

AUTOMATION AND ANALYSIS IN TELECOM NETWORKS

*Project report submitted in partial fulfilment of the requirement for the
degree of*

BACHELORS OF TECHNOLOGY

in

ELECTRONICS AND COMMUNICATION ENGINEERING

By

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DECLARATION

I by this meansacknowledgethat the work narrated in this report named as “**AUTOMATION AND ANALYSIS IN TELECOMNETWORKS**” in partial gratification of the requirements for the endowment of the degree of **Bachelor of Technology in Electronics and Communication Engineering**appeared in the department of Electronics and Communication Engineering, Jaypee University of Information Technology Waknaghat is an originaltranscription of my endemic work accomplish over a duration from date 3 Feb 2020 to May 2020 under the administration of (**Neeraj Bhatnagar**) (Senior Manager-SDU Bharti BMAS SA MNS SLOP SDU BH Tools & Auto) and (**Dinesh Kumar**) (Program Manager BMAS SA MSN SLOP SDU BH PMgmt).The issue epitomized in the report has not been submitted for the honor of some other degree or confirmation.



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This is to affirm that the above proclamation made by the competitor is consistent with the best of my insight.



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LIST OF ABBREVIATIONS

RCA	Root cause analysis
OSS	Operation system support
ICT	Information of communication technology
BCF	base alarm from base transceiver station
LTE	Long term evolution
EDA	Exploratory data analysis
UI	User interface
AI	Artificial intelligence
MacOS	Macintosh operating system
IOS	Iphone operating system
SMS	Short message service
FDMA	Frequency division multiple access
TDMA	Time division multiple access
ETSI	European telecom standard institute
GSM	Global system for mobile communication
SIM	Subscriber identity module
DECT	Digital enhanced cordless telecommunication
SS	Switching system
BSS	Base station system
MSC	Mobile switching centre

HLR	Home location register
VLR	Visitor location register
EIR	Equipment identity register
AUC	Authentication centre
BSC	Base station controller
BTC	Base transceiver station
MAC	Medium access layer
RAN	Radio access network
SGSN	Security GPRS support node
GGSN	Gateway GPRS support node
MME	Mobile management entity

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ABSTRACT

My three-month temporary job undertaking, "AUTOMATION AND ANALYSIS IN TELECOM NETWORKS", was with Ericsson, Noida Office beginning from 3 February 2019. The report is set up to cover the essential subtleties of the issues and the arrangements utilized all through the excursion of this three-month temporary position. This primary objective region of the undertaking was automation in telecom systems and their investigation, to make sense of an approach to give ideal mechanization to the main driver examination in systems. The principle point of the task was to figure out how to deal with such enormous information of the day by day result of the OSS dump and oversee it likewise so it tends to be additionally used in the right format.

The serious issue looked in this venture is the huge measure of information that came each hour of the day and creating a system to automate underlying driver investigation in systems. The procedure is explained with subtleties appropriately in up and coming sections however when all is said in done, before experiencing the investigation part we should think about the systems their segments and in what direction they work. The Plans about how the system work from the front office to the back office where all the computerization and examination part going to be done was structured by individual operational units Leads and were confirmed with the assistance of different venders.

After the fulfilment of the considerable number of stages, the normal outcomes from this venture were automation through the collocated data of 2g and 4g based on given data that consists of all the important attributes of 2g networks and 4g networks according to circle exist within India. 4g uses bandwidth from 2g and 3g unutilized bandwidth by the collocation of 2g with a 3g band.

This automation and analysis in telecom networks are accomplished using python for coding and main libraries from it were pandas, NumPy, whereas other platforms and software used, were Jupyter notebooks, excel, log files, and CSV files. This report gives a clarification of said tools. Jupyter notebook is a web application where you can make as well as offer reports that contain live code, conditions, perceptions just as content, the Jupyter Notebook the perfect instruments to assist you with gaining information science and information investigation abilities.

Chapter – 1

Introduction

1.1 General Introduction

Automation and analysis in telecom networks are mainly concern over the 2g networks ,3g networks ,4g networks , 5g networks and data analysis. There can be logic through which we can automate the distribution of bands by the colocation of different networks. Data analysis is characterized as a procedure of cleaning, changing, and displaying information to find helpful data for business dynamics. The reason for Data Analysis is to extricate valuable data from information and taking the choice dependent on the information investigation. At whatever point we take any choice in our everyday life is by contemplating what happened last time or what will occur by picking that specific choice. This is only breaking down our past or future and settling on choices dependent on it. For that, we accumulate recollections of our past or dreams of our future. So that is only information investigation. Presently same thing the examiner accomplishes for business reasons for existing, is called Data Analysis.

1.2 Organization

Ericsson is one of the main suppliers of Information and Communication Technology (ICT) to specialist organizations. We empower the full estimation of the network by making game-changing innovation and administrations that are anything but difficult to utilize, receive, and scale, making our clients effectively in a completely associated world. Telefonaktiebolaget LM Ericsson, otherwise called Ericsson, is a worldwide systems administration and media communications organization that is headquartered in Stockholm. The organization offers services, software, and framework in data and innovation for media communications operators, traditional broadcast communications, and Internet Protocol (IP) organizing hardware, portable broadband, activities, and business bolster administrations, digital TV, IPTV, video systems, and a broad administrations activity.

Ericsson had a 27% piece of the overall industry inside the 2G/3G/4G portable system foundation advertise in 2018. Lars Magnus Ericsson established the organization in 1876 and starting in 2016 it's headquartered in Stockholm, Sweden. There is an aggregate of

95,000 individuals utilized at Ericsson and it works in around 180 nations. Likewise, as of September 2019, the organization holds more than 49,000 conceded licenses incorporating various of those in remote interchanges and the organization additionally invests wholeheartedly in being the creator of Bluetooth innovation.

1.2.1 Vision

“Our purpose is to empower an intelligent, sustainable and connected world. For more than a century, we have been putting smart tools in the hands of people in every sector of our society, creating intelligent technologies that drive positive change. We remain committed to this effort, leaving no one behind.”

1.2.2 Brand Values

TRUST: We are a devoted accomplice and a power for good in the public eye.

DEVELOPMENT: We transform bits of knowledge without hesitation to propel ventures and society. Any Technology super-brand must be energized by persevering advancement and development.

PERFORMANCE: We excel with the best people and technology. Superior Performance has always been at the core of our brand.

1.2.3 Core Values

RESPECT: We must treat people with respect and value diversity. We must recognize the value of property and the environment.

PERSEVERANCE: We should always put in the extra effort even when things seem hard, troublesome or even impossible.

