SERVICE ORIENTED QOS BASED MAPPING OF TELECOM SERVICE PROVIDER IN PAKISTAN

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Submitted to Faculty of Department of Computer Software Engineering National University of Sciences and Technology, Islamabad in partial fulfillment for the requirements of a B.E Degree in Computer Software Engineering, June 2018

In the name of Allah, the Most Beneficent, the Most Merciful

ABSTRACT

SERVICED ORIENTED QOS BASED MAPPING OF TELECOM SERVICE PROVIDER IN PAKISTAN

QoS parameters for the telecom industry are outlined by PTA. These parameters act as a guide line to maintain their quality of service by the telecommunication operators. In the annual report released by PTA it was mentioned that only few of the Telecom operator are able to achieve these QoS parameters. Validity of the performance parameters that are provided need to be investigated, as there is no third party verification of QoS parameters. Telemap aims to provide a third party verification tools for some of the QoS parameters. Telemap is a software tool that is used to calculate Received Signal Strength (RSSI) across different geographical areas across the Pakistan. The telecommunication providers that are included are Ufone, Telenor, Zong, Mobilink and Warid. RSSI is plotted on server side by using Different maps and charts. RSSI is presented on maps as point data form and also using Heat maps by the help of different color schemes apart data can be visualized using graphs and charts.

CERTIFICATE FOR CORRECTNESS AND APPROVAL

It is certified that work contained in the thesis – Serviced Oriented QoS Based Mapping of Telecom Service Provider in Pakistan, carried out by Maj Musharraf, Capt Arslan, Capt Khurram, Capt Zahid under supervision of Lec Ayesha Naseer for partial fulfillment of Degree of Bachelor of Software Engineering is correct and approved.

Approved By

Lec Ayesha Naseer

Department of CSE, MCS

DECLARATION

We are hereby declaring that this application neither as whole nor as a part has been copied out from any source. It is further declared that we have developed this application and accompanied report entirely on the basis of our personal efforts, under the sincere guidance of our supervisor and teachers. If any part of this system is proved to be copied out from any source or found to be reproduction of someone else, we shall stand by the consequences.

DEDICATION

To our Parents, who have never failed to give us financial and moral support for giving all our needs during the time we developed our system. To our supervisor, Lec Ayesha Naseer who has given us great support and valuable suggestions throughout the implementation process and finally to our respected teachers who supported us all the way.

ACKNOWLEDGMENT

Foremost, we would like to thank Allah Almighty who gave us opportunity to perform this task. It only became possible due to His benevolence and blessed capabilities.

First of all we would thank Lec Ayesha Naseer who gave us this idea, motivated us and provided preliminary guidelines to work on this project. We would like to express our sincere gratitude to our supervisor for continuous support of our studies and project work, for her patience, motivation, enthusiasm and immense knowledge. Her guidance helped us in all the time of research and writing thesis. Without her we could not imagine having a better advisor and mentor for our project. During the course of work she never refused to help us.

We have no words to describe our kind sensations and respect to our family. It is by virtue of their affection and continuous support with prayers enabled us to attain the target. Last but not the least we would like to thank our friends for supporting us spiritually throughout our bachelor degree.

PREFACE

This thesis will present the detail study, design and implementation and testing of the project "QOS for telecommunication providers of Pakistan". To easily understand the scenario we have divided it into seven Chapters.

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

Chapter two: 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 Three: This chapter contains the detailed design of the application of the system and the objects in the system. The development techniques and interfaces of our system are discussed in this chapter.

Chapter Four: This chapter discusses the system development like the information about the hardware and software and tools which used for the development of the system.

Chapter Five: This chapter discusses software requirement specifications in which each module describes its functionality, behavior, performance and quality by unit testing. It is concerned with the environment and deployment settings and contains all the information regarding the services that this system will provide.

Chapter Six: This chapter discusses results and evaluations on the data and the detail information about how the prediction reports will be generated.

Chapter Seven: This chapter contains the user manual which has all the information about how to install and how to use the software.

TABLE OF CONTENTS

LIST OF FIGURE

LIST OF TABLES

CHAPTER # 1
INTRODUCTION

1.1 Introduction

The main theme of this project is to monitor the QoS parameters of all the telecommunication providers i.e. Ufone, Mobilink, Telenor, Zong and Warid.

Signal strength, Location and time are the main parameters which are added to the scope of this project, measure across the maximum achievable characteristics using android mobile phone.

The calculated data will be transmitted to the GIS based server application which will plot the Signal strength of different service providers by using statistical and graphical locations. On the server side, GIS based mapping, application will receive the data and present it in different analysis modes.

1.2 Background of the system

Our project is related to the development of an android based application for QOS for telecommunication providers of Pakistan. Signal strength is the main parameter which is added to the scope of this project, measure across the maximum achievable geography. Signal strength will be calculated/ observed on the mobile app, will be transmitted to the GIS based server application which will plot the network coverage by using statistical and graphical locations. On the server side, GIS based mapping, application will receive the data and present it in different analysis modes

1.3 Objectives of the system

The objective of project is to monitor the telecommunication service providers across Pakistan i.e. Ufone, Mobilink, Telenor, Zong and Warid. In this project we will extract signal strength, location, time etc. of Telecommunication service providers across Pakistan. More over the data collection of the current as well as new version will be extended to 1000 records minimum. It also tells about types of services i.e. 2 G, 3G, and 4G and tells distance from the BTS tower to the client mobile phone.

1.4 Significance of the System

The significance of our APP is that we can check signal strength of any types of cellular company's network anywhere and anytime. If a user wishes to check his/her signal strength within their area this application is more convenient. Our application shows the users that which network has the strongest signal strength within their area.

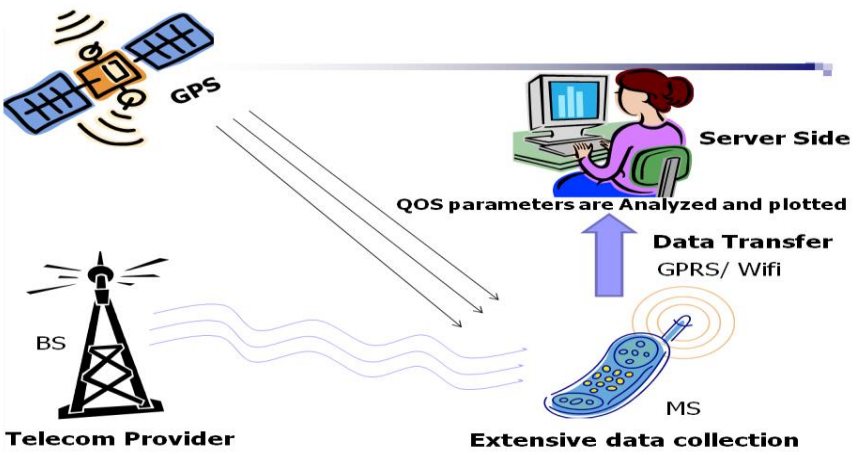

Figure 1.1 overview of the system

The above figure shows that how client side (mobile app) communicate and send its respective data to the server side (Website).This process is described as under

a. Mobile app get the user location by using GPS (Global Positioning System).

b. Mobile App get Signal Strength and other measurements from BTS tower through which it is connected.

c. After getting all the important measurements the respective data is sent over webserver where present it in different on the server side, GIS based mapping, Web server will receive the data and present it in different analysis modes analysis modes. On the server side, GIS based mapping, application will receive the data and present it in different analysis modes.

CHAPTER # 2
LITERATURE REVIEW

2.1 Introduction

The main theme of this project is to monitor the QoS parameters of all the telecommunication providers i.e. Ufone, Mobilink, Telenor, Zong and Warid.

Signal strength, Location and time are the main parameters which is added to the scope of this project, measure across the maximum achievable characteristics using android mobile phone.

The calculated data will be transmitted to the GIS based server application which will plot the Signal strength of different service providers by using statistical and graphical locations. On the server side, GIS based mapping, application will receive the data and present it in different analysis modes

2.2 Scope

First we developed a mobile application that is useful for checking the quality of services in different cellular networks of Pakistan. This mobile application is developed in java. This application is used to extract Signal strength, location and time.

This application finds the location using GPS to get location of client mobile phone. This application tells us how device is near or far from the BTS tower. It also keeps the record IMEI number (unique number for mobile set) and data is sent on web by using GPRS/Wi-Fi

2.3 Definitions, Acronyms and Abbreviations

QoS	Quality of service
RSSI	Received signal strength
GPS	Geographical Positioning system
GPRS	Generalized packet radio service
GIS	Geographical information system
SDK	A software development kit that enables developers to create applications for the Android platform.

BS	Base station

2.4 Overall Description

2.4.1 Product Perspective

This product can be useful in following perspective:

a. Analyze and interpret parameters according to the PTA.

b. This project can be used in different aspects for example if any user is interested in buying any cellular network i.e. Ufone Mobilink Warid Zong and Telenor. This can be helpful for them. It also important for anyone who wants information regarding any cellular company performances i.e. their signal strength etc.

c. We can provide this tool to different cellular companies where they can check their performance.

d. It can helpful regarding complaints issues for cellular companies.

2.4.2 Functionalities

Followings are the Functional Requirements:

Android application:

a. First we will develop an android application that will extract the Signal Strength of different cellular networks.

b. Signal Strength of the service provider is recorded against the current location and time.

c. After taking all the important readings from the android based application, the whole data is sent over web through GPRS/Wi-Fi.

d. In case of no connectivity, all the record set is logged on the smart device for defined period / memory consideration and transmitted over the web as soon as the connection is made available.

Web Server:

a. Mapping for the signal strength against the mobile location.

b. Extensive reporting based on user profile, service provider, service type.

c. Mapping of 2G & 3G services over the GIS based maps.

d. Classification of service providers i.e. Zong , Mobilink , Telenor etc. against the service over the GIS maps

e. Heat map and geo tagging over the web server

Non Functional Requirements:

a. Mobile App should support Android As an operating System.
b. GPS will always be ON to get location's latitude & longitude.
c. App must be able to get data after every 2 hours.

