RADIO NETWORK PLANNING AND OPTIMIZATION IN TELETALK BANGLADESH LTD.

BY

MD. MAHBUB MURSHED
ID: 083-19-971

This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Electronics and Telecommunication Engineering

Supervised By

MR. MOHASHIN UDDIN PATHAN
Lecturer
Department of ETE
Daffodil International University

DAFFODIL INTERNATIONAL UNIVERSITY
DHAKA, BANGLADESH

Letter of Transmittal

August 15, 2012

To
Dr. Md. Fayzur Rahman,
Professor & Head Department: Electronics & Telecommunication Engineering Faculty: FSIT
Daffodil International University, Dhaka

Subject: Submission of Internship Report

Dear Sir,

I have pleasure in submitting my report on **"Radio Network Optimization in Teletalk Bangladesh Ltd.".**According to your requirement I had worked on the sector of telecommunication in Teletalk Bangladesh Limited under the instruction of Mohammad Wali Hasan, Manager, and System Engineer. It was a challenging work because; in our country Teletalk Bangladesh Limited is using such kind of higher technology. Before this training we had little knowledge about telecom sector. While, working on it, I needed to enter the Mobile Switching Centre of Teletalk, which was an exceptional case during internship. I had also got an opportunity to precipitate in troubleshooting during optimization.

Though there were many hindrances arose during we were conducting data and information for this project, I tried my level best to collect as much necessary information as possible.

I would like to request you to accept my report and oblige thereby.

Thank you, Sir
Yours sincerely

MD.Mahbub Murshed

ID:083-19-971

ETE, Department

Approval

The internship report titled **"Radio Network Optimization in Teletalk Bangladesh Ltd." has been** submitted by MD.Mahbub Murshed

ID:083-19-971

to the ETE Department of Daffodil International University for satisfactorily partial fulfillment of the requirement for the degree of Bachelors of Science in Electronics and Telecommunication Engineering (BS ETE). The presentation has been held on August 27, 2012.

BOARD OF EXAMINERS

Dr. Md. Fayzur Rahman
Professor and Head
Department of ETE
Faculty of Science & Information Technology
Daffodil International University

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Mirza Muhammad Golam Rased
Assistant professor
Department of ETE
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Daffodil International University

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Faculty of Science & Information Technology
Daffodil International University

Internal Examiner

Dr. Subrata Kumar Aditya
Professor and chairman
Department of applied physics,
Electronics and telecommunication engineering
University of Dhaka

External Examiner

ACKNOWLEDGEMENT

This Intern Report which is entitled as **"Radio Network Planning and Optimization in Teletalk Bangladesh Ltd."** is the concrete effort of a number of people.

All praise to **Allah**, the **Almighty**, and the **Mercifu**l. Without his blessing and endorsement this report would not have been accomplished.

In the process of conducting this research project, I would like to express my gratitude and respect to some generous persons for their immense help and enormous cooperation.
At First I would like to pay my gratitude and respect to my supervisor **Mr.Mohashin Uddin Pathan who** gave and confirmed the permission and encouraged me to go ahead with my internship.

I would like to thank our honorable Prof Dr. Md. Fayzur Rahman**,** Professor & Head**,** ETE for giving me permission to commence the internship and to prepare my research about this splendid topic.

After that I would like to express our gratitude to Manager, System Engineering Teletalk Bangladesh Ltd; for his keen interest and valuable suggestions about this topic. I will never forget my instructor **Engr Asif ferdous,** for him cooperative attitude for my research and also for giving me courage to do this work.

I also, thanks to my parents, and some friends who keep on this long process with me, always offer support

Declaration

I hereby declare that, this internship has been done by us under the supervision of **Mr. Mohashin Uddin Pathan, Lecturer and Dept of ETE of** Daffodil International University. I also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

Supervised by:

_____

Mohashin Uddin Pathan
Lecturer
Department of ETE
Daffodil International University

Submitted by:

_____

Md. Mahbub Murshed
ID: 083-19-971
Department of Electronics & Telecommunication Engineering
Daffodil International University

ABSTRACT

As a modern technology the microwave is the main technical support of Teletalk. In our country Teletalk covers maximum area through the microwave radio link backbone. This frequency is received by the GSM Antennas and then the cell phone can receive the frequencies from GSM antennas of BTS. In this research paper, radio network planning and optimization process have been descried by me. In order to meet the requirements of the mobile services, the radio network must offer sufficient coverage and capacity while maintaining the lowest possible deployment costs. For doing this research I had to go Rupayan Tower, Ramna where MSC (Mobile Switching Center) located and many other places. It is hoped that technology will be known and the thirst of knowledge about this topic will be quenched successfully.

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OVERVIEW

1-1 Company Overview

Teletalk Bangladesh Limited is a public limited company, registered under the Registrar of the Joint stock companies of Bangladesh. Total shares owned by the Government of the Peoples Republic of Bangladesh.

This company continues to grow and engage customers through clear commitment of offering high quality products and services as well as leading customer retention and loyalty programmers. Teletalk continues to be a part of the revolution that's connecting millions of Bangladeshi people along with the world.

Teletalk Bangladesh limited was established keeping a specific role in mind. Teletalk has forged ahead and strengthened its path over the years and achieved some feats truly to be proud of, as the only Bangladeshi mobile operator and the only operator with 100% native technical and engineering human resource base, Teletalk thrives to become the true people's phone – "আমাদের ফোন".

Basic objectives for which the Company was formed are highlighted in following:

- To provide mobile telephone service to the people from the public sector
- To ensure fair competition between public and private sectors and thereby to safeguard public interest
- To meet a portion of unmitigated high demand of mobile telephone
- To create a new source of revenue for the government.

Incorporation of Teletalk:

Teletalk Bangladesh Limited (the "Company") was incorporated on 26 December, 2004 as a public limited company under the Companies Act, 1994 with an authorized capital of Tk.20, 000,000,000 and became the only government sponsored mobile telephone company in the country. On the same day the Company obtained Certificate of Commencement of Business.

Company's Network Expansion:

Teletalk Bangladesh Limited has continually expanded its network to better accommodate its growing customer base as well as to keep the promise of providing better service. Presently Teletalk has already established its network foothold in 64 Districts, 402 Upazilas, and most of the highways. Teletalk keeps continuing its network expansion in order to reach all the corners of Bangladesh.

Scope to be explored:

The term 'm-Governance' is derived from e-governance which refers to government's use of information and communication technology for exchanging information as well as services with citizens, businesses, and other arms of government. Teletalk is prepared to provide with the help of third party software, mobile interactivity for the citizens of Bangladesh with m-Governance. This may includes, but not limited to

1 Mobile based Live Citizen Reporting Solution
2 Mobile User Info bank (Database of Mobile Users of Bangladesh)
3 Agriculture information services for the farmers and also for the end users, like product price in different parts of the country.
4 Product ID for all consumer products/ Organization.
5 Interactivity between Government and the Citizens.

Possible departments who will be directly benefited from the above services are:

1 Police.
2 Rapid Action Battalion
3 Fire Service

4 NBR
5 Agriculture Department.
6 BRTA
7 BSTI
8 BTRC
9 Election Commission
10 Health Services.

1-2 Services

Teletalk offers a wide range of services to its customers. Following are an outline of the services presently available with Teletalk:

GPRS (General Packet Radio Services)

Teletalk offers internet browsing facility for both post-paid and pre-paid subscribers. One can use this facility by using data-cable in computer also. Handsets with GPRS option enable this facility. Through Teletalk GPRS, the subscribers can use the facilities like browsing, email, internet chatting, data transfer etc.

Push-pull services

As ordinary SMS, one can receive answer to a question he/she asks. By using this push-pull service, one can have the latest updates of important cricket matches. Besides, other important information like weather forecast, prayer time, quotes, horoscopes and especially sehri-iftar timing during Ramadan etc are also available.

SMS

It allows a SMS of 160 characters each available both in English and Bangla.

ISD and EISD

Every subscriber of Teletalk gets the opportunity of Economic ISD or EISD in 55 countries @ reduced rate per minute. Under this facility, the subscriber should dial 012, then country code, then area code and finally the desired number – instead of dialing access code 00.

DESA Load shedding push-pull service

For the very first time in Bangladesh, Teletalk with the co-operation from DESA has instituted a service for consumers to obtain evening load shedding schedule through SMS. With minimal charging of Taka 1.00 per SMS. This service is a welcomed addition to the citizens of Dhaka Metropolitan area that comes under auspices of DESA services.

Mobile Applications through GPRS

Teletalk has also introduced some Java Mobile applications in collaboration with various content providers. Among them “Cricket Update” and “Bangla SMS” are included.

Voice SMS

Teletalk has introduced "Voice SMS" service for its customers in order to send voice message.

Other unique services

Teletalk has instituted some other unique value added services to accommodate growing customer needs as well as to be in the top edge of current mobile telephony advancements.

1-3 Corporate Social Responsibility

CSR (Corporate Social Responsibility) during the financial year:

Teletalk believes in the empowerment of the people as well as the power inherent in all of us to collectively enforce positive change in our own lives. As a company still in its early years, Teletalk Bangladesh Limited still engaged itself in several CSR activities. Notables among them during the financial year have been described below:

1. Teletalk has established a short code SMS helpline for children with disability/diseases:

   The “666 – Helpline for Children” was established with a view to create a specialized fund for children with dire need of financial assistance. All SMS sent

to this number will be charged and the amount will be retained in a special fund. This fund will be used for rehabilitation / treatment of the children.

2. Children's art initiative:

   Teletalk has created a unique outlet to acknowledge and encourage children's art. With association from "Talent Promotion Initiative" Teletalk has arranged a children's art competition, where children have engaged in a day long painting competition with Bangladeshi seasonal themes.

   Teletalk Bangladesh Limited then published a special "Billboard Calendar" based on selected pictures from the competitions.

3. Blanket Distribution Program:

   In Rangpur district Teletalk distributed 500 (Five Hundred) pieces of Blankets to the distressed people in the winter through Anjuman Mofidul Islam.

4. Medical Treatment for Bushra:

   Teletalk initiated a helping program for Bushra – a patient of blood cancer. One can send SMS for Bushra to help raise fund for medical treatment. For a girl of 3 year old needing bone marrow transplantation, Teletalk's unique way of extending help as well as including the community at large was appreciated.

5. Blood Donation Program:

   Teletalk has sponsored and directly participated in voluntary blood donation program. ORCA (Old Rajshahi Cadet Association) had organized a blood donation program which was sponsored by Teletalk.

1-4 Theme

Teletalk is unveiled their real reason to launch by giving a patriotic theme which is related with the economic development of our country. The Theme of Tele Talk is "দেশের টাকা দেশেই রাখুন" which means Keep your Money in your Country.

1-5 Mission & Vision

To innovate and constantly search for new ways to enhance the services to customer's current needs and desires for the future. The vision is to know about the customers' requirements and fulfill their needs better than anyone else.

1-6 Coverage of Teletalk

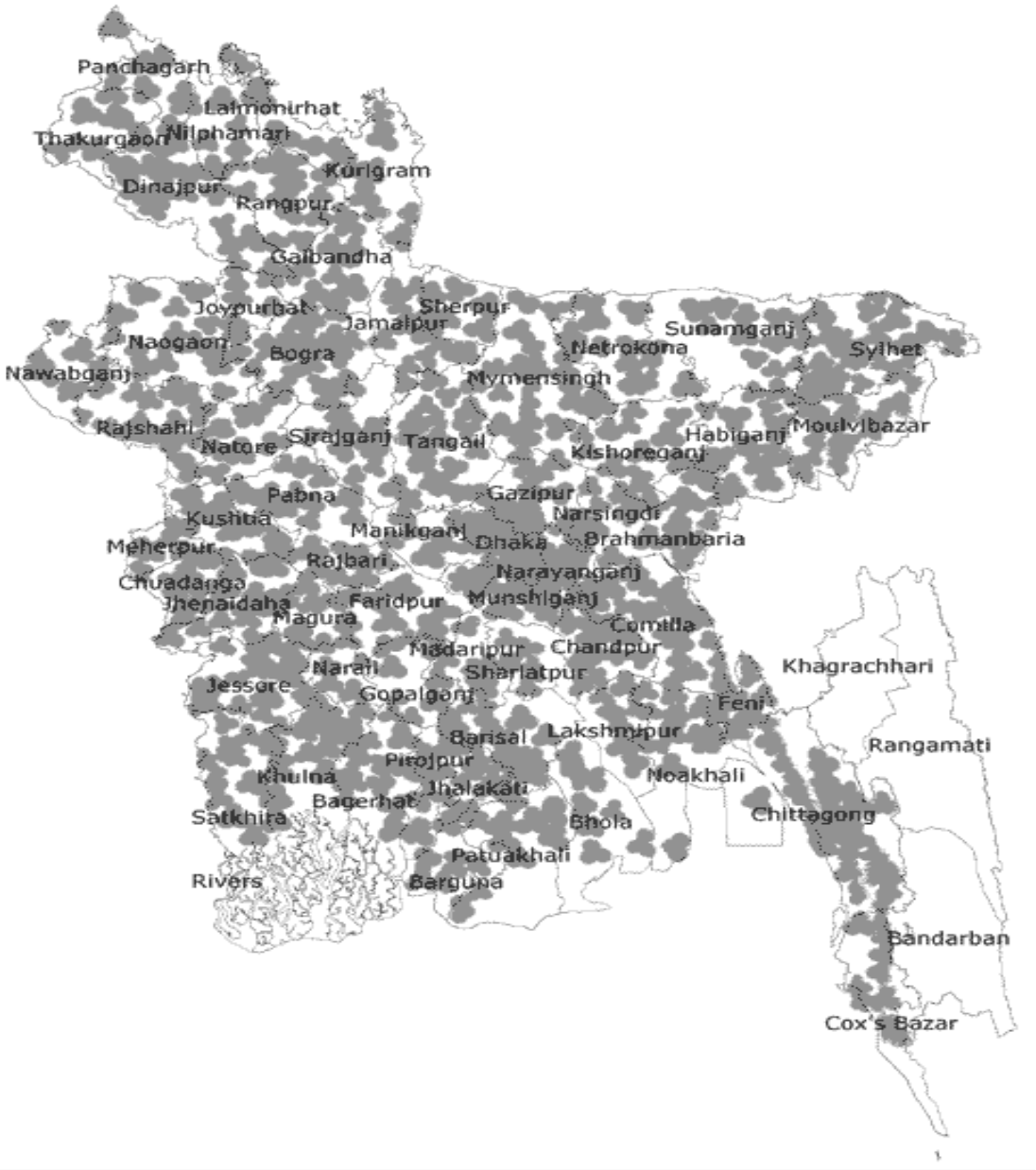


Figure 1: Coverage of Teletalk in Bangladesh

1-7 Report Organization

Chapter 1 describes the company profile while chapter 2 explains the planning procedure, models, planning tools etc in detail. I have also mentioned the network optimization steps, the flow chart of optimization. I have conducted the drive test on regular basis with my team over there. My test report is described in detail in this chapter. During optimization I had to visit some BTS. Here I have described the equipments of BTS from my practical experience.

Chapter 3 details some trouble shooting operation. I have got an opportunity to participate with my team during troubleshooting. The procedure of analyzing and handling has been described in this chapter.

CHAPTER 2
RADIO NETWORK PLANNING AND OPTIMIZATION

2-1 Introduction

Since the early days of GSM development, GSM system network planning has been undergoing extensive modification so as to fulfill the ever-increasing demand from operators and mobile users with issues related to capacity and coverage. Radio network planning is perhaps the most important part of the whole design process owing to its proximity to mobile users.

The radio access part of the wireless network is considered of essential importance as it is the direct physical radio connection between the mobile equipment and the core part of the network. In order to meet the requirements of the mobile services, the radio network must offer sufficient coverage and capacity while maintaining the lowest possible deployment costs.

Radio Network Design Objectives:

- ✓ Maximise coverage
    1. Coverage area per base station site (Minimise network cost)
    2. Coverage class within the radio cell (Maximise service quality)
- ✓ Minimise interference (Maximise service quality)
- ✓ Maximise capacity (Within available frequency spectrum)

2-2 Various Steps Involved In Planning Procedure

Planning means building a network which should able to provide service to the customers wherever they are. This work can be simplified and structured in certain steps. The steps are

- ➢ System requirements
- ➢ Define radio planning
- ➢ Initial network plan
- ➢ Surveys
- ➢ Individual site design
- ➢ Implementation
- ➢ Launch of service

- On-going testing

This process should not be considered just as it is depicted, in a single flow of events. For instance, the radio planning and surveying actions are interlinked in an ongoing iterative process that should ultimately lead to the individual site design.

2-3 Planning Models

Propagation in land mobile service at frequencies from 300 to 1800MHz is affected in varying degrees by topography, morphography, ground constants and atmospheric conditions. A very common way of propagation loss presentation is the usage of so called propagation curves, normally derived from some measurement formulae are

- Okumara Y. and others, for field strength and its variability in VHF and UHF land Mobile Radio Service.
- Hata. M, Empirical formula for Propagation Loss in Land Mobile Radio Services.
- Cost –207, Digital Land Mobile Radio Communication.
- Cost-231, Urban Transmission Loss for Mobile Radio in the 900 and 1800MHz bands.

