East West University
Internship (Industrial Training) Report
On
3G/WCDMA & Radio Optimization

In

(Metro Teleworks)

By

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Disclaimer

This is to declare that this is the internship report based on 3G/WCDMA & Radio Network Optimization from METRO TELEWORKS. This internship report has not been submitted elsewhere for any purpose.

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Acceptance

This internship report has been presented to the department of Electronics and Communications Engineering, East West University and submitted for the partial fulfillment of the requirement for degree of B.Sc. in Electronics and Telecommunication Engineering, under complete supervision of the undersigned.

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Of course thanks to the Metro Teleworks Ltd, as they thought that I was capable enough to do training with them. I am gratified to the **Additional General Manager** of the Radio Planning department **Mr Gopal Chandra Gope & Atiqur Rahman** and last but not the least all the senior officials of Metro Teleworks Ltd, with whom I have spent one of the most important stages of life.

Finally, I am forever grateful to my parents & All my honorable faculty members for their patience and love.

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EAST WEST
UNIVERSITY

Abstract

METRO Teleworks LTD is now the leading telecommunications service provider situated in the capital city of Bangladesh. As a part of the industrial training I was assigned to this prominent company for a three months training from 1st of November to 30th 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 several 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.

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PART ONE: Introduction

1.1 Scope of Training

I was assigned to the Radio Planning Department of the Metro Teleworks, I had to work on cell planning, frequency planning and everything related to the Radio frequency planning. The most important thing was that all those were related to my major course.

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 pros and cons about GSM& 3G and the other one is to imply that knowledge for the practical works. 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, feeder swap, basic idea on Grade of Service.
- ➢ Customers complain handling - why customers complain, how problem resolved.
- ➢ Very basic GSM & 3G feature study - Hopping, Power control, HSPA, HSDPA.
- ➢ Drive Test

1.2 Company profile

Company Name:**METRO TELEWORKS**

About Metro Telworks :

The Wireless telecommunications industry has undergone explosive growth and has become global in its scope and ambitions. Spectrum is becoming severely congested. Quality network design is no longer a "nicety", but rather a necessity. With the New technologies like LTE, 3G, Wi-Max being introduced, competition is getting severe and the Telecommunications Industry is looking for simpler, cost effective and innovative ways to maintain the Networks.

Metro Telworks was formed in 2004 and is primarily engaged in providing RF services &In building solutions to OEM's, NEM's and Telecom Operators. With established foot prints across the Globe, Metro Telworks has already started implementing Automation in its services resulting into Cost Efficient and improved delivery to its Customers.

Metro Telworks has expanded itself to cover Turnkey solutions, RF Planning and Optimization, Network Performance Services, Switch Planning, IP Planning, Project management and End to End Services as a Solution, in its ambit of Services.

It also undertakes task based projects requiring delivery of tangible results in the form of either cell site production or network quality improvement and has consistently met or exceeded Key Performance Indicators (KPI).

1.3Goal of Metro Teleworks :

"To provide Cost efficient Services for emerging Telecom Networks, carrying innovative products to enable our customers to achieve excellence in their performance"

Metro Global Telecom Service Pvt. Ltd.

Figure 1.1 : Organization Chart

PART TWO: Overview

2.1 3G/ WCDMA Overview :

Over the past decade, wireless communications has seen an exponential growth and will certainly continue to witness spectacular developments due to the emergence of new interactive multimedia applications and highly integrated systems driven by the rapid growth in information services and microelectronic devices. So far, most of the current mobile systems are mainly targeted to voice communications with low transmission rates. In the near future, however, broadband data access at high transmission rates will be needed .

UMTS, short for **Universal Mobile Telecommunications System**, is a 3G networking standard used throughout much of the world as an upgrade to existing GSM mobile networks. UMTS makes use of WCDMA, a technology that shares much with CDMA networks used throughout the world, though it is not compatible with them.
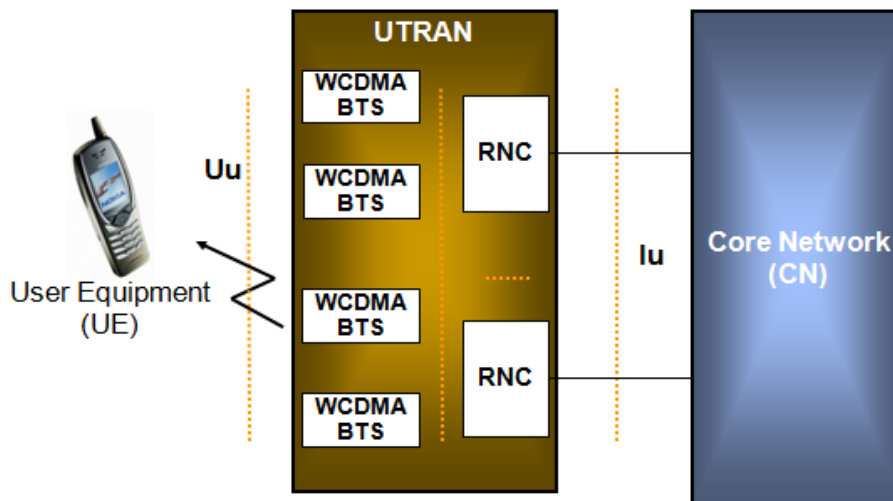
2.2 3G Network Architecture:

Fig 2.1: UMTS Network Architecture For 3G.

