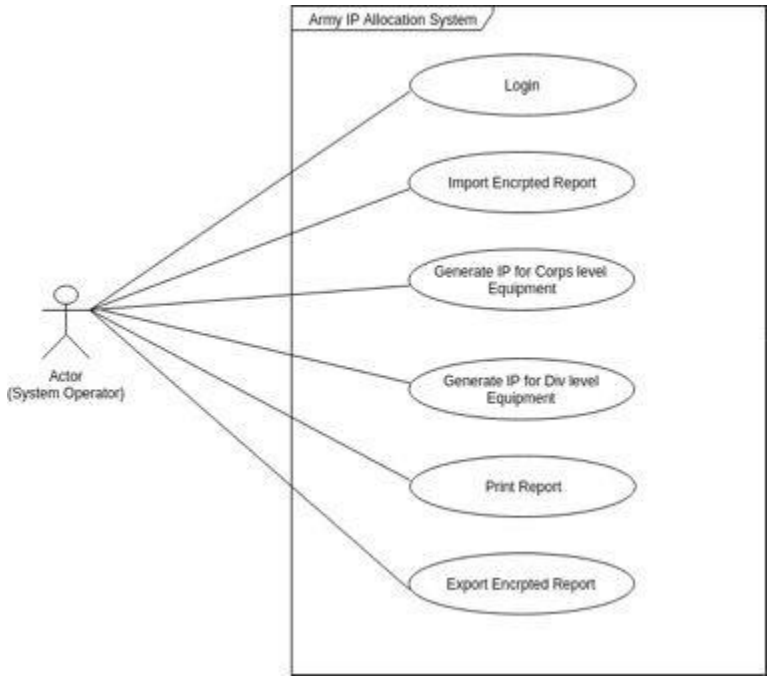
planning which will not only give us an edge in planning but also help in countering Foxland's offensive schemes.

1.33 Stakeholders of the System

The stakeholders of the system are given below:

- Project Developers
- Project operators (Military personnel)
- Corps level network engineers
- Division level network engineers

1.34 Graphical Use Case Model



1.35 Textual Representation of Each Use Case

- **Login Use Case:** Providing the capability to the user to login to the system using his/her username and password. The credentials must be stored in an unreadable form.
- **Import Encrypted Report:** User should be able to import a previously exported report into the system. User will need to provide a unique password which was used to encrypt the report at the time of its generation.
- **Generate IPs for Corps Level Equipment:** User should be able to select the Corps level and enter the Corps' equipment requirements and system will generate its corresponding network/IP pools.
- **Generate IPs for Division Level Equipment:** User should be able to select the Division level and enter the Division's equipment requirements and system will generate its corresponding network/IP pools.
- **Print Report:** The generated report should be printable directly by the system.
- **Export Encrypted Report:** Generated report should also be exportable using a password provided by the user.

1.36 Rationale for Use Case Model

Defining a use case model for the system ensured between the system stakeholders that no requirements were missed during the implementation of the system and all the interactions defined in the use case model are completed and can be verified upon delivery/productionization of the system.

1.37 Non-Functional Requirements

The primary non functional requirements of the system are given below:

Security Requirements:

- The most important aspect of the system is security as it will be deployed in a sensitive organization. Therefore, all the credentials of the system should be stored in a non-readable form.
- Hash of password should be stored instead of actual password to ensure credentials are not lost even if the credentials file which contains the hash of the password is lost.
- The system generated report should be exportable in an encrypted format.
- The password used for the encryption of the report should not be stored anywhere in the system.
- User should be able to provide a unique password for every report.
- The encryption algorithm used must be industry standard or NIST recommended.

Design Constraints:

- Since most of the military systems are running on Windows platform, therefore, the system should be able to run on Windows XP, Windows 7, Windows 8 and above.
- System should be developed using Python using concepts of Object-Oriented programming.

Usability:

- System should be easy to use.
- The training time of a new user for complete functionality of the system should not exceed more than 10 minutes.

