Internship Report on

RF Engineering

Of

METRO GLOBAL TELECOM SERVICES PVT LTD

Submitted By

MD. Islam Hossain

Id: 2011-2-55-010

Department of ECE

East West University

Submitted To

Mohammad Arif Iftekhar

Lecturer

Electronics and Communications Engineering

Industrial Placement Report

—o *Supervised By* o—

Mohammad Arif Iftekhar

Lecturer

Department of ECE

East West University

—o *Prepared by* o—

MD. Islam Hossain

ID# 2011-2-55-010

Declaration

I hereby declare that this internship report is the outcome of my own Work. Requisite references are quoted to support my work. I also declare that this internship report, neither in whole nor in part, has been previously submitted anywhere else for any degree.

_____

Md. Islam Hossain

ID: 2011-2-55-010

ECE Department

EAST WEST UNIVERSITY

SUPERVISIOR'S CERTIFICATION

This is to certify that Md. Islam Hossain, ID: 2011-2-55-010, Department of Electronics and Communication Engineering, East west university, has done this internship report on RF Engineering of **METRO GLOBAL TELECOM SERVICES PVT LTD** AS partial requirement of BSc in ETE degree. To the best of my knowledge, this report is original in nature and has been prepared by his guidance and was nowhere submitted for any purpose.

Mohammad Arif Iftekhar
Lecturer
ECE Department
East West University
Date:

Supervisor's endorsement_____

Mohammad Faijul Islam
Manager
Operation & Delivery
METRO GLOBAL TELECOM SERVICES PVT LTD.

Signature: _____ Date:

Acknowledgement

First of all I wish to convey my cordial thanks and gratitude to Almighty Allah to complete the Internship program successfully and also those who all rendered their cooperation in making this report.

I would like to thank **Mohammad Arif Iftekhar, Lecturer, Department of Electronics and Communications Engineering (ECE), East West University, Dhaka** for guiding me with lots of his effort and time to perform this Internship program.

I thank and express my gratitude to **Mohammad Faijul Islam – Operational Manager** of Radio Planning Department, for giving me opportunity to do Internship under his supervision and providing lots of his support during the training phase.

Of course thanks to the METRO GLOBAL TELECOM SERVICES PVT LTD, as they thought that I was capable enough to do training with them. I am gratified to the **RNO Engineer** of the Radio Planning department **Gopal Chandra Gope, Md. Atiqur rahman** and last but not the least all the senior officials of the Radio Planning department of Networks Division of Metro global telecom services pvt ltd, with whom I have spent one of the most important stages of life.

Finally, I am forever grateful to my parents for their patience and love.

Abstract

Metro Telworks Ltd is now the leading service provider company situated in the capital city of Bangladesh, with more than 10 million subscribers. As a part of the industrial training I was assigned to this prominent company for a three months training from 6th of September to 5th of December.The objective of this report is to provide the detail information of the company as well as to describe about all the tasks or projects I did during my training period.

I would like to break up this report into four phases. 1st phase of the report gives the different aspects of the company as well as the scopes of the training along with the analytical part associated with the radio planning or frequency planning. 2nd phase gives all the tasks or projects that have been conducted during the training.3rd phase give the overview of analysis of some problems concerning voice calls. Last but not the least phase of this report contains the outcomes and comments about this wonderful experience of my life.

Table of Contents

Chapter 1: Introduction

1.1 Scope of Training

As I was assigned to the Radio Frequency Optimization Department of the Networks Division of the **METRO GLOBAL TELECOM SERVICES PVT LTD**, I had to work on

- ✓ RSCP, Ec/Io, Ec/No, RSSI, TX Power, Pilot Pollution, CQI, HSPA.
- ✓ Dropped call analysis
- ✓ Drive test analysis
- ✓ Field measurements and acceptance testing
- ✓ Handover success analysis
- ✓ Interference analysis
- ✓ Frequency & Strategy Planning and everything related to the Radio frequency optimization.

The most important thing was that all those were related to my course major. As my supervisor has informed me that I would not have to do any particular assignment during my training, it would be more like the works they do during their working hours. Basically there has been 2 phases of my training. One is to know the Drive Test using Genexprobe and the other one is to Making Report using GENEX Assistant. By doing that I would be able to know about the followings:--

- ➢ To study and participate in overall Cell design process - why/when new site requirement triggered, site survey, best option judge, designing new site - key consideration, coverage prediction.
- ➢ Post-performance monitoring of new site - Traffic, Quality of Service, Resource utilization.
- ➢ Radio network Tuning and preliminary optimization - Neighbours tuning, Handover performance.
- ➢ Resource dimensioning - Signalling/Traffic channel dimension, Congestion analysis, basic idea on Grade of Service.
- ➢ Customers complain handling - why customers complain, how problem resolved.
- ➢ Very basic GSM feature study - Hopping, Power control.
- ➢ Radio capacity analysis - Erlang B Table
- ➢ Drive Test

1.2 Company Profile:

Company Name: **METRO GLOBAL TELECOM SERVICES PVT LTD**

Metro Teleworks was founded in 2004 by experienced telecom professionals. Established itself as a leading service provider in India and has expanded successfully to other fast growing markets in South Asia, Africa, Middle East, Southern and Northern America.

Key Services **(GSM/GPRS/EDGE, 3G, CDMA 1X, WCDMA, Wi-MAX, LTE**)

1.3 Other Services offered by METRO:

Other services offered metro GLOBAL TELECOM SERVICES PVT LTD are as follows-

RF Planning and Implementation:

- ✓ Initial dimensioning of the radio network
- ✓ CW Propagation model tuning
- ✓ Site survey and candidate identification
- ✓ Coverage and capacity planning
- ✓ Frequency and neighbor planning
- ✓ Interference analysis
- ✓ Parameter planning
- ✓ Field measurement and acceptance testing
- ✓ BTS Installation and ,commissioning
- ✓ Final foot prints and pre-launch optimization

RF Optimization:

- ✓ Parameter configuration check and optimization
- ✓ Site hardware configuration and optimization
- ✓ Frequency &Strategy planning
- ✓ Top X Site targeting (Drop call, high traffic, handover)
- ✓ Drive test and verification
- ✓ Various optimization reports (Drop call, handover)
- ✓ System growth / expansion Planning
- ✓ Ongoing active Operations and Maintenance

Network Audit:

- ✓ Coverage drive test Outdoor and Indoor
- ✓ Speech Quality Index (SQI)
- ✓ Voice Quality - Customer Perceived
- ✓ Congestion- Network availability
- ✓ Receive Level Fluctuation
- ✓ Recommendations for network improvement.

Network Performance:

- ✓ Provide Subscriber perception of Quality service.
- ✓ QoS reports for Senior Management.
- ✓ Drive test &Performance data control.
- ✓ Benchmark figures against competitors.
- ✓ Independent benchmarking of vendor equipment.
- ✓ Continuous/repetitive monitoring to highlight slow degradation of network quality.
- ✓ Provision of engineering data for further analysis.