PROFESSIONALISM: We must act professionally and set high standards. We should take

1.3 Motivation

Ericsson advancements have changed each area of society, assisting with making positive change. We stay focused on driving this excursion. Expanding on our organizer's centre conviction of making correspondence accessible for all, we have been the main thrust behind the absolute most remarkable advancements in the world. Our industry is one of only a handful not many that contacts nearly everybody, wherever consistently, and by 2020, 90% of the total populace will be secured by versatile broadband systems. We hold more than 54,000 conceded licenses that have changed lives, ventures, and society in

general. Our advancements along with experiences into how they can comprehend business needs and genuine issues make transformative change in the public eye. By creating and conveying new correspondence advancements that are anything but difficult to embrace, use, and scale, we empower an eco-arrangement of players to improve on a cost-effective stage. These advancements are catalysing new ways for individuals and organizations to interface and succeed.

We enable our clients to associate individuals and change ventures, just as address probably the most squeezing difficulties within recent memory like environmental change, and in doing so make an increasingly feasible world. When I used to work on data came from OSS dump of 2g 3g and 4g networks which was part of our curriculum at that time , it created huge interest in me and I was very much eager to learn and to know the background process of each network. At that time, I used to think like

- How the real network is created
- How the traffic is controlled
- How the data gets exchanged at each layer

As Ericsson is a pioneer in all these fields it motivated me more and gave me an opportunity to see things live for the one (above mentioned) which I used to think of during my college days. So, these all things motivated me, and made me think more about networks and data analysis.

1.4 Objective

The target of the project is to configuration start to finish answers for automating main driver examination of 2g systems 3g systems and 4g organizes over yonder colocated BCF initialization alert and blackout caution. The structure of the framework incorporates the change of information from OSS dump, execution of different rationales for the covering of BCF introduction caution, and blackout alert to enormous arrangements of information that went ahead a regular routine. The targets of the task additionally incorporate the increasingly more information on 2g systems 3g systems and 4g systems. robotization and examination of system frameworks actualize various rationales and plans dissecting different information that went ahead a consistent schedule and different components like the real beginning and the real finish of BCF initialization alarm and blackout alerts there comparing hubs and cell names.

1.5 Target Specification

Ericsson here basically operates as in two different manners as one for Bharti airtel and another for vendors different from Bharti and out of India as I was the part of sdu Bharti

our work is concerned distinctly for sdu Bharti airtel India and Our customer which is certainly Bharti airtel expect us to convey reports to there group which was essentially the auto RCA report. auto RCA report was utilized to figure the blackout from the systems based on BCF initialization alarm and outage alerts from the 2g organize 3g systems and 4g systems. We likewise incorporate the various locales or we can say the various circles of India to keep up the auto RCA report. To recognize the ascent or drop in blackout cautions originating from the various circles of India.

1.6 Scope of Work

The automation and analysis in telecom systems are intended to figure main driver investigation for the 2g systems 3g systems and 4g systems blackout cautions for different operational units of an association. This includes investigating different information sources, OSS dump, BCF initialization alarm real beginning and real completion times in correlation with the comparing blackout alert genuine beginning and real consummation time of various systems, diverse cell information occasion ids enode_b_fdd and enode_b_tdd for the proficiency of the system. The frameworks are intended to effectively reproduce the mechanization in the use of groups in case of prerequisites from the customer's side.

Chapter – 2

Conceptual Overview

2.1 Network Division

In my three month internship being a part of the telecom company firstly everyone talks about telecom basics that consist of multiplexing, multiple access, frequency division multiple access, time division multiple access, high-speed packet access, and many more and it's the basic part of telecom from which we are already aware of so let's start with the generations in telecommunication here Simply, the "G" that we usually use after different generations stands for "GENERATION" of the telecom networks. Whenever you connect to the internet, the speed and capacity of your internet that you use for various purpose depends upon the signal capacity that used to be shown like 2G, 3G, 4G, and 5G, etc. We also have network division for all the networks whether its of any generation and its given as follows in fig(2.1).

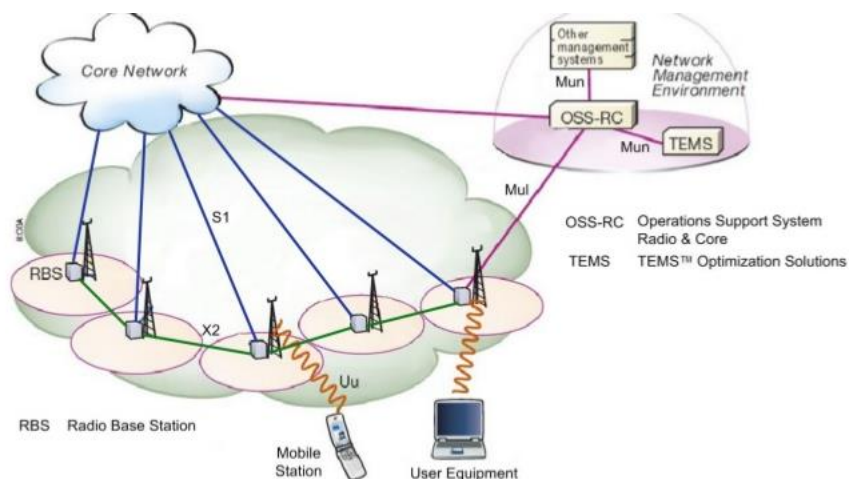


Fig. 2.1 Network Division

Every Generation is characterized as a lot of phone arrange measures, which detail the innovative usage of a specific cell phone framework and we here use to manage The speed increments and the innovation utilized on consistent schedule to accomplish so speed likewise changes and we can have organizes appropriately for the duration of the day or night on regular routine we know 1G offers 2.4 kbps, 2G offers 64 Kbps and

depends on GSM, 3G offers 144 kbps-2 mbps though 4G offers 100 Mbps - 1 Gbps and depends on LTE innovation and now we are going towards the fifth era too so lets first beginning with the theoretical investigation of every one of these ages.

Features	1G	2G	3G	4G	5G
Start/Development	1970/1984	1980/1999	1990/2002	2000/2010	2010/2015
Technology	AMPS, NMT, TACS	GSM	WCDMA	LTE, WiMax	MIMO, mm Waves
Frequency	30 KHz	1.8 Ghz	1.6 - 2 GHz	2 - 8 GHz	3 - 30 Ghz
Bandwidth	2 kbps	14.4 - 64 kbps	2 Mbps	2000 Mbps to 1 Gbps	1 Gbps and higher
AccessSystem	FDMA	TDMA/CDMA	CDMA	CDMA	OFDM/BDMA
Core Network	PSTN	PSTN	Packet Network	Internet	Internet

Fig. 2.2 Comparison between different Networks

2.2 Data Analysis in Automation

Being a part of the automation team SDU Bharti I have to work on data that came from OSS dump that belongs to different circles of India to automate the BCF initialization alarm and outage alarm so let's take a look over data analysis, its process of analysis. Data assessment is portrayed as a methodology of cleaning, changing, and showing data to discover significant information for business dynamic. The purpose behind Data Analysis is to isolate significant information from data and taking the decision reliant on the data examination.

At whatever point we take any decision in our regular day to day existence is by thinking about what happened last time or what will happen by picking that particular decision. This is just separating our past or future and choosing decisions reliant on it. For that, we collect memories of our past or dreams of our future. So that is just data examination. By and by same thing master achieves for business objects, is called Data Analysis.