Chapter IV : Architecture

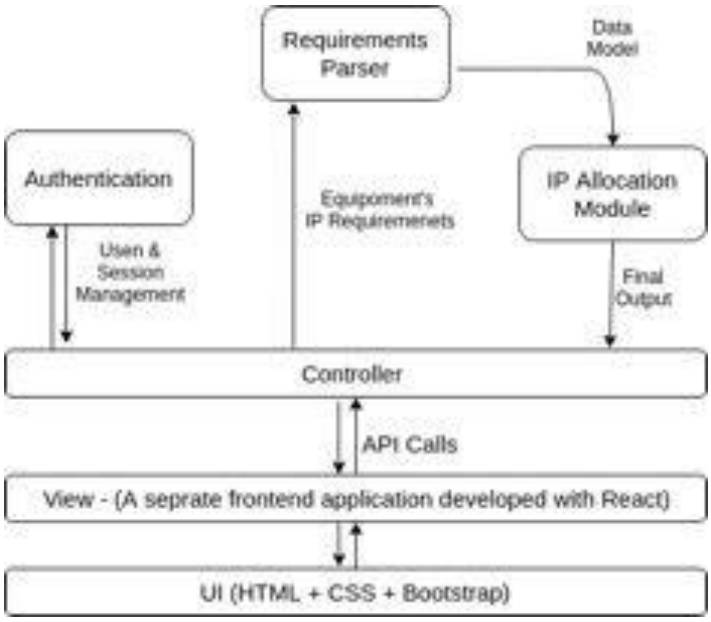
1.38 Architecture Style

The system is developed using the MVC framework and includes the following modules:

- **Authentication:** The user registration, password management and maintaining the session of the logged in user is done within this module.
- **View:** This module is responsible for the propagation of equipment IP requirements data between the UI and the Controller.
- **Controller:** The controller receives the equipment and its IP requirements data from View, passes it on to the Requirements Parser. It is also responsible for returning the result to the View after the requirements have been processed by the IP Allocation Module.
- **Requirements Parser:** This module is responsible for parsing the requirements received from the View into our data model.
- **IP Allocation Module:** The core functionality for the IP pool generation and subnet allocation to the equipment resides in this subsystem. It receives the data model object from the Requirement Parser, generates the output model and passes it on to the Controller.
- **CryptoModule:** This module will handle all the cryptography operations of the system. Let it be generation of the hash of passwords for matching with the existing password hash stored on the system, exporting an encrypted results file or decryption of an existing or previously encrypted generated file.

1.39 Architecture Model

The following architecture diagram expresses the high level overview of the system:



1.40 Technology, Hardware and Software Used

Tools and technology used during the development of the system is given below:

- Python 2.7.11
- Jinja Templates
- React (Facebook's Open Source Framework for Frontend Development)
- HTML, CSS, Javascript
- JetBrains PyCharm IDE
- System was developed on Ubuntu 18.04 OS

1.41 Rationale for Architectural Model

The MVC (Model-View-Controller) architecture was preferred for the development of the system as it brings a very modular approach to the system. Every subsystem is very distinct and the separation of duties for each subsystem becomes loud and clear. Here, the View is responsible for data exchange between UI and controller using APIs. The controller passes

those requirements to the Requirements Parser to generate the data models, and those data models are passed down to the IP Allocation module for the actual processing.This architecture model also allowed us to map the equipment's IP requirements into the JSON data models which were transferred between frontend and backend to services using RESTful APIs.

Chapter V : Design

INTRODUCTION

1.1 Purpose

This section describes the architecture as well as the system design of the "Automated IP Planning System". It is intended to convey the practical aspect of how the system will be developed.

1.2 Scope

Networking of the army's equipment at the Corps as well as the Div level has been an issue. This process takes a lot of time if done manually and is very much prone to errors. Also, the correctness of the manual process has to be checked manually which is also a very cumbersome process and is subject to the domain knowledge of the operator. Our proposed system solves that problem in an automated fashion. The operator is now only needed to input the equipment which requires the IP allocation, and our system automatically generates the IP pool and assigns the subnets to that equipment. Our system will not only reduce the time required to complete the task but it will also remove the probability of errors in the output.

1.3 Overview

In the first section, this document presents the introduction of the system being developed. Later, in the second section this document presents the overview of the system being developed followed by the architecture of the system. The data design including the data flow is described in the "Data Design" section.

1.4 Reference Material

1.5 Definitions and Acronyms

This document makes use of the following system specific jargon:

Acronyms	
MVC	Model View Controller
API	Application Programming Interface
JSON	JavaScript Object Notation
Definitions	
Corps	The highest hierarchy level of army being used in the system.
Auxiliary Corps	Corps Elements that help function the Corps HQ properly.
Div	Short form of “division”. A hierarchy level in a Corps.