Transmission and Planning:

- ✓ Initial dimensioning of the transmission network
- ✓ Existing network evaluation/expansion
- ✓ Capacity and topology planning

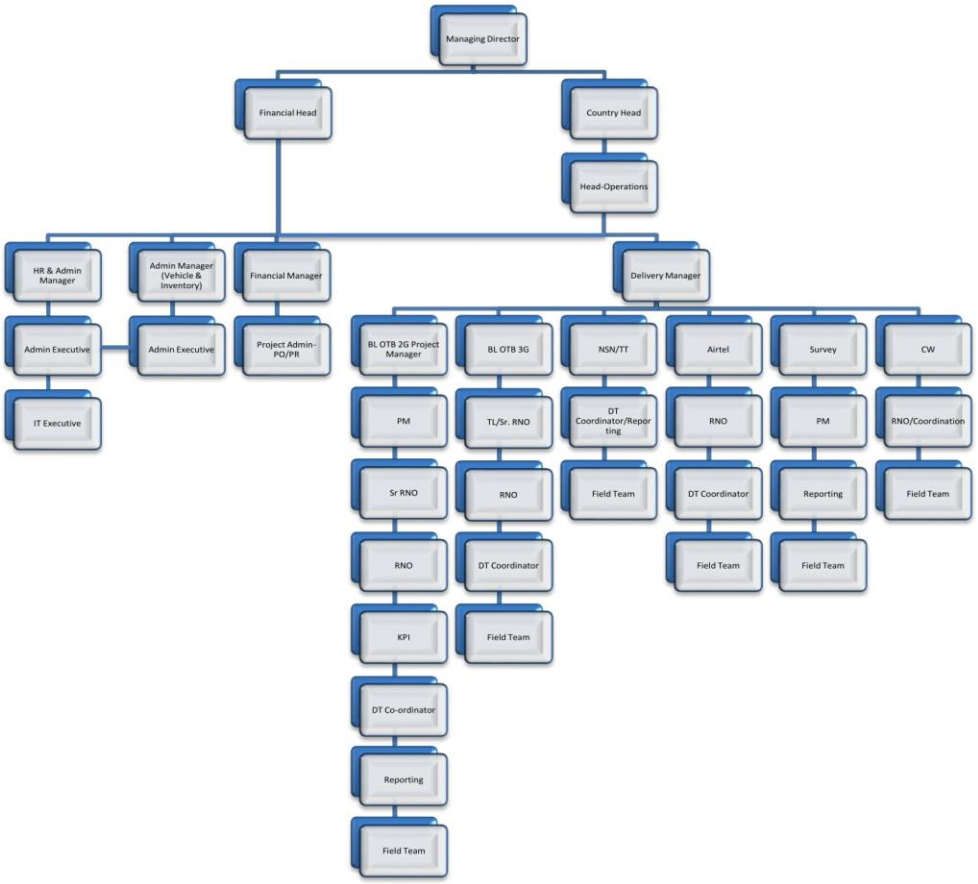
Network management planning:

- ✓ MW link level planning and interference analysis
- ✓ Transmission media selections: microwave (PDH), SDH, optic, copper, leased line, Satellite
- ✓ Technical site surveys
- ✓ Line-of-sight surveys
- ✓ Synchronization planning
- ✓ Routing with timeslot allocation

[Ref: 4]

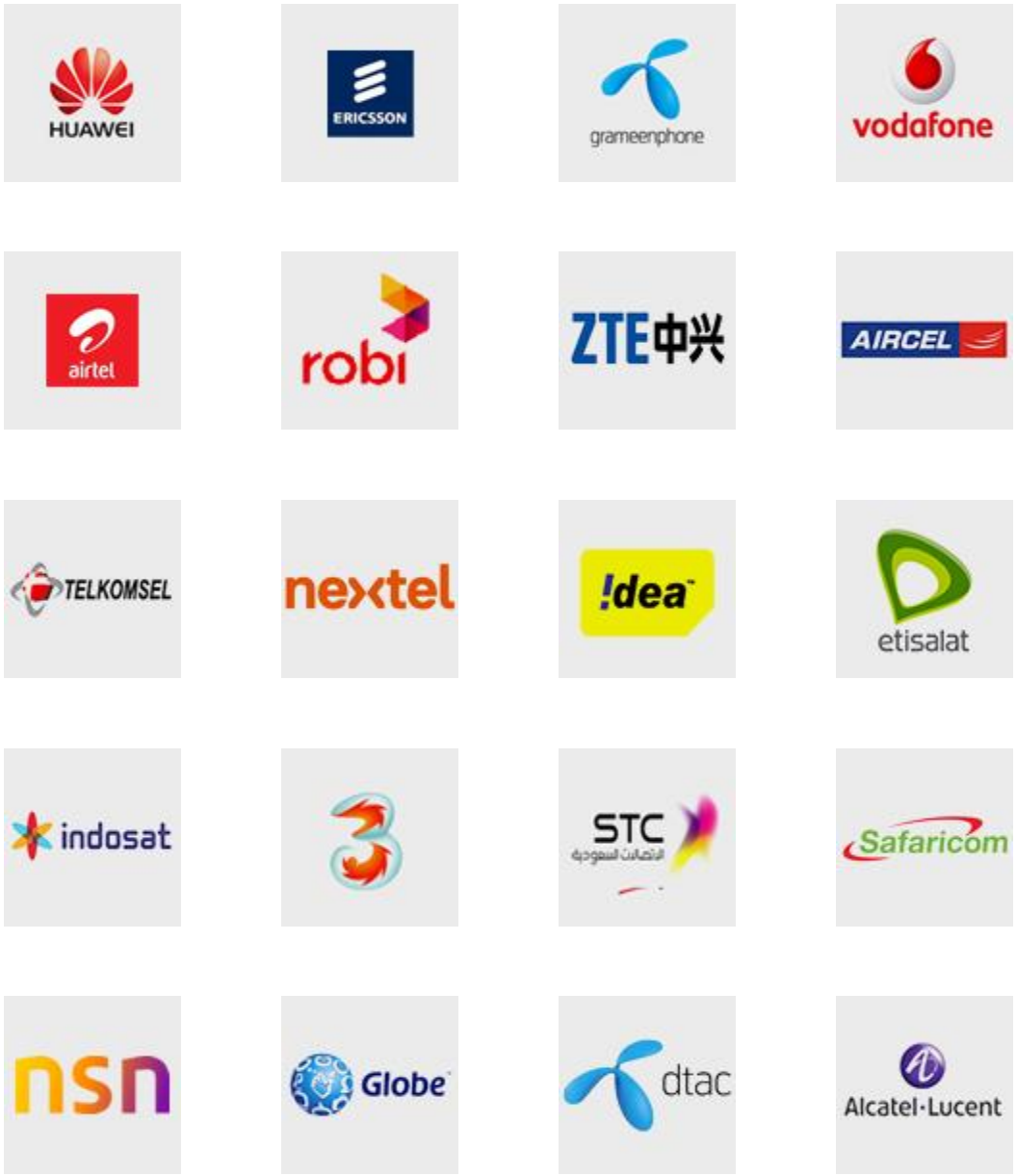
1.4 Metro Telworks Organogram:

Metro Global Telecom Service Pvt. Ltd.