2.2.1 Step 1: Asking the right question?

The initial move towards any kind of information investigation is to ask the privilege question(s) from the given information. Recognizing the goal of the examination, it gets simpler to choose the type(s) of information we will need to reach inferences.

2.2.2 Step 2: Information Wrangling

Information wrangling, now and again alluded to as information munging, or Data Pre-Processing, is the way toward social occasion, evaluating, and cleaning of "crude"

information into a structure reasonable for examination. Information wrangling has 3 sub-steps:

- **Gathering data:**

Subsequent to distinguishing the target behind our examination, the following stage is to gather the essential information required by us to reach suitable determinations. There are different strategies by which we can gather data. Some of which are: —

For this report for understating this well, we will utilize the titanic informational index transferred in kaggle.com for our examination. Right off the bat, Lets import all the libraries and the 'train.csv' informational index we will require all through our investigation.

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
%matplotlib inline

data=pd.read_csv('train.csv') # Gathering data
data.head()
```

	PassengerId	Survived	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	1	0	3	Braund, Mr. Owen Harris	male	22.0	1	0	A/5 21171	7.2500	NaN	S
1	2	1	1	Cumings, Mrs. John Bradley (Florence Briggs Th...	female	38.0	1	0	PC 17599	71.2833	C85	C
2	3	1	3	Heikkinen, Miss. Laina	female	26.0	0	0	STON/O2. 3101282	7.9250	NaN	S
3	4	1	1	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0	1	0	113803	53.1000	C123	S
4	5	0	3	Allen, Mr. William Henry	male	35.0	0	0	373450	8.0500	NaN	S

Fig. 2.3 importing data for data analysis

- **Assessing of data**

After the information has been assembled, put away in a bolstered arrangement, and allocated to a variable in Python. It's a great opportunity to increase some elevated level outline of the sort of information we are managing. It incorporates picking up data, for example if we want to see the rows and columns of the data then we can access it in the following way.

```
print('Number of rows: ',data.shape[0],'\nNumber of columns: ',data.shape[1])
```

```
Number of rows: 891
Number of columns: 9
```

Fig. 2.4 Accessing Data

Next sections present in the informational index, alongside the information type and number of non-invalid qualities. STEP-3 Exploratory Data Analysis

```
data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 891 entries, 0 to 890
Data columns (total 12 columns):
 PassengerId      891 non-null int64
 Survived         891 non-null int64
 Pclass          891 non-null int64
 Name             891 non-null object
 Sex              891 non-null object
 Age             714 non-null float64
 SibSp           891 non-null int64
 Parch           891 non-null int64
 Ticket          891 non-null object
 Fare            891 non-null float64
 Cabin           204 non-null object
 Embarked        889 non-null object
dtypes: float64(2), int64(5), object(5)
memory usage: 83.6+ KB
```

Fig. 2.5 gathering data information

The above yield shows the name of segments, alongside a few non-invalid qualities and the information sort of every segment. From the above yield some columns have missing values, which we need to deal with in Data Cleaning stage.

- **Data Cleaning**

Data cleaning is the way toward distinguishing and remedying missing, or mistaken records from an informational index. In this procedure, information present in the "crude" structure (having missing, or off base qualities) are cleaned fittingly with the goal that the yield information is drained of absent and incorrect qualities. Since no two informational indexes are same, subsequently the technique for handling absent and mistaken qualities shift enormously between informational indexes, however more often than not, we either top off the missing qualities or expel the component which can't be worked upon. In the above data set age column have many missing values which will now deal with following method.

```

import random
print('Number of Missing values in Age:',data['Age'].isnull().sum())

mean = data['Age'].mean()
std = data['Age'].std()
lower_limit = round(mean-std,0)
upper_limit = round(mean+std,0)
random_list=[]
for i in range(0,177):
    random_list.append(random.randint(lower_limit,upper_limit))

random_list=np.array(random_list)

age=data['Age'].values

k=0
for i,j in enumerate(age):
    if np.isnan(age[i]):
        age[i]=random_list[k]
        k+=1

data['Age']=age

print('Number of missing values in age: ',data['Age'].isnull().sum())

```

```

Number of Missing values in Age: 177
Number of missing values in age: 0

```

Fig 2.6 Data cleaning

2.2.3 STEP-3 Exploratory Data Analysis

When the data is gathered, cleaned, and prepared, it is prepared for Analysis. As you control data, you may discover you have the specific data you need, or you may need to gather more information. During this stage, you can utilize information investigation apparatuses and programming which will assist you with understanding, decipher, and determine ends dependent on the prerequisites.

As the Titanic data collection is presently cleaned, we will currently do some modEDA's on it.

Analyze utilizing visualization techniques, which Gender was given more priority during the rescue operation?