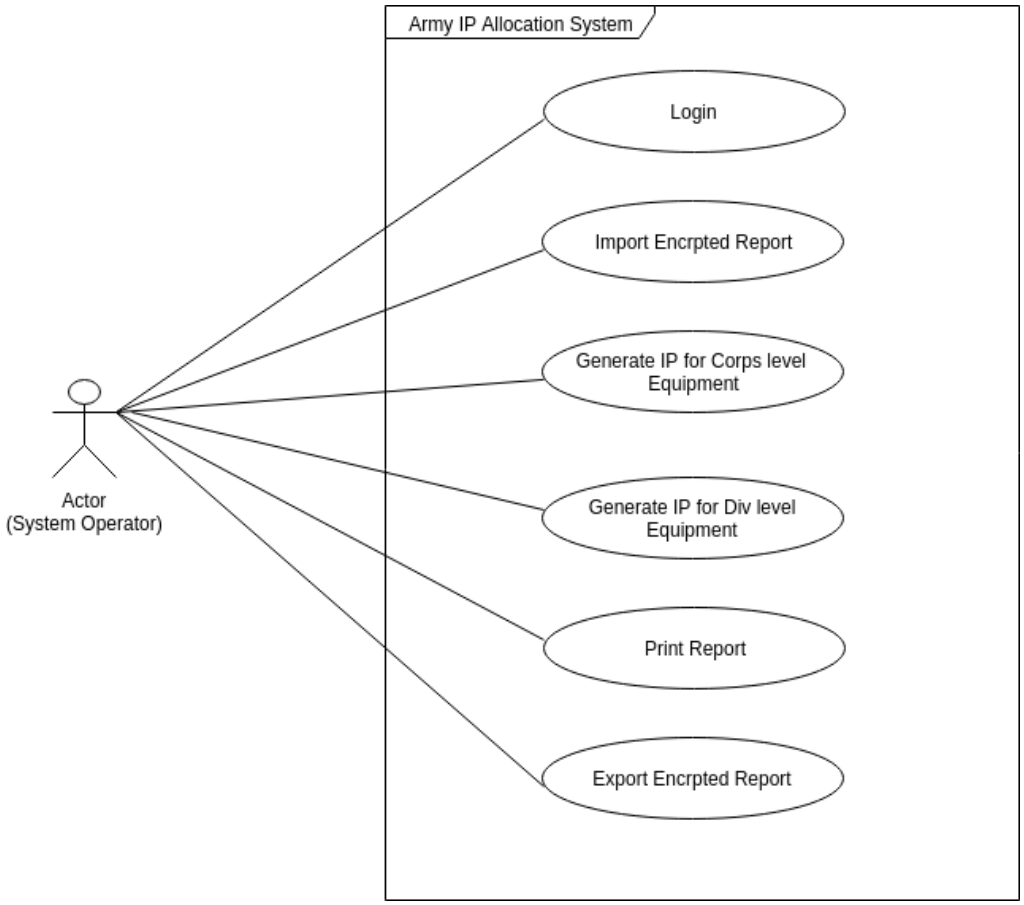
SYSTEM OVERVIEW

After induction of IP based NG PATCOMs(Next Generation Pakistan Army Tactical Communication Equipment System) initially IP planning has received many setbacks because of lack of experience of officers/soldiers and new technology. The aim behind the creation of this software is to bridge that gap and help in easy and flexible implementation of the communication plans of the IP based equipment. Up till now no centralized software is in use that can automate the IP planning activities.

‘Automated IP Planning System’ is an application designed to help troops/officers of Pakistan Army peculiar to Corps of Signals in their operational activities to be able to plan and implement the IP based communication systems in the field within a short period of emergency. In case of Escalation/Field exercise, this software will assist the communicators in groundwork efficiently. The software also strives to ease the minor matters related to allotment of IP addresses to communication equipment within the formations.