Metro Global Telecom Services Pvt. Ltd., Road-132, House -56/C (3rd Floor),
Gulshan-1, Dhaka-1212, Web-www.metrotelworks.com

1.5 Customers:



[Ref: 6]

Chapter 2: Overview

2.1 UMTS-WCDMA Technology:

The first Multiple Access Third Generation Partnership Project (3GPP) Wideband Code Division networks (WCDMA) were launched in 2002.Currently, WCDMA networks are deployed in UMTS band of around 2 GHz in Europe and Asia, including Japan and America Korea. WCDMA is deployed in the 850 and 1900 of the existing frequency allocations and the new 3G band 1700/2100 should be available in the near future. 3GPP has defined WCDMA operation for several additional bands, which are expected to be commissioned in the coming years.

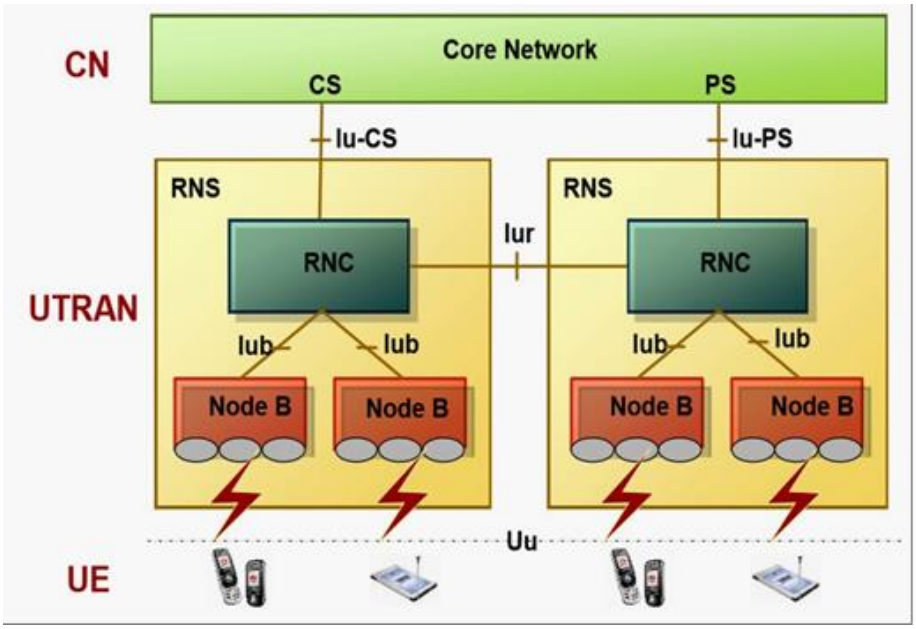


Figure2.1: WCDMA System Architecture

. [Ref 2]

The UMTS network architecture can be divided into three main elements:

- UE:**[User Equipment]** The USER Equipment or UE is a major element of the overall 3G UMTS network architecture. It forms the final interface with the user. In view of the far greater number of applications and facilities that it can perform, the decision was made to call it user equipment rather than a mobile.
- RNS:**[Radio Network Subsystem]**The UTRA, UMTS radio access is the technology that is the radio interface, and the network, or UMTS Radio Access Network is known as the UTRAN. Sometimes the UTRAN may also be known as the Radio Network Subsystem, or RNS.

  The UMTS Radio Access Network, UTRAN, or Radio Network Subsystem, RNS comprises two main components:

  1. **RNC:** Radio Network Controller
  2. **Node B:** Node B is the term used within UMTS to denote the base station transceiver
- CN:**[Core Network]**In view of the different ways in which data may be carried, the UMTS core network may be split into two different areas-

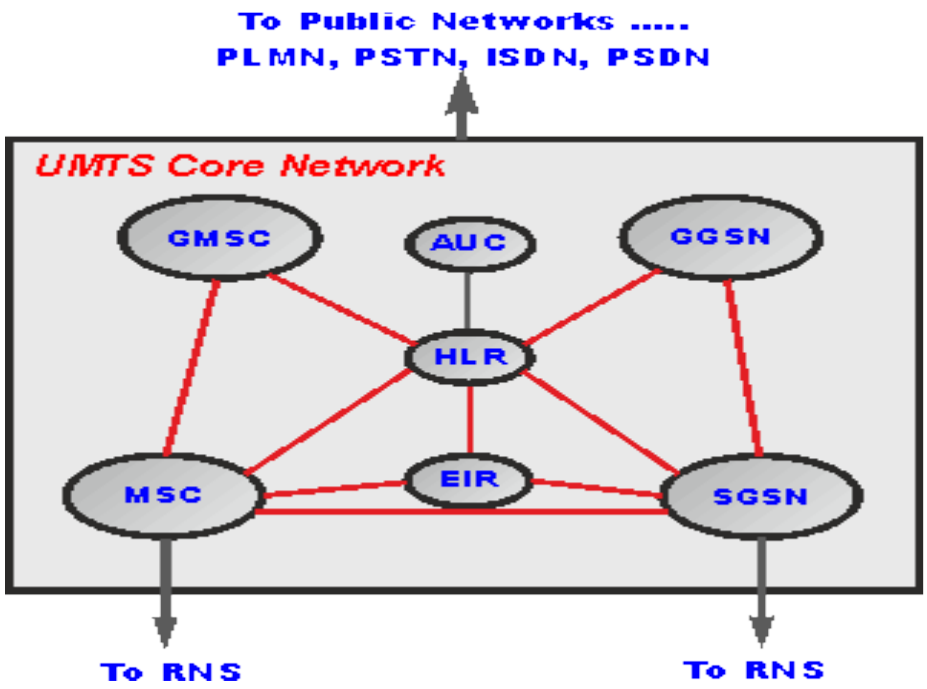


Figure2.2: Core Network

Circuit switched elements:

- **MSC**: Mobile switching center
- **GMSC**: Gateway Mobile switching center

Packet switched elements:

- **SGSN** :Serving GPRS Support Node
- **GGSN** :Gateway GPRS Support Node

[Ref 1]

EIR: Equipment identity register
HLR: Home location register
AuC: Authentication centre

2.2 WCDMA Characteristics:

WCDMA characteristics are provided as follows-

- ✓ Support two basic modes: FDD and TDD modes.
- ✓ High chip rate (3.84 Mcps) and data rates (up to 2 Mbps).
- ✓ Employs coherent detection on uplink and downlink based on the use of pilot symbols.
- ✓ Inter-cell asynchronous operation.
- ✓ Fast adaptive power control in the downlink based on SIR.
- ✓ Provision of multi rate services.
- ✓ Packet data.
- ✓ Seamless inter-frequency handover.
- ✓ Intersystem handovers, e.g. between GSM and WCDMA.
- ✓ Support for advanced technologies like multi user detection (MUD) and smart adaptive antennas.