```
! Adding a new column 's' to store survived status as a string for
! better visualisations.
data['s']=''
data.loc[(data['Survived']==1), 's'] = 'Survived'
data.loc[(data['Survived']==0), 's'] = 'Not Survived'
sns.countplot(x='Sex', hue='s', data=data)
```

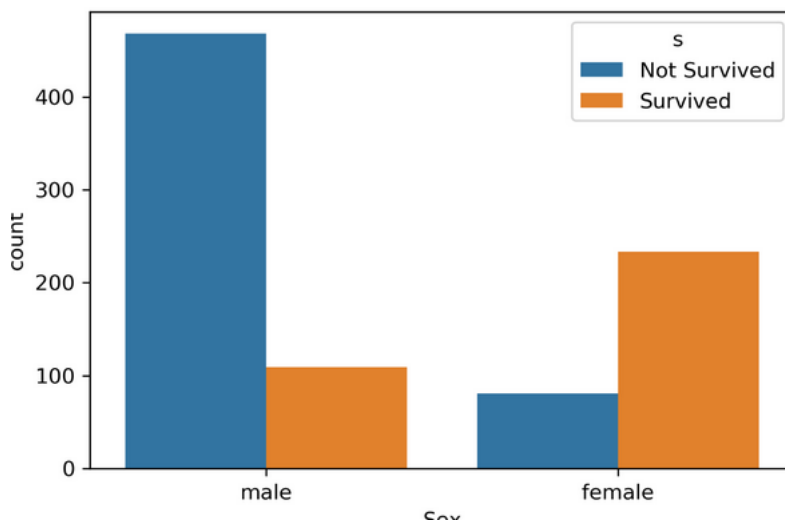


Fig. 2.7 exploratory data analysis

In this manner, from the above representation, we can surmise that females were given need during the salvage activity because of their low mortality consider contrasted with guys.

2.2.4 STEP-4 Conclusion

After the investigation stage is finished, the subsequent stage is to decipher our examination and make inferences from it. As we decipher the information, there are 3 key inquiries which ought to be posed by us: —

- Did the investigation answer my unique inquiry?
- Was there any impediment in my investigation which would influence my decisions?
- Was the examination sufficiently adequate to help dynamic?

From the examination of the titanic informational collection (connect), we had the option to discover the main considerations which added to an individual's possibility of

endurance.

2.2.5 STEP-5 Communicating Results

Since data has been investigated, ends have been drawn; it's a great opportunity to convey your discoveries to the concerned individuals or imparting to mass utilizing data narrating, composing online journals, making introductions or documenting reports. Incredible relational abilities are an or more in this phase since your discoveries should be conveyed in a legitimate manner to others.all the steps are not following each other they are actually non linear in nature.

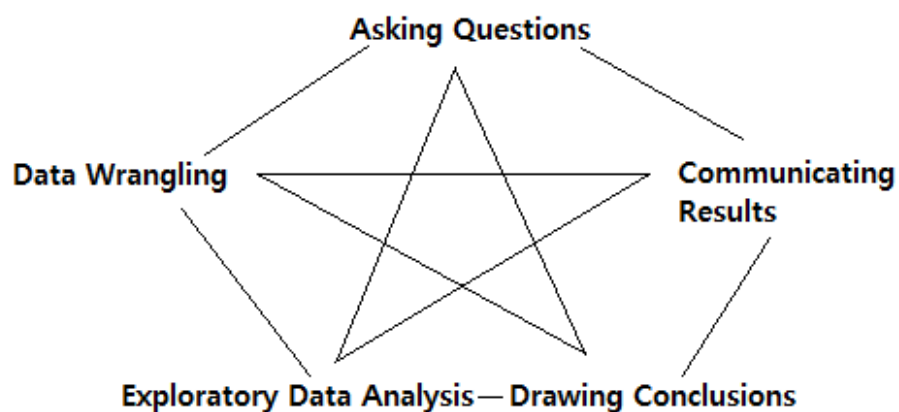


Fig .2.8 Interlinkage between different steps of data analysis

2.3 Software And Programming language Used

Introduction to software and programming language used in automation and analysis of telecom networks is given as follows well we cannot discuss them completely here there some introduction about them is given along with them.

2.3.1 Jupyter Notebook

jupyterLab is an online keen improvement condition for Jupyter scratch cushion, code, and data. JupyterLab is versatile can plan and arrange the UI to help a wide extent of work forms in data science, intelligent enlisting, and AI. JupyterLab is extensible and estimated: create modules that incorporate new fragments and fuse with existing ones.TheJupyter Notebook is an open-source web application that grants you to make and offer documents that contain live code, conditions, portrayals and record content. Uses include: data cleaning and change, numerical amusement, verifiable showing, data discernment, AI, and altogether more.

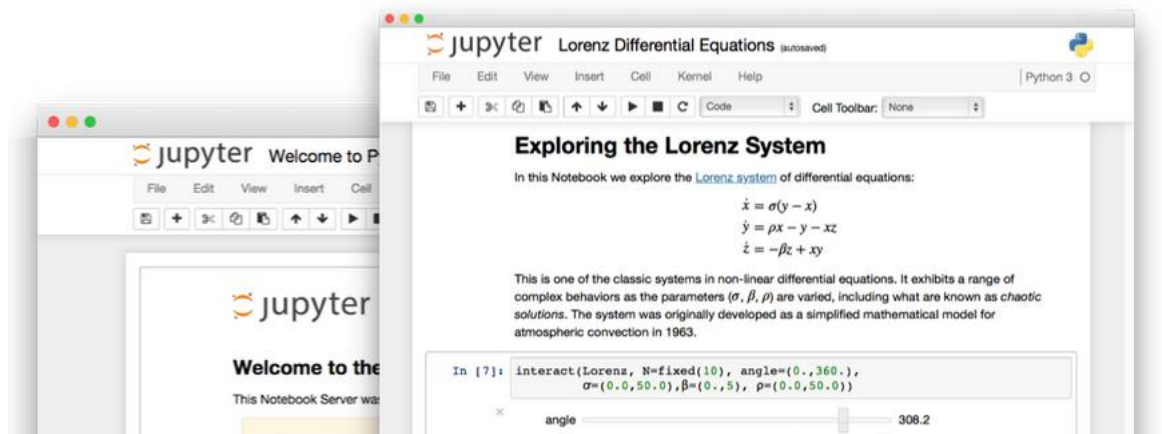


Fig .2.9 jupyter notebook IDE

2.3.2 Excel

Excel is a spreadsheet made by Microsoft for different platforms Windows, macOS, Android, and iOS. Its features can be used to calculate, diagramming gadgets, turntables, and an enormous scope programming language called Visual Basic for Applications.

2.3.3 Python

Python is a deciphered, huge level, extensively valuable programming language. created by Guido van Rossum in 1991, Python's structure thinking stresses code seriousness with its striking usage of immense whitespace. Its language constructs and thing arranged technique intend to help programming engineers with making clear, reliable code for nearly nothing and gigantic degree ventures.

Python is logically created and waste assembled. It reinforces different programming gauges, including sorted out (particularly, procedural), object-arranged, and utilitarian programming. Python is as often as possibly depicted as a "batteries included" language due to its sweeping standard library.

Python was envisioned as a substitution to the ABC language. Python 2.0, released in 2000, introduced features like overview discernments and a refuse arrangement system fit for get-together reference cycles. Python 3.0, released in 2008, was a critical change of the language that isn't absolutely in turn around great, and much Python 2 code doesn't run unmodified on Python 3.

Chapter-3

GLOBAL SYSTEM FOR MOBILE COMMUNICATION