Link budget

A link budget must be compiled before start of the dimensioning of the radio network. In the link budget, different design criteria for coverage (e.g. outdoor, indoor, in-car) is determined.
In the link budget, factors such as receiver sensitivity and different margins are considered

Path loss formula

L (dB) = 69.55 26.16 * Log10 (f) -13.82 * Log10 (Hb)-Am[44.9-6.55 * Log10 (Hb)] * Log10 (d)-K

Am: correction factor for effective mobile station antenna

K: terrain correction factor

1800MHZ band using Cost231-HATA model:

L (dB) = 46.3 33.9 * Log10 (f) -13.82 * Log10 (Hb)-Am[44.9-6.55 * Log10 (Hb)] * Log10 (d) C

GSM link balance and coverage distance Estimation tools

Legend	DL			UL	
Set by User	BTS max. transimt power (dBm)	46	a	MS max. transimt power (dBm)	33
Derived value	BTS combiner loss (dB)	4.5	b	BTS combiner loss (dB)	0
Result value	7/8 feeder length (m)	55.00		7/8 feeder length (m)	55.00
	5/4 feeder lenght(m)	0.00		5/4 feeder lenght(m)	0.00
	1/2 jumper length (m)	5.00		1/2 jumper length (m)	5.00
	feeder connector loss (dB)	0.50		feeder connector loss (dB)	0.50
	BTS feeder and connector loss (dB)	3.28	c	BTS feeder and connector loss (	3.28
	BTS antenna gain (dBi)	18.00	d	BTS antenna gain (dBi)	18.00
	Effective Radiated Power EIRP(dBm)	56.22	e=a-b-c+d	BTS antenna diversity gain (dB)	3.00
	MS sensitivity (dBm)	-102	f	BTS sensitivity (dBm)	-110.00
	Noise correction (dB)	2.00	g	Noise correction (dB)	2.00
	Actual environment sensitivity (dB)	-100.00	h=f+g	Actual environment sensitivity	-108.00
	Max. path loss (dB)	156.22	I=e-h	Max. path loss (dB)	158.72
	Body loss	3.00	j	Body loss	3.00
	Std. Dev. Of Slow Fading(dB)	8		Std. Dev. Of Slow Fading(dB)	8.00
	expected area coverage probability	95%		expected area coverage probab	95%
	corresponding edge coverage probability	85%		corresponding edge coverage probability	85%
	expected shadow fading margin (dB)	8.3	k	expected shadow fading margir	8.3
	clutter loss (dB)	13	l	clutter loss (dB)	13
	allowed DL Propagation loss (dB)	131.93	m=I-j-k-l	allowed UL Propagation loss (dB)	134.43
	allowed Propagation loss satisfying link balance (dB)	131.93			

Table 1: GSM link balance and coverage distance Estimation tools

Environment-Loss-Std.]

Environment	Penetration Loss (dB)	Std. Dev. Of Slow Fading(dB)
Dense Urban	25	8
Urban	20	8
SubUrban	15	8
Rural Area(Semi-open Area)	8	7
High Way(Open Area)	3	4

Clutte

Clutter Type	Penetration Loss (dB)
In Building	refer to C5~C9
In Car	10
Dense Trees	13
Water	-3
outdoor	3

Cable loss

	900MHZ	2000MHZ	450MHZ	1800MHZ
7/8 FeederdB/100m)	4.03	6.46	2.7	5.87
5/4 Feeder(dB/100m)	2.98	4.77	1.9	4.31
1/2 Jumper(dB/100m)	11.2	17.7	7.6	16.1

Table 2: Different parameter values

2-4 Planning Tools

Tools are the software packages that help for planning the network. Teletalk uses some of the software packages for cellular network planning. These are

- Networking planning system (NPS/X)
- Network measurement system (NMS/X) developed by Nokia

Cellular planning with NPS/X is based on utilization of digitized map and measurement results. The design database includes the parameters of the base stations, antennas, propagation models and system parameters.

The basic package includes:

- Coverage area calculation
- Composite coverage area dominance
- Point to point calculation
- Interference area calculation etc.

2-5 Planning for Cellular Network

For a well-planned cell network planner should meet the following requirements:

- Coverage as required and predicted.
- Co channel and adjacent channel interference levels as predicted for maintaining good quality of service.
- Minimum antenna adjustments during the optimization process.
- Maximum the network capacity (Erl/km2) with limited frequency band (MHz) by reusing the same frequencies.
- Minimum changes to the BSS parameters/database during the optimization phase.
- Facilitate easy expansion of the network with minimal changes in the system.

In general the planning process starts with the inputs from the customer. The customer inputs include customer requirements business plans system characteristics and any other constraints. After the planned system is implemented the assumptions made during the planning process need to be validated and corrected wherever necessary through an optimization process.

Total planning process can be divided in to five parts:

- Capacity Planning
- Coverage Planning
- Frequency Planning
- Parameter Planning
- Optimization

2-6 Frequency Resource of GSM System

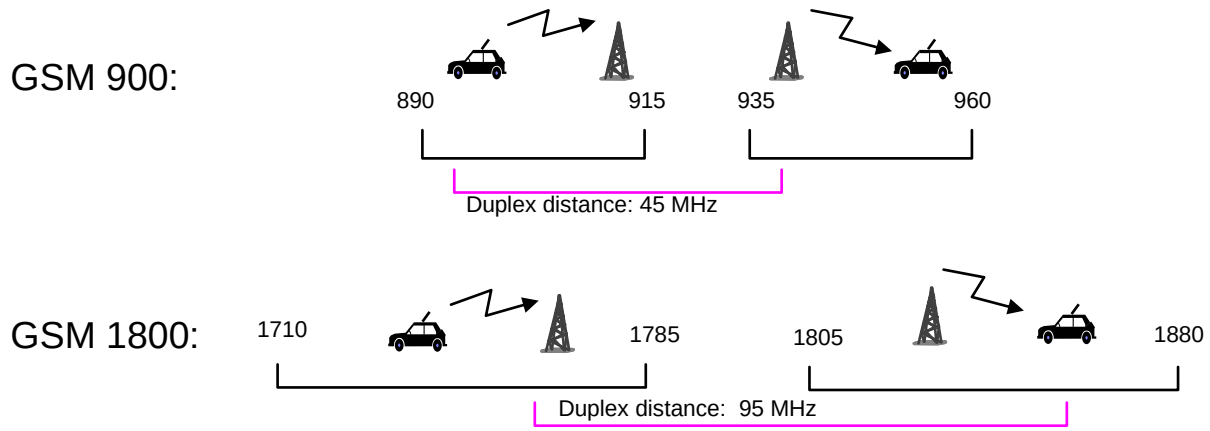


Figure 2: Frequency Resource of GSM System

Frequency Band Configuration:

- **GSM900:**
  - BTS receiver (uplink): f1 (n) = 890.2 + (n-1) * 0.2 MHz
  - Teletalk's BTS receiver (downlink) = 890.2 – 895 MHz
  - BTS transmitter (downlink): f2 (n) = f1 (n) + 45 MHz
  - Teletalk's BTS transmitter (downlink) = 935.2 - 940 MHz

- **GSM1800:**
  - BTS receiver (uplink): f1 (n) =1710.2 + (n-512) * 0.2 MHz
  - Teletalk's BTS receiver (uplink) = 1710.2 - 1720.0 MHz
  - BTS transmitter (downlink): f2 (n) = f1 (n) + 95 MHz
  - Teletalk's BTS transmitter (downlink) = 1805.2 - 1815.0 MHz

GSM consists of GSM 900 and GSM 1800 according to different system frequency bands. GSM is a duplex system. According to the GSM protocol, the uplink frequency band (MS to BTS) of

GSM 900 is 890 MHz – 915 MHz, and the downlink frequency band (BTS to MS) is 935 MHz - 960 MHz, the duplex distance is 45 MHz; the uplink frequency band of GSM 1800 is 1710 MHz - 1785 MHz, while the downlink frequency band is 1805 MHz – 1880 MHz, the duplex spacing is 95 MHz. In different countries, the specified frequency resource is allocated to different operators; each operator may only have a part of resources in the entire frequency band. With the limited resources, frequency planning plays an important role in maximizing the system capacity and service quality to achieve the goal and thus maximize the benefit of the operator.

2-7 Frequency Planning

The main goal of the frequency-planning task is to increase the efficiency of the spectrum usage, keeping the interference in the network below some predefined level. Therefore it is always related to interference predictions. There are two basic approaches to solve the frequency assignment problem.

- Frequency reuse patterns
- Automatic frequency allocation

Frequency allocation for the user links is established by radio planning also named as GSM frequency. This interface between the MS and BTS is termed Access Network. Therefore, the air interface is sub-divided as: Transmission Network and Access Network. Proper reuse of the frequency and reduce co-channel interference also a vital issue in this planning. Frequency planning tries to maximize the information flow (voice or data) over the radio interface and simultaneously to maximize the efficiency of the radio network infrastructure. In cellular radio systems planning the same frequencies are reused as often as possible in order to maximize capacity and thus minimize the radio network investments. The target is to have the maximum number of transceivers (a transmitter and receiver pair) at each base station without reducing radio quality. It has already been explained that frequency planning (together with capacity planning) begins with the specification of the required frequency channels (transceivers) at each base station. This work is related to the frequency reuse factor.

Teletalk Frequency Bands and ARFCNs:

- 25 for GSM 900 band
- 50 for GSM 1800 band

Number of BTS 1300, number of BSC 18(NSN-10 and huawie-8), number of MSC 4.

Operator	Carrier	Start Frequency	End Frequency	Total Frequency	Total Carriers	
TBL	1-25	890.2	895	4.8	25	
OT-B	27-50	895.4	900	4.6	24	900
TMIB	52-87	900.4	907.4	7	36	
GP	89-124	907.8	914.8	7	36	
Summary	1-124	890.2	914.8	23.2	120	

Operator	Carrier	Start Frequency	End Frequency	Total Frequency	Total Carriers	
TBL	1-25	890.2	894.8	4.8	25	
OT-B	27-50	895.4	900	4.6	24	900
TMIB	52-87	900.4	907.4	7	36	
GP	89-124	907.8	914.8	7	36	
Summary	1-124	890.2	914.8	23.2	120	

Table 3: Bangladesh GSM 900 and 1800 frequency bands

2-7-1 Frequency Reuse

A frequency used in one cell can be reused in another cell at a certain distance. This distance is called reuse distance. The advantage of digital system is that they can reuse frequencies more efficiently than the analogue ones, i.e. the reuse distance can be shorter, and the capacity increased. A cellular system is based in reuse of frequencies. All the available frequencies are divided into different frequency groups so that a certain frequency always belongs to a certain frequency group. The frequency groups together form a cluster. A cluster is an area in which all

frequency groups are used once, but not reused. The frequencies can be divided into different frequency groups. This introduces the terms reuse patterns and reuse grids. The most common reuse patterns in GSM are “4/12” and “3/9”.

4/12 means that the available frequencies are divided into 12 frequency groups, which in turn are located at 4 base stations sites. This assumes that the base station has three cells connected to it. The frequency groups are often assigned a number or name such as A1, B1, C1, D1, A2…D3.

3/9 means that the available frequencies are divided into 9 frequency groups located at 3 sites. Problem with C/A might appear in certain parts of a cell, arising from adjacent frequencies in neighboring cells.

Frequency Groups	A1	B1	C1	A2	B2	C2	A3	B3	C3
Channels	1	2	3	4	5	6	7	8	9
	10	11	12	13	14	15	16	17	18
	19	20	21	22	23	24			

Figure 3: Example of Channel assignment of 24 frequencies in a 3/9-cell plan.

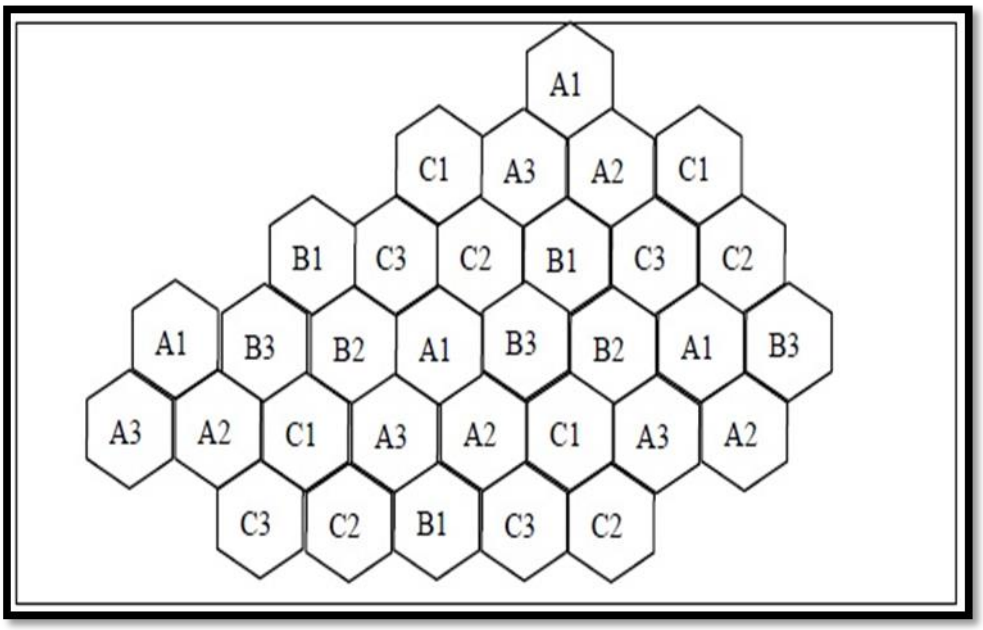


Figure 4: 3/9 - frequency reuse pattern

2-7-2 Frequency Planning Principle:

During frequency planning I had to maintain the following things:

- There should be no co-channel frequency carriers in one BTS.
- The frequency separation between BCCH and TCH in the same cell should be not less than 400K.
- When frequency hopping is not used, the separation of TCH in the same cell should be not less than 400K.
- In non-1*3 reuse mode, co-channel should be avoided between the immediately neighbor BTS.
- Neighbor BTS should not have co-channels facing each other directly.
- Normally, with 1*3 reuse, the number of the hopping frequencies should be not less than twice of the number of frequency hopping TRX in the same cell.
- Pay close attention to co-channel reuse, avoiding the situation that the same BCCH has the same BSIC in adjacent area.

2-8 Network Verification and Optimization

This is the last step of the network planning procedure. It can start during the network trial period and continues after opening the commercial service and during the network expansion.

The aim of this process is to evaluate and maximize the quality of service in the network with the corresponding set of quality criteria.

2-8-1 Network Verification

The purpose of the network verification (NV) is to evaluate an independent and objective quality of service (QOS) inside a given service area. This is done with network measurement system. Some OMC traffic measurements are dine in parallel to provide a statistical data and to complete the network picture.

The network verification procedure consists of the following steps:

- Planning of the measurement resources (including tools), reference network, schedule and test route(s)
- Setting of the network performance objectives and quality criteria
- Measurement execution and analysis of the statistical results
- Reporting to the customer the results of analysis
- Agreement on possible corrective actions if the set quality criteria is not met

The field verification takes place after successful completion of site acceptance. It should be repeated before and after any major network hardware/software changes to verify their affect on the network quality.

The service area, or the part of the network to be verified, is defined as a group of cells giving continuous coverage. It is always connected with a selection of test routes; the all verification and optimization activities are based in recurrent measurements over the same routes.

2-8-2 Network Optimization

Network Optimization can be defined as a continuous process of improving overall network quality. Looking at network quality two different views should be considered. The customers (subscribers) view and the more comprehensive operators view overall network quality is illustrating this.

Usually a subscriber is not interested in site leasing or maintenance socts. As long as his service is not affected things like spectrum efficiency and network traffic are of no interest to him.

Network optimization service and more general the Nokia Quality cycle service package are designed to support the operator in the most efficient way to improve all different aspects of network quality.

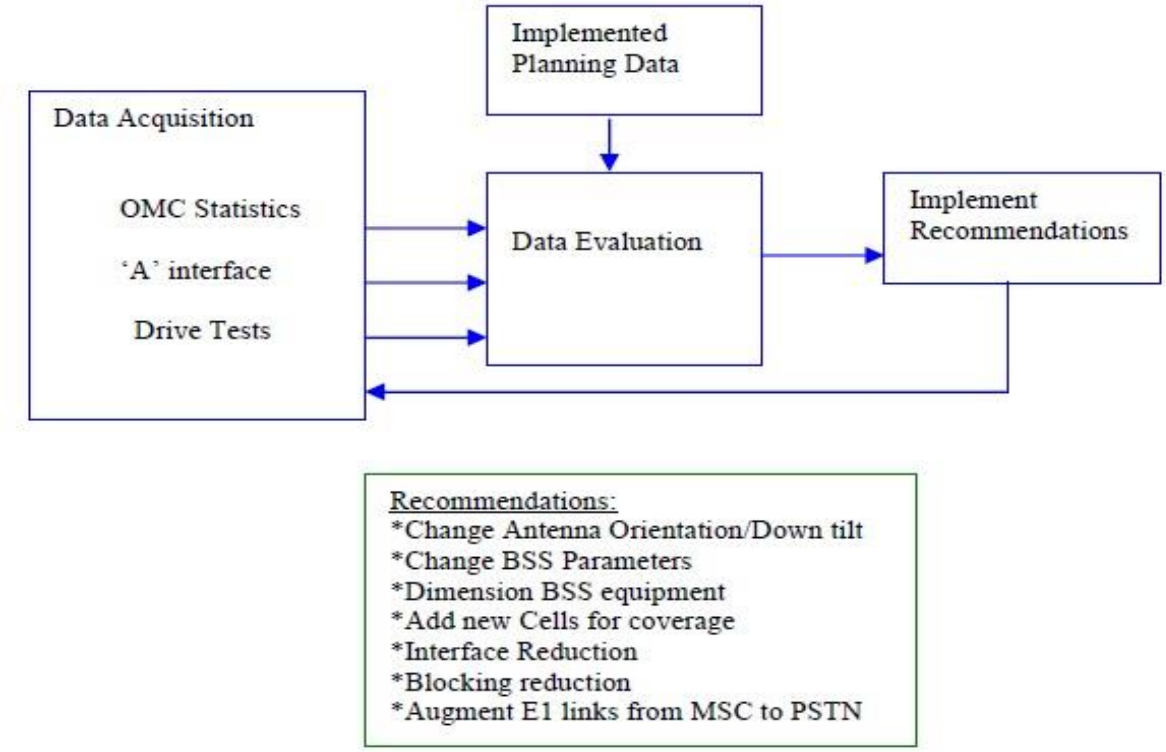


Figure 5: Optimization Process

Radio network optimization means network performance improvement utilizing existing network resources.