Table: 2.1: WCDMA Specifications

Channel Bandwidth	5 MHz
Duplex Mode	FDD and TDD
Downlink RF Channel Structure	Direct Spread (DS)
Chip Rate	3.84 Mcps
Frame Length	10 ms
Spreading Modulation	Balanced QPSK (downlink), Dual-channel QPSK (uplink) Complex spreading circuit
Data Modulation	QPSK (downlink), BPSK (uplink)
Channel Coding	Convolution and turbo codes
Coherent detection	• User dedicated time multiplexed pilot (downlink and uplink) • common pilot in downlink
Channel Multiplexing in Downlink	Data and control channel are multiplexed
Channel Multiplexing in Uplink	• Control and pilot channel time multiplexed • I&Q multiplexing for data and control channel
Multirate	Variable spreading and multicode
Spreading Factors	4-256 (uplink), 4-512 (downlink)
Power Control	Open and fast closed loop (1.6 kHz)
Spreading (downlink)	OVSF sequences for channel separation. Gold sequences 218-1 for cell and user separation (truncated cycle 10 ms)
Spreading (uplink)	OVSF sequences. Gold sequence 241 for user separation (different time shifts in I and Q channel, truncated cycle 10 ms)
Handover	Soft handover, Softer handover, Hard Handover etc.

[Ref 7]

2.3 Coverage:

Coverage is a fluctuating parameter depends on lot of factors which changes from area to area and position of user. An area is under coverage if radio signal is sufficient enough to make successful call. Coverage can be classified as-

- Outdoor Coverage(requires 0 - 105dBm signal, Best less than -70dBm)
- In car Coverage (requires 5 - 10dBm higher signal than outdoor)
- Indoor Coverage(requires 15 - 25dBm higher signal than outdoor)

Probability of Coverage(area):

- Good: 90% probability
- Very good: 95% probability
- Excellent: 99% probability
- Requires more investment for higher probability of coverage

Capacity

How many users can be served by the network maintaining a target Quality of service (QoS).Capacity of a network can be defined as follows-

- Busy hour traffic handling ability
- Calling minutes handling ability [BH traffic vs. Avgas traffic]
- No. of Subscriber [BH mErl per Sub]

Quality of Service (QoS)

- Accessibility of network
- Speech quality and call drop.

2.4 Site surveys Overview:

The cell planning process results in a cell plan with nominal site positions. If the operator has access to existing locations, it is necessary to adapt the cell plan according to these locations. For this reason, it is important that the cell planner has a basic knowledge of the locations that can be used.

Radio Network Surveys: The on-site cell planning work that takes place is called the "Radio Network Survey". A more detailed survey is performed on the base station sites. This is called the "site investigation".

Basic Considerations:

The following aspects of site selection must be studied:

- Position relative to nominal grid
- Space for antennas
- Antenna separations
- Nearby obstacles
- Space for radio equipment
- Power supply/battery backup
- Transmission link
- Service area study
- Contract with the owner

Radio Measurements

- Path loss parameters
- Time dispersion
- Interfering transmitters

2.5 Different Site Solutions:

- **Roof top [RT] Site:** Usually in urban area.
- **Green Field [GF] Site**: Usually in Rural area.

These two above type of sites may have the following solutions

- **900MHz Site:** for both coverage, capacity and quality requirement
- **Collocation with1800MHz BTS:** for capacity and quality requirement
- **3rd cabinet with 1800Mhz BTS:** for capacity requirement
- **2100MHZ UMTS:** for 3G coverage.

Some other special case solutions in dense urban area:

- **IBS [In Building Solution]:** For better coverage, capacity and quality.
- **MC [Micro cell]:** To improve quality as well as capacity in the hot spot like traffic junction and road.
- **Repeater site:** For better coverage and quality. Repeater cannot ensure capacity.

Figure2.3: Green Field site

Figure2.4: Rooftop site

Chapter3: Drive TEST

3.1 Drive Test Overview:

DRIVE TEST can be used as a tool for investigations and maintenance of cellular networks in order to ensure coverage, service quality or to pinpoint problem areas. The Purposes of Drive Testing-

- To provide path loss data for initial site survey work.
- To verify the propagation prediction during the initial planning of the network.
- To verify the network system parameters.
- To provide the initial test parameters used in Benchmarking.
- To verify the performance of the network after changes have been made e.g. when a new TRX is added; the removal or addition of a new site; any power adjustments or changes to the antenna; any changes in clutter or traffic habits.
- To measure any interference problems such as coverage from neighboring countries.
- To locate any RF issues relating to traffic problems such as dropped or blocked calls.
- To locate any poor coverage areas.
- To monitor the network against a slow degradation over time, as well as monitoring the network after sudden environmental conditions, such as windstorm or electrical Storms.
- To monitor the performance of a competitor's network.

When to Drive Test:

Drive testing can take place during the day or at night and is dependent upon the Operator's requirements and subscriber habits. Drive testing during the day will imitate the conditions as Seen by subscribers, but may clog up the network if call analysis is being performed. Drive testing during the night will allow a greater area to be surveyed due to the reduction in vehicular traffic jam. It will also allow for certain test signals to be transmitted and tested, particularly when setting up a new site, without interrupting normal operation. However, night-time testing does not imitate the conditions experienced by subscribers. For planning purposes, drive testing is typically performed at night and for maintenance purposes, drive testing is performed during the day.

Where to Drive Test:

Some areas of a network will have greater performance problems than others. Drive testing should not be regular throughout the whole network, but should be weighted towards areas where there are significant RF problems. There may be other areas of the network that require temporary coverage during a certain time of the year e.g. an exhibition Centre or a sports stadium. These areas should be examined and planned in greater detail. Sometime operators can perform drive test for their customary check for a certain city or some specific clusters of a city.

3.2 Types of drive Test:

Drive test can be performed in very many ways. Different types of drive test fulfill different types of requirement from the customer.

- Single site Verification (SSV) Drive Test.
- Cluster Drive Test.
- Acceptance Drive Test
- Site Swapping Drive Test
- Benchmarking Drive Test
- Functionality Test
- Walk Test for IBS

Tools (Drive Test Kit):

Drive testing needs some distinctive type of tools, like some special mobile phones and Software. The followings are list of tools generally required for drive test: Drive testing needs some distinctive type of tools, like some special mobile phones and software. The followings are list of tools generally required for drive test:

Hardware:

- **Drive test vehicle:** Four wheeler vehicles are perfect for drive test to access important but tough access roads or muddy roads.
- **Power Inverter:** This device inverts DC power to AC power. We can use it to invert vehicle's DC power to AC power to ensure uninterrupted power supply to the laptop and other electronic devices during DT.
- **Laptop computer:** DT laptop should be with good condition and configuration, like high speed processor and especially RAM volume should be more for smooth drive testing.
- **Mobile phones and phone charger:** Special mobile phones designed with field measurement features. How many mobile phone should we use during DT depends on the types of DT. Some testing requires one phone and some other requires two or more. Chargers are also compulsory to keep the phone always charged.
- **Data cables:** Data cable depends upon the model of the mobile phone. Every mobile phone has its own data cable to transfer measured data to the software installed in the laptop.
- **GPS:** GPS generally used for positioning purpose. In DT positioning is very important both for visualization (current position during DT) and analytical point of view. Car GPS also attached on top of the vehicle like external antenna and connected with laptop through cable.
- **USB Hub:** Sometime when we need to work with two or more mobile phones then we need more USB ports, but our laptop ports are limited. So we have to use USB hub or PCMC USB card, which will provide us more USB ports to connect more equipment.