GSM was first developed by ETSI to support protocols for 2G networks used by wireless devices. It comprises only of circuit switched network which supports SMS (Short Message Services) and voice calls. The access techniques used are Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA). The modulation technique used is 8-PSK (Phase Shift Keying) which supports 3 bit/symbol.

3.1 PHASE OF GSM

In 1980s, the group that were doing developing the GSM Model realised that it was not possible for them to construct the whole model at one go with all the features so they decided to release it in various phases with some addition in features in all the respective stages.

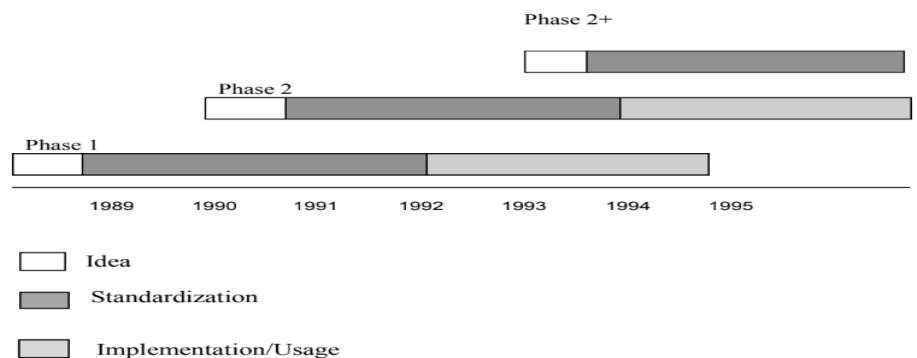


Fig 3.1 GSM Model phase

Phase 1

Phase 1 consisted of features like:

- Call forwarding
- Voice Telephony
- International Roaming
- Call Barring
- SMS

Stage 1 included highlights like figuring and Subscriber Identity Module (SIM) cards. Later it was shut and can't be changed.

Phase 2

Phase 2 consisted of additional features like:

- Call hold
- Call Waiting
- Conference Calling
- Charge Advice
- Identification of Call

Phase 2+

- Multiple profiles
- numbering plans
- Access to services
- working with GSM 1800, GSM 1900 and with the most important Digital Enhanced Cordless Telecommunications (DECT).

3.2 GSM COMPONENTS

The GSM design can be partitioned into two sections: Each of these frameworks are included various practical units which are singular segments of the portable system. The two frameworks are:

- Switching System
- Base Station System

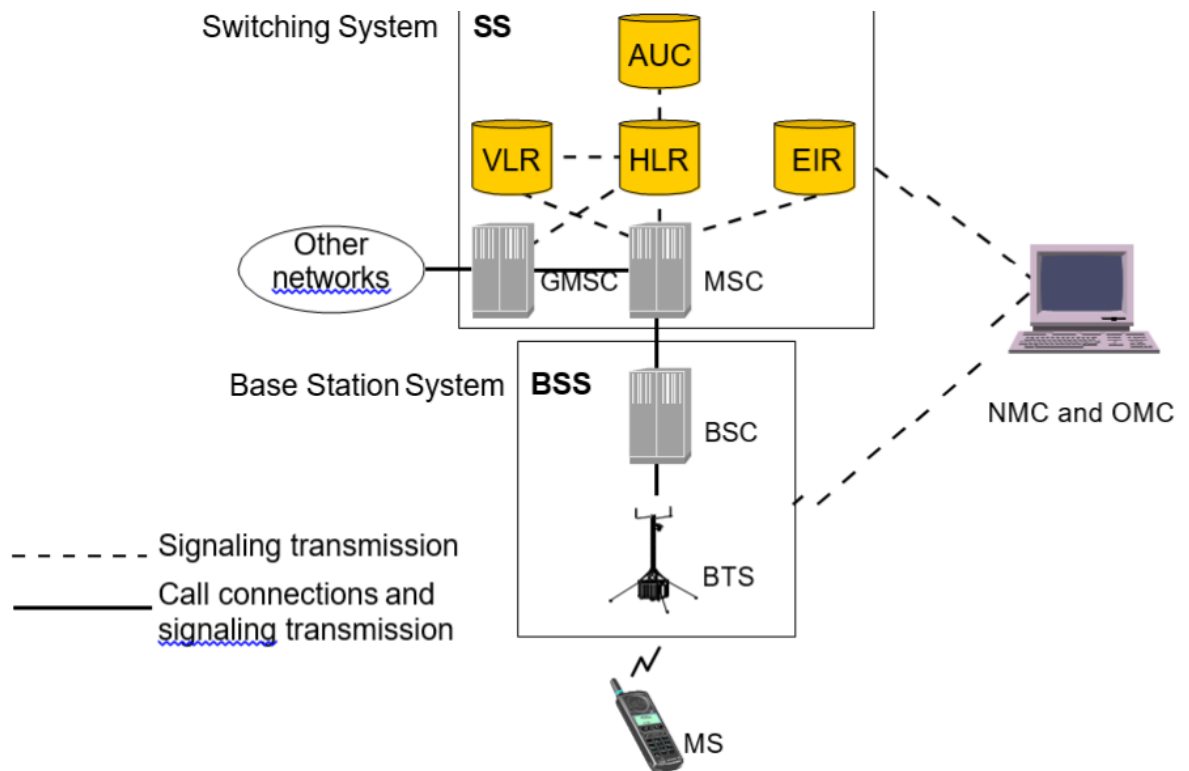


Fig 3.2 GSM Network Component

Switching System: It is the core part of the network which is responsible for routing and switching of calls. It also handles subscriber's information. The nodes which are a part of Switching System are:

• **Mobile Switching Center (MSC):**

The MSC performs the call switching and routing processes for the mobile network. It routes calls to and from other telephony and data systems, such as the Public Switched Telephone Network (PSTN), Integrated Services Digital Network (ISDN), public data networks, private networks and other mobile networks with the help of some protocols.

Its functions are: o It is a part of control layer.

1. It serves mobile subscribers, taking care of mobility management.
2. Establishes and control speech and data connections.
3. Store and manage subscriber data using in-built VLR.
4. Manage radio resources by control of the RAN nodes like BSC and RNC.
5. Connect to SGSN by Gs Interface in Packet Switched Network (in case of GPRS).
6. Route calls inside a PLMN using BICC and ISUP signaling.
7. subscription information until subscription is deleted.

- **Home Location Register:**

The HLR is a brought together database that stores and deals with every single versatile membership and subtleties that has a place with a particular administrator. It goes about as a changeless location for an individual's membership data until that membership is erased. Its principle capacities are as per the following:

- o Permanent Storage of details
- o Billing and Charging
- o Location Update o Subscriber's authentication information(IMSI,IMEI)

- **Visitor Location Register:**

The VLR database comprises of information pretty much all the versatile supporters that are right now associated with a specific MSC. Along these lines, there is only one VLR for a MSC in a specific system. The VLR by and large holds a transitory database of memberships with the goal that the MSC can support all the endorsers right now visiting that specific MSC. The VLR can be viewed as a conveyed HLR as it additionally stores information like HLR yet its information is brief not normal for HLR's. Its capacities are:

- o Temporary storage of data
- o We can identify the current location of both visitors and home subscribers from VLR.

- **Equipment Identity Register (EIR):**

The EIR a database that contains mobile equipment identity information of a subscriber. This particular register helps to block calls from stolen, unauthorized, or defective Mobile Stations. Its main function is to store the IMEI number of a person. It also maintains the grey, black and white list which greatly helps in the mobile tracing activities.

- **Authentication Centre:**