2.3 WCDMA Frequency and Spectrum:

- Uplink=1920MHz -1980 MHz
- Downlink= 2110MHz -2170MHz
- Bandwidth=60 MHz

Actual B.W assign to operator is 5MHz

And out of that 3.84 MHZ is utilize.

In WCDMA frequency reuse factor =1 because time and frequency remains constant.

UE (User Equipment):

In the Universal Mobile Telecommunications System (UMTS) and 3GPP Long Term Evolution (LTE), **user equipment** (**UE**) is any device used directly by an end-user to communicate. It can be a hand-held telephone, a laptop computer equipped with a mobile broadband

Elements of UTRAN :

Radio Network Controller

> ➢ Owns and controls radio resources in its domain (BSC in GSM)
> ➢ Service Access Point for all services that UTRAN provides for the CN

Node B

> ➢ Acts as the radio base station (BTS in GSM)
> ➢ Converts the data flow between the Iub and Uu interfaces

2.4 Major Interfaces in UMTS :

There are four major new interfaces defined in UMTS

I$_u$

-The interface between UTRAN and the CN
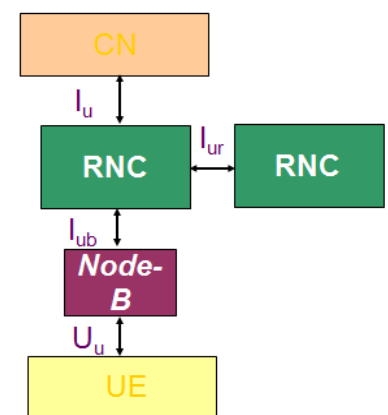
I$_{ur}$

-The Interface between different RNCs

Fig 2.2: Interface in UMTS

I_{ub}

-The interface between the Node B and the RNC

U_u

-The air interface

I_u- the Core Network to UTRAN Interface :

There are two parts to the I_u interface

I_{u-ps} connecting UTRAN to the PS Domain of the CN

I_{u-cs} connecting UTRAN to the CS Domain of the CN

No radio resource signalling, travels over this interface

The I_u interface divides the UMTS network into the radio specific UTRAN and the CN.

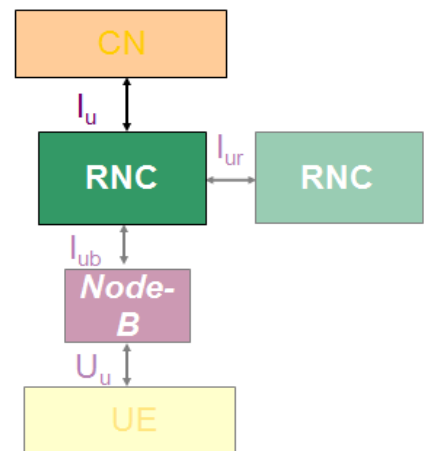
Fig 2.3: In CN to UTRAN

I_{ur} - the Inter-RNC Interface :

-The I_{ur} interface allows soft handovers between Node-Bs attached to different RNCs

-It is an open interface to allow the use of RNCs from different manufacturers

-Its functions may be summarized :

Support of basic inter-RNC mobility

Support of Dedicated and Common Channel Traffic
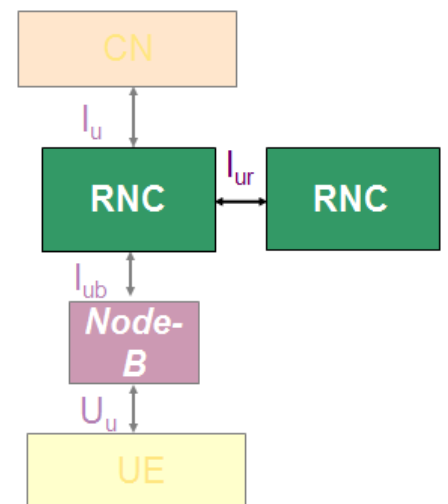
Fig 2.4: I_{ur}Inter RNC Interface

I$_{ub}$ - the RNC to Node-B Interface :

-The I$_{ub}$ is an open interface to allow the support of

different manufacturers supplying RNCs and Node-Bs

-Its major functions are:

1. Carries dedicated and common channel traffic between the

RNC and the Node-B

2. Supports the control of the Node-B by the RNC
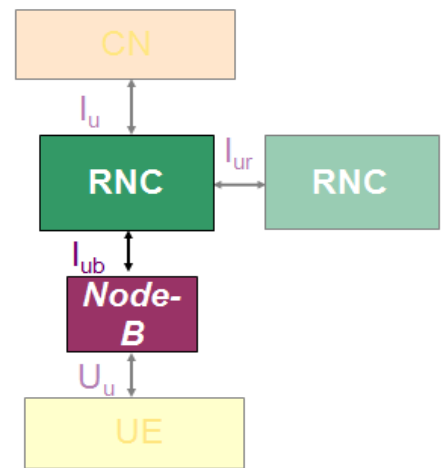
Fig 2.5:I$_{ub}$RNC to node B

U$_u$ - the Air Interface :

-Clearly the U$_u$ must be standardised to allow multiple UE vendors to be supported by a

network

-The major functions of the U$_u$ are to:

1. Carry dedicated and common channel

traffic across the air interface

2. Provide signaling and control traffic

to the mobile from the RNC and the Node-B

2.5 3GPP R99 Architecture :

Fig 2.6:U$_u$ - the Air Interface

Fig 2.7:3GPP R99 Architecture

Base Station Subsystem (BSS) :

The **base station subsystem** (**BSS**) is the section of a traditional cellular telephone network which is responsible for handling traffic and si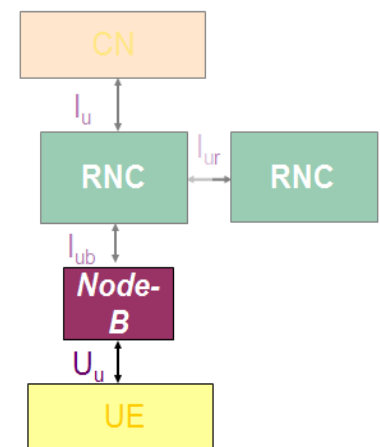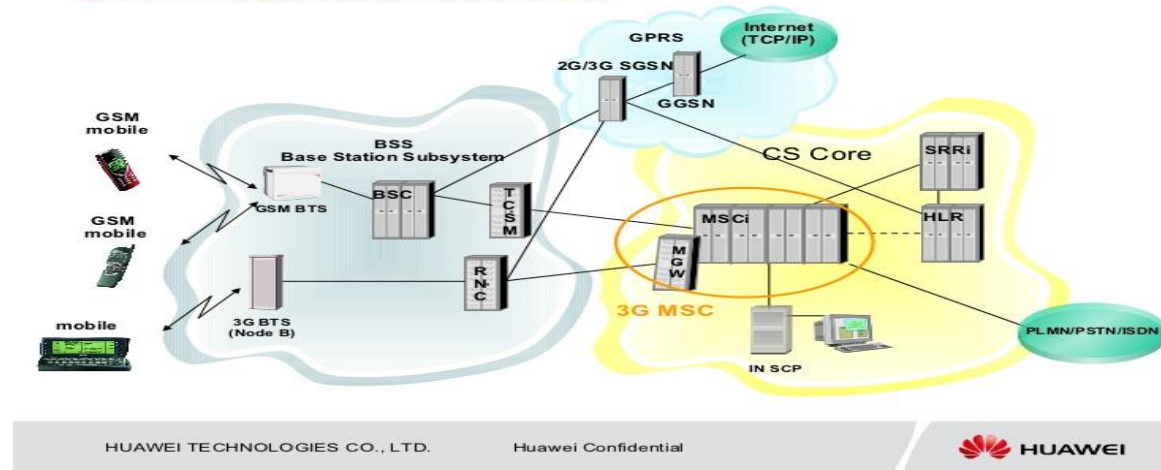gnaling between a mobile phone and the network switching subsystem. The BSS carries out transcoding of speech channels, allocation of radio channels to mobile phones, paging, transmission and reception over the air interface and many other tasks related to the radio network.

Base Station Controller (BSC)

The Base Station Controller (BSC) handles most radio-related functions and is the BSS's center point. The BSC manages the entire radio network including:

· Configuration of the network.

· Administration and remote control of the RBSs.

Base Transceiver Station / Radio Base Station(BTS/RBS)

The Base Transceiver Station (BTS), or as Ericsson calls it Radio Base Station (RBS) handles the radio interface to the MS. The BTS is the radio equipment (transceivers and antennas) needed to serve each cell in the network. One RBS includes all BTSs on a site.

Operation And Support System (OSS)

OSS is based on an application in the product family Telecommunications Management and Operations Support (TMOS). OSS is a two-level management function. For centralized control of a network, the installation of a Network Management Center (NMC) with subordinate Operation and Maintenance Centers (OMC) is advantageous.The OSS is designed as a coherent management system used to support a number of other network elements.

2.6 Cell Planning:

WCDMA radio network planning includes…….

i)Dimensioning

ii) Detailed capacity and coverage planning and

iii) Network optimization.

In thedimensioning phase an approximate number of basestation sites, base stations and their configurationsand other network elements are estimated, based onthe operator's requirements and the radio propagationin the area. The dimensioning must fulfill theoperator's requirements for coverage, capacity andquality of service. The planning and the optimizationprocess