3.3 Software and necessary files:

- **Data collection Software:** This is the software through which field data will be collected. With this software we can analyze the field data also. This software should be licensed from the vendor company for proper authorization. Every software has a key to work properly. The most popular software for data collection is "GENEX Probe" from HUAWEI.

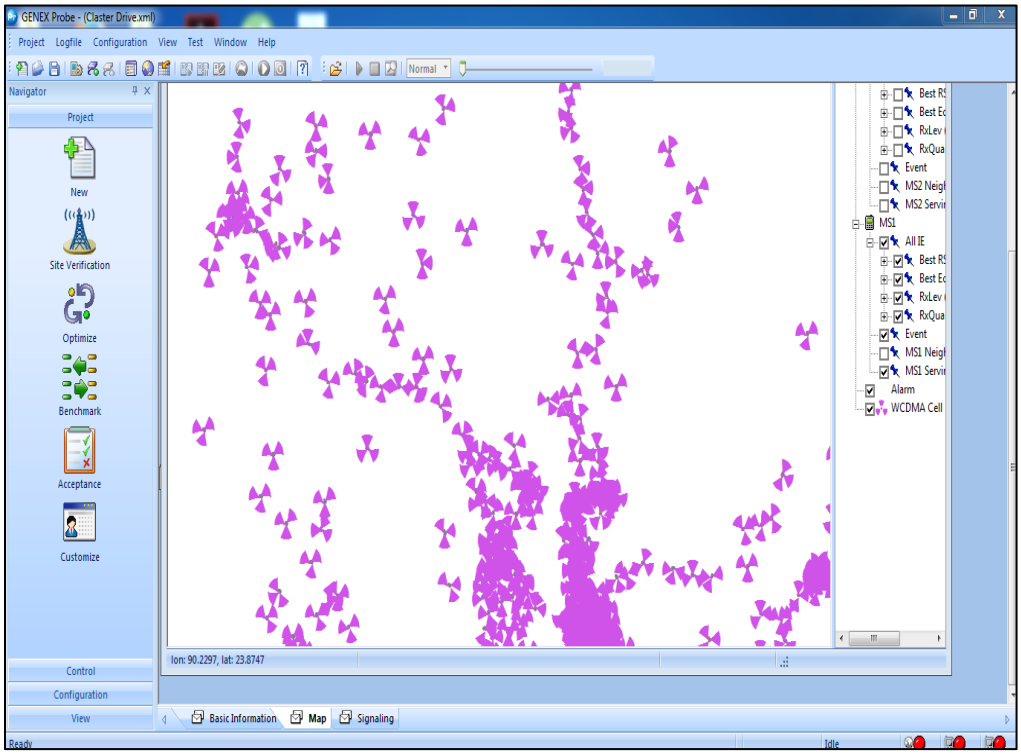


Fig3.1: GENEX Data Collection Software

- **Digital Map:** During drive test digital map is necessary for finding the way to reach the selected site/cluster and do DT according to some predefined routes. We can load the digital map of the whole region or we can load the map of some specific roads that need drive test. This map comprises all the accessible DT routs.

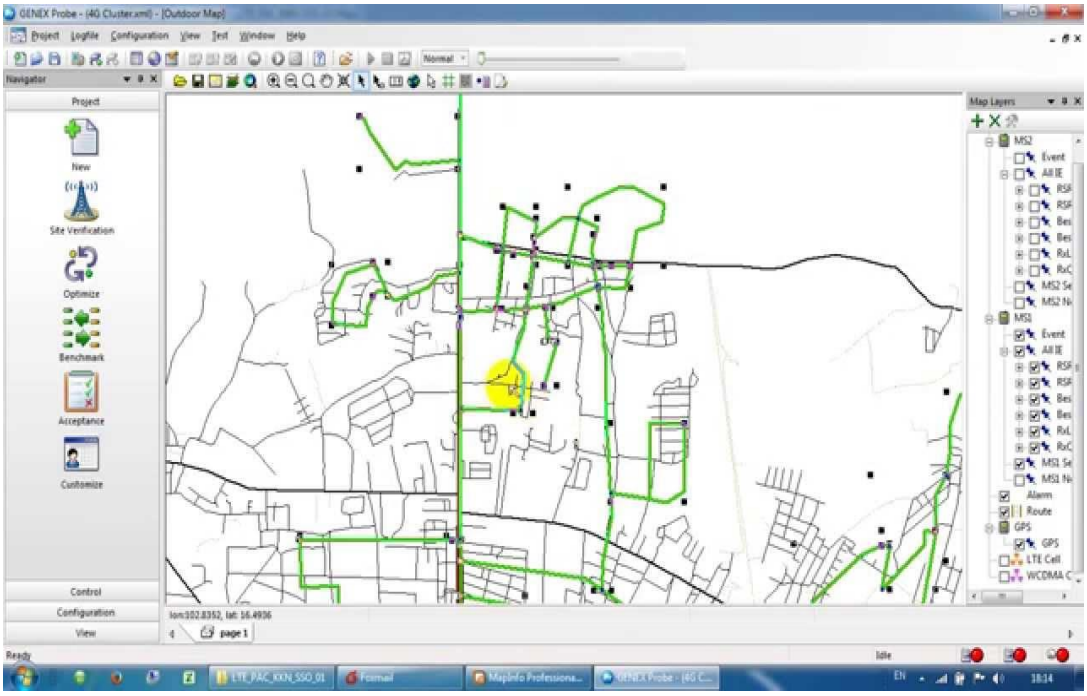


Fig3.2: Digital Map

- **Cell file:** We must load the cell file into the data collection software. A cell file contains all the necessary information related to the site, like ID of that site, assigned frequencies of that site, direction of the antennas of that site etc. Whenever we load the cell file we can see the position of that site in the digital map. Then we can easily find out our required sites form the map and also the roads to be covered for that site.