The primary capacity of the AUC is to confirm the supporters endeavouring to utilize a system. It is utilized to shield the system from extortion supporters. The AUC is a database that is associated with the HLR which furnishes it with the validation parameters and figuring keys used to ensure that the system is secure.

- **Base Subsystem:**

It consists of two parts which are mainly responsible for radio resource allocation.

- **Base Station Controller**

The BSC controls all the radio-related usefulness of a GSM arrange. It is a kind of switch that gives capacities like handover, radio channel designation, and cell setup. Various BSCs are commonly constrained by an MSC. It likewise controls BTS.

- **Base Transceiver Station**

The BTS controls the radio interface to the Mobile Station. The BTS includes the radio gear, for example, handsets and reception apparatuses which are expected to serve every phone in the system. A gathering of BTS is normally constrained by a BSC.

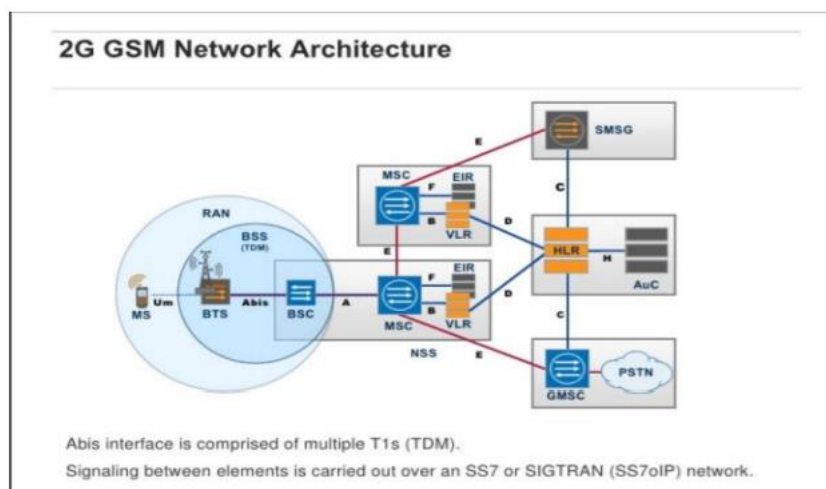


Fig . 3.3 2G GSM Network Architecture

3.3 3G NETWORK

The 3G framework comprises of two primary parts: the User Equipment (UE) and UTRAN. The UE is the cell phone and the UTRAN is the base station and the system knowledge. Both the UE and the UTRAN are made out of various layers. The four least layers are the physical layer (PHY), the Medium Access Layer, the Radio Link Layer (RLC), and the Radio Resource Layer (RRC). This content will give a general portrayal of the UE and the capacity of the various layers with the attention on the RRC layer

since this is the main layer engaged with the task.

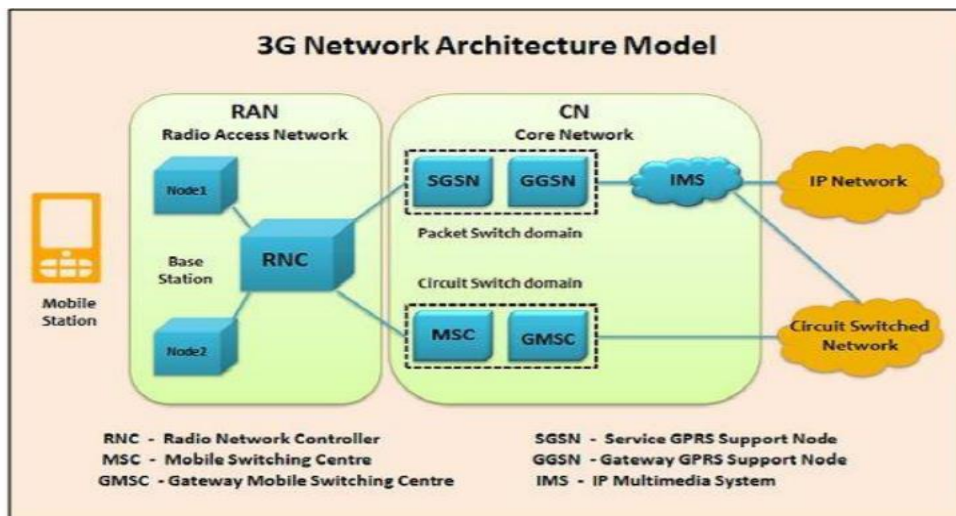


Fig. 3.4 3G Network Architecture Model

WCDMA (Wideband Code Division Multiple Access) is a type of communication standard which is used in 3G cellular communication. Here, the access technique used is Code Division Multiple Access (CDMA). The frequency of 5 MHz is supported. Type of Modulation technique used is Quadrature Amplitude Shift Keying (QPSK).

3.3.1 Radio Access Network Part (RAN)

• NodeB:

It works just like a BTS in GSM network. One of its main task is radio resource management. Some of its functions are :

- o Connecting with RNC by IuB interface.
- o Connection of MAC protocol for transport channels such as RACH, FACH
- o Inner and Open loop power control
- o Radio Channel coding/decoding
- o Connecting User Equipment (UE) with Uu interface.
- o RF processing

• RNC (Radio Network Controller):

It works just like BSC in GSM network. Some of its functions are :

- o RNC controls radio resources in its area. One RNC controls multiple nodeB.
- o It works just like BSC but the difference is that it is more intelligent.
- o RNC looks after resource allocation.
- o Connecting to Circuit and Packet Switched Networks respectively.

o Connecting two RNC via X2 interface.

3.3.2 CORE PART:

The core part have packet switched and circuit switched. circuit switch core part is same as that of GSM network and it is already explained earlier. Now, we will focus on the packet switched network. It generally handles the data part. There are two parts:

Serving GPRS Support Node (SGSN):

The main function is that it provides authentication to the subscriber through Authentication Center (AUC). The IDS (Internal Domain Server) helps SGSN to detect the appropriate GGSN and helps the connection between them.

Gateway GPRS Support Node (GGSN):

It provides end to end service. GGSN generally provides an IP to the subscriber and connects it to different IPs like Facebook, Google, etc. IP given to us is private and dynamic in nature.

3.3.3 User Equipment (UE):

It is similar as Mobile Station (MS) in GSM network. Its advantage is that it is more intelligent and it can do multitasking. These type of handsets are usually capable of connecting to the internet. It is supports connectivity between two devices or between device and internet. The name is provided by the 3GPP standard. These phones usually consists of USIM (Universal Subscriber Identity Module).

3.4 Long Term Evolution (LTE)