The overview of the system is depicted by the following use-case diagram:

SYSTEM ARCHITECTURE



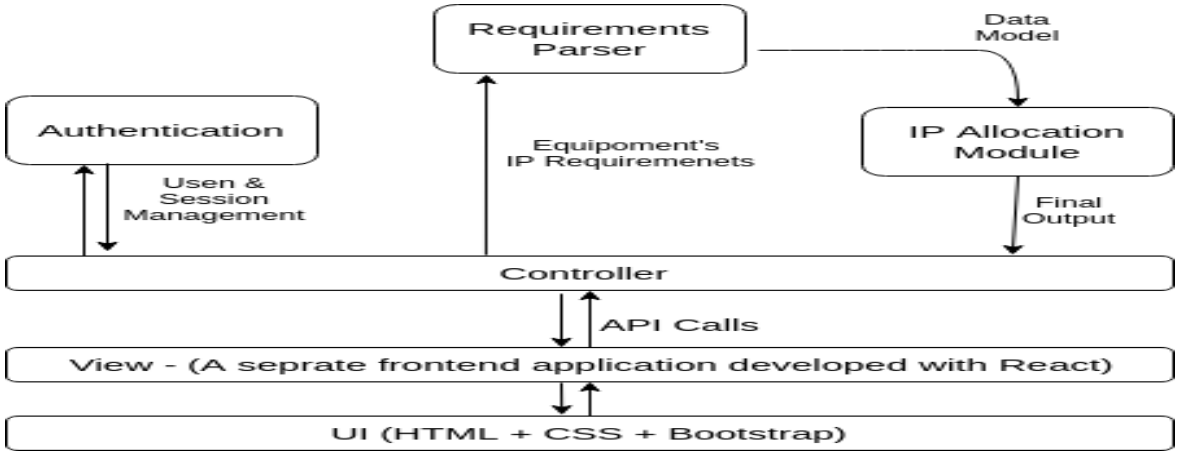
1.6 Architectural Design

The system is developed using the MVC framework and includes the following modules:

- **Authentication:** The user registration, password management and maintaining the session of the logged in user is done within this module.
- **View:** This module is responsible for the propagation of equipment IP requirements data between the UI and the Controller.
- **Controller:** The controller receives the equipment and its IP requirements data from View, passes it on to the Requirements Parser. It is also responsible for returning the result to the View after the requirements have been processed by the IP Allocation Module.

- **Requirements Parser:** This module is responsible for parsing the requirements received from the View into our data model.
- **IP Allocation Module:** The core functionality for the IP pool generation and subnet allocation to the equipment resides in this subsystem. It receives the data model object from the Requirement Parser, generates the output model and passes it on to the Controller.
- **CryptoModule:** This module will handle all the cryptography operations of the system. Let it be generation of the hash of passwords for matching with the existing password hash stored on the system, exporting an encrypted results file or decryption of an existing or previously encrypted generated file.

The following architecture diagram expresses the high level overview of the system:



Design Rationale

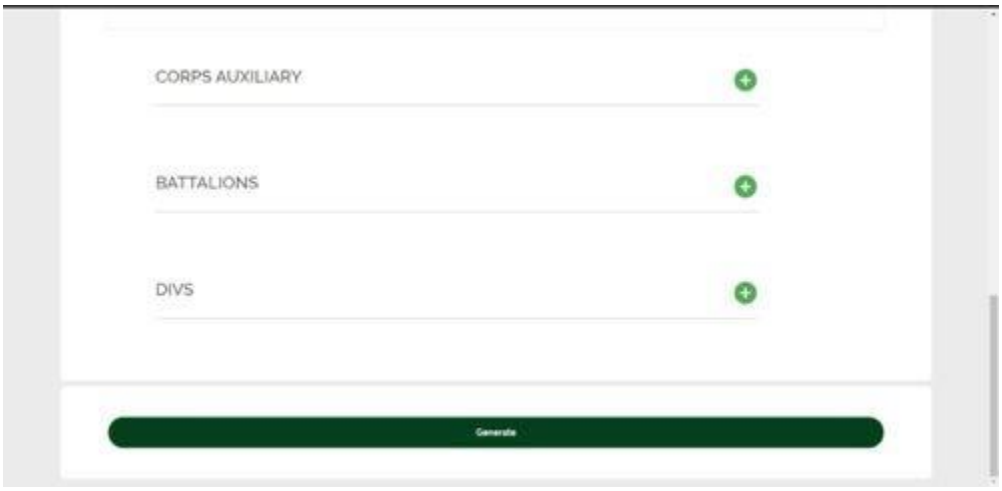
The MVC (Model-View-Controller) architecture was preferred for the development of the system as it brings very modular approach to the system. Every subsystem is very distinct and the separation of duties for each subsystem becomes loud and clear. Here, the View is responsible for data exchange between UI and controller using APIs. The controller passes those requirements to the Requirements Parser to generate the data models, and those data models are passed down to the IP Allocation module for the actually processing.