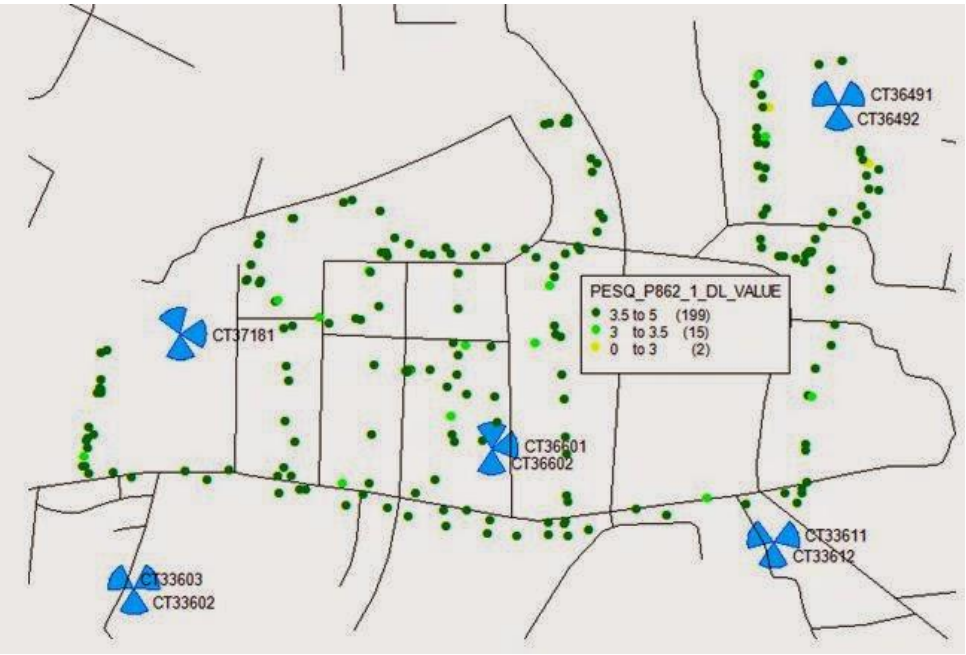


Fig3.3: Cell File

- **MapInfo:** MapInfo allowed us to include mapping functionality into DT software. We can easily plot our sites position, routes, and building drawings (for indoor test) with this software. MapInfo has the ability to combine and display, on a single map, data from a variety of sources that are in different formats and projections. The software is capable of overlaying vector layers on the same map.

- **Hardware Drivers:** All the mobile phones and GPS need driver software to synchronize with the drive test software. Every equipment drivers must be installed properly in the laptop otherwise they will not work properly.

3.4 Pre Test Preparations:

- Verify from BTS or BSC personnel if the site is up and running.

- Collect the parameters for the cells/sector(s) under test from the RF Planning team. Verify that the BCCH & NBCCH frequencies, MAIO list, Handover candidates, HSN, BSIC, and other parameter values set in the BSC are correct.

- Verify that the BCCH frequencies are loaded into the mobile monitoring software (GENEX cell file) for cells/sector(s) under test. The GENEX may need to be configured or reconfigured as cells/sectors are added or any change in frequency plan.

- Obtain the MSC test number to be used for testing (record in data sheet).

- Obtain the drive van, GSM phone number and GSM IMEI of SIM to be used for testing (record in data sheet).

- At Site, Verify the orientations of antennas, antenna heights, antenna types and if possible, tilts. These observations may be made with the help of a pair of binoculars and a compass. These observations should be recorded in the SSFT record sheet.

- Determine the initial start/stop points on the map for each cells/sector(s) under test. The start/stop points should be approximately 0.5 km. or less away from the site, close to the center of the sector within the coverage of the sector/cell under test.

- Determine the preliminary circular drive route around the cell, which intersects each start/stop point for each sector. This route should represent the area of the site coverage to be tested.

- Verify the van setup (like cigarette lighter, inverter, software installed on the laptop, proper cables, PCMCIA card if required) Tum the drive test laptop computer ON and bring up the Test software and ensure GPS is tracking.

Chapter 4:Functionality Test

4.1 Procedure of Functionality Test:

In Swap Night, the RF engineers have to do the Functionality Test for the purpose of monitoring the network performance of the new equipment of a BTS. Functionality Test consists of some test named as:

- Call Set-up
- Long Call/Short Call
- Basic Handover
- Data Test
- Possible Feeder Swap etc.

To do the Functionality Test RF engineers have to maintain some files such as:

- DT Route
- Cell File
- Cluster Boundary
- Parameter List
- Team Plan
- Night Duty BSC Engineers contact Number

4.3 RSCP Plot:

RSCP is measured by MS1, which is in idle mode during the test.In **Sunamgonj Cluster-1**, RSCP is OK in most area. Not On Air sites are marked with Red circle.

Follow is RSCP plot :

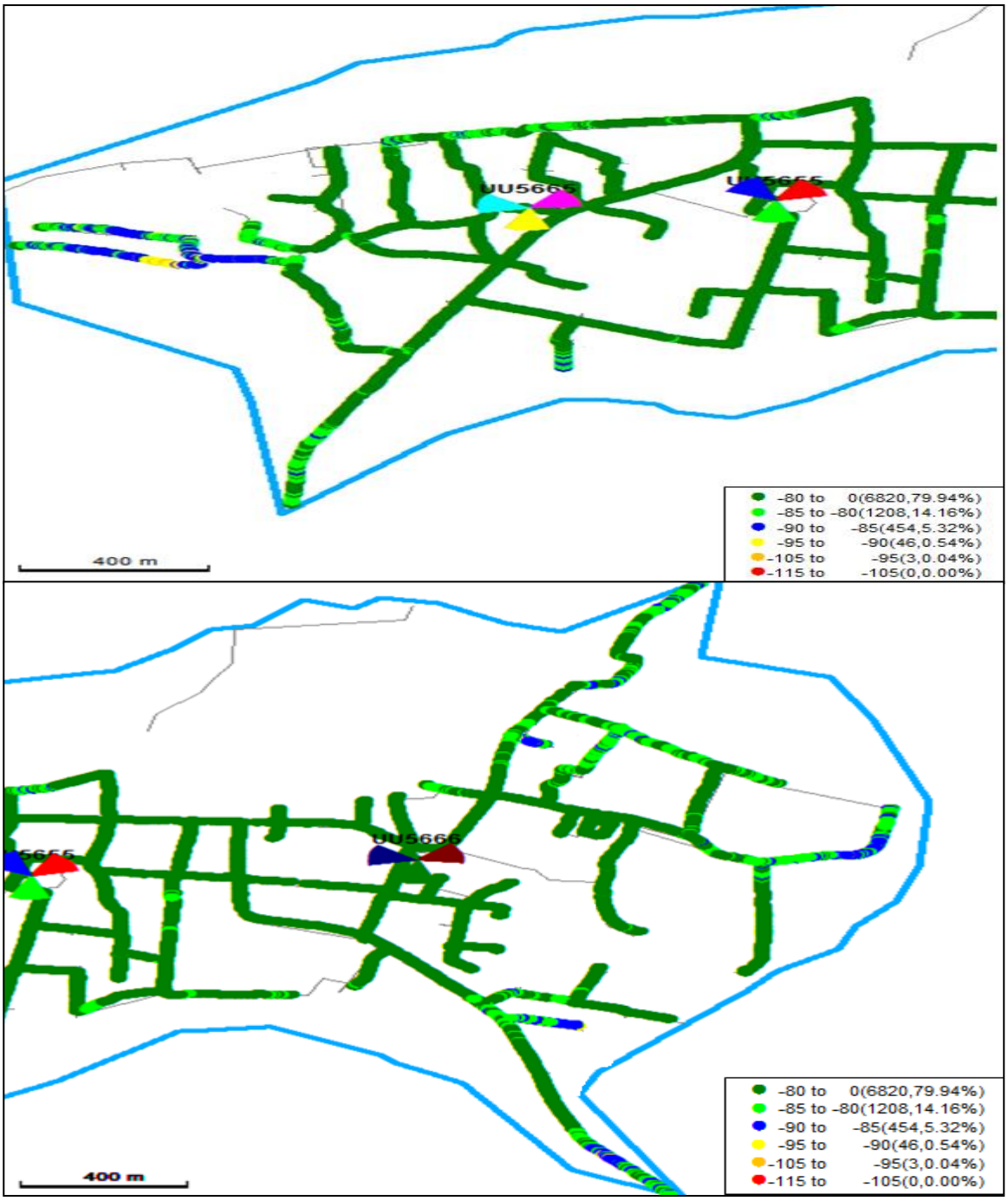


Fig4.2:RSCP Plot

4.4 Ec/No Plot:

Ec/No is measured by MS1, which is in idle mode during the test.In **Sunamgonj Cluster-1**, Ec/No is OK in all the area.Not On Air sites are mentioned by Red Circle.