Research on LTE began during the mid 2004 by 3GPP (Third Generation Partnership Project), a media transmission body. LTE advanced from UMTS (Universal Mobile Telecommunication System), which developed from GSM. The most importantly form of LTE was reported in Release 8 of the 3GPP details. The quick increment in the utilization of information, web based games, IP-TV, and so forth required the improvement of a more up to date innovation with higher velocities and information rates. In this manner, LTE was created with 300 Mbps top downlink and 75 Mbps top uplink. LTE is an ideal innovation to help administrations like Voice over IP (VOIP) and video conferencing. It utilizes both the FDD (Frequency Division Duplexing) and TDD innovation.

3.4.1 Network Architecture

The architecture of LTE have following components:

- The User Equipment.
- The Evolved UMTS Terrestrial Radio Access Network.

- The Evolved Packet Core.

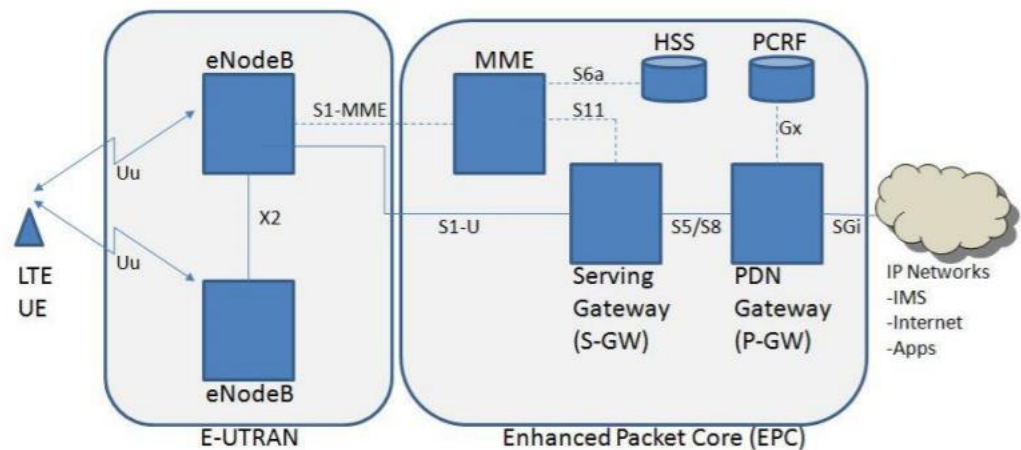


Fig. 3.5 4G architecture

- **e-NodeB:**

The E-UTRAN handles the radio interchanges between the UE and the advanced parcel center and simply has one single segment, called eNodeB . Each eNodeB is a base station that controls the UEs in at least one than one cell. The base station that is discussing straightforwardly with a versatile is known as its serving eNodeB.

- **MME:**

MME represents Mobility Management Entity. MME controls the activities of the UE by methods for flagging messages and Home Subscriber Server (HSS).Some of its capacities are:

- o NAS Security
- o Idle state mobility handling
- o EPS bearer control

- **PGW:**

The Packet Data Network Gateway (P-GW) speaks with the outside world for example parcel information systems, through SGi interface. Every bundle information organize is given a passage name (APN). The PDN portal capacities same as the GPRS bolster hub (GGSN) and the serving GPRS bolster hub (SGSN) in UMTS and GSM.

- **SGW:**

The serving portal (S-GW) fills in as a switch, and advances information between the base station (BS) and the PDN passage. Its usefulness is comparative as SGSN of GSM innovation.

- **HSS:**

Home Subscriber Server (HSS) is a central database that contains all the necessary information about the network operator's subscribers. It acts same as the Home Location Register (HLR) in GSM.

- **PCRF:**

PCRF represents Policy Control and Charging Rules Function. It is a part which is answerable for approach control and dynamic, just as for controlling the charging functionalities in the Policy Control Enforcement Function (PCEF), which is available in the PGW. It for the most part monitors the plans bought in by a specific client.

Chapter 4

RESULT ANALYSIS

After the culmination of the considerable number of stages, the normal outcomes from this task were robotization through the assembled information of 2g and 4g dependent on given information that comprises of all the significant traits of 2g systems and 4g systems as indicated by circles exist inside India. 4g utilizes transmission capacity from 2g and 3g unutilized transfer speed by the collocation of 2g with a 3g band.

This automation and analysis in telecom systems are practiced utilizing python for coding and principle libraries from it were pandas, NumPy, while different stages and programming utilized, were Jupyter notebook, text files, log files, and CSV files.

4.1 Insight about 2g network 4g network and collocated files

Automation root cause analysis project basically handle through three different files where first one is 2g network file of the circle which is already populated with its Auto RCA column through this file we actually need unique cell names of 2g circles along with its Auto RCA and actual starting time of alarm and actual end time of alarm. then we have collocated file where we have 2g cells that are mapped with 4g enode_b_fdd and 4g enode_b_tdd enode_b_names we have to take these names from this file. third file here we have is 4g file from where we have to take enode_b_names actual start time of outage alarm and actual end time of outage alarm and corresponding auto RCA column.

4.2 Work flow

As we already said about what are the main column that we have to fetch from 2g network file, 4g network file and collocated file now we have to understand the work flow which is given below.

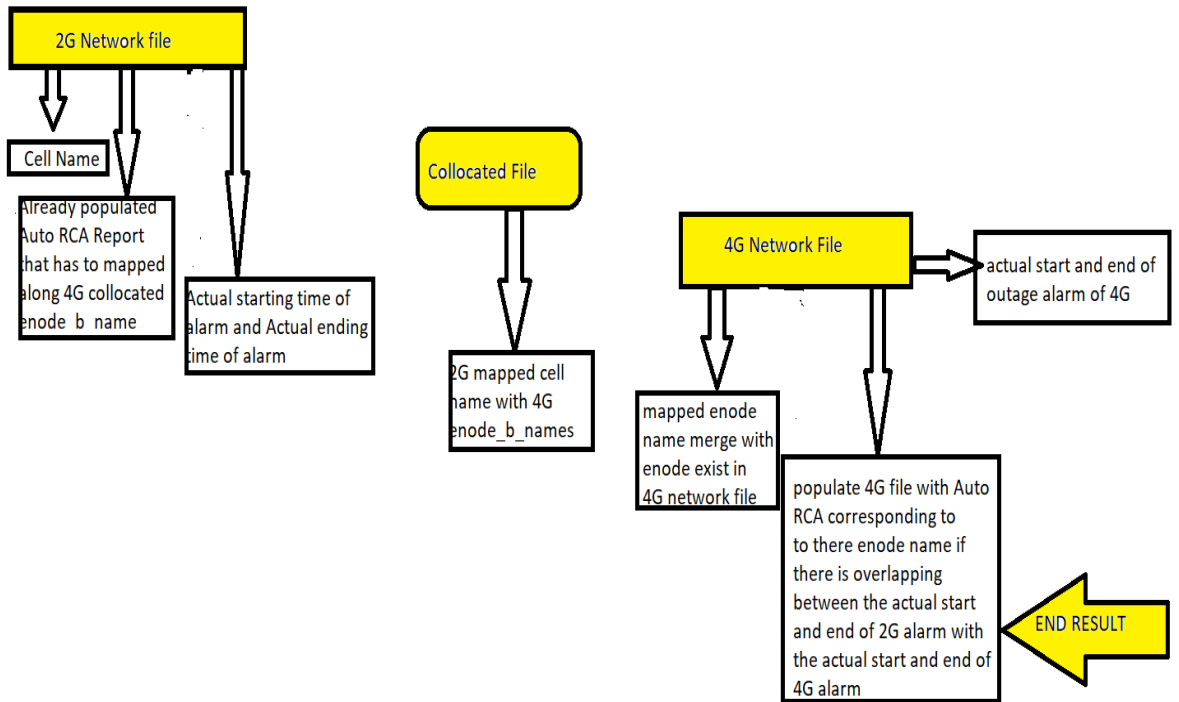