Steps of optimization in general:

- Data collection and verification

- Data analysis
- Parameter and hardware adjustment
- Optimization result confirm and reporting

The purpose is increasing the utilization of network resources and solving the existing and potential problem on the network, identifying solutions for future network planning.

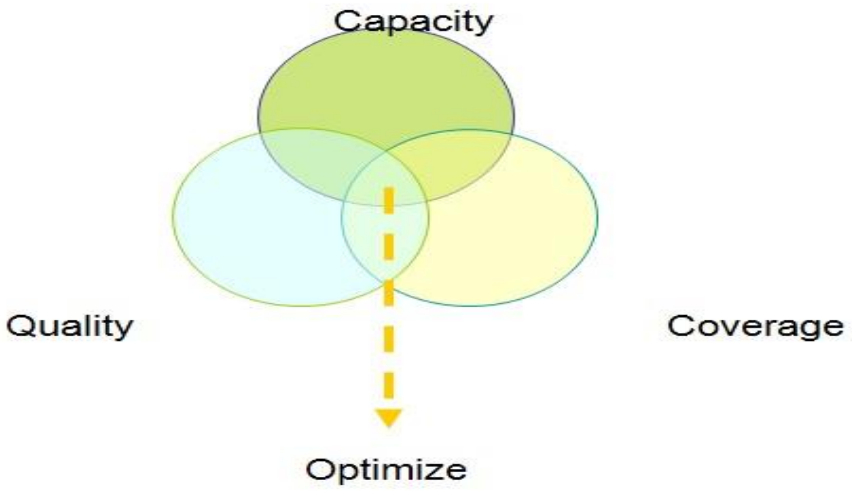


Figure 6: Radio Network Optimization

2-8-3 Concept of RN Optimization:

- Due to the mobility of subscribers and complexity of radio wave propagation, most of network problems are caused by increasing subscribers and the changing environments.
- RN Optimization is a continuous process that is required as the network evolves
- In the following case, the network should be optimized
    - New network or expansion on existing network.
    - The network quality decreased seriously and there are many complaints from subscribers.

- An event occurs suddenly which affects the network performance seriously.
- The number of subscribers increased and affects the network performance gradually.

2-8-4 Flow Chart of Network Optimization

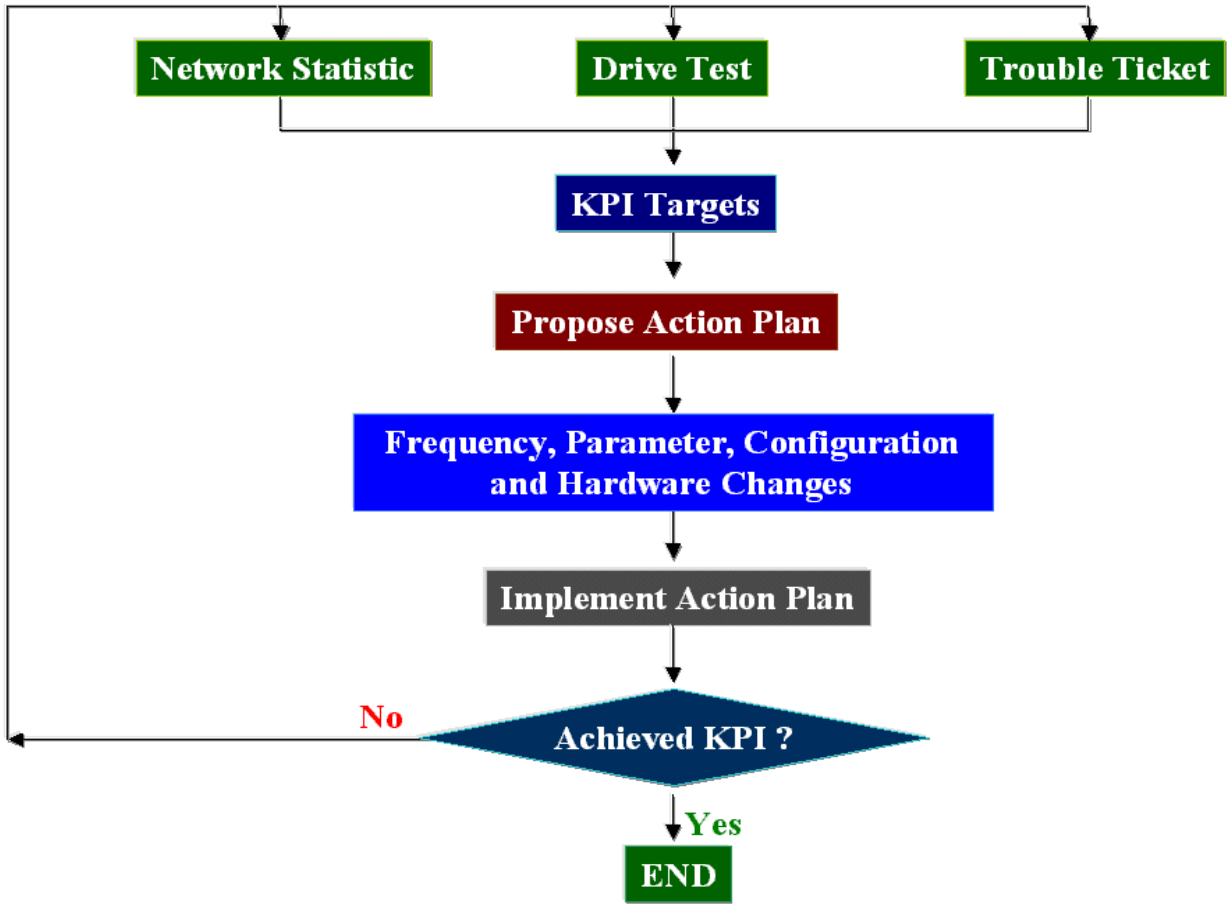


Figure 7: Flow Chart of Network Optimization

2-8-5 Radio Network Optimization Process

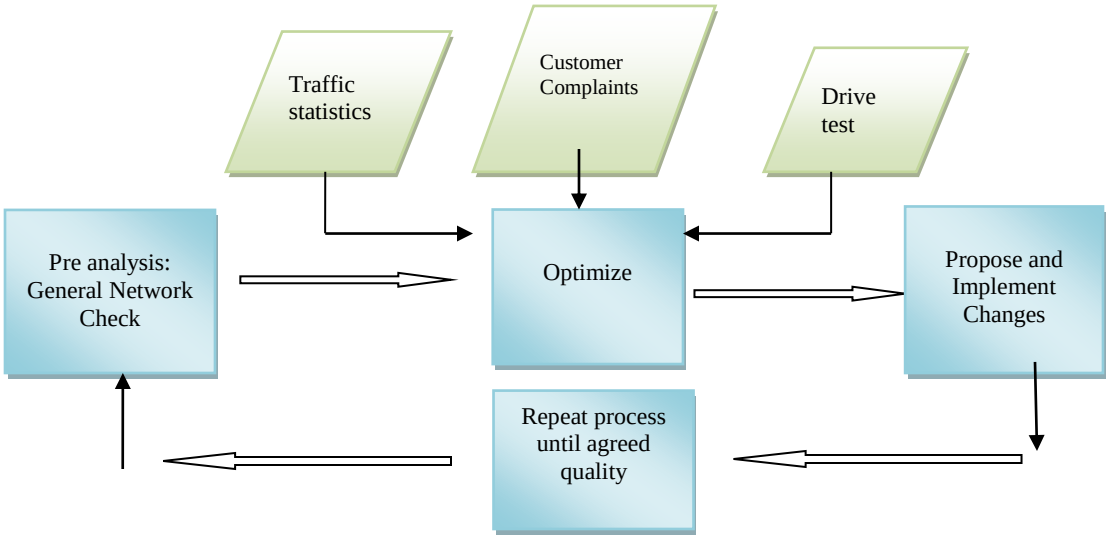


Figure 8: Flow diagram of RNP

2-8-5-1 Pre-analysis: General Network Check

Steps to be carried out:

- Determine original network planning objectives
- Collect information about network status
- Determine functional network structure, e.g.
    - BTS / BSC locations. Antenna direction/ azimuth, tilting etc.

- services and features used
- Network structure (macro cell, microcell etc.)

➢ Determine the network element configuration, e.g.

- number of TRX per cell
- sector / Omni configuration

➢ Visit selected sites

➢ KPI analysis

2-8-5-2 Customer Complaints Analysis

Quality targets:

➢ The customer's quality expectations are very simple:

- Availability of the service anywhere, anytime
- Call setup time within limits
- Good speech quality during the call
- Normal termination of the call

➢ Quality problems are indicated by:

- Poor signal levels
- High locking rates
- High bit error rates
- Dropped calls/handover failures

2-8-5-3 Collect / Analyze OMC Statistics or KPI Analysis

OMC Measurement

- Handled traffic (congestion on TCH, SDCCH)
- dropped calls
- Interference
- Handover reason (due to UL_QUAL, Power budget, distance…)

2-8-5-4 Collect / Analyze Drive Test Measurements

Test Measurement

➢ Collect MS measurement report data (Downlink only!!)

- BER (RXQUAL)
- Serving signal level
- Channel Number

- CI and LAI
- Timing Advance
- Layer 3 messages
- BSICs
- Signal and power levels of neighboring cells

2-8-5-5 Propose / Implement Changes

- Changes requested using standard forms
- Proper approval necessary (signatures)
- Physical change requests
  - Change antenna direction, tilt, height etc.
- Database change requests
  - Change frequency, add neighbour etc.
- Should be implemented quickly
- All involved parties must be informed

2-8-6 Optimization Tools

Nokia is providing a variety of tools for network optimization. NMS/X, Nokia network measurement system for GSM/DCS and NMT network quality survey, network tracing and for multi channel field strength measurements covers all demands for field measurements. A portable version allows indoor measurements.

NPS/X, Nokia network planning system, is also a powerful tool for network optimization. Its features for down and uploading data from the OMC, the GSM/DCS simulator, the link to the measurement system NMS/X and many other features provide the optimization personnel with an advanced tool.

2-8-7 Drive Test:

In general, Drive Test can be defined as a method that used to verify the actual condition of RF signals certain operator at certain place.

I was testing the network in particular area to give the real picture of the network's performance on the field, with a certain tools.

2-8-7-1 Several Functions of Drive Test:

- Analyzing customer complaint of certain operator in their home or office area
- Finding problem in BTS (Timeslot Check, TRX Check, Swap Feeder)
- Analyzing the result of optimization process (continuity and all of area)

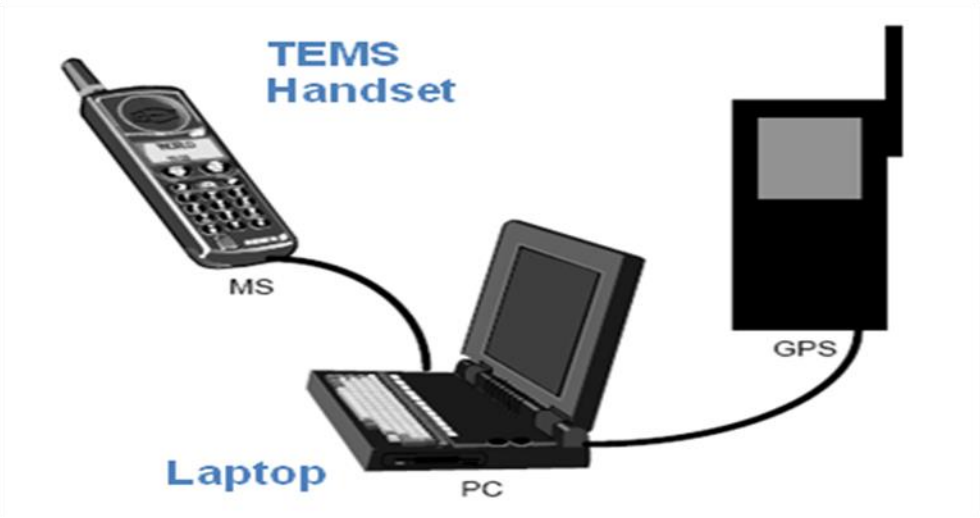


Figure 9: Equipment setup during drive test

2-8-7-2 Software's that are Used for Drive Test:

There are software's can be used for drive test that installed on laptop. For The Drive test basically most used software's are: TEMS Investigation (Ericsson), NEMO (Nokia). We used TEMS for our test.

2-8-7-3 Drive test equipments

I was using some equipments during drive test, those are given below:

- TEMS Handset (complete with Charger, Headset, Data Cable) and USB Hub
- Laptop (installed TEMS Investigation) and Adapter

- Inverter and Terminal
- Battery and Charger
- GPS

2-8-7-4 During Drive Test we had to maintain the Followings things:

- power supply needed, usually using inverter in the car from laptop, GPS and MS
- GPS should use external antenna
- MS can use external antenna or not use external antenna.

(Use external antenna means measure RxLevel "Pedestrian / Street Level")

(Not use external antenna means measure RxLevel "In car level) => More realistic result

If using scenario not external antenna, MS position should be carefully chosen and stable during drive test

2-8-7-5 Mode of Drive test:

We use two MS for drive test. This two MS should be in two different modes

- **Dedicated / Continuous / Long Call Mode:**
  - Making continuous call along drive test activity
  - Before starting the route, call the drive test number, ex 199 for Telkomsel, And only stop the call when the route (drive test) finish.

- **Idle Mode**
  - Along the drive test activity, the MS is "ON" but no call occur

Flow Steps of Drive Test

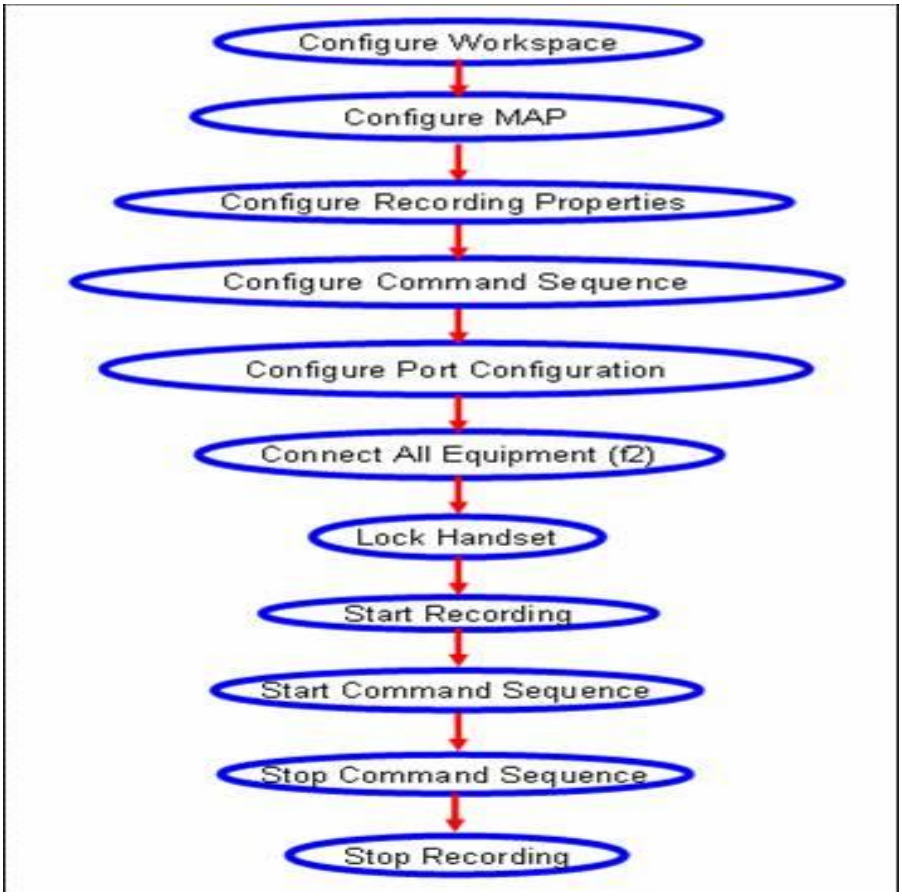


Figure 10: Flow steps of DT

2-8-7-6 Drive test parameter

These are the parameters that are measured during drive test**:**

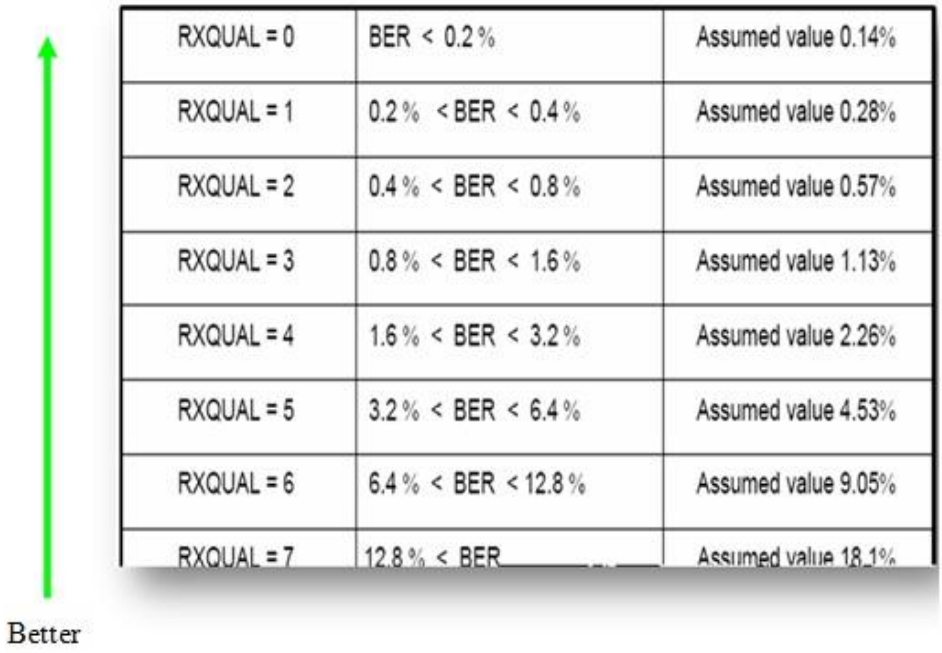
1. Rx Level
2. Rx Quality
3. FER
4. BER Actual
5. SQI
6. C/I
7. MS Power Control Level
8. DTX
9. TA(Time Advance)
10. RL Timeout Counter (Cur)
11. RL Timeout Counter (Max)
12. MS behavior Modified

1. Rx Level: Level of Received signal strength. In dBm or Steps. If the value in form of step subtract 110 to the value to get dBm value. Rx Level is received power level at MS (maximum Rx Level measured by MS is (±) – 40 dBm.