Follow is Ec/No plot:

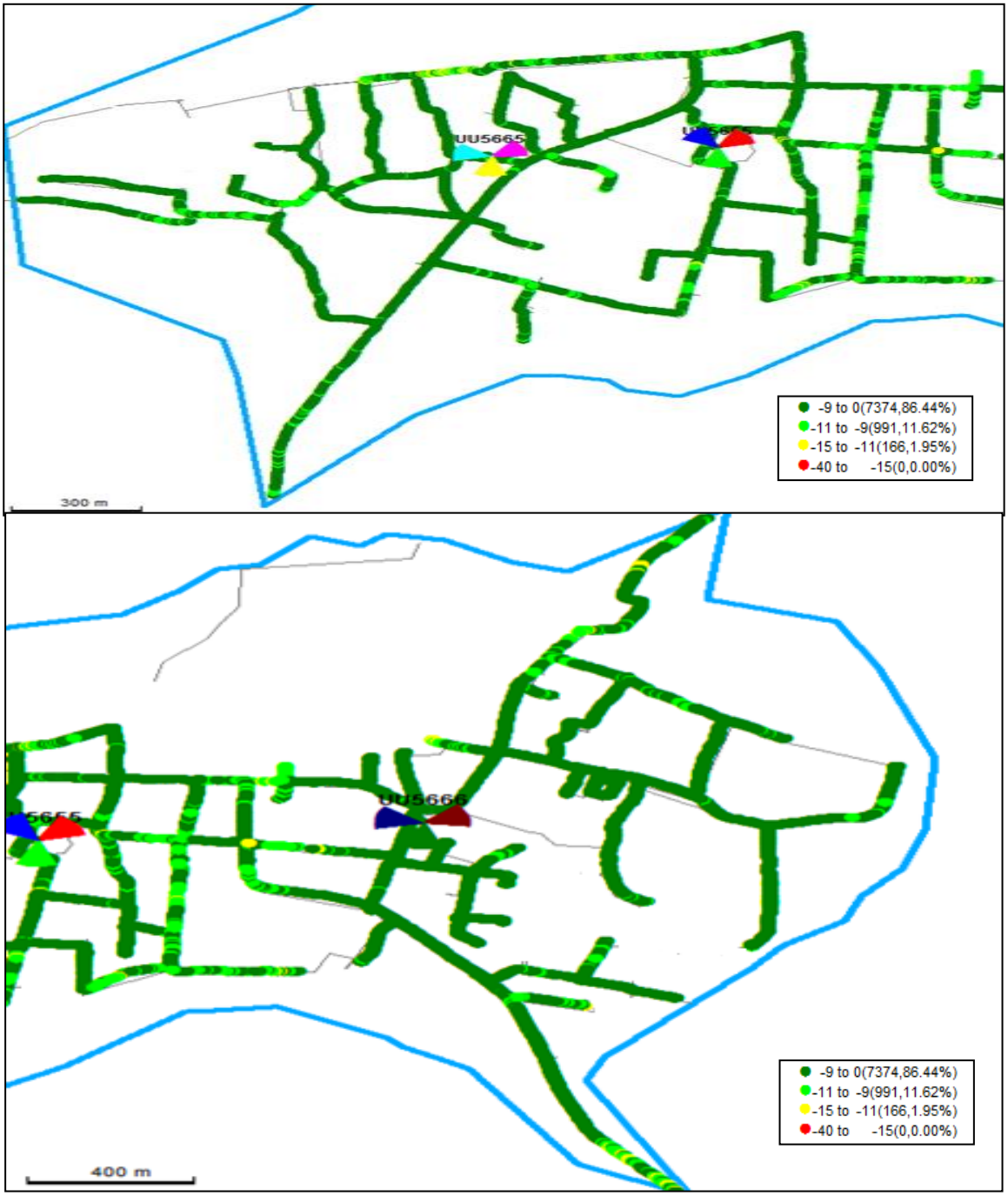


Fig4.3:Ec/No plot

4.5 HSDPA Plot:

HSDPA throughput is measured by data card, which download files from Airtel ftp server.During post HSDPA throughput test, more than 2GB files download from the server.So, throughput was good.Follow is HSDPA throughput plot :