Fig 4.1 Work flow diagram of Auto RCA

4.3 Logic behind overlapping

As we already discussed earlier we have to populate 4G report file with Auto RCA in accordance with the overlapping between the alarm interval that came from 2G Network file and the alarm interval that came from 4G Network file according to following logic.

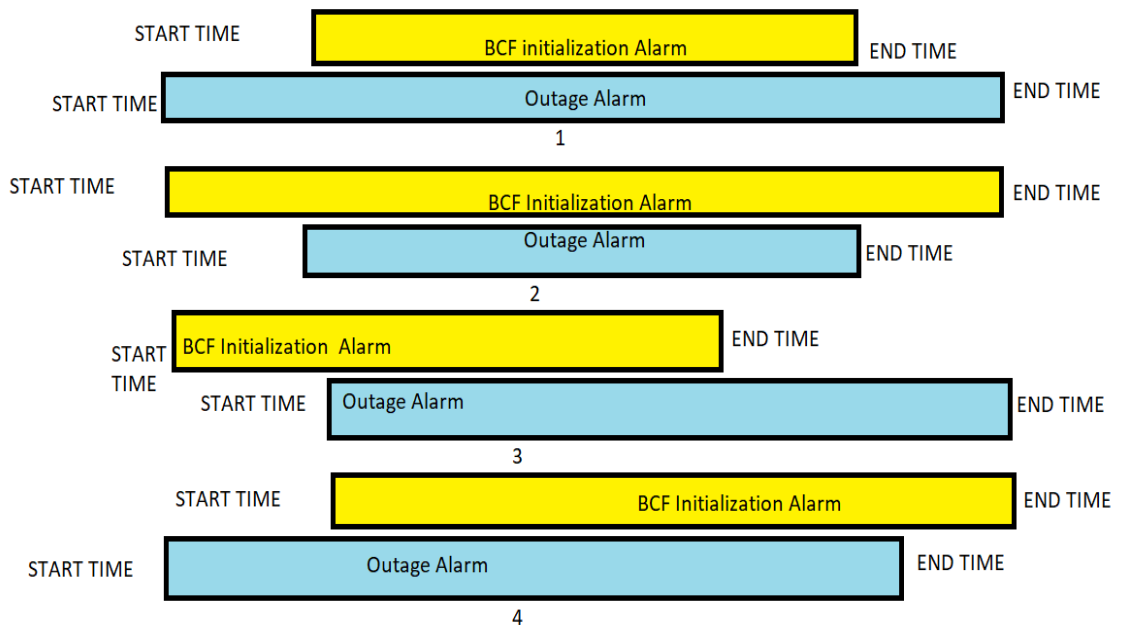


Fig .4.2 Overlapping logical representation

We can populate 4G report if and only if there is an overlapping of these interval in the above mention way.

Chapter 5

Conclusion And Future Scope

As we know that our main motive is to analyse the Alarms that came from different Networks and we have to automate their root cause analysis report on the basis of their criticality so that we can our network more and more efficient. there are total 4 types of alarms that we consider in telecom and according to which we populate out different reports of different networks. these four different alarms and there resolving methodology is given below.

Alarm name	Alarm type	Response time
A1	Critical	1hr 45 mins
A2	Major	4hrs
A3	Minor	6hr
O1,O2	Warning	30 Days

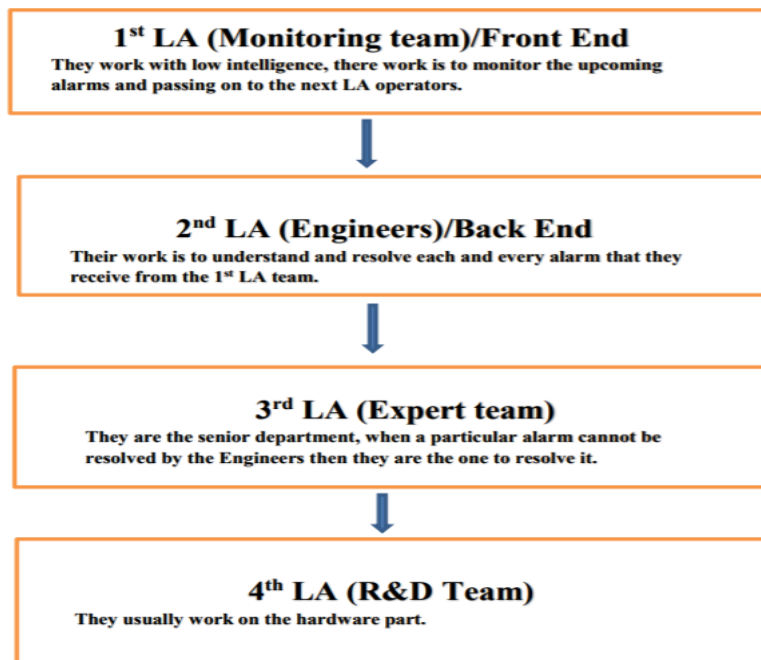


Fig . 5.1 Alarm type and Alarm resolving methodology

5.1 Work Conclusion

- During the 1st month, I got an overview of the telecom basics including GSM, 3G, 4G model architectures, and important nodes (like Visitor Location Register, Home Location Register, MSC, BSC, RNC, NodeB, etc).
- After this, I was assigned a few projects with the SDU Bharti Team in the Automation domain. Currently, I am a part of two projects, namely Auto RCA (Automation in Root Cause Analysis) and ONE-FM (one-FM Project that consist different venders even Ericsson as well).
- My first Project with Auto-RCA deals with alarms that came from different nodes of different networks of all the 23 circles of Bharti India.
- My other project with One-FM deals with different states of critical alarms . In the later months, I will be working on the nodes and live networks of Ericsson wherein I will be automating and analysing the nodes deployed at different locations.
- Likewise filling in as an intern in a professional workplace has made me acquainted with a portion of the key business issues applicable to the ICT business, for example, guideline, legitimate contemplations, and the financial aspects of media communications foundation, and so on. Most importantly, I have obtained applicable association abilities, client care aptitudes, organize arranging abilities, and so forth and I immovably accept that the specific arrangement of logical and center aptitudes in the field of media communications and systems administration could be applied to successfully oversee tasks and organizations inside the capital-escalated ICT industry in which I wish to work sooner rather than later.

5.2 Future Scope

Administrators are searching for approaches to expand limit, inclusion and at same time guarantee that their business KPIs are met. They have been requesting a superior situation for advancements to have the option to give it a shot and execute new plans of action. The mechanization and examination in telecom systems are intended to figure underlying driver investigation for the 2g systems 3g systems and 4g systems blackout alerts for different operational units of an association. This includes dissecting different information sources, OSS dump, BCF initialization alarm beginning, and real completion

times in correlation with the relating blackout caution genuine beginning and real consummation time of various systems, distinctive cell information occasion ids enode_b_fdd and enode_b_tdd for the productivity of the system. The frameworks are intended to be effectively duplicate the mechanization in the usage of groups in case of prerequisites from the customers side. They need productive systems and activities where administrations can be sent rapidly and easily while having the apparatuses to convey and offer new administrations. They additionally need virtual answers for empower an exceptional adaptability and adaptability, from littler decentralized organizations to bigger concentrated arrangements.

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