That is Receiving level in terms of dBm that mobile is receiving from the site. Range of -30 dBm to -110dBm

2. Rx Quality: Received signal quality level, measured base on BER (bit error rate).

The value is between 0-7, the lower the better.



RXQUAL = 0	BER < 0.2 %	Assumed value 0.14%
RXQUAL = 1	0.2 % < BER < 0.4 %	Assumed value 0.28%
RXQUAL = 2	0.4 % < BER < 0.8 %	Assumed value 0.57%
RXQUAL = 3	0.8 % < BER < 1.6 %	Assumed value 1.13%
RXQUAL = 4	1.6 % < BER < 3.2 %	Assumed value 2.26%
RXQUAL = 5	3.2 % < BER < 6.4 %	Assumed value 4.53%
RXQUAL = 6	6.4 % < BER < 12.8 %	Assumed value 9.05%
RXQUAL = 7	12.8 % < BER	Assumed value 18.1%

Figure 11: RX Quality

3. FER: Frame Erasure Rate it represents the percentage of frames being dropped due to high number of non-corrected bit errors in the frame. It is indication of voice quality in network.

4. BER Actual: Ratio of the number of bit errors to the total number of bits transmitted in a given time interval. BER is a measure for the voice quality in network. Depending on BER Rx Qual is measured. e.g., BER 0 to 0.2 % corresponds to Rx Qual 0. Max. BER countable and useful is up to 12.8 % which corresponds to Rx Qual of max. 7

5. SQI: The parameter used by TEMS to measure Speech Quality. SQI has been designed to cover all factors that Rx Qual lack to measure. SQI is a more sophisticated measure which is dedicated to reflecting the quality of the *speech* (as opposed to radio environment conditions). This means that when optimizing the speech quality in your network, SQI is the best criterion to use. SQI is updated at 0.5 s intervals. It is computed on basis of BER and FER. For EFR 30, FR – 21 & HR – 17 are respectively ideal values.

SQI computation considers the factors:

- the bit error rate (BER)
- the frame erasure rate (FER)
- data on handover events
- statistics on the distribution of these parameters

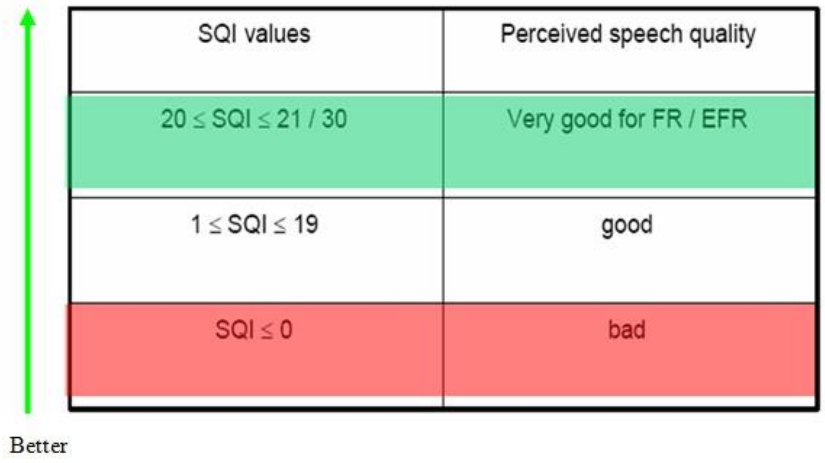


Figure 12: SQI

6. C/I: The carrier-over-interference ratio is the ratio between the signal strength of the current serving cell and the signal strength of undesired (interfering) signal components. It should be atleast > 9 .The C/I measurement function built into TEMS Investigation enables the identification of frequencies that are exposed to particularly high levels of interference, something which comes in useful in the verification and optimization of frequency plans.

7. MS Power control level: Displays range of power control from 0 to 8 depending upon network design. E.g. 0 means no power control and 1 means level that is defined by operator viz. 2 dBm less acc. to Airtel.

8. DTX: Discontinuous transmission (DTX) is a mechanism allowing the radio transmitter to be switched off during speech pauses. This feature reduces the power consumption of the transmitter, which is important for MSs, and decreases the overall interference level on the radio channels affecting the capacity of the network.

9. TA: Value that the base station calculates from access bursts and sends to the mobile station (MS) enabling the MS to advance the timing of its transmissions to the BS so as to compensate for propagation delay. Value of 0 means MS in radius of 550mt from BS.

10. RL Timeout Counter (Cur): This parameter defines the maximum value of the radio link counter expressed in SACCH blocks range of 4 – 64 in step size of 4. it shows current value of RLT. Decrease by 1 but increase by 2. When it reaches zero it results in normal DROP Call.

11. RL Timeout Counter (MAX): This parameter defines the maximum value of the radio link counter expressed in SACCH blocks range of 4 – 64 in step size of 4. It shows current value of RLT normally 16, 20, 24.

12.**MS Behavior Modified:** This window shows current settings for the mobile station, for instance whether handover is disabled or multiband reporting enabled.

2-8-9 Common Problems of RN Optimization

2-8-9-1 Coverage Problem:

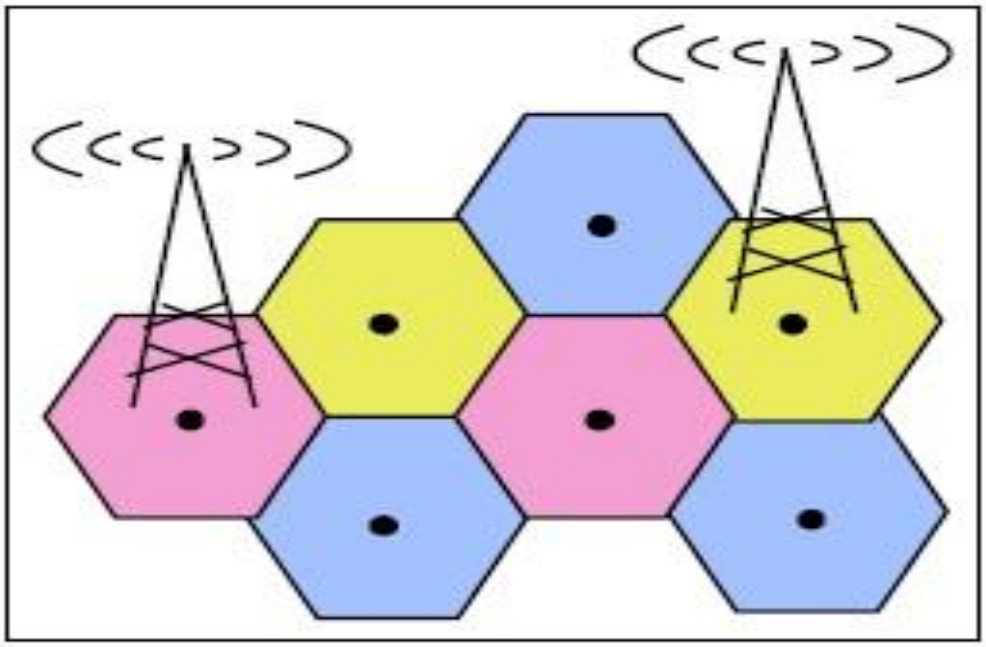


Figure 13: Coverage Problem

- Coverage hole
  - Coverage hole may exist when coverage areas of two BTS do not overlap or there are some big obstacles in the coverage area, this lead to no signal or very poor signal level.
- Over shooting
  - In the actual network, the high BTS antenna can propagate far away along a road and serve in area which it's not suppose to serve in; which result in the "isolate Island" problem.

2-8-9-2 Capacity Problem:

- TCH congestion
  - Check TCH congestion rate: attempted TCH seizer's failure for all (no radio resource available) on OMC traffic statistics data, or compare the busy hour traffic of each cell with the calculated capacity in different GoS to judge the situation of traffic congestion.

- Traffic balance
  - Adjust the antenna height, down tilt, and change the TX power of BTS and MS.
  - Adjust parameters for cell selection, cell reselection and handover
  - Enable load handover and direct retry functions.

2-8-9-3 Interference Problem:

- How to locate the interference
  - Interference band in TCH Measurement Function (Statistics)
  - Receiving Level Measurement Function (Statistics)
  - Rx Qual (Drive test)
  - Ratio of handovers for uplink/downlink quality (Statistics)

- Receiving Quality Measurement (Statistics)
- Call drop measurement function (Statistics)
- Too many handover failure and reestablishment failures (Statistics)

➢ Check and solve the interference problems

- Check the place with interference and conversation quality by drive test.
- Use spectrum analyzer to find out the interference in the frequency band.
- Enable frequency hopping, DTX and power control functions.
- Check and eliminate equipment problems (if any).

➢ Means to decrease the interference

- Increase the reuse distance between the co-frequency and adjacent frequencies.
- Decrease the transmitting power of BTS.
- Adjust the antenna height, azimuth, and down-tilt.
- Use the anti-interference technologies, such as frequency hopping, power control, DTX, and so on.

2-8-9-4 Handover problems:

➢ Handover failure and handover delay lead to bad quality or call drop.

➢ Frequent handover decreases the conversation quality and increases system signaling load.

➢ Unreasonable proportion of outgoing inter-cell handover to incoming inter-cell handover results in imbalanced traffic.

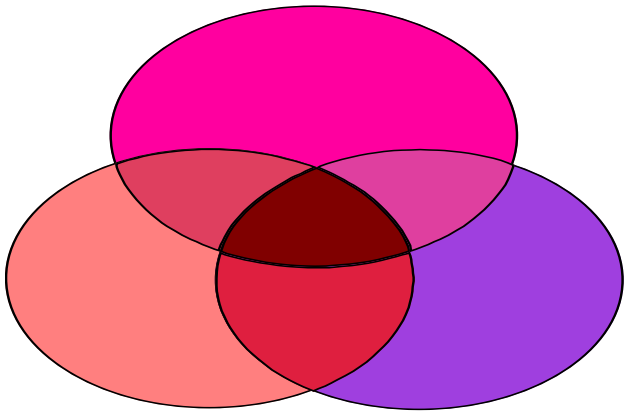


Figure 14: Handover Problem

- Check and solve handover problems:
    - Check the handover parameters (OMC)
    - Inter-cell Handover Measurement Function (Statistics)
    - Undefined Adjacent Cell Measurement Function (Statistics)
    - Outgoing Inter Cell Handover Measurement Function (Statistics)
    - Incoming Inter Cell Handover Measurement Function (Statistics)
    - TCH Measurement Function (Statistics)

2-8-9-5 Call Drop Problem:

- TCH call drop
    - During the GSM network operation, call drop is the main reason the subscribers complain. It usually refers to the call dropped after TCH channel seized or conversation connected, which can be located via traffic statistics or drive test.
    - There are many call drop causes. Such as poor signal strength, interference and improper parameters.
    - There are two important counters related call drop, radio link timeout (RLT downlink) and SACCH multi-frame number (uplink) sent in system information. These two counters should be set properly according to the traffic and coverage.

2-8-9-6 Dual-band Network Problem:

Optimization for dual-band network

- Take the following special approaches when optimize the dual-band network, most of the approaches are same as single-band network optimization:
    - When GSM 900M and GSM 1800M network belong to a same LAC the features of two network are basically same. Parameters such as CRO can be set flexibly according to the traffic, thus can balance the traffic and avoid cell congestion.

      When GSM 900M and GSM 1800M network has their own location area code, CRH and CRO should be set properly to avoid frequent location update.

CHAPTER 3

Practical role (Account of work done)

3-1 Proposal of new BTS set up due to high congestion

I have got an opportunity to participate frequency plan in specific area of Bogra. I used the software TornedoN – asset module for Planning.

On 10thMarch, 2012 we got complain from customer in specific region of Bogra. The problem was call drop, noise in signaling voice, bad sound quality etc. My duty was to find out the problem. To find out this problem at first I have accumulated the KPI data from NSN (Nokia Siemens Network) server.

The following table shows the KPI data on 10th March, 2012. The regions where this problem occurred are Bogra exchange, Sutrapur, Jalesharitola, Bogra Medical, NuraniMor, Tinmatha, Subgram, Bogra MW.

Start Time	Object Name	Region	Traffic	Call Drop Rate	TCH congestion rate	HO Success Rate
18:00:00	Bogra_BSC6000	Bogra Ex-1	2.34	1.0795	2.365	92.36
19:00:00	Bogra_BSC6000	Bogra Ex-1	4.93	1.2472	2.012	90.36
20:00:00	Bogra_BSC6000	Bogra Ex-1	3.21	0.9456	3.123	89.45
18:00:00	Bogra_BSC6000	Bogra Ex-2	16.63	30.36	73.328	49.36
19:00:00	Bogra_BSC6000	Bogra Ex-2	15.23	29.36	68.176	48.62
20:00:00	Bogra_BSC6000	Bogra Ex-2	23.36	41.46	74.04	47.65
18:00:00	Bogra_BSC6000	Bogra Ex-3	18.34	41.99	52.3	68.264
19:00:00	Bogra_BSC6000	Bogra Ex-3	24.45	26.19	51.65	68.576
20:00:00	Bogra_BSC6000	Bogra Ex-3	24.95	33.845	52.97	65.08
18:00:00	Bogra_BSC6000	Bogra Medical-1	23.56	28.562	72.816	52.816

19:00:00	**Bogra_BSC6000**	**Bogra Medical-1**	**18.98**	**33.12**	**74.816**	**64.816**
20:00:00	**Bogra_BSC6000**	**Bogra Medical-1**	**24.67**	**41.326**	**68.164**	**63.264**
18:00:00	**Bogra_BSC6000**	**Bogra Medical-2**	**24.56**	**33.416**	**41.32**	**69.456**
19:00:00	**Bogra_BSC6000**	**Bogra Medical-2**	**23.56**	**34.059**	**50.132**	**68.465**
20:00:00	**Bogra_BSC6000**	**Bogra Medical-2**	**23.97**	**29.327**	**49.698**	**57.659**
18:00:00	**Bogra_BSC6000**	**Bogra Medical-3**	**2.032**	**1.023**	**2.013**	**97.62**
19:00:00	**Bogra_BSC6000**	**Bogra Medical-3**	**5.84**	**2.3952**	**7.328**	**92.653**
20:00:00	**Bogra_BSC6000**	**Bogra Medical-3**	**4.67**	**1.4751**	**6.264**	**91.62**

Start Time	Object Name	Region	Traffic	Call Drop Rate	TCH congestion rate	HO Success Rate
18:00:00	Bogra_BSC6000	Bogra MW-1	15.67	31.7751	57.36	48.264
19:00:00	Bogra_BSC6000	Bogra MW-1	18.32	29.0096	57.344	57.344
18:00:00	Bogra_BSC6000	Bogra MW-2	0.67	0.1251	2.264	93.264
19:00:00	Bogra_BSC6000	Bogra MW-2	2.12	0.7236	2.304	93.304
20:00:00	Bogra_BSC6000	Bogra MW-2	1.12	1.2436	5.104	94.104
18:00:00	Bogra_BSC6000	Bogra MW-3	5.19	1.0507	7.848	86.848
19:00:00	Bogra_BSC6000	Bogra MW-3	6.73	1.1669	5.616	88.616
20:00:00	Bogra_BSC6000	Bogra MW-3	4.24	1.2472	7.608	86.608
18:00:00	Bogra_BSC6000	Jalesharitola-1	6.19	2.5807	7.048	86.048
19:00:00	Bogra_BSC6000	Jalesharitola-1	3.39	0.3967	1.288	92.288
20:00:00	Bogra_BSC6000	Jalesharitola-1	2.93	1.9129	8.056	86.056
18:00:00	Bogra_BSC6000	Jalesharitola-2	16.93	41.9129	71.056	48.056
19:00:00	Bogra_BSC6000	Jalesharitola-2	19.92	39.2576	72.064	52.064
20:00:00	Bogra_BSC6000	Jalesharitola-2	18.24	26.2472	66.608	53.608
18:00:00	Bogra_BSC6000	Jalesharitola-3	24.92	37.2076	43.064	40.064
19:00:00	Bogra_BSC6000	Jalesharitola-3	22.67	39.1251	42.264	32.264
20:00:00	Bogra_BSC6000	Jalesharitola-3	31.93	41.9129	38.056	28.056
18:00:00	Bogra_BSC6000	Nooranimor-1	1.92	0.0176	8.464	97.464
19:00:00	Bogra_BSC6000	Nooranimor-1	3.56	1.4868	1.152	96.152
18.00.00	Bogra_BSC6000	Tinmatha-2	21.406	37.032	47.958	47.94958
18.00.00	Bogra_BSC6000	Sutrapur-2	20.815	30.063	45.375	55.73745

Table 4: KPI analysis of Bogura during high traffic

From the above table we can see that the range of traffic of this specific area was (15-30), which is very high. For this reason handover success rate was very poor (28-70) from the table 1 and the call drop rate was high. From the above KPI data, the range is 25-45.