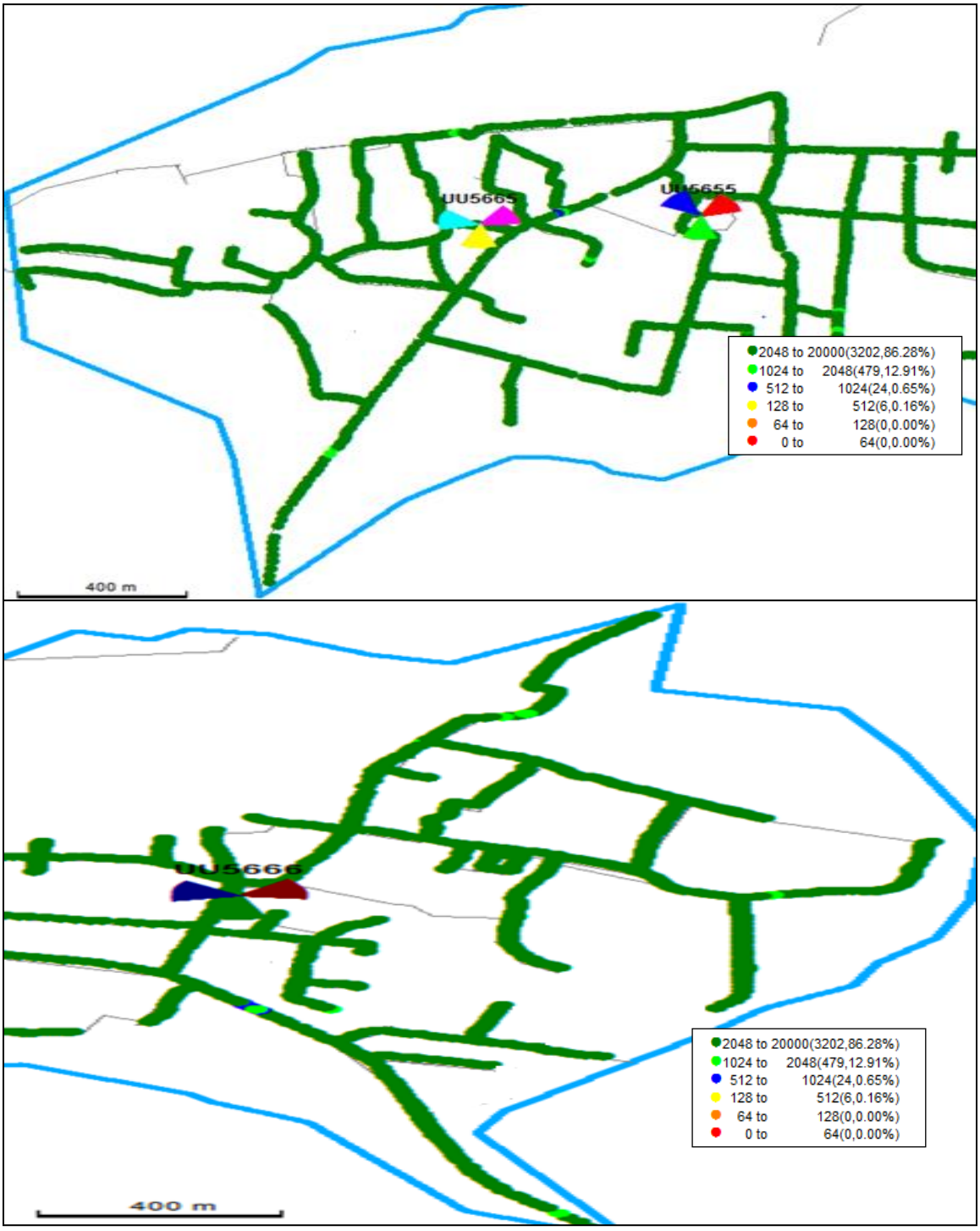


Fig4.4:HSDPA Plot

4.6 HSUPA Plot:

HSUPA throughput is measured by data card, which upload files to Airtel ftp server. During post HSUPA throughput testmost of the throughput is good with greater than 1Mbps.Follow is HSUPA throughput plot.

Fig4.5: HSUPA Plot

4.7 Proper Handover:

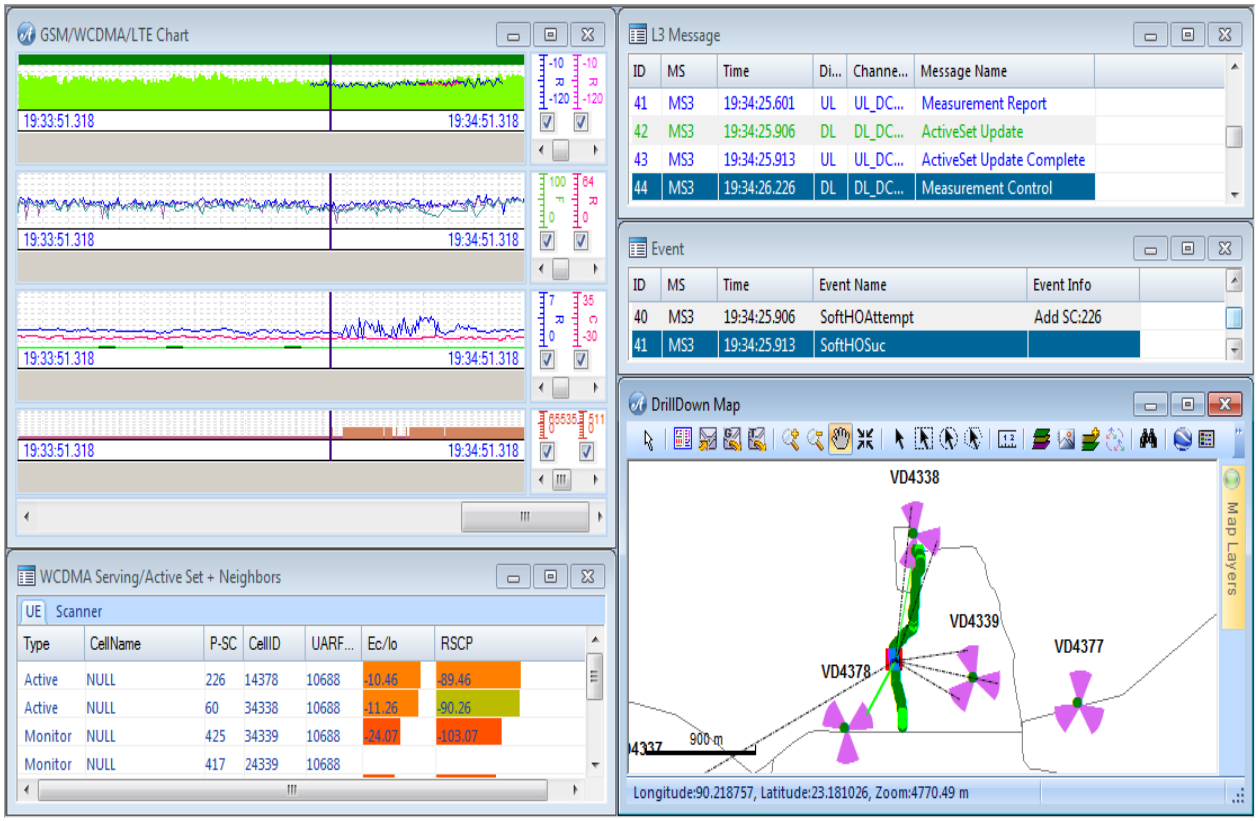


Fig4.6: Proper Handove

CHAPTER 5: Conclusion

5.1 Benefits from the Internship Program

One of the most positive aspects of my placement was the wide variety of work involved. The diversity of different tasks made for a very interesting work environment; this allowed me to develop a variety of skills.

I was always learning something new. The combination of **Research, Investigative and Technical** work made an interesting and educational job. What I learnt while working for METRO GLOBAL TELECOM SERVICES PVT LTD will be of great value in any future carrier that I do – it taught me a lot of good practices and techniques.

5.2 Conclusion

As a leading telecommunication service provider company in Bangladesh, I believe that METRO GLOBAL TELECOM SERVICES PVT LTD. has been able to provide me such a kind of unforgettable experience for the 3 months during my training period. The most important thing that I have learnt is how to meet the deadlines for the assigned projects or tasks and how to organize them for the maximum benefit of the company. As a telecommunication major student, I feel lucky enough to work with METRO GLOBAL TELECOM SERVICES PVT LTD. The kind of technical knowledge I have learnt during my training period, I believe these experiences and knowledge will help me in my whole life especially in my working era.

5.3References:

1. http://www.radio-electronics.com/info/cellulartelecomms/umts/utra-utran-umts-radio-access-network.php

2. http://www.radio-electronics.com/info/cellulartelecomms/umts/umts-wcdma-network-architecture.php

3. http://www.telecomsource.net/attachment.php?attachmentid=373&d=1323504838

4. http://www.metrotelworks.com/services-we-offer.html

5. https://books.google.com.bd/books?id=9frZBwAAQBAJ&pg=PA166&lpg=PA166&dq=UMTS+site+solution&source=bl&ots=u3dgMYKxdO&sig=UXBwVFq8OBHmJE5SHDpYZLHRw9A&hl=en&sa=X&ved=0ahUKEwiRveOL9MHJAhXGHY4KHR0CBzcQ6AEIMjAF#v=onepage&q&f=false

6. http://www.metrotelworks.com/customers.html

7. http://www.umtsworld.com/technology/wcdma.htm