1.42 GUI (Graphical User Interface) Design

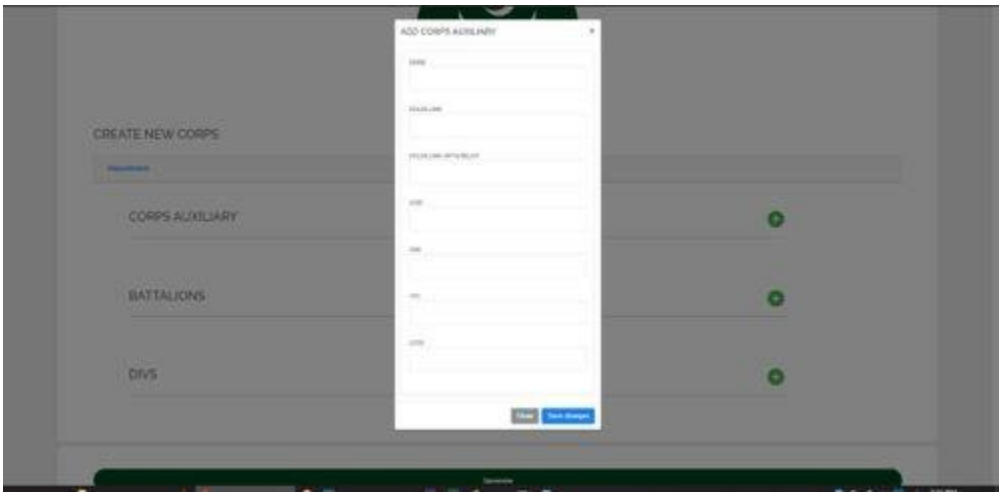
User login page:

Adding a Corps level equipment

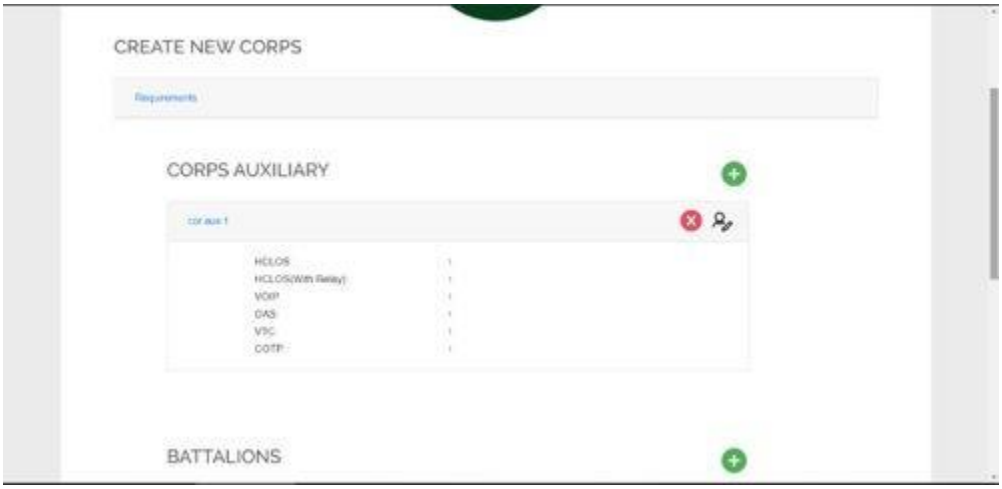
Another view to add the equipment requirements.



Adding auxiliary corps.



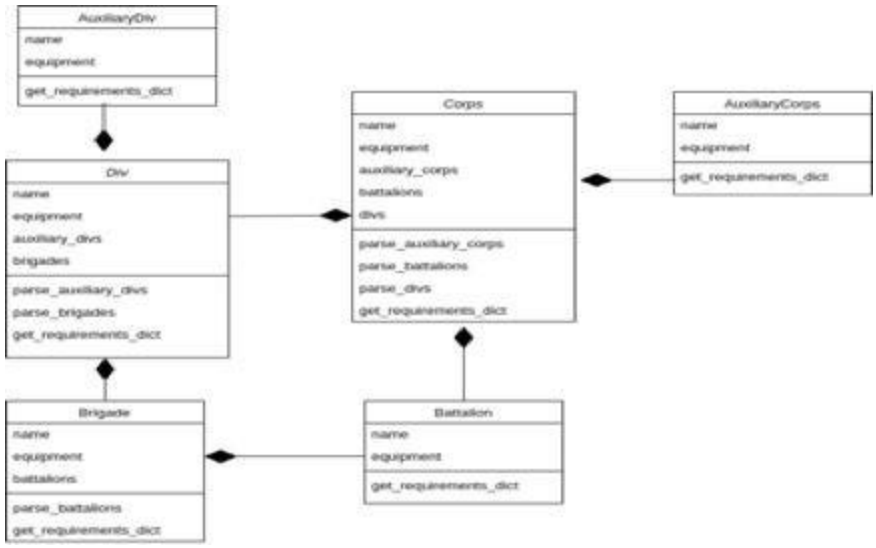
Another view of added Corps auxiliary.