Through this KPI analysis I have found the reason behind call drop. Call drop rate was high this is because of high congestion and poor handover success rate. I reported it to my supervisor. Then I proposed my supervisor to attempt a drive test in Bogra Staff Quarter for checking the receiving power of signal. After that a team visited that area for conducting drive test. After conducting drive test we observed that the receiving level of signal in that area is poor. So I made a proposal to add a new BTS in Bogra staff quarter.

The following figure indicates the new BTS, which is under proposed. This is the snap short from Google earth software.

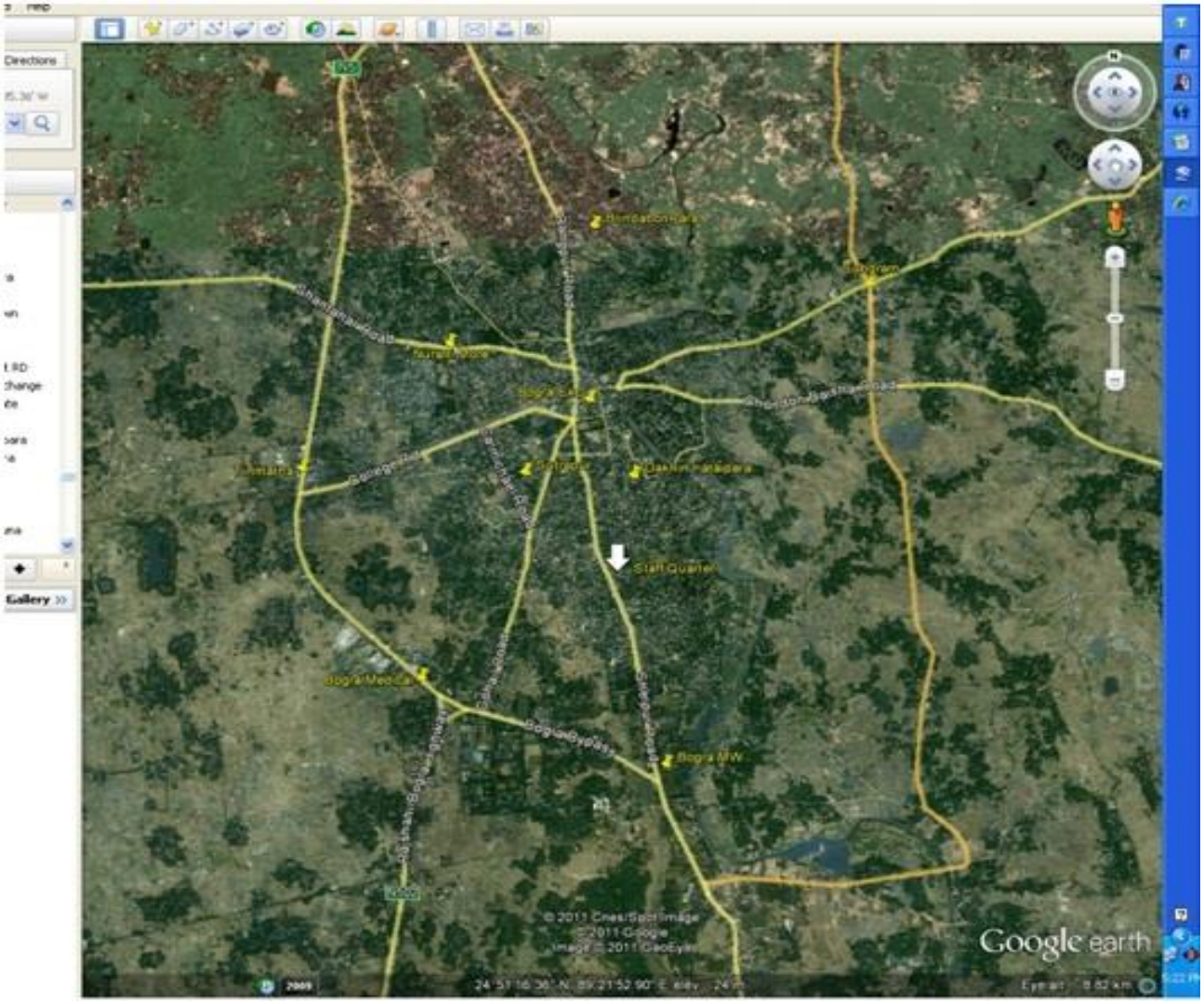


Figure 15: Proposal to add new BTS in Bogura Stuff Quarter.

The following figure shows the frequency distribution and data base of specific region in Bogra. For this frequency planning teletalk used TornadonN- planner and asset module.

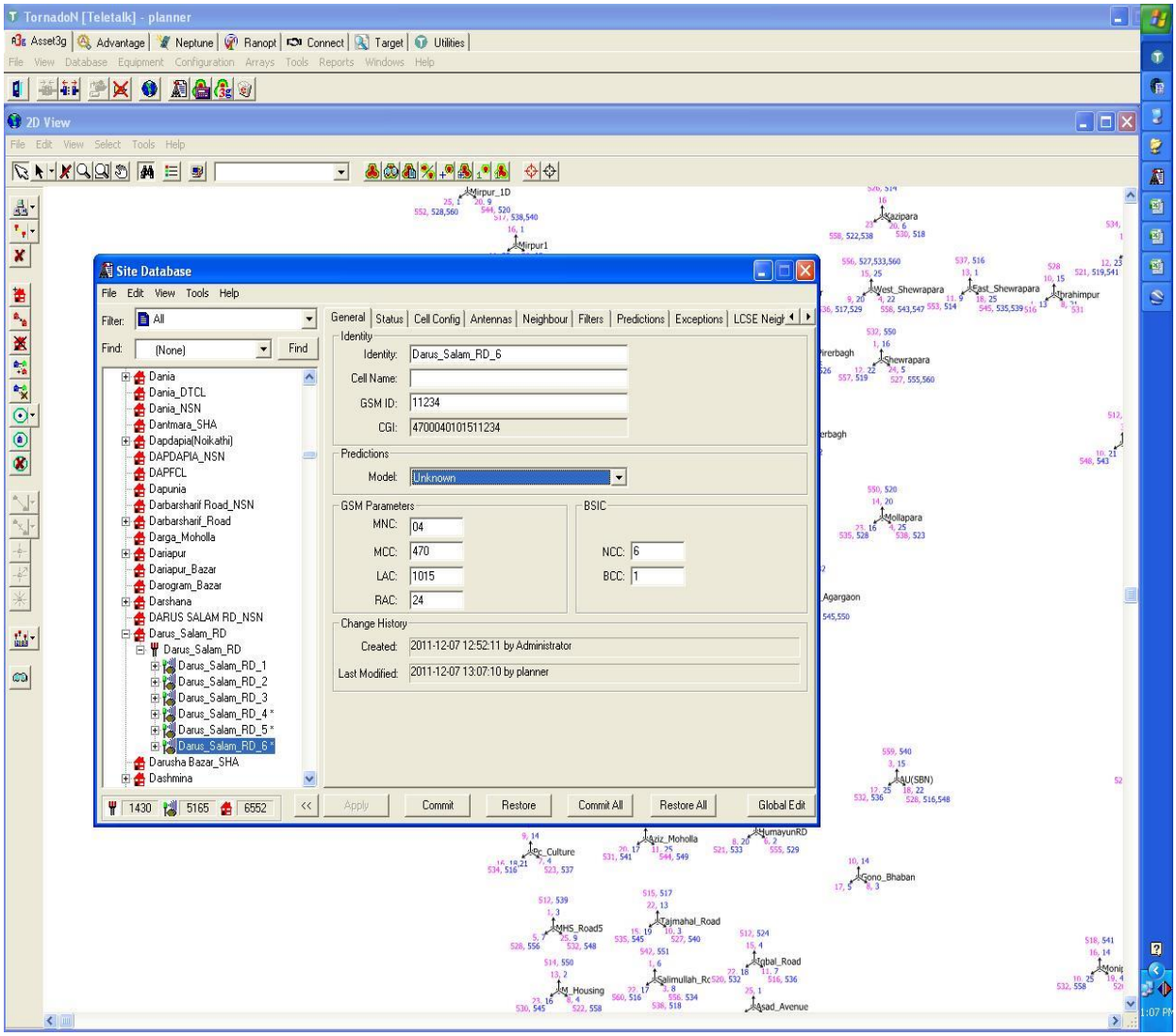


Figure 16: Frequency distribution and database of Bogura

The following figure shows the cell database of Bogura Staff Quarter. After declaring the latitude and longitude I have declared the neighboring area of Bogura Saff Quarter

After that I made this frequency planning Bogra Staff Quarter, with the help of my supervisor. I have collected the snap short of that which is mentioned in the following figure.

CELL DATABASE			
SITE DESCRIPTION			
NAME	Staff Quarter	DATE	6-Dec-11
ADDRESS	Staff Quarter,Bogra,mahbub Alom,1732818777		
COORDINATES			
LATITUDE	26.3364	LONGITUDE	88.5721

NETWORK INFORMATION	SECTOR 1	SECTOR 2	SECTOR 3
CELL NAME	Staff Quarter-1	Staff Quarterr-2	Staff Quarter-3
Azimuth (Degree)	0	120	240
BCCH	23	21	18
BSIC	02	02	02
CI(DEC)	51281	51282	51283
CI(HEX)	C851	C852	C853
LAC(DEC)	5161	5161	5161
LAC(HEX)	1429	1429	1429
RAC(DEC)	130	130	130
RAC(HEX)	82	82	82
CGI	470041429C851	470041429C852	470041429C853
BSC	Bogra_BSC6000	Bogra_BSC6000	Bogra_BSC6000
CONFIGURATION	1	1	1

NEIGHBOUR LIST

NEIGHBOUR	SECTOR 1	SECTOR 2	SECTOR 3
NEIGHBOUR 1	Staff Quarter-2	Staff Quarter-1	Staff Quarter-1
NEIGHBOUR 2	Staff Quarter-3	Staff Quarter-3	Staff Quarter-2
NEIGHBOUR 3	Jalesharitola-2	Bogra_MW-1	Bogra_Mdical-1
NEIGHBOUR 4	Jalesharitola-3		Bogra_Mdical-2
NEIGHBOUR 5	Bogra_Exc-2		Sutrapur-2
NEIGHBOUR 6	Bogra_Exc-3		Tinmatha-2
NEIGHBOUR 7	Sutrapur-2		

Table 6: Cell database of new site (Bogura Staff Quarter)

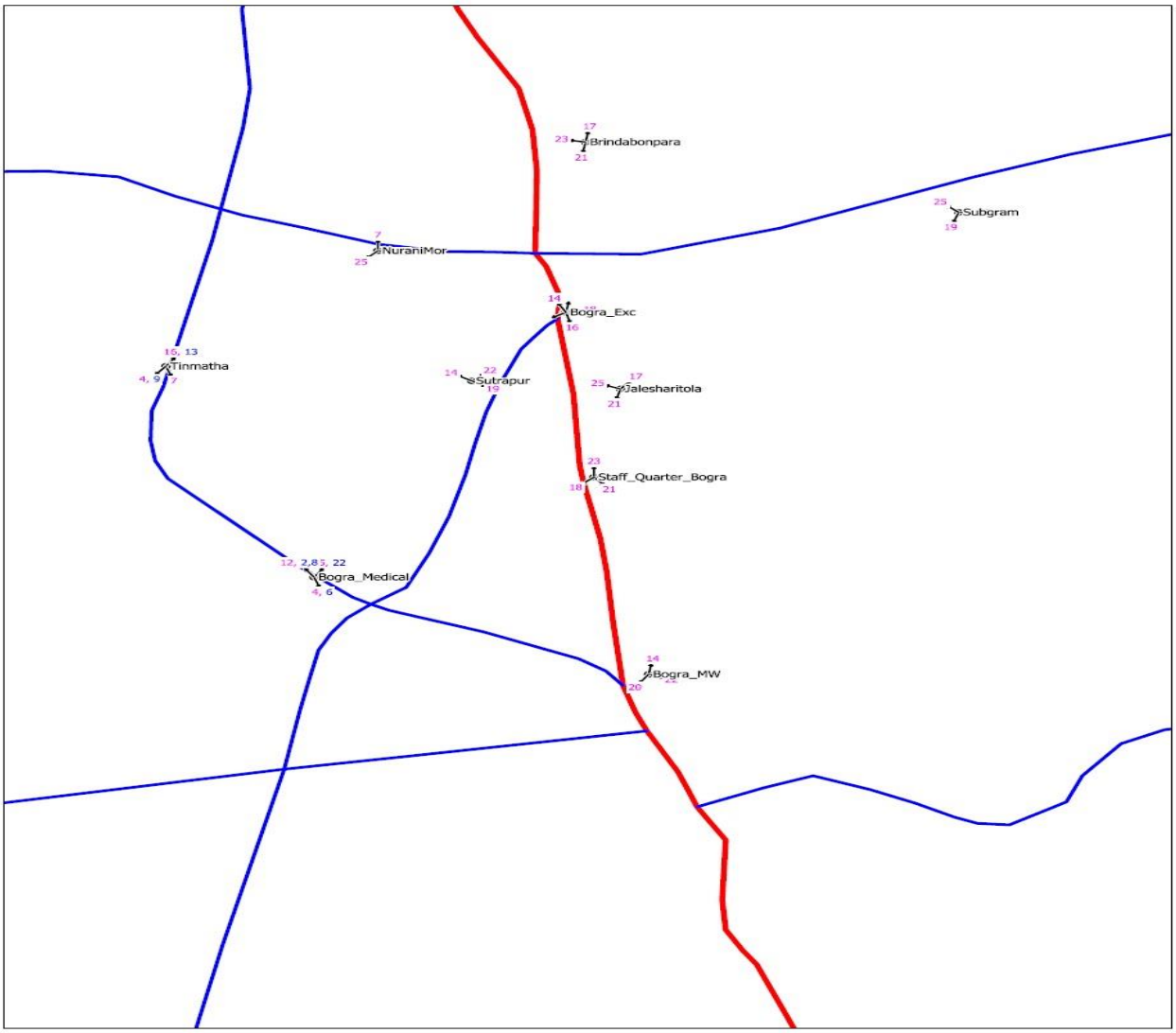


Figure 17: Frequency planning of Bogura

The following figure shows the frequency coverage of specific region in Bogra, when new BTS of Bogra Staff Quarter already completed.