2.4.3 Users and Characteristics

The General users of this Application can be subdivided into two types:
1. Administrator.
2. General Users

Generally the user is administrator of Telemap and he is the general user also. Administrator can manage the data for general users.
The General Users comprise of normal users.

2.4.4 Operating Environment

This is real world app based on client and a server. Clients are the users that use the app that is developed and server is responsible for interpreting and analysing the results and to generate results at the end on the performance based.
The software's, OS and languages used are mentioned below

Software: Java/titanium
OS: Android
Languages: PHP, java
Android based cell.

2.4.5 Design and Implementation Constraints

2.4.5.1 Aim:

The main aim of this project is to calculate:

1. Signal strength.
2. Call quality.

In this project there are three main phases making a mobile app that is used for data collections that is developed using java language.

Developing Mobile App:

The first and important module in this project is android based mobile app which is developed using java on Eclipse (Android Developer tool) platform.

Interface:

There will be an interface on which signal strength is transmitted. Interface may include:

1. Service operator.
2. Signal strength (in dBm).
3. User's location.
4. Other cell Information like IMEI, Cell id, etc.

Operation and Features:

1. This app is installed on the cell phones of users.
2. Can only support android cell other than that is not acceptable.
3. Signal strength is calculated using this mobile app and will be transferred to server side.
4. This mobile app is responsible for generating the message after some time to inform the user to ON GPS/GPRS if both are not available respectively.

Server Side:

After developing mobile app the next step is to build a server side to store and manipulate data that will be calculated using developed mobile app. The main features are:

Database:
After the data collection it is transmitted to the server side that is based on web page where there is information of all related networks.

Maps:
On the server side different maps are used to indicate that city or part of city to whom that data is related there will be clear description and satellite image of that part whom the information belongs. We use different mapping scheme that is helpful to clearly

understand eg. We have used different color schemes on maps to display any attributes of that place.

a. Save addresses for faster directions

b. Drop a pin to see the street

c. Start GPS navigation in seconds

d. More ways to zoom

e. See a list instead of a map

f. Get more information about a business

g. Save a place for later

h. Let Google figure out what we should do

i. Rate your favorite spots

j. Go offline

Types of Maps:

Following are types of maps

a. Climate maps
b. Economic or resource maps
c. Physical maps
d. Political maps
e. Road maps
f. Topographic maps
g. Graphs:

Apart statistical graphs etc. are used to view the different reviews of users of signal strength, SMS delivery time etc. so that it is easy to compare them with different cities or it is very important for the user who wants to buy any network mention above.

2.4.6 User Documentation

There is a separate Help module in the Application for user support.

2.4.7 Assumptions and Dependencies

a. Here assumption will be that we have cell phone that should have Android. Cell phones other than Android are not applicable.
b. Another Assumption is that GPRS or Wi-Fi should be active on that cell phone through which it will send data. If GPRS or Wi-Fi is not active then it will send values in message.

2.4.8 External Interface Requirements

User Interface:

The interfaces that are available to the users are:

a. Mobile app. interface.
b. Server side interface

Mobile app Interface:

This interface is directly associated with the users a simple interface is available for the users which contains:

1. Service operator.
2. Signal strength (in dBm).
3. User's location.
4. Other cell Information like IMEI, Cell id, etc.

Server side:

This is another interface that is available to the users that will be in the form of a web page that contains information of different cellular networks with the help of charts, graphs etc.

Hardware Interfaces

There will be no such hard interface used in this project.

2.4.9 Performance Requirements

Following are the performance requirements for the product:

1. User must have cell having Android OS.
2. GPS must be on for the user cell.
3. Data must be sent after 10 or 20 minutes to server side.

2.5 QoS Parameters

Different applications have different requirements regarding the handling of their traffic in the network. Applications generate traffic at varying rates and generally require that the network be able to carry traffic at the rate at which they generate it. In addition, applications are more or less tolerant of traffic delays in the network and of variation in traffic delay. Certain applications can tolerate some degree of traffic loss while others cannot. These requirements are expressed using the following QoS-related

Bandwidth - the rate at which an application's traffic must be carried by the network

Latency - the delay that an application can tolerate in delivering a packet of data

Jitter - the variation in latency

Loss - the percentage of lost data

2.5.1 Measuring cellular signal strength

Received Signal Strength Indicator (**RSSI**) is a measurement of the Radio Frequency (RF) power present in a received radio signal at the mobile device. It is generally expressed in *dBm* and the best throughput comes from placing the device in an area with the highest RSSI.

Signal strength is one of an important factor needs to be taken into account when deploying wireless network. Signal attenuation or signal loss occurs as the signal passes through air and also affected by other factors, including natural and artificial phenomena and structures (such as walls, wireless interference, device power output, and even ambient humidity and temperature).

Object	Plasterboard wall	Class wall with metal frame	Cinder block wall	Office window	Metal door	Metal door in brick wall	Human body
Signal Attenuation	3dB	6dB	4dB	3dB	6dB	12dB	3dB

The above shows that how the Signal Strength is varying material to material and how much attenuation (Internal factors) effect in the Signal Strength.

The Cellular page on the Status**:** Statistics screen shows the current state of the cellular modem including the RRSI

100dBm or less = Unacceptable coverage
-99dBm to -90 dBm = Weak Coverage
-89dBm to -70 dBm = Medium to High Coverage
-75 dBm or greater = Strong Coverage

Signal strength measurement formulas

The power in dBm is the 10 times the logarithm of the ratio of actual Power/1 milliWatts.
DBm stands for "decibel milliWatts"
It is a convenient, dimensionless way to measure power.
The exact formula is P (dBm) = 10 • log10 (P (W) / 1mW)
Where
P (dBm) =Power expressed in dBm
P (W) = the absolute power measured in Watts
mW = milliWatts
log10 = log to base 10From this formula, the power in dBm of 1 Watt is 30 dBm. Because the calculation is logarithmic, every increase of 3dBm is approximately equivalent to doubling the actual power of a signal.

From this formula, the power in dBm of 1 Watt is 30 dBm. Because the calculation is logarithmic, every increase of 3dBm is approximately equivalent to doubling the actual power of a signal.

2.5.2 Path loss

Path loss (or path attenuation) is the reduction in power density (attenuation) of an electromagnetic wave as it propagates through space. Path loss is a major component in the analysis and design of the link budget of a telecommunication system.

This term is commonly used in wireless communications and signal propagation. Path loss may be due to many effects, such as free-space loss, refraction, diffraction, reflection,aperture-medium coupling loss, and absorption. Path loss is also influenced by terrain contours, environment (urban or rural, vegetation and foliage), propagation medium (dry or moist air), the distance between the transmitter and the receiver, and the height and location of antennas.

2.5.2.1 Causes

Path loss normally includes propagation losses caused by the natural expansion of the radio wave front in free space (which usually takes the shape of an ever-increasing sphere), absorption losses (sometimes called penetration losses), when the signal passes through media not transparent to electromagnetic waves, diffraction losses when part of the radio wave front is obstructed by an opaque obstacle, and losses caused by other phenomena

2.5.2.2 Path loss formula

Path loss is usually expressed in db. In its simplest form, the path loss can be calculated using the formula

$$L = 10\ n\ \log_{10}(d) + C$$

where L is the path loss in decibels, n is the path loss exponent, d is the distance between the transmitter and the receiver, usually measured in meters, and C is a constant which accounts for system losses.

2.5.3 Factors Affecting Signal Strength

Following are the Factors that affect signal Strength

a. **Geometric field pattern** of the antenna in the direction(s) that cause signal to be receivable at the measurement location. The higher the geometric gain of the antenna in directions that influence the receiving location, the greater the received signal could be there.

b. **Power being radiated by the transmitting antenna;** the more power being transmitted, the greater the remote signal strength. Obstruction loss between the transmitter and receiver; i.e. is there an ocean or mountain in the path of the signal that absorbs / reflects a given amount of it? Are there obstructions like trees, buildings, etc.? These will all cause path loss.

c. **Propagation absorption loss between the transmitter and receiver;** is some of the signal absorbed in the air, the ionosphere, by the ground, by foliage, by rain/clouds/snow etc.

d. **Propagation path distance between the transmitter and receiver;** depending on the path of signal propagation there will be some loss due to the geometric diffusion of signal energy and hence field strength over that distance.

e. **Multi-path or diffractive signal degeneration at the receiving location.** It's possible for signals to arrive at the receiver from several different paths or reflections. In the case of multiple signal paths the signal may not 'add up' in phase at the receiver and hence the overall signal strength may become erratic or weaker at the receiver, or in some cases it could be enhanced.

2.5.4 Mapping Of Received Signal Strength

A map is any spatial representation of information. More formally, a map is a list of objects and their locations. There are two kinds of maps:

Feature-based: Lists of objects (features), where each object consists on:

1) The position of the object, and

2) A list of properties that characterize that object.

For instance, if we had a robot with a camera, we could store a list of objects of the form: {pose, image description}, where image description is any description of an image captured by the robot (color, SIFT/SURF descriptors, etc.), and pose would be the position and orientation of the robot when it took the image.

Location-based: similar, but instead of a list of objects we have a list of positions, and each position contains a feature. A common location-based map is the grid occupancy map: a 2D grid (2d matrix) where each cell represents a tiny area of the environment, and tells us whether that area is free or occupied.

Therefore, a RSSI radio map will be any spatial representation of the RSSI properties of the environment. For example:

1. A grid where each cell contains the average RSSI values expected at that cell (one grid per beacon).

2. A grid where each cell contains a list with the average RSSI values expected from every beacon or Wi-Fi AP.

3. A list of RSSI values received and the positions where they were capture.

2.5.5 Applications of RSSI

Following are the applications of RSSI

a. Localization in Wireless Ad-hoc Sensor Networks using multiple alterations with RSSI for Logistic Applications.

b. Indoor localization system using RSSI measurement of wireless sensor network based on ZigBee standard.

c. A sorted **RSSI** quantization based algorithm for sensor network localization.

d. Cell sense: A probabilistic RSSI-based GSM positioning system.

e. Combined RSSI/SNR-driven intermodulation-mitigation scheme for CDMA terminals.