A View of the Final Output Diagram

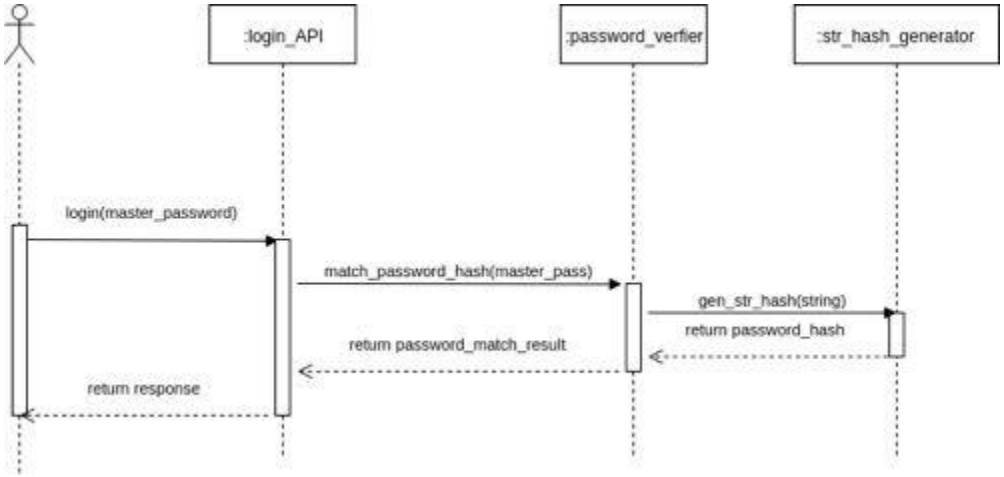
1.43 Static Model (Class Diagrams)

The Requirement Parser module parses the above JSON object to populate the following OOP design:

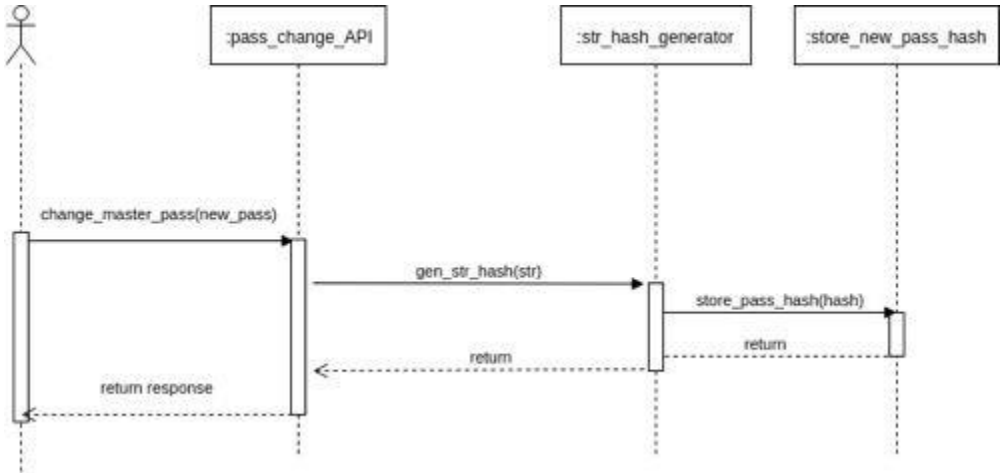


1.44 Dynamic Model (Sequence Diagrams)

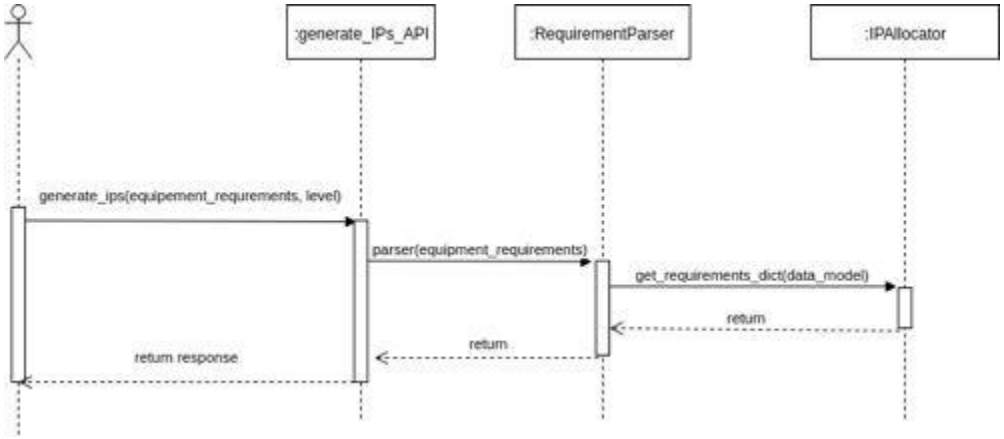
User login sequence diagram:



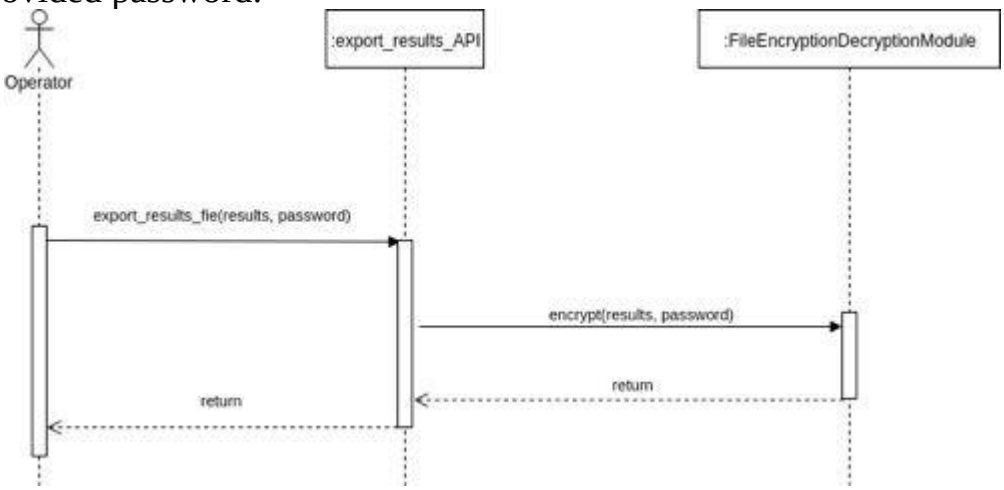
Sequence diagram for changing or system's master password:



Sequence diagram for generation of Corps level IPs. The similar sequence of instructions will be used to generate the Div level requirements.



Sequence diagram for exporting of results in an encrypted file using the provided password.



Chapter VI : Test Plan

1.45 Requirements/specifications-based system level test cases

Test Case ID	tc00001
Name	Login
Description	User login on the main page
Test Inputs	User credentials (Username + Password)
Outputs	User will be logged in. Main page will be displayed.

Test Case ID	tc00002
Name	Generate Corps Level IPs
Description	User will generate corps level IPs and generate a report
Test Inputs	Equipment details of the Corps Level. Seed network /16 CIDR Password to Encrypt the Report
Outputs	Report will be generated successfully and displayed to the user.

Test Case ID	tc00003

Name	Generate Division Level IPs
Description	User will generate Division level IPs and generate a report
Test Inputs	Equipment details of the Division Level. Seed network /16 CIDR Password to Encrypt the Report
Outputs	Report will be generated successfully and displayed to the user.

Test Case ID	tc00004
Name	Printing Report
Description	User will print Corps/Division level report
Test Inputs	User clicks on “Print Report” button on the report
Outputs	Report will be printed in a tabular form.

Test Case ID	tc00005
Name	Change Password
Description	User will print Corps/Division level report
Test Inputs	New password
Outputs	Password hash is updated in the credentials file and “password updated successfully” message is displayed to the user.