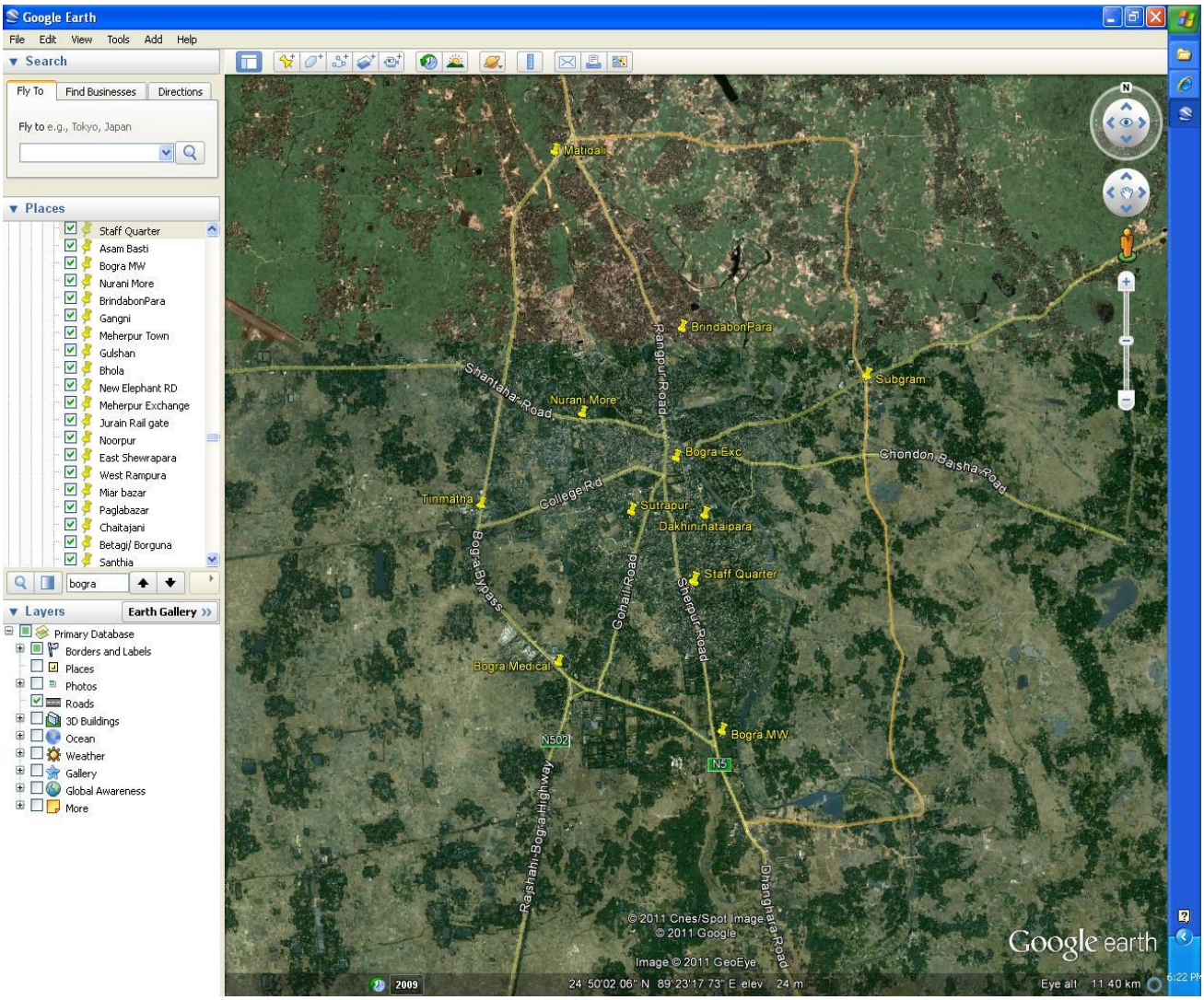


Figure 18: New BTS set up in Bogura Staff Quarter

On 7th December 2011, when the new BTS site is already running, I have done the previous job, that is, accumulated the KPI data from NSN (Nokia Siemens Network) server.

Start Time	Object Name	Region	Traffic	Call Drop Rate	TCH congestion rate	HO Success Rate
16.00.00	Bogra_BSC6000	Bogra Ex-1	3.568	1.078296	4.55524	94.55524
16.00.00	Bogra_BSC6000	Bogra Ex-2	4.978	0.109316	2.34154	92.34154
16.00.00	Bogra_BSC6000	Bogra Ex-3	4.572	1.100384	2.97896	92.97896
16.00.00	Bogra_BSC6000	Bogra Medical-1	12.51	2.27502	2.5163	80.5163
16.00.00	Bogra_BSC6000	Bogra Medical-2	2.053	1.264966	1.23379	81.23379
16 .00.00	Bogra_BSC6000	Bogra Medical-3	1.806	0.039532	5.32158	97.32158
16.00.00	Bogra_BSC6000	Bogra MW-1	0.46	1.00992	19.4348	99.4348
16.00.00	Bogra_BSC6000	Bogra MW-2	3.95	0.0867	3.9555	93.9555
16.00.00	Bogra_BSC6000	Bogra MW-3	4.126	1.090572	1.67918	93.67918
16.00.00	Bogra_BSC6000	Jalesharitola-1	2.844	0.062368	5.69192	95.69192
16.00.00	Bogra_BSC6000	Jalesharitola-2	2.375	0.27205	2.72825	80.72825
16.00.00	Bogra_BSC6000	Jalesharitola-3	0.086	0.001692	0.0560	99.00
16.00.00	Bogra_BSC6000	Nooranimor-1	0.872	0.018984	8.78796	98.78796
16.00.00	Bogra_BSC6000	Nooranimor-2	4.326	1.094972	3.36518	93.36518
16.00.00	Bogra_BSC6000	Nooranimor-3	3.638	0.079836	4.44534	94.44534
16.00.00	Bogra_BSC6000	Staff Quater-1	6.786	1.039092	7.35298	94.35298
16.00.00	Bogra_BSC6000	Staff Quater-2	5.421	0.909062	9.49603	93.49603
16.00.00	Bogra_BSC6000	Staff Quater-3	6.942	1.064524	5.53806	91.53806
16.00.00	Bogra_BSC6000	Subgram-1	3.383	0.074226	4.84569	94.84569
16.00.00	Bogra_BSC6000	Subgram-2	2.825	0.06195	5.72175	95.72175
16.00.00	Bogra_BSC6000	Subgram-3	3.799	1.083378	4.19257	94.19257

16.00.00	**Bogra_BSC6000**	**Sutrapur-1**	**2.188**	**0.047936**	**6.72184**	**96.72184**
16.00.00	**Bogra_BSC6000**	**Sutrapur-2**	**2.815**	**0.06173**	**5.73745**	**95.73745**
16.00.00	**Bogra_BSC6000**	**Sutrapur-3**	**2.449**	**0.053678**	**6.31207**	**96.31207**
16.00.00	**Bogra_BSC6000**	**Tinmatha-1**	**9.037**	**2.198614**	**5.96891**	**85.96891**
16.00.00	**Bogra_BSC6000**	**Tinmatha-2**	**1.406**	**0.030732**	**7.94958**	**97.94958**
16.00.00	**Bogra_BSC6000**	**Tinmatha-3**	**7.242**	**1.159124**	**8.78706**	**88.78706**

Table 7: KPI analysis of Bogra after set up new BTS in Staff Quarter

The above table shows the KPI data after setup a new BTS. From this KPI data it is clear that the traffic of Bogra is very low due to set up a new BTS in Bogra Staff Quarter. So call drop rate minimize due to low traffic and high handover success rate. In this way I have solved the problem.

3-2 Drive test

During my internship period, I was faced with some trouble in indoor as well as in some outdoor sites. In this chapter I have described some cases that I faced during my working days.

I have got an opportunity to perform Drive test. My test report and observation are given below:

Test Report – 1

Customer Address: House# B 57, Lalkuthi, Mazar Road, Mirpur-1

CB- Lalkuthi-4, Cell: 01552302440

Site ID: Lalkhuti

Area: Mirpur

BSC: DK06

Complain type: Bad noise, call dropping continuously, one sided last 1-1.5 month.

Problem 1: Encircle area creating interference between Bagbari_1 TCH(14) and Mirpur 1E_3 BCCH(14).

RX Qual:

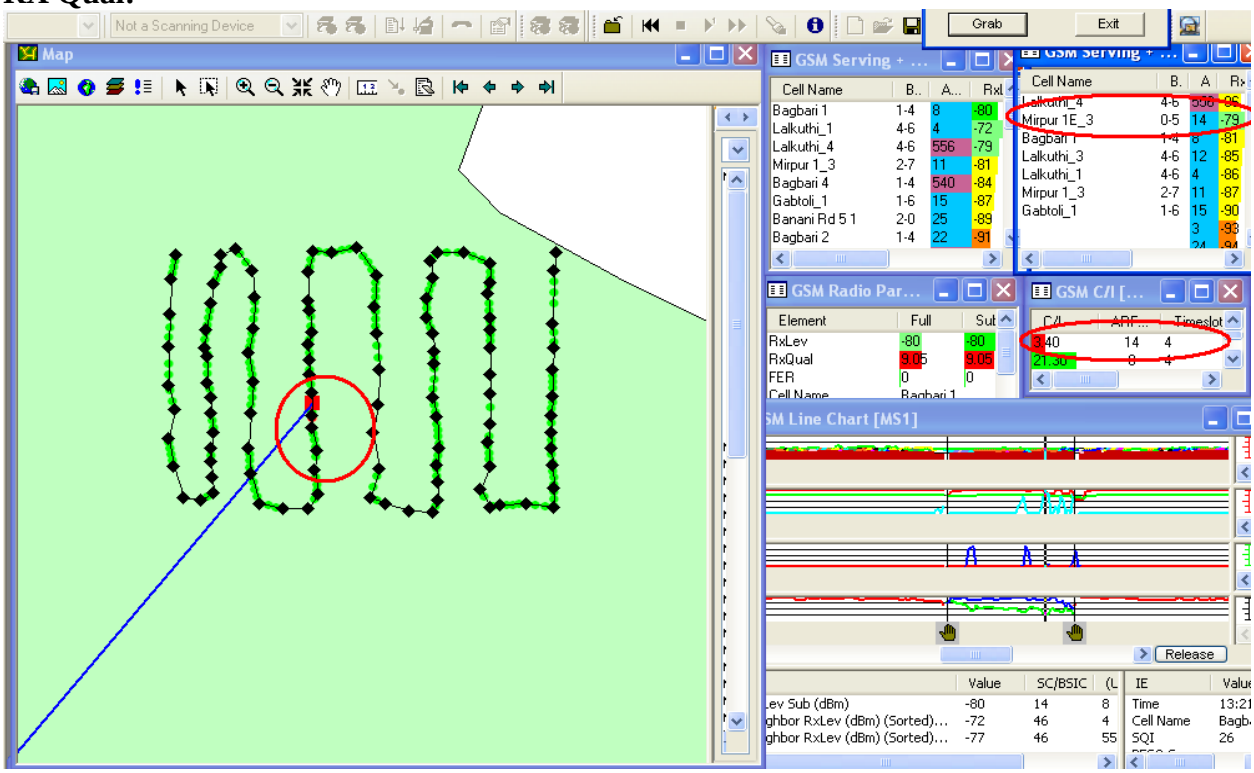


Figure 19: Observation of RX Qual by using TEMS Software

Mirpur 1 E located 3rd circle

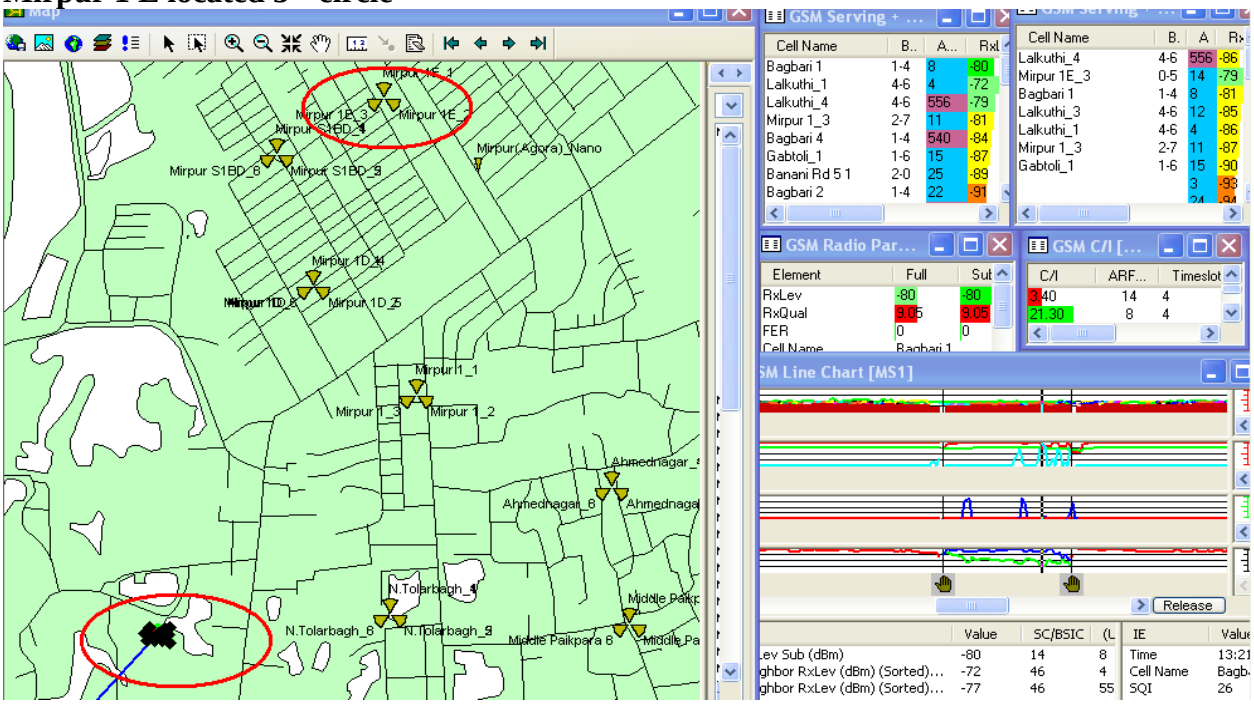


Figure 20: Observation of RX Level by using TEMS Software

Observation:

Throygh my observation I have found the fololloweing things:

1. It showing good RX level.
2. Interference creating between Bagbari_1 TCH(14) and Mirpur 1E_3 BCCH(14). Mirpur 1E situated at the 3rd circle and it GSM height is 32m. Due to excess height of Mirpur 1E overshooting between Bagbari_1 TCH(14) and Mirpur 1E_3 BCCH(14) which creating interference at encircle area.
3. Work order already issued to reduce GSM height of Mirpur 1E so no need to change frequency at Mirpur 1E_3 BCCH(14) .

Another problem occurred in Dhaka club, test report and observation are given below:

Test Report – 2

Customer Complain: From Dhaka Club

Serving Cell: Dhaka Club-6

Rx Level Plot of Dhaka Club:

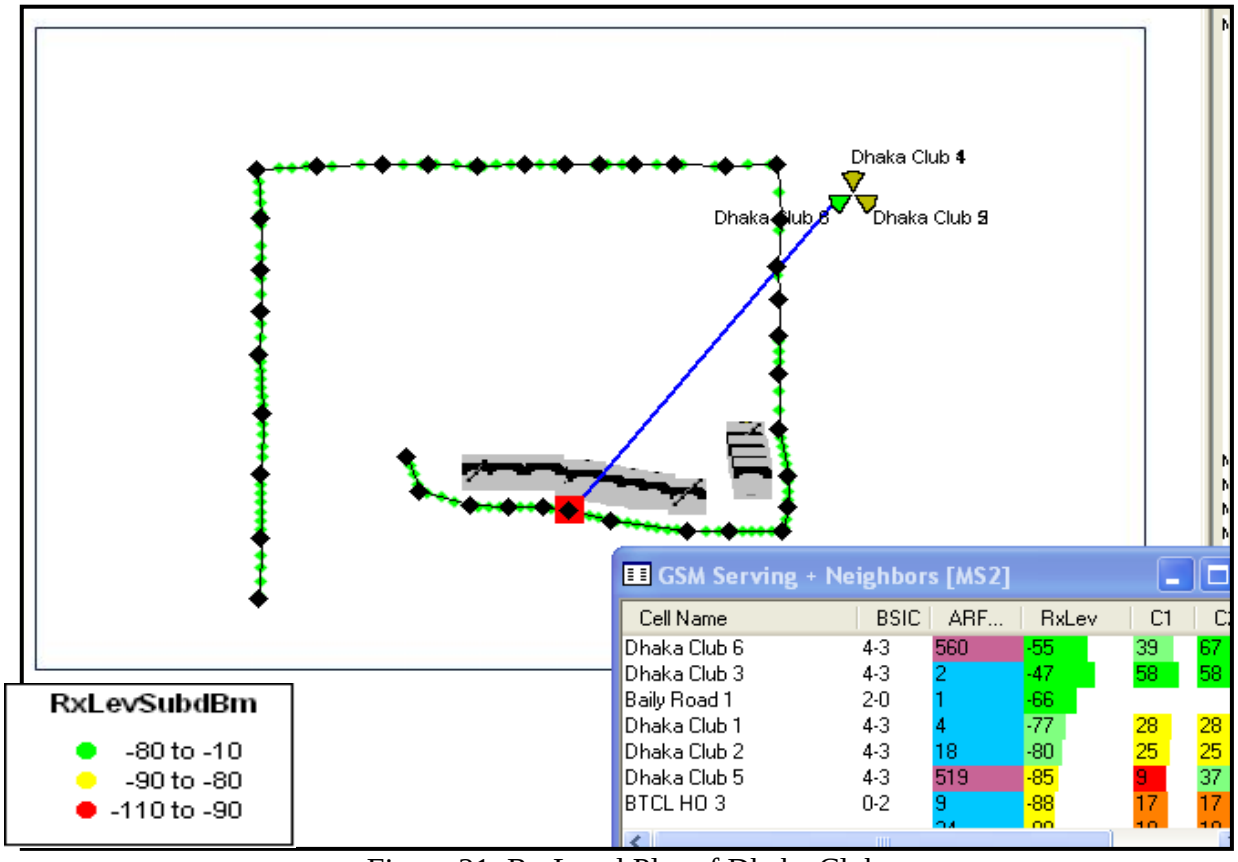


Figure 21: Rx Level Plot of Dhaka Club

Rx Qual Plot of Dhaka Club:

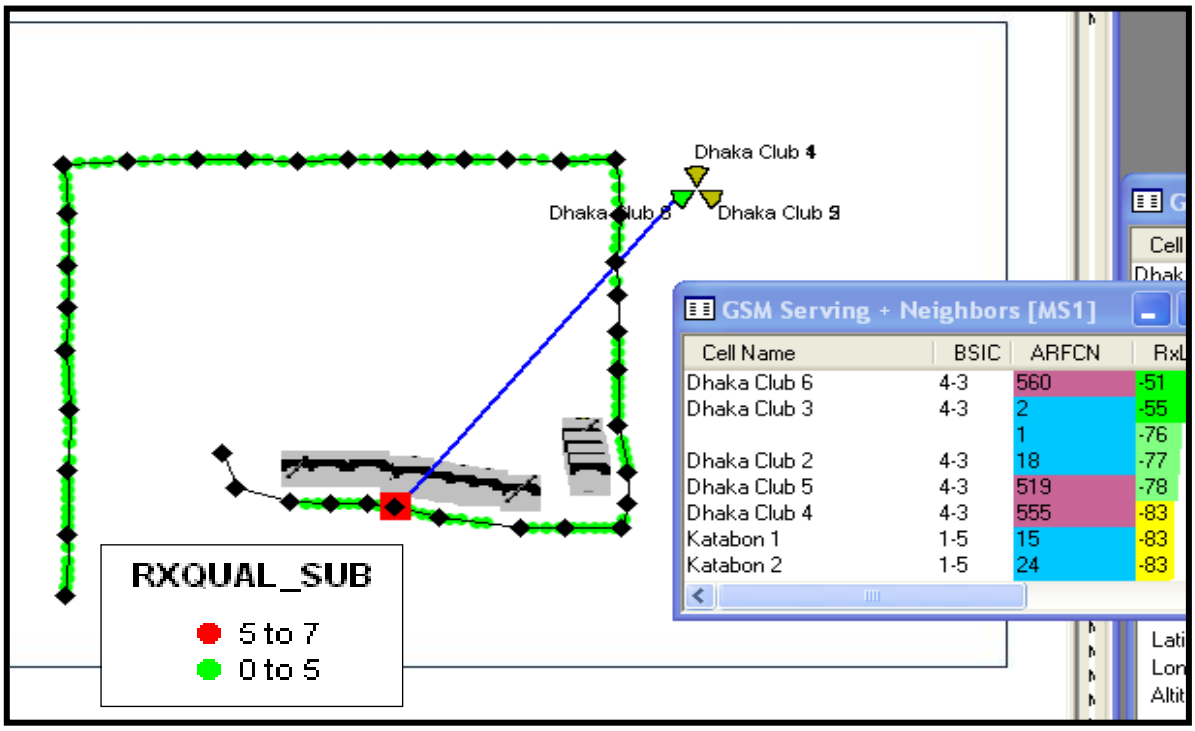


Figure 22: Rx Qual Plot of Dhaka Club

Google View of Dhaka Club:

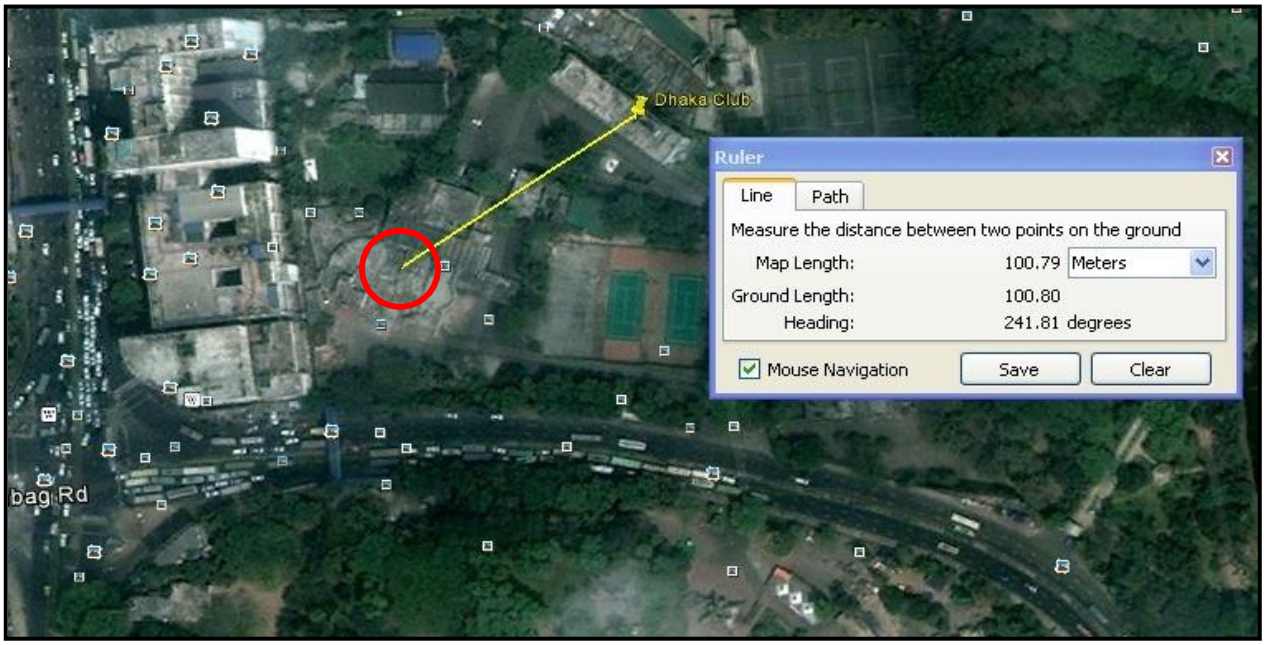


Figure 23: Dhaka Club, Viewing by Google Earth Software

Observations:

- The distance from site Dhaka Club to complained room is only 100m and azimuth of Dhaka Club-3/6 to complain room is 241 degree. Along with my supervisor, we made several calls in that place and found no problem. Rx level is -50 to -60 dbm which is well satisfactory for call establishment. Rx Qual is also very good.

I have done another drive test with my team. My test report is given below.

Test report – 3

DT Report: Banasree Blk E

Rxlevel Plot:

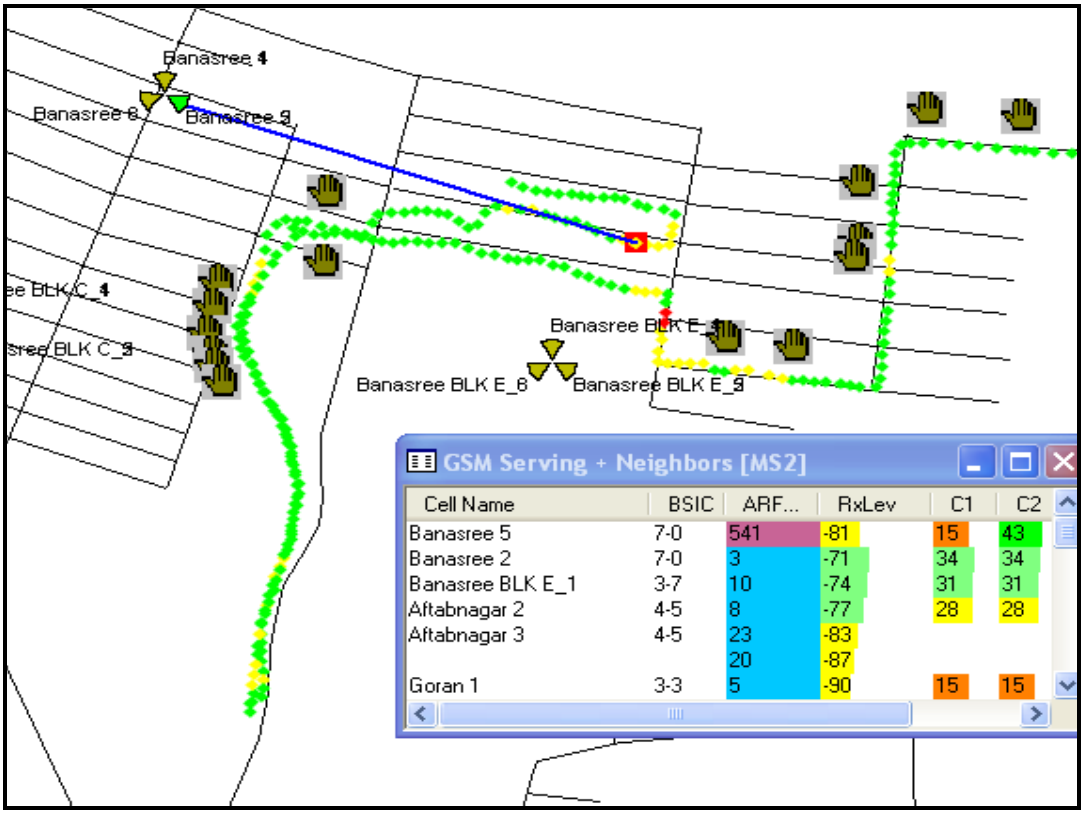


Figure 24: Rx level Plot of Banasree Blk E

Observations & Solutions:

1. In 900 Band Banasree Blk K 2 & Banasree Blk K 3 are swapped with one another. Should be rectifying this immediately.
2. Need to Check any obstacle at Banasree Blk K-1 & Banasree Blk K -2, if no obstacle found then up tilt these two cells two degree and do re drive test cause Rxlevel is poor around 200 m.
3. Banasree 2 & 3 should be down tilt 2 degree to reduce overshooting.

3-3 Analyzing Calling Test Result and Troubleshooting

Generally, all the services are provided by the BSS where the largest portion is the voice service. Therefore most of the fault relative with the BSS affects the normal calls of subscribers straightforwardly or indirectly. While working in Teletalk during my internship period, I was faced with such type of problem. In this circumstance, I did the calling test which is an easy and swift technique in order to check whether the call processing function and relative modules of the BSC are normal or not.

On **28.09.2011** at **11.00 am**, I figured out the following problem.

A BTS30 with configuration of S (1/1/1) is there. All of its three cells were at the frequency of 119, 123 and 105 respectively. The call initiated via this BTS had no voice, whether the call was to an MS or to a fixed phone.

- So, in the beginning I viewed the TRX (Transceiver) and TMU (Timing/ Transmission and Management Unit) states and found they were perfectly normal and no alarm was generated.
- Through signaling trace, I found the call procedure was complete.

- The BTS was situated in the second module of the BSC where I have found all the other BTSs were in normal condition. Further, I checked the BSC data configuration and here also I could not trace any problem.

- Afterward I opened the back door of the BTS to check and examine the cables and here also I found everything all right.

- Subsequently I operated the soft & hard reset over the BTS, then pulled the TMU out and then again inserted it and reloaded the software. To my surprise, I saw, the trouble was not eradicated yet. Then I thought of replacing the TMU and TRX. However the trouble was still there.

- After that I went to the BSC equipment room. Over there, I changed the BTS to another trunk port and monitored that call can be easily set up via that BTS with that configuration. The possibility of BTS failure was removed.
- Then I selected the BIE (Base station Interface Equipment) and then reinserted it. Then I replaced the trunk cable and HW (Highway). But the trouble was still there.

- After that I did some dialing tests by using an MS and observed the MS could not be disconnected. I guessed that the problem might be in time slot interchange. I knew that, time slot interchange problem is basically caused by E3M (E-3 Sub Multiplexer) or GNET (Switching Network Board) failure.

Basically, this calling test is used extensively in the testing of various functions of the BSS and very common in the routine maintenance. It is frequently carried out with the interface message trace. I had to do this test often several time during my internship period.

Figure 25: BSC equipment room

3-4 Swap Feeder

There's a possibility that we have wrong installation, for example swap feeder. Swap feeder occur when the installation switch by mistake

In 900 Band Banasree Blk E 2 & Banasree Blk E 3 are swapped with one another

I offered to change the connection between feeder combiner and placed ant2 cable to right combiner which was installed for sector 2 and also changed ant3 cable to the combiner which was installed for sector 3

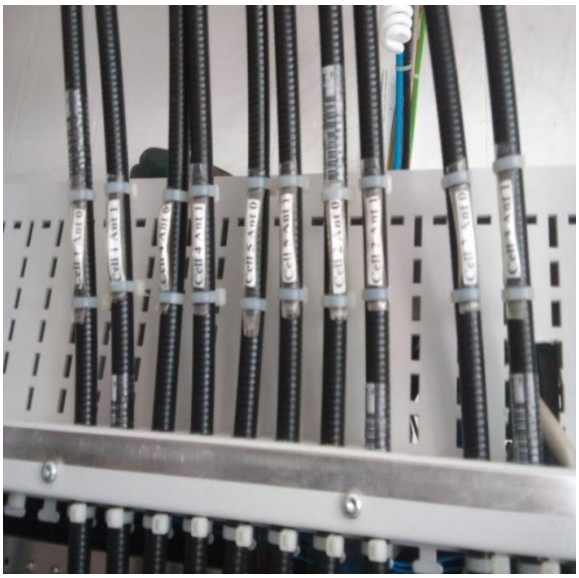
. 

Figure 26: Banasree Blk E 2 & Banasree Blk E 3 are swapped with one another

3-5 Adding TRX or CU to reduce high Congestion

From KPI Analysis I observed that Bansree BLK E- 5 sector had high congestion rate for this reason the handover success rate was very poor. To reduce congestion rate I offered them to add a CU or TRX in 1800band at Banree BLK E sector 5.

From KPI I found a graph of congestion rate of perticular Banree BLK E sector 5.

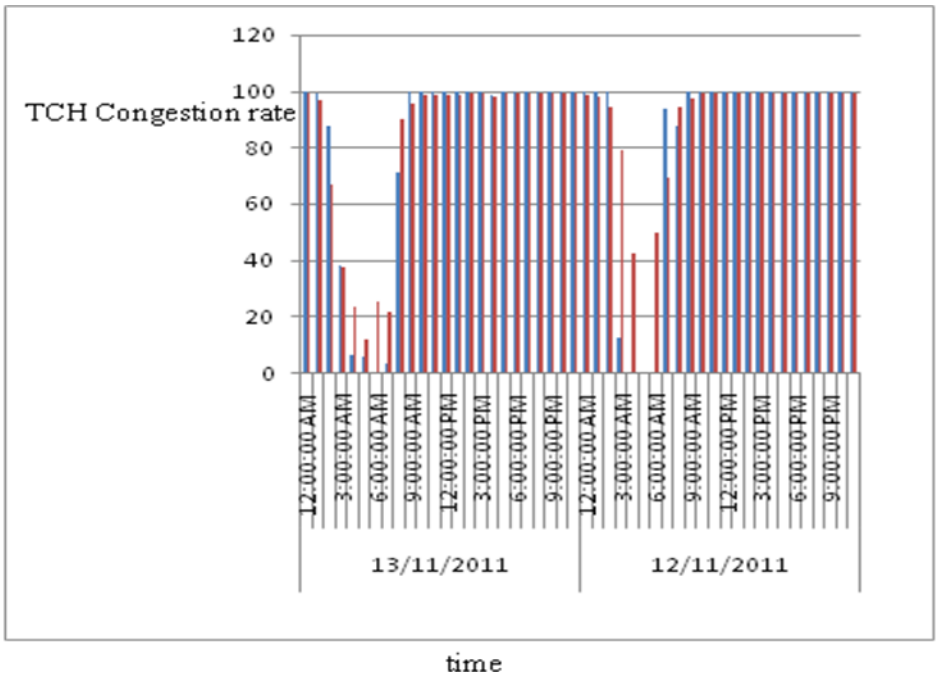


Figure 27: Congestion rate of Banasree BlK E_5

Figure 28: Adding a FCU at Banasree BLK E- 5

3-6 OML Link Disconnected For E1 Grounding Error

On 10th October, I did an onsite inspection with my engineer colleagues as per my supervisor's permission. I was informed that a site's OML (Operation and Maintenance link) was frequently interrupted and the indicator (corresponding to the E1cable) at BSC flashed.

In the beginning, I could not understand how to handle such case. Then my supervisor's advice, I could fix up the problem in the following way.

1) Firstly I self-looped the BTS at the rack top and found the indicator of the E1 cable was OFF.
2) Then I self-looped the BTS on the DDF (Digital Distribution Frame) and found the indicator of the E1 cable was OFF.
3) After that I self-looped the BSC on the DDF and found the indicator corresponding to the E1 cable at BSC was OFF. Then I restored the BSC.
4) Afterward, I powered the TMU on and then off and found the trouble still existed. Then I restored the TMU (Timing/ Transmission and Management Unit).
5) I removed the E1 cable connector from the DDF and found the trouble still existed. Then I restored the E1 cable connector.
6) I disconnected the E1 cable that run from the transmission system from the DDF. Then I tested the voltage difference between the grounding cable of the E1 cable and that of the DDF and found the Tx & Rx differences both ranged between 0.001V-0.004V. Then I restored the E1 cable.
7) I disconnected the E1 cable that run from the BTS from the DDF. Then I tested the voltage difference between the grounding cable of the E1 cable and that of the DDF and found the Tx & Rx differences were both 0.003V. Then I restored the E1 cable.
8) I disconnected the E1 cable from the rack top, powered off the rack and removed the TMU. Then I tested the resistance between the cabinet-top E1 cable connector case and the grounding cable of the rack and found they were insulated from each other. Then I restored the E1 cable.