2.5.6 Heat Map

a. Upload your Excel data to Plotly's grid. Open the data file for this tutorial in Excel. ..

b. Traces your plot should look something like this. ...

c. Style and annotate! Your plot should look something like this.

2.5.7 Geo Tagging Map

a. Open Google Maps and make sure you're signed in...

b. In the top left corner, click the main menu.

c. Click My Maps to see a list of maps you created recently.

d. Click a map in the list (or click See all your maps)

CHAPTER # 3
SYSTEM DESIGN

Introduction

This chapter contains the detailed design of the application and the architectural design of the system and the objects in the system. The development techniques and communication links between servers and interfaces of our system are discussed in this chapter.

3.1 Static View

3.1.1 Use Case Diagram

Following diagram shows course of events that take place when an actor (user and other allowed interactions) interacts with system.

Use case for mobile app

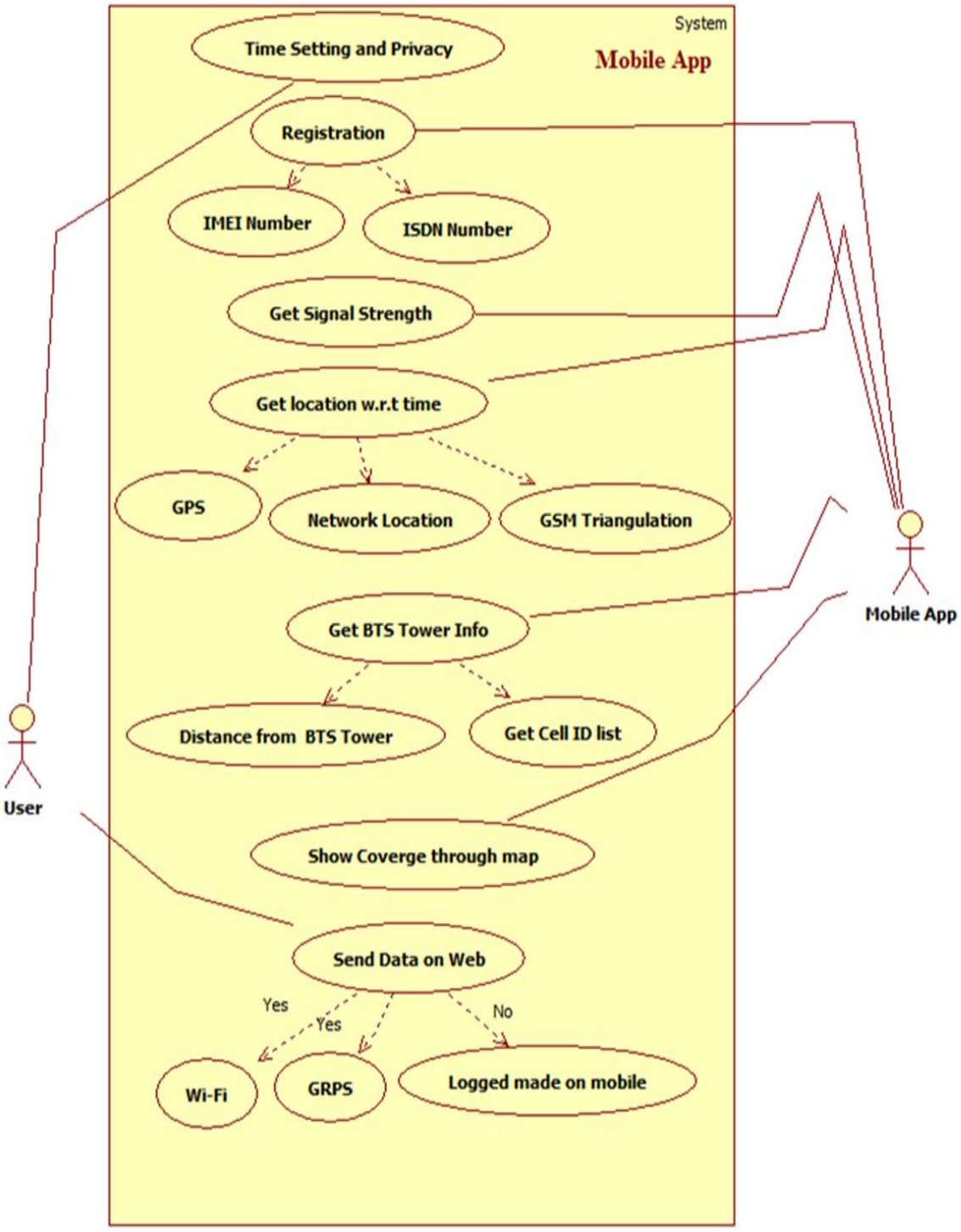

Figure 3.1 Use Case Diagram App

For WEB Server

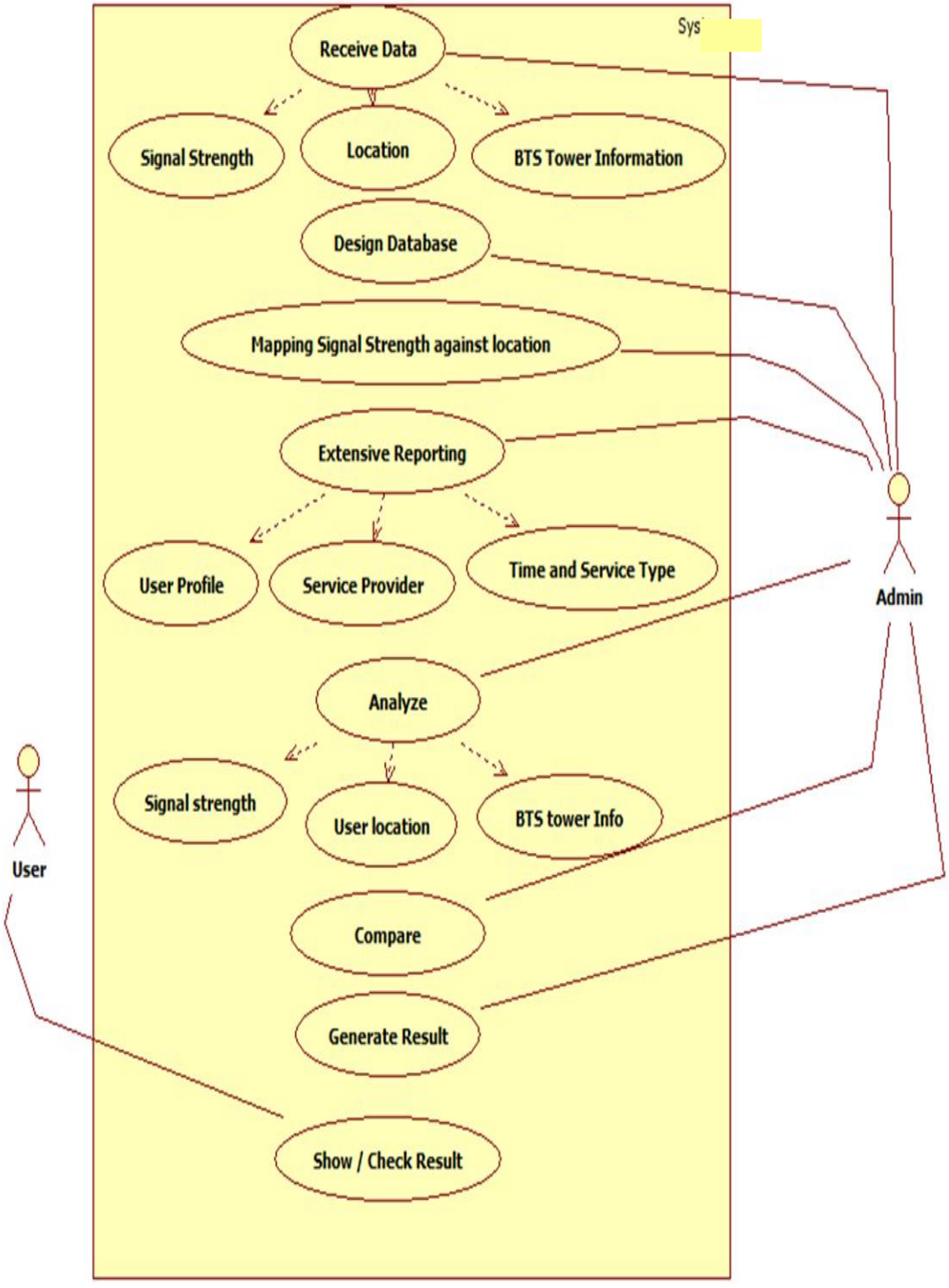

Figure 3.2 Use Case Diagram Server

Client

Use Case ID	1		
Use Case Name	User Sends Data on web		
Actors	User		
Created By	Group Members	**Last Updated B**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Conditions	The actor has to open the application on mobile first.		
Post-Conditions	If the use case is successful the actor is now sending data to the server, if it is otherwise, the state remains unchanged.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application. □ The actor opens the application application starts getting location, signal strength and time and sends to server over wif . □ No data is logged on the mobile.		
Alternative Flow	**First Alternative Flow** The use case starts when an actor opens the mobile application. □ The actor opens the application starts getting location, signa strength and time and sends to server over wifi . □ No data is logged on the mobile, but in case if the wifi or GPRS is		

	not currently available then data is send to the server later

Table 3.1 User Sends Data on web

Use Case ID	2		
Use Case Name	Time Setting		
Actors	User		
Created By	Group Members	**Last Updated B**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Conditions	The actor has to open the application on mobile first.		
Post-Conditions	If the use case is successful the actor will set time during which data is collected, if it is otherwise, the state remains unchanged.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application. □ The actor opens the application and sets time and privacy settings.		
Alternative Flow	The use case starts when an actor opens the mobile application. □ The actor opens the application application and sets time and privacy settings. □ If coverage is not good at specific location, actor can enhance		

	time in settings to get more data .

Table 3.2 Time Settings

Use Case ID	3		
Use Case Nam	Registration		
Actors	Mobile application		
Created By	Group Members	**Last Updated By**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Condition	The actor has to open the application on mobile first.		
Post-Conditions	If the use case is successful the IMEI and ISDN is provided for registration.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application. □ The actor opens the application and IMEI and ISDN of that mobile is stored.		

Table 3.3 Registration

Use Case ID	4		
Use Case Name	Get Location wrt time		
Actors	Mobile application user		
Created By	Group Members	**Last Updated B**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Conditions	The actor has to open the application on mobile first and get location through GPRS.		
Post-Conditions	If the use case is successful it will get the location wrt time, if it is otherwise, the state remains unchanged.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application. □ The actor opens the application and it will get the location wrt time through GPS.		
Alternative Flow	The use case starts when an actor opens the mobile application. □ The actor opens the application and it will get the location wrt time through GPS. □ If GPScoverage is not good at specific location, location will be retrieved by network location or GSM triangulation .		

Table 3.4 Get Location w.r.t Time

Use Case ID	5		
Use Case Nam	BTS tower Information		
Actors	Mobile application user		
Created By	Group Members	**Last Updated By**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Condition	The actor has to open the application on mobile first and get location through GPRS and get tower information .		
Post-Conditions	If the use case is successful it will get the tower information, if it is otherwise, the state remains unchanged.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application □ The actor opens the application and it will get the location wrt time through GPS and distance from nearest BTS is calculated.		

Table 3.5 BTS Tower Information

Use Case ID	6		
Use Case Nam	Show coverage		
Actors	Mobile application user		
Created By	Group	**Last Updated By**	Group Members

	Members		
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The actor opens the application on mobile.		
Pre-Condition	The actor has to open the application on mobile first and go to maps.		
Post-Conditions	If the use case is successful it will provide the coverage of different cellular networks on the map, if it is otherwise, the state remains unchanged.		
Normal Flow(Primary Scenario)	The use case starts when an actor opens the mobile application. The actor opens the application and it will get the coverage of different cellular networks on the map.		

Table 3.6 Show Coverage

SERVER

Use Case ID	7		
Use Case Name	Receive Data		
Actors	Administrator		
Created By	Group Members	**Last Updated B**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The Administrator opens the web page at server.		
Pre-Conditions	The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.		

Post-Conditions	If the use case is successful it will recieve signal strength,locatio and BTS information from different users.
Normal Flow(Primary Scenario)	The use case starts when an administrator opens the web page a server. □ The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.
Alternative Flow	The use case starts when an actor opens the mobile application □ The actor opens the application and it will get the location wrt time through GPS. □ If GPScoverage is not good at specific location, location will be retrieved by network location or GSM triangulation .

Table 3.7 Receive Data

Use Case ID	8		
Use Case Nam	Mapping signal Strength against location		
Actors	Administrator		
Created By	Group Members	**Last Updated By**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The Administrator opens the web page at server.		
Pre-Condition	The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.After		

	Designing data base , will map signal strengths against their locations.
Post-Conditions	If the use case is successful it will map according the the data base.
Normal Flow(Primary Scenario)	The use case starts when an administrator opens the web page at server. □ The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.After Designing data base , will map signal strengths against their locations through geo tagging.

Table 3.8 Mapping Signal Strength against Loctaion

Use Case ID	9		
Use Case Nam	Analyse ,compare,Generate Results		
Actors	Administrator		
Created By	Group Members	**Last Updated By**	Group Members
Date Created	8/1/2018	**Last Updated**	8/1/2018
Description	The Administrator opens the web page at server.		
Pre-Condition	The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.After Designing data base , will map signal strengths against their locations.At server end all the results will be analysed , comparasion is drawn on the basis of quality of service by different service providers.		

Post-Conditions	If the use case is successful it will generate results based on the quality of service to the end users.
Normal Flow(Primary Scenario)	The use case starts when an administrator opens the web page at server. □ The Administrator opens the web page at server and recieves signal strength,location and BTS information from different users.After Designing data base , will map signal strengths against their locations through geo tagging. At server end all the results will be analysed , comparasion is drawn on the basis of quality of service by different service providers.

Table 3.9 Analyze,Compare,Generate results

3.2 Logical View Point

3.2.1 Class Diagram

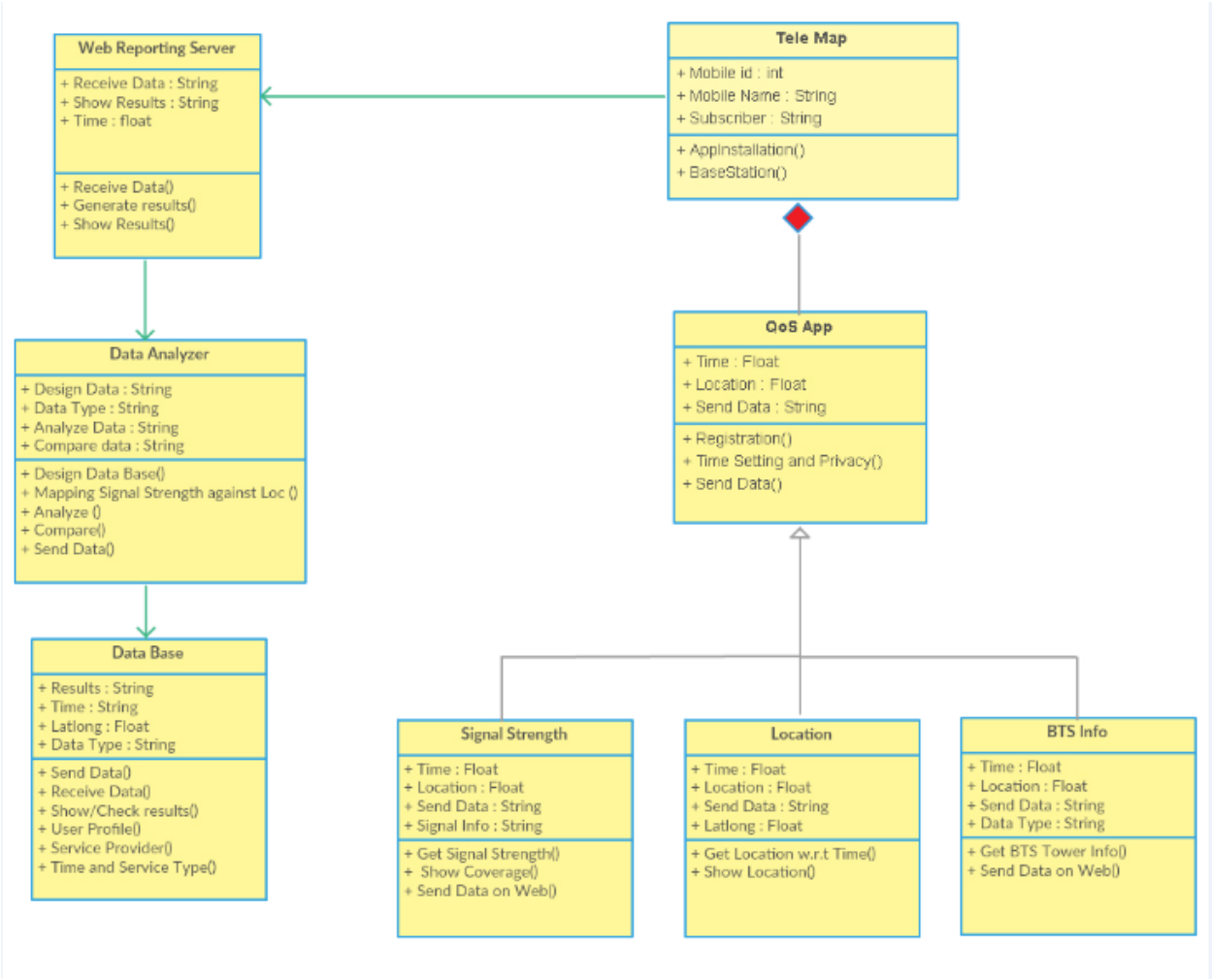

Figure 3.3 Class diagram

3.3 Interface (GUIs)

Generally Telemap consists of two main interfaces i.e. Mobile app interface and server or website interface.

3.3.1 Mobile app Interface

Figure 3.4 Initial Loading screen

3.3.2 Server side Interface

Figure 3.5 Website Starting Interface

3.4 Dynamic View

3.4.1 Sequence Diagram

A Sequence diagram is an interaction diagram that shows how processes operate with one another and in what order. It is a construct of a Message Sequence Chart. A sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario

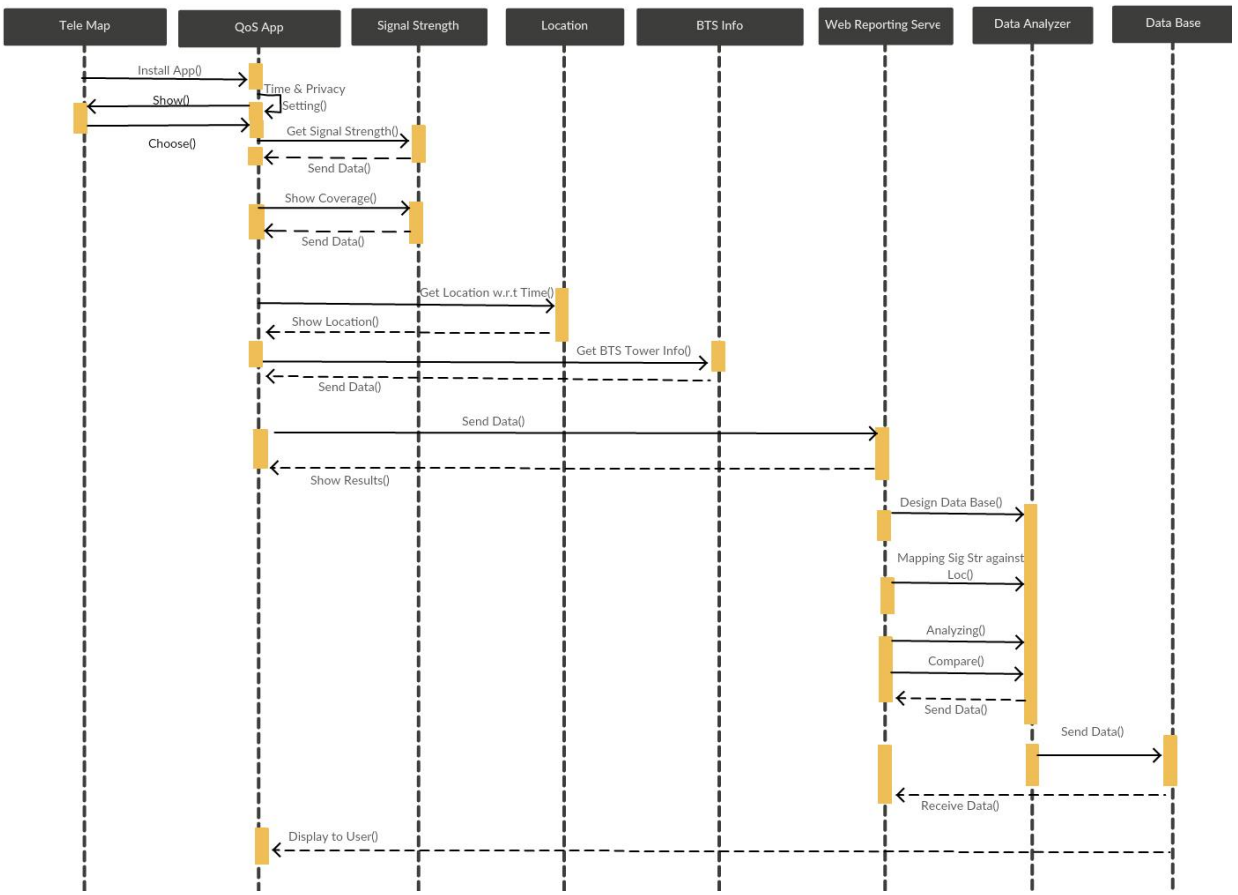

Figure 3.6 Sequence diagram

3.4.2 State Transition Table

In automata theory and sequential logic, a state transition table is a table showing what state (or states in the case of a nondeterministic finite automaton) a finite semi automaton or finite state machine will move to, based on the current state and other inputs. A state table is essentially a truth table in which some of the inputs are the current state, and the outputs include the next state, along with other outputs.

STATE	EVENT	ACTION	NEXT STATE
Mobile App Interface	•Calculate Signal Strength. •Calculate SMS delivery time. •Calculate Lat & Long. •Calculate Mobile Id.	•Store •Forward To Server.	Server Interface
Server Side	•Get Signal Strength. •Get SMS delivery time. •Get Lat & Long. •Get Mobile Id.	•Store In Data Base •Plotting Maps. •Plotting Graphs •Analysis	Mobile app data collection

Table 3.7 state Transition Diagram

CHAPTER # 4

DEVELOPMENT AND CONFIGURATION MANAGEMENT

4.1 Introduction

The tools and platforms used in this project are Android SDK, Java SDK, Java IDE (Eclipse) and ADT plug-in. There are various tools and APIs (Application Programming Interface) provided by Android SDK necessary for developing applications on Android platform using Java. Integrated development environment (IDE) is really a software program providing you with a number of services for software programmers. In this project the java IDE used is Eclipse. Android Development Tools (ADT) is a plug-in for the Eclipse IDE that gives a powerful, integrated environment to design Android applications.

4.2 Coding Standards

For coding Eclipse platform is used. Eclipse is a universal tool platform - an open, extensible IDE. The code base for the Eclipse project should avoid using names that reference a particular company or their commercial products. In Eclipse, an editor is used to contain the primary content, such as a document or data object, which users interact with. In every case, this content is the primary focus of attention and a reflection of the primary task.

4.2.1 Algorithm:

An algorithm is an effective method that can be expressed within a finite amount of space and time and in a well-defined formal language for calculating a function. Starting from an initial state and initial input (perhaps empty), the instructions describe a computation that, when executed, proceeds through a finite number of well-defined successive states, eventually producing "output “and terminating at a final ending state. The transition from one state to the next is not necessarily deterministic; some algorithms, known as randomized algorithms, incorporate random input.

```
START
For(i==Random transition time) {
do
{
Calculate Signal Strength()
Calculate SMS Delivery time()
While {
If(GPS=Available) {
Calculate Lat & Long
else
Send Request Message
}}
endwhile
If (GPRS/Internet ==Available) {
Send Data to server side
Else
Send Message Containing Data
}
Analysis
}
i – –
}
END
```

4.2.2 Application Code:

```
@Override
protected void onCreate(Bundle savedInstanceState) {

        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_main);
        first = (TextView)findViewById(R.id.first);
        myLocationText = (TextView)findViewById(R.id.textView1);
        mylatitude = (TextView)findViewById(R.id.textView2);
        cellid = (TextView)findViewById(R.id.textView3);
        mycell = (TextView)findViewById(R.id.textView4);
        btnsync = (Button)findViewById(R.id.btn_sync);
        Log.i("info", "0");
        GPSTracker gpsTracker = new GPSTracker(this);

        if(gpsTracker.isGPSEnabled || gpsTracker.isNetworkEnabled){
```

```
MyListener   = new MyPhoneStateListener();
Tel      = ( TelephonyManager )getSystemService(Context.TELEPHONY_SERVICE);
el.listen(MyListener ,PhoneStateListener.LISTEN_SIGNAL_STRENGTHS);

ocationManager locationManager;
cationManager = (LocationManager)getSystemService(Context.LOCATION_SERVICE);
ocation location =locationManager.getLastKnownLocation(LocationManager.GPS_PROVIDER);
/updateWithNewLocation(location);

tringBuilder cellinfo = new StringBuilder();
tringBuilder nettype = new StringBuilder();
tringBuilder sig = new StringBuilder();

ettype.append("");
ellinfo.append("");
ig.append("");



TelephonyManager tm = (TelephonyManager) getSystemService(Context.TELEPHONY_SERVICE);
String IMEI = tm.getDeviceId();
GsmCellLocation cellLocation = (GsmCellLocation) tm.getCellLocation();
if(cellLocation != null){
        data_imei = IMEI;
StringBuilder mycellstr = new StringBuilder();
mycellstr.append("IMEI: " + IMEI);
mycellstr.append("\n");
mycellstr.append("My Cell ID: " + cellLocation.getCid() + "\nMy Operator: " +
getNetworkOperatorName());
mycell.setText(mycellstr);
cellid.setText("");
List<NeighboringCellInfo> neighboringCellInfos = tm.getNeighboringCellInfo();
for(NeighboringCellInfo neighboringCellInfo : neighboringCellInfos)
{
        if(neighboringCellInfo.getNetworkType() == 1){
```

4.2.3 Website Code:

```
<?php

        include("library/library.php");
        $res = mysqli_query($con,"SELECT * FROM `signal_strength`");
        $lat = array();
        $long = array();
        $rssi = array();
        $address = array();
        $imei_2 = array();
        while($row = mysqli_fetch_object($res))
        {
                $lat = $row->latitude;
                $long  = $row->longitude;
                $rssi = $row->rssi;
                $opname = $row->operator_name;
                $address= $row->address;
                $imei_2= $row->imei_2;
?>
var latlong=new OpenLayers.LonLat(<?php echo $long; ?>,<?php echo $lat; ?>);
                 var feature_point1 = new OpenLayers.Feature.Vector(
                new OpenLayers.Geometry.Point(<?php echo $long; ?>,<?php echo $lat; ?>).transform(
            new OpenLayers.Projection("EPSG:4326"),
            map.getProjectionObject()
        ),


               vector_layer, { toggle: true, multiple: false, multipleKey: 'shiftKey' }
               );

           map.addControl(select_feature);
           select_feature.activate();
           function selected_feature(event) {


   $('#firstli').html('<strong>Network Type: </strong>'+'GSM');

   $('#secondli').html('<strong>RSSI   : </strong>'+event.feature.attributes.rssi+" dBm");

    $('#thirdli').html('<strong>IMEI   : </strong>'+event.feature.attributes.imei_2);

  $('#address').html(event.feature.attributes.address);

   $('#fourthli').html('<strong>Opperator Name: </strong>'+event.feature.attributes.opname);

               //Show all the selected features
   //            document.getElementById('map_feature_log').innerHTML += 'All selected features: ';
           }
           vector_layer.events.register('featureselected', this, selected_feature);

                       map.setCenter(
```

4.3 Development Plan

Activity	Members	Time Required
Basic interface layout	Maj Musharraf Aslam Capt Arslan Naseer Capt Khurram Shehzad Capt M. Zahid Iqbal	1st March to 15th March
Mobile app completed		20th to 25th March
Database Design		30th March to 10th April
Database finalized		15th April to 25th April
Basis Server/webpage interface		30th April to 15th May
Server side finalized		18th May to 24th May
Modifications in app and website added, Final interface completed		25th May to 15th June

CHAPTER # 5
QUALITY ASSURANCE

5.1 Introduction

Quality assurance (QA) refers to the engineering activities implemented in a quality system so that requirements for a product or service will be fulfilled. It is the systematic measurement, comparison with a standard, monitoring of processes and an associated feedback loop that confers error prevention. This can be contrasted with quality control, which is focused on process outputs.

Two principles included in QA are: "Fit for purpose", the product should be suitable for the intended purpose; and "Right first time", mistakes should be eliminated. QA includes management of the quality of raw materials, assemblies, products and components, services related to production, and management, production and inspection processes.

This chapter concerns about the quality assurance and detail analysis of quality testing is discussed under subsequent headings. Under test plan headings, a test case of each module is discussed in detail.

5.2 Test Cases

a. Develope test cases.

b. Execute tests based on the developed test cases for the software.

c. Report defects from the executed test cases if any.

d. Provide complete test report.

e. Incorporate or manage changes later in the stage of the project development.

5.3 Features to be Tested

Following Features are tested:

a. Software will be able to access the information of “cell phone” (Cell ID, RSSI, IMEI number), “Network” (Network Type, Company) and SIM information (Country Code, Serial No., Subscriber ID), and uploaded it on Server.

b. Software will be able to store the data to view and access its contents.

c. Software will be able to provide previous and current data against each location and cell ID w.r.t time.

d. Software will be able to analyze and compare the data on server side and show in graphical format.

5.4 Test Approaches

Acceptance test will be executed based on this acceptance test plan. And after all test cases are executed, a test report will be summarized to show the quality of QoS for Telecommunication providers application. Following test approaches will be used in test execution:

a. **Unit test**. Developers are responsible for unit testing. The implementation of each module and individual component will be verified separately.

b. **Integration test**. After the unit test is passed above the defined quality threshold, testers will execute the integration test cases. After all the modules are integrated, it is crucial to test the product as a black-box.

c. **Positive and negative testing design technique**. This approach will be combined with unit test and integration test. Test cases are designed in obvious scenarios, which ensure that all functional requirements are satisfied. What's more, different test cases will also be covered to show how the system reacts with invalid operations.

5.5 Items Pass/Fail Criteria

Details of the test cases are specified in section Test Deliverables. Following the principles outlined below, a test item would be judged as pass or fail.

a. Preconditions are met

b. Inputs are carried out as specified

c. The result works as what specified in output => Pass

d. The system doesn't work or not the same as output specification => Fail.

5.6 Suspension Criteria and Resumption Requirements

Any bugs found can be fixed by developers quickly and no need to start the testing process from the beginning. However, when major bugs will block some test cases as they are interdependent and the testing has to be paused.

5.7 Test Deliverables

Following are the Test Cases:

5.7.1 User Interface Testing:

Test Case Number	01
Test Case Name	Open QoS Application
Description	Testing Application whether it runs on cell.
Testing Technique	Unit testing, Black Box Testing
Preconditions	Application must be installed on android cell.
Input Values	Click on Application icon
Steps	• Open android cell. • GoTo Telecom QoS app icon. • Click on the app icon.
Expected output	QoS application will open.
Actual output	App opened showing different tabs.
Status	Test case passed successfully.

Table 5.1 Open QoS App

Test Case Number	02
Test Case Name	Press Upload to Transfer Data
Description	Press upload button to send data
Testing Technique	Unit testing, Black Box Testing
Preconditions	App should be opened and cell should be working with SIM card installed of any network and internet must be

	connected.
Input Values	Click on " Upload " Button
Steps	• Open the application • Main Screen is open. • Select the ‘Dashboard’ tab. • Click on Upload button.
Expected output	Message displayed and Data uploaded to server.
Actual output	Data uploaded to server.
Status	Test case passed successfully.

Table 5.2 Press Upload to transfer Data

Test Case Number	03
Test Case Name	Status
Description	Status module will show information about States, Cell information, Network and SIM information.
Testing Technique	Unit testing, Black Box Testing
Preconditions	App must be opened.
Input Values	Click on " Status " Module
Steps	• Open the application • Main Screen is open. • Select the ‘Status’ module.
Expected output	Screen with the list containing State, cell information, network and SIM information will appear.
Actual output	Screen with the list containing State, cell information, network and SIM information will appear.
Status	Test case passed successfully.

Table 5.3 Status

Test Case Number	05
Test Case Name	Coverage
Description	It will show coverage of the network at your specific location.
Testing Technique	Unit testing, Black Box Testing
Preconditions	App must be opened.
Input Values	Click on " Coverage " Button
Steps	• Open the application • Main Screen is open. • Select the ‘Coverage button.
Expected output	Coverage of your network is shown at your specific location in google map.
Actual output	Coverage of your network is shown at your specific location in google map.
Status	Test case passed successfully.

Table 5.5 Coverage

Test Case Number	06
Test Case Name	Extra Information
Description	It will show Cell ID and RSSI information of different networks at specific location.
Testing Technique	Unit testing, Black Box Testing
Preconditions	App must be opened.
Input Values	Click on “Extra Info “Button.
Steps	• Open the application • Main Screen is open.

	• Select the ‘Extra Info’ tab.
Expected output	Screen with the RSSI information will be shown using different cells with their IDs.
Actual output	Screen with the RSSI information will be shown using different cells with their IDs.
Status	Test case passed successfully.

Table 5.6 Extra Information

Test Case Number	07
Test Case Name	Time Interval
Description	It will set the time after which the Data will automatically be uploaded/updated.
Testing Technique	Unit testing, Black Box Testing
Preconditions	App must be opened.
Input Values	Click on "Time Interval" button.
Steps	• Open the application • Main Screen is open. • Select the ‘Time Interval’ button. • Select the Time.
Expected output	Screen with display message appears showing different time lapse.
Actual output	Screen with display message appears showing different time lapse.
Status	Test case passed successfully.

Table 5.7 Time Interval

Test Case Number	08

Test Case Name	Log Data
Description	Maintaining a list of Cells, whose information regarding signal strength, Latitude, Longitude, Company, Network type and IMEI will be shown.
Testing Technique	Component testing, Black Box Testing
Preconditions	App must be opened.
Input Values	Click on dropdown button on top right.
Steps	• Open the application • Main Screen is open. • Select the 'Dropdown' button on top right of the screen. • Click on "Log Data" button.
Expected output	Screen showing information regarding signal strength, Latitude, Longitude, Company, Network type and IMEI, using different cells will appear.
Actual output	Screen showing information regarding signal strength, Latitude, Longitude, Company, Network type and IMEI, using different cells will appear.
Status	Test case passed successfully.

Table 5.8 Log Data

SERVER SIDE

Test Case Number	09
Test Case Name	Map
Description	It will show the complete map of Pakistan with the labels showing different network coverage at different areas.
Testing Technique	Component testing, Black Box Testing
Preconditions	Server application must be opened.

Input Values	Click on "Map" button.
Steps	• Open the application • Main Screen is open. • Select the ‘Map’ button.
Expected output	Map will be opened showing cellular coverage of different networks..
Actual output	Map opened showing cellular coverage of different networks..
Status	Test case passed successfully.

Table 5.9 Map

Test Case Number	10
Test Case Name	Heat Map
Description	It will show the complete map of Pakistan with the labels showing different network coverage at different areas
Testing Technique	Component testing, Black Box Testing
Preconditions	Server application must be opened
Input Values	Click “Heat Map” icon.
Steps	• Open the application • Main Screen is open. • Select the ‘Heat Map’ button.
Expected output	Map will be opened showing cellular coverage of different networks.
Actual output	Map opened showing cellular coverage of different networks.
Status	Test case passed successfully.

Table 5.10 Heat Map

Test Case Number	11
Test Case Name	Graphical Information
Description	It will show the coverage information of different networks using bar chart.
Testing Technique	Component testing, Black Box Testing
Preconditions	Server application must be opened.
Input Values	Click "Graphical Information" button.
Steps	• Open the application • Main Screen is open. • Select the 'Graphical Information' button.
Expected output	Bar chart showing information of different networks will appear.
Actual output	Bar chart showing information of different networks appeared.
Status	Test case passed successfully.

Table 5.11 Graphical Information

CHAPTER # 6
RESULTS AND DISCUSSION

6.1 Introduction

This chapter entails detailed discussion on the results of the accuracy analysis which was conducted for checking the accuracy of the software.

6.2 Results and Discussion

The result of accuracy analysis indicates 100% APP and 100% server side.

6.3 Future Enhancement

Telemap is a comprehensive application but it can be enhanced further and many other useful features can be added to it.

6.4 Mobile Application Results

Figure 6.1 Home page

Figure 6.2 Status

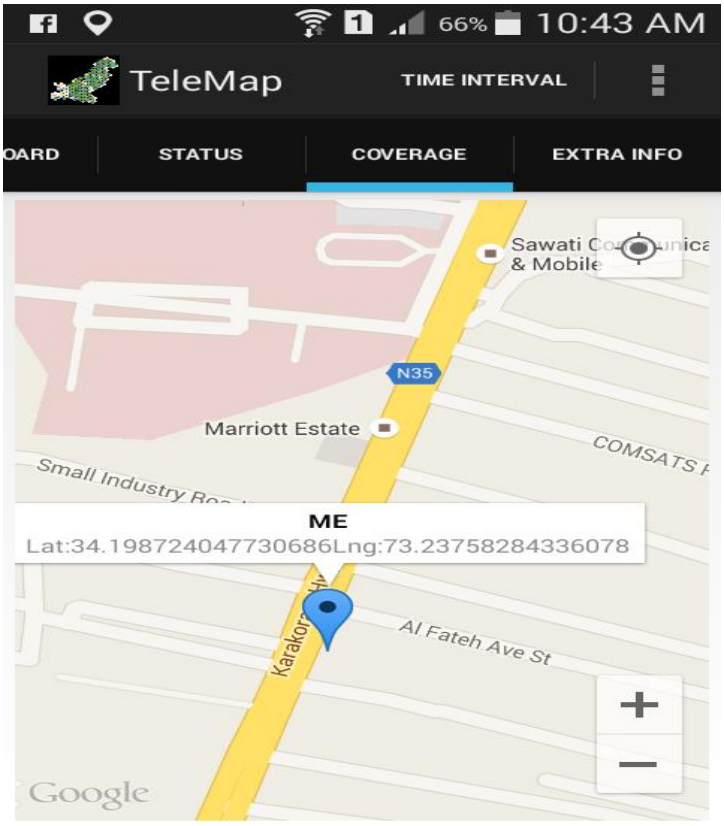

Figure 6.3 Coverage Map

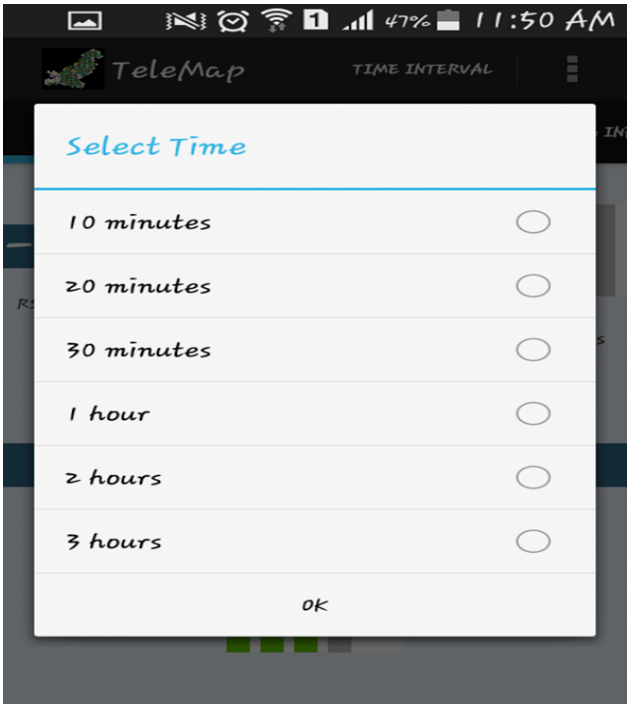

Figure 6.4 Time Interval Setting

Figure 6.5 Other Network info

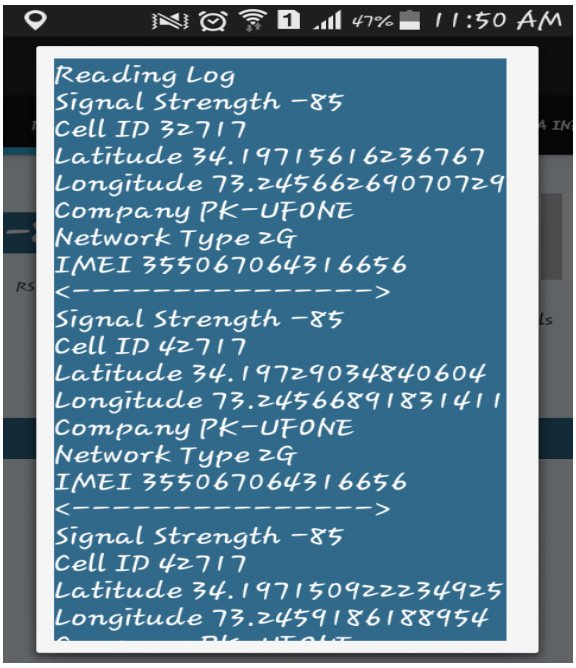

Figure 6.6 Logged Data

6.5 Website Results

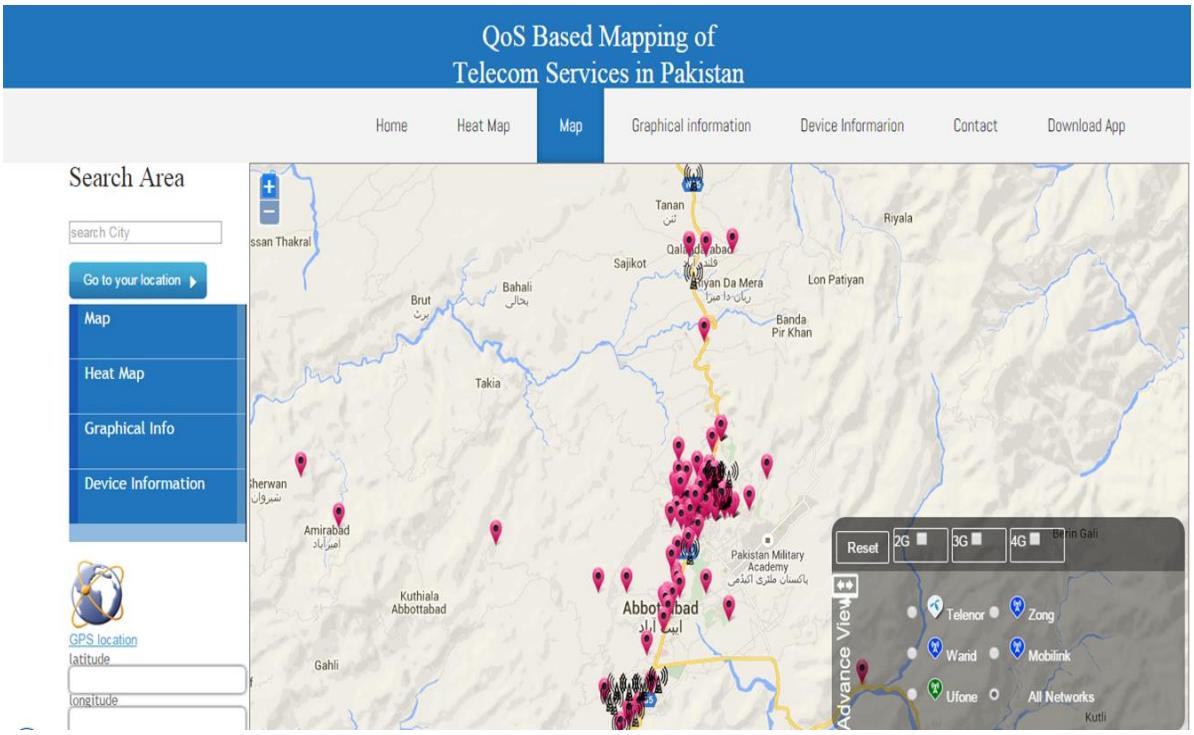

Figure 6.7 Geo tagging Map

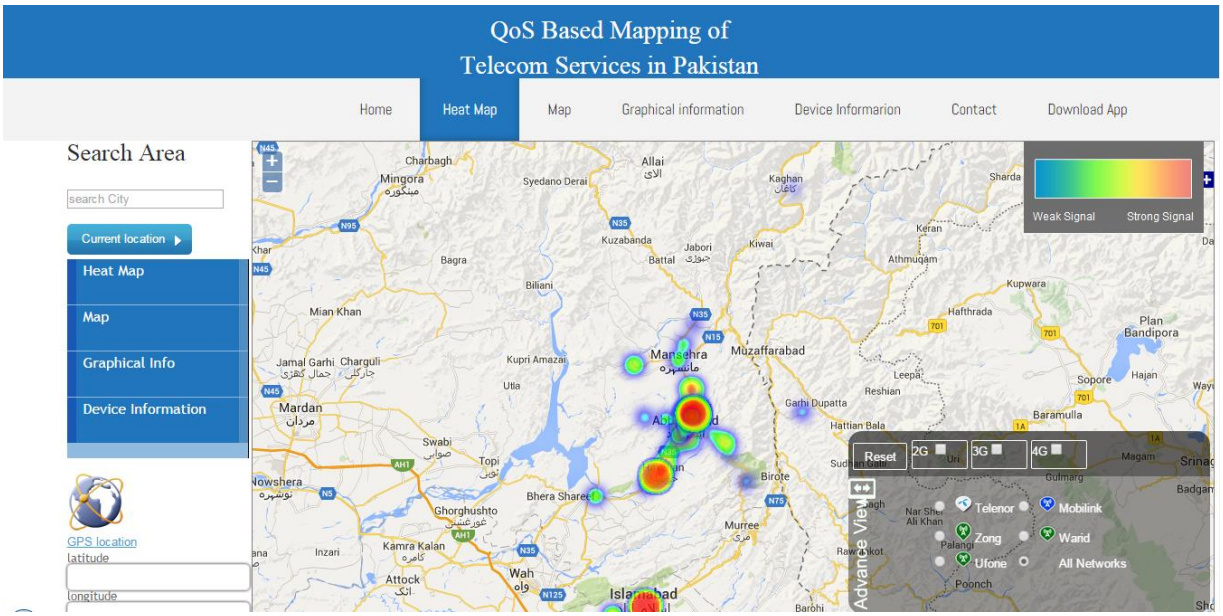

Figure 6.8 Heat Map

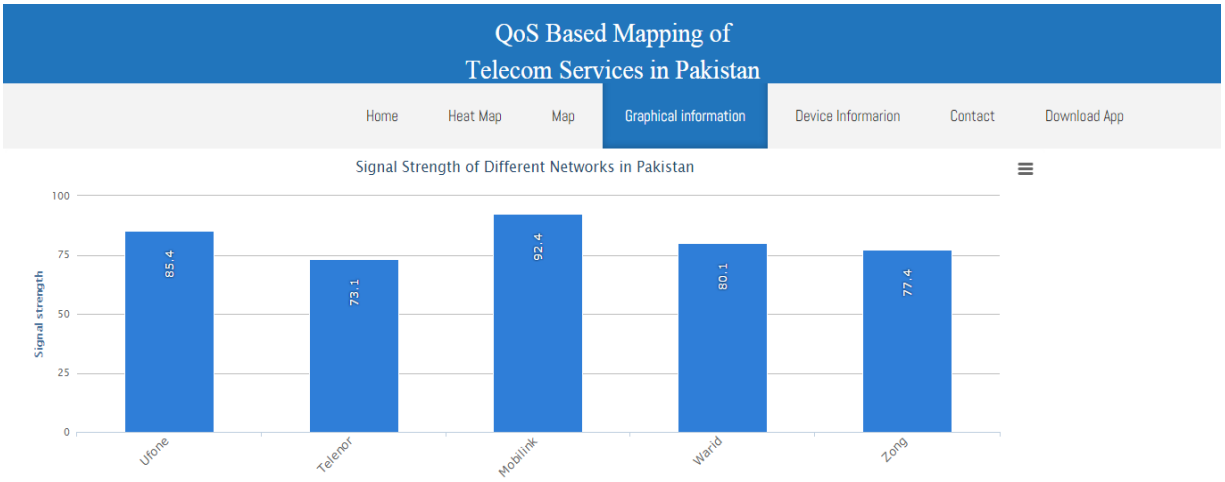

Figure 6.9 Graphical Information

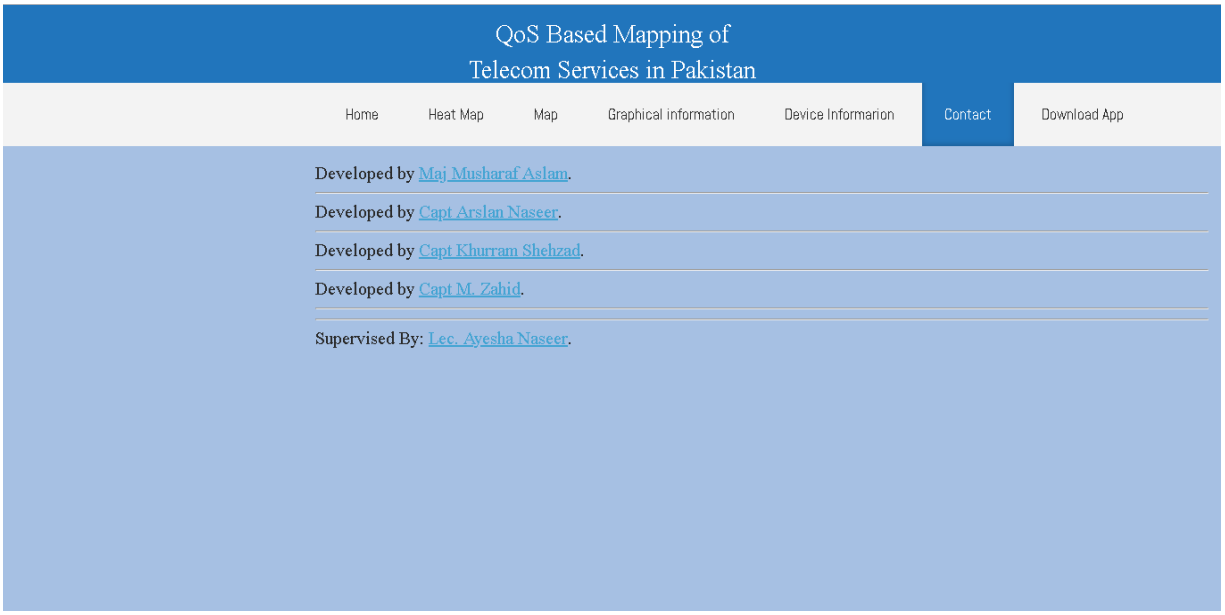

Figure 6.10 Contact information

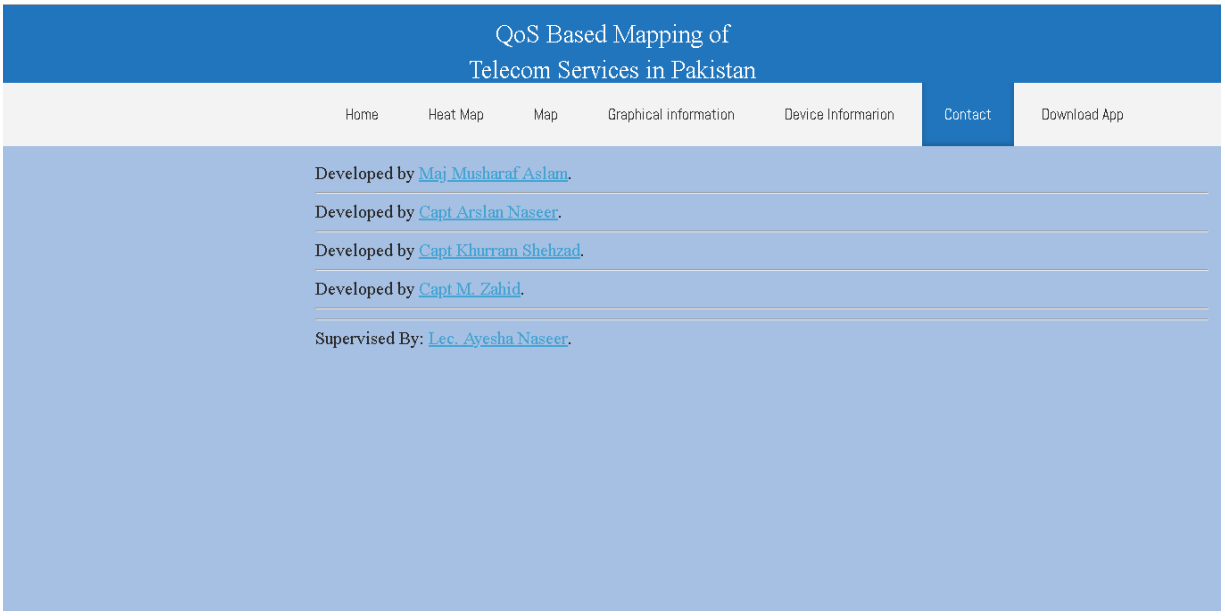

Figure 6.11 Download App apk file

CHAPTER # 7

USER MANUAL

7.1 Introduction

The user guide will give complete description of all the platforms and tools used and how to install the software's needed to develop the application. The main tools used are installing the android SDK for Windows, eclipse and suitable JDK or JRE. This particular guideline can summarize the way to set up this Google android SDK as well as established your selected improvement environments.

7.2 Installation Guide

7.2.1 Installing Application

Download our application from our website i.e. Telemap.pk or from any source once you have Apk file press install app as show below

Figure 7.1 App installation process

Note: Make sure you've got the first item in the Applications menu – Unknown sources – ticked. This will allow installation of non-Market software.

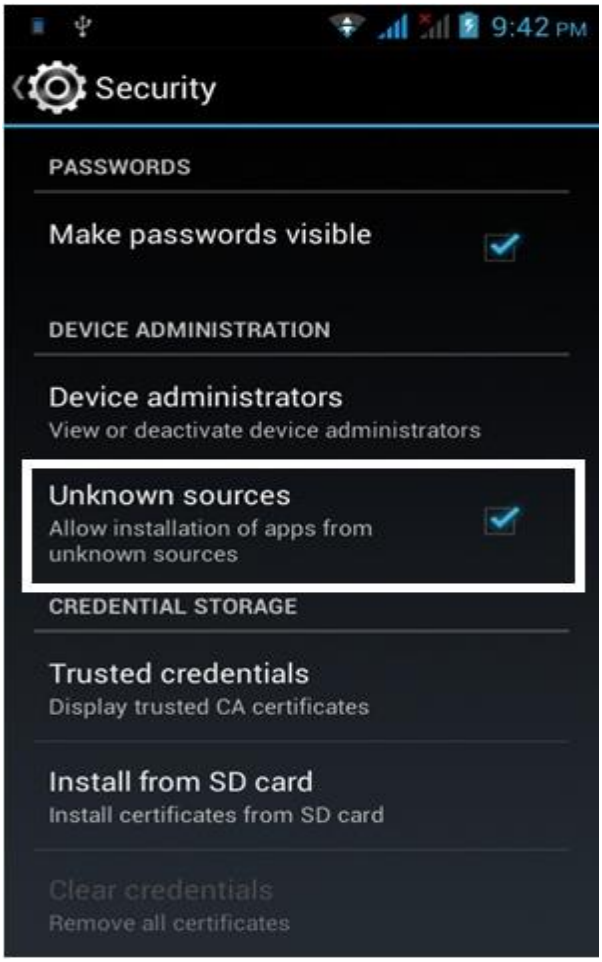

Figure 7.2 Unknown sources check

7.3 Hardware/Software Requirements for the System

7.3.1 Hardware Requirements

Cell phone with android OS is required with GSM enabled.

7.4 Supported Operating System

Android OS with 4 or above

7.5 Major features of the System

a. Getting Signal strength
b. Getting Location and other information's of cell
c. Displaying it in different analysis mode

7.6 Operating Manual

7.6.1 Keyboard keys/shortcuts defined

Android uses many shortcut keys during typing and browsing here are some of the typing shortcut keys:

a. **Alt + Spacebar:** Place a unique character

b. **Shift + Del:** Remove the character to the right of the cursor

c. **Alt + Del:** Remove an whole line

d. **Shift + Shift (press it twice):** Stimulate caps-lock; click shift once more to exit

e. **Alt + Trackball-Left:** Shift pointer to starting of line.

f. **Alt + Trackball-Right:** Move pointer to end of line

g. **Alt + Trackball-Up:** Move pointer to top of page

h. **Alt + Trackball-Down:** Move pointer to base of page

i. **Shift + Trackball-Left/Right:** Emphasize written text for reducing or copying

j. **Menu + X:** Cut written text (will cut all written text on-screen unless particular figures are highlighted)

k. **Menu + C:** Duplicate written text to clipboard (will copy all written text on-screen unless particular figures are highlighted)

l. **Menu + V:** Insert written text from clipboard

m. **Menu + A:** Select all written text in the current field.

7.7 References

- www.w3schools.com
- http://maps.google.com/
- http://propakistani.pk/2009/12/29/cellular-companie-qos-survey-results/
- http://www.academia.edu/2554765/Measurements_and_QoS_Analysis_of_Live-World_Mobile_Telecommunication_Networks
- http://telecompk.net/wp-content/uploads/2007/10/paper_110907.pdf

CHAPTER # 08

FUTURE WORK

8.1 Future Work

Any software of this kind always needs more and more work to evolve. There are a lot of possible changes and additions that can be done to the system to improve its performance and functionalities. To be more useful for the users, Details of Call/messages rates , Upcoming and current packages details of each Service provider can be incorporated for better selection of the Network to use against some specific location. The system has been made in a modular fashion which enables integrating new features very easy.

Furthermore, the practical usage of the system can be increased by adding more and more services to software.

CHAPTER # 09

BIBLIOGRAPHY

9.1 Bibliography

1. Zain J.M., Wan Mohd W.M.., El-Qawasmeh E. (eds) Software Engineering and Computer Systems. ICSECS 2011. *Communications in Computer and Information Science*, vol 180. Springer, Berlin, Heidelberg

2. Benkic, K., Malajner, M., Planinšic, P., Cucej, Ž., Using RSSI value for distance estimation in Wireless sensor networks based on ZigBee, in Proc. IWSSIP Conf., Jun. 2008, pp. 303-306.

3. Chapre, Y., Mohapatra, P., Jha, S., Seneviratne, A., Received Signal Strength Indicator and Its Analysis in a Typical WLAN System, School of Computer Science & Engineering, University of New South Wales, Sydney, Australia.

4. Bose, A., Foh , C. H., A Practical Path Loss Model For Indoor WiFi Positioning Enhancement, IEEE ICICS 2007.

5. Oguejiofor, O., Okorogu, V., Adewale, A., Osuesu, B., Outdoor Localization System Using RSSI Measurement of Wireless Sensor Network, International Journal of Innovative Technology and Exploring Engineering, vol. 2, Jan. 2013, pp. 1-6

6. "Database System Concepts", Abraham Silberschatz, Henry F. Korth and S. Sudarshan, McGraw-Hill Education (Asia), Fifth Edition, 2006.

7. Beizer, B.: Software Testing Techniques, 2 edn. Van Nostrand Reinhold Co., New York, NY, USA (1990)