9) Then I switched on the TMU DIP switch that corresponded to the grounding cable of the E1 cable to OFF and found the trouble still existed. Then I restored the DIP switch.
10) Then I removed the E1 cable connector from the DDF and switched the TMU DIP switch that corresponded to the grounding cable of the E1 cable to OFF. Then I found the trouble disappeared. The BTS reset and operated normally.
11) I replaced the TMU (with the E1 cable ungrounded). I let the E1 cable connector case contact the DDF and found the TMU indicator corresponding to the E1 cable flashed at a frequency of 20Hz-30Hz.
12) I restored the TMU to the original one and removed the E1 cable connector from DDF. Then I cleaned up the equipment room and left.

This is how I solved the trouble.

3-7 visiting the BTS site

During optimization trouble shooting, I had to visit some BTS, All the BTS's I have visited were tower BTS. The height of the BTS depends up to the coverage requirement but usually in the city area it can be 15 meters to 25 meters. But in rural area it can be 35 to 40 meter. The racks of Teletalk are supplied by many vendors like Nokia Siemens Networks (NSN), Huawei and Ericsson. But all the sites I have visited were NSN racks.

There are usually three cells in the antenna which covers the whole 360 degree angle. It is divided as 0 - 120, 120 - 240 and 240 - 360 degrees. A NSN BTS can normally give 1km coverage around.

Teletalk uses E1 carrier and fiber optic for the transmission. Many operators use the microwave antennas. But it is hard to maintain microwave links in the cities so they don't use microwave antennas. The connector of the feeder cables plays an important role. The connectors should be made properly neither the voltage standing wave ratio (VSWR) nor distance to fault (DTF) gets higher which can cause interference later on. The limit for VSWR is 1.3 and for DTF it is 1.15 in Teletalk.

In every BTS of Teletalk has two air conditioners with an adjustable timer because if one breaks down the other can continue. There are many kinds of alarms are set in the panel. If a component of the rack gets down the BTS will sent an alarm to the BSC it is connected to. And from the BSC the specific module can be switched off. As the BTS components needs dc voltage so a rectifier is used to make the ac voltage into dc. What voltage is needed depends on the type of BTS. The NSN BTS I observed needed - 48 volts.

For one Tx cable two Rx cable is needed. So the number of Rx cable is double of Tx cable. Because one Rx is for normal and the other is for diversity connection. Most of the BTS we have commissioned has thee GSM900 and three GSM1800 modules and the TRx configuration is 222 and 444.

3-7-1 Base Transceiver Station (BTS) Equipments

1. BTS cabinet
2. Indoor Unit (IDU)
3. Rectifier
4. Backup battery
5. Chrome Block and Data distribution Frame
6. Antenna
7. AVR (automatic voltage regulation)

3-7-1-1 BTS cabinet

It consists of the following equipments:

- **ACOM or Combiner:**

A combiner is a device at the base station that allows connection of several transmitters to one antenna. There are two types of combiner's hybrid and filter. Hybrid combiner can combine two incoming transmitter signals to one outgoing signal and allows all frequencies. A filter combiner

allows only a selected frequency in the transmit band to pass through and duplexer means we can use the same antenna both uplink and downlink paths.

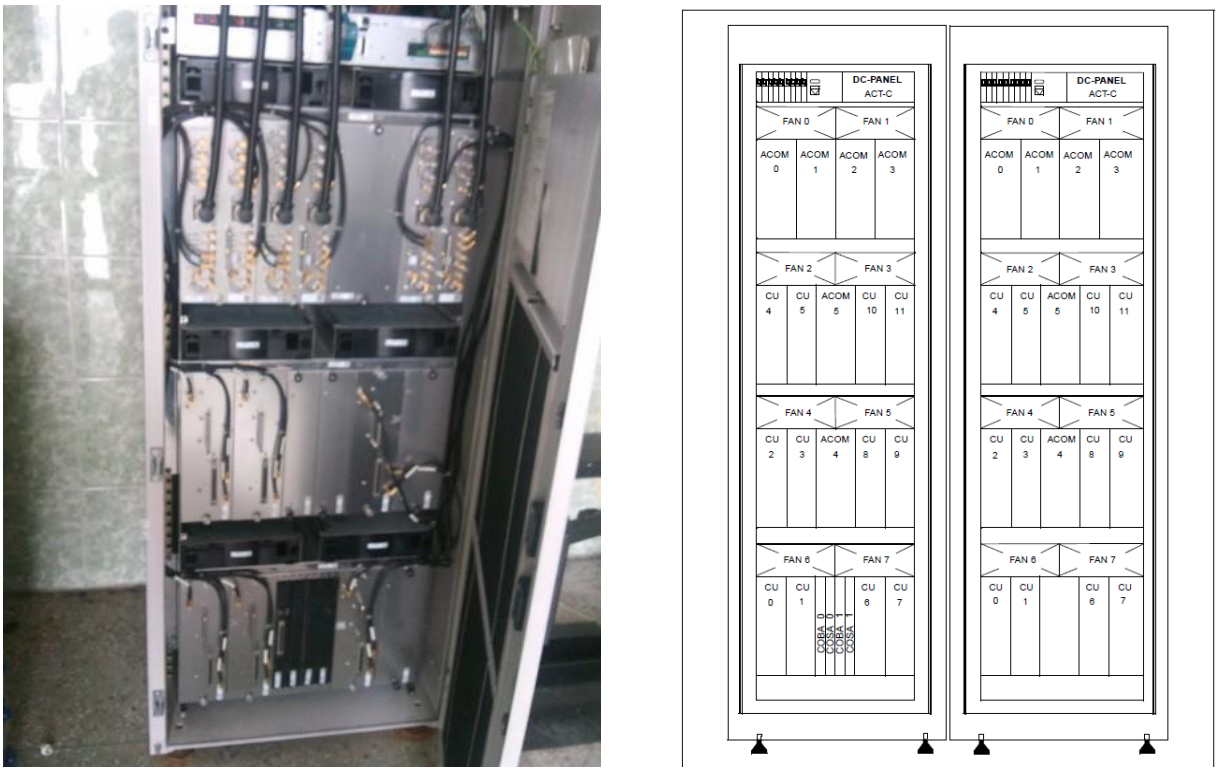


Figure 29: Siemens BTS

- **Control Unit (FCU):**

The FCU has the following functions:

- Controls and supervises fans
- Generates alarms
- Man-Machine Interface (MMI) for the fans

- **Core basis (COBA):**

The COBA is the central board of the core. The main components of this board are the base core controller, the advanced clock generation, the serial link interface controller that manage the external interface towards the carrier units, the PCM30/24 inter-faces, the internal system alarm

interface, and also an interface to one COSA to expand the BTS. The COBA has to be installed in the base rack.

Types of COBA:

- M: COBA2P8Vx
- M: COBA4P12Vx

- **Core satellite (COSA):**

The main task of the COSA board is to increase the number of the PCM30/24 Abis inter faces. The COSA is an optional module. It is located in the base rack. The COSA is controlled by the COBA and receives the working-clock from the COBA. The first 8 carrier units in the base rack are supported by the COBA. The COSA supports4 additional carrier units in the base rack and 12 carrier units in the extension rack. The COSA extends the configuration by up to 6 Abis ports. In the configuration with COBA and COSA, the BTS can support a maximum of 8 PCM lines and a maximum of 24 carrier units.

Types of COSA:

- COSA6P16COBA2P8 extension with 6 Abis links and 16 CC-links
- COSA4P12COBA4P12 extension with 4 Abis links and 12 CC-links

- **Carrier units (CU):**

The CU is a carrier unit variant which supports GMSK modulation. Different variants of CUs for the several frequency bands GSM900, GSM1800 and GSM1900 exist.

- **GSM carrier unit (GCU):**

The GCU is a carrier unit variant that supports GMSK modulation. Different variants of GCUs for the frequency bands GSM900 and GSM1800 exist.

- **EDGE carrier unit (ECU):**

The ECU can support EDGE functionality in uplink and downlink. In downlink direction, the signaling and traffic data are received from the core and converted into GMSK or 8PSK modulated signals which are amplified to the desired power level. With the intro-direction of EDGE, it is possible to mix EDGE and non-EDGE timeslots on the same carrier. Different variants of ECUs for the several frequency bands GSM850, GSM900,GSM1800, and GSM1900

exist .The mechanical design of ECU is identical to that of all other CU versions; it is therefore hardware compatible and fits into all BTS racks

3-7-1-2 IDU or MMU:

Ericsson Mini-Link is a series of commercially very successful microwave links. They are used world-wide for back-hauling GSM BTS and UMTS Node-B. Every microwave link is a point-to-point link. Each side of the link has an IDU (In Door Unit) and ODU (Out Door Unit). The IDU is responsible for transmitting and receiving at the respective microwave frequency (normally 7-38GHz).

There are different types of MMUs, representing the different link speeds of the microwave link, The MMU has connections for the data links (E1, E3, STM-1, etc.) as well as a coaxial wire connecting it with the ODU. Banglaphone maintain the BTS of teletalk by this IDU .

Figure 30: IDU

3-7-1-3 Rectifier:

Rectifier converts the power from 3-phase AC to single-phase DC. In BTS rectifier provides DC power supply to CU, COBA, COSA, and IDU. The DC power will not necessarily be at the

correct voltage to charge the battery. The alternator always tries (for a given engine RPM) to put out the same amount of power. Since power is equal to volts times amps, if the bike is not using much current (battery fully charged, no heavy electrical loads), the voltage will rise. It is the job of the regulator to supply the load so that the voltage is kept within specified limits. It does this by consuming the excess electrical power as heat.

Figure 31: Rectifier which rectifies the AC Voltage into DC.

3-7-1-4 Backup battery (BATTPACK):

The backup battery guarantees continuous operation for a certain time in case of main breakdown or AC/DC failure.

The battery backup time depends on the configuration and the battery type. Different battery types for each BTS type are available. Backup batteries are mandatory for AC-supplied systems and must be installed in the Service racks. All battery systems connected to one AC/DC system should have the same capacity. The capacity of the backup battery can be increased by additional batteries in separate Service2 racks.

3-7-1-5 Chrome Block and Data distribution Frame:

Data distribution frame is a passive device which terminates cables, allowing arbitrary interconnections to be made. For example, the Main Distribution Frame (MDF) located at a telephone central office terminates the cables leading to subscribers on the one hand, and cables leading to active equipment (such as DSLAMs and telephone switches) on the other. Service is provided to a subscriber by manually wiring a twisted pair (called a jumper wire) between the telephone line and the relevant DSL or POTS line circuit.

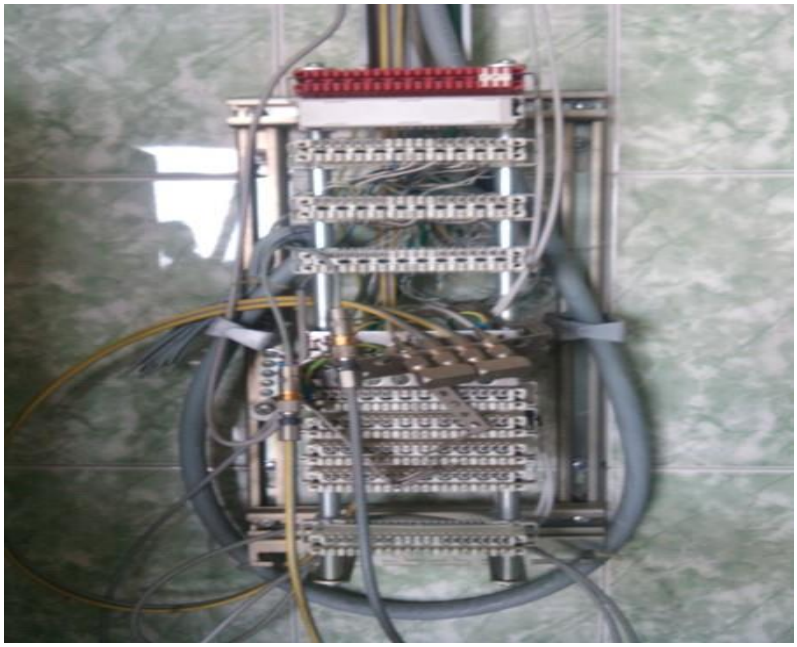


Figure 32: Chrome block and Data Distribution frame

3-7-1-6 Antenna:

This is the structure that lies underneath the BTS. It can be installed as it is or disguised in some way. There are 2 types of antenna Teletalk use Single band which supports GSM900 and Dual-band which supports GSM900 and GSM1800 for uplink and downlink.

Figure 33: GSM microwave antenna

3-7-1-7 AVR (automatic voltage regulation)

Sometimes the nation grid's power is fluctuated, in this case this AVR (Automatic Voltage Regulator) maintain a constant voltage for the operation of the air conditioner.

Figure 34: AVR

3-8 MSC Visiting with Supervisor as Training Purpose

Teletalk have 5 MSC which are located in different places. I have visited one GMSC 600K which is located in Ramna. Main Switching Center (MSC) is one of the Copernican and sophisticate place for a mobile operating company. Because the main function of call processing is controlled and made by this place. So, visiting MSC during internship is very unusual. I am very lucky that I got an opportunity of a pleasant visit in one of MSC of Teletalk. The main function of MSC is for call- switching in Cellular as well as GSM system. Its overall purpose is the same as that of any telephone exchange. When the MSC provides the interface to PSTN, it will be known as a Gateway MSC (GMSC). In this position it will provide the switching required for all mobile originated or terminated traffic. Inside of MSC there is a switching center. All the E1 cable from BTS connected to a device which connects to MSC.As not being familiar with the equipments which are functioning in MSC, my supervisor introduces me about their I have got a few time to visit that MSC.

4-1 Conclusion

As there was an opportunity to serve Teletalk in many ways, I have gathered a lot of experiences throughout the entire internship program at the company. There was a scope to observe RF planning and optimization procedures and also have knowledge about the entire Base Station System. In this report I have explained my practical experiences as well as my ideas or knowledge about RF planning and optimization and also about GSM system in Teletalk. I have learned so many significant procedures from my supervisors and colleagues and conducted some tests and did troubleshooting on a regular basis throughout my entire Internship period. The topics of optimization (of the radio network configuration and a short explanation of the most important radio parameter areas) have led to an understanding of the optimization process and the observation of two key issues of radio network optimization: configuration management and radio network functionalities.

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Teletalk Bangladesh Ltd.
Government Owned Mobile Phone Operator in Bangladesh

House # 41, Road # 27
Block-A, Banani
Dhaka 1213, Bangladesh
Phone : 880-2-885 10 60
Fax : 880-2-988 28 28

No: TBL/HR/Intern/2010-2011/65. Date: 21-September-2011

To:
Ms. Shahnaz Islam
Job Counselor, CPDS,
North South University.

Subject: **Acceptance of Internship proposal.**

Ref: Your letter No. Date: 12-September-2011.

Dear Sir/Madam,

In response to your letter mentioned in the reference, Teletalk Bangladesh Limited is pleased to accept your request for giving internship opportunity to your students **Mr. Muhammad Istiak Al Yousuf, ID # 052-328-045 and Mr. Udoy Shuva Rahman, ID # 053-264-545**.

Teletalk Bangladesh Limited will not provide any Allowance.

We shall provide them the best possible opportunity during those 06 (six) weeks stay in Teletalk.

They may kindly be instructed to report to Project Director, 3G Mobile Project.

This letter has been issued with the approval of Managing Director, Teletalk Bangladesh Limited.

(Md. Mahfuzar Rahman)
General Manager
Human Resources

Copy:-

1. Concerned General Managers, TBL.
2. Project Director, 3G Mobile Project, TBL.
3. Concerned Interne.
4. Office Record

Teletalk Bangladesh Ltd.
Government Owned Mobile Phone Operator in Bangladesh

House # 41, Road # 27
Block-A, Banani
Dhaka 1213, Bangladesh
Phone : 880-2-885 10 60
Fax : 880-2-988 28 28

No: TBL/HR/Intern/2010-2011/83 Date: 11-December-2011

To:
Ms. Shahnaz Islam
Job Counselor, CPDS,
North South University.

Subject: **Extension of Internship.**

Ref: TBL/HR/Intern/2010-2011/65, date. September 21, 2011.

Dear Sir/Madam,

In response to your letter mentioned in the reference, Teletalk Bangladesh Limited is pleased to extend internship to **Mr. Udoy Shuva Rahman, ID # 053-264-545** for 6 (Six) weeks more.

11.12.11

(Md. Mahfuzar Rahman)
General Manager
Human Resources

Copy:-
1. Project Director, 3G Mobile Project, TBL.
2. Mr. Udoy Shuva Rahman, ID # 053-264-545.
3. Office Record

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To whom it may concern

This is certify that Rosdana Tasnim, bearing ID no. 08205068, a student of the Department of Electrical & Electronic Engineering of International University of Business Agriculture & Technology (IUBAT), Dhaka, Bangladesh attended an Industrial Practice program from *7th September, 2011 to 7th December, 2011* at Teletalk Bangladesh Ltd as the part of academic course. During her Industrial attachment she has taken some practical experience about Radio Network Planning, Optimization, drive test, Access and Core Network elements of our network. More details, she has participated with our teams during the troubleshooting of base stations, capacity expansion of access networks and conducting the drive test of radio network.

Nothing has been recorded against her character and conduct during her attachment.

I wish her every success in life.

08/12/2012

(Mohammad Razaul Karim Rizvi)

Manager, System Engineering

Md. Razaul Karim Rizvi
Manager, *System Engineering*
Teletalk Bangladesh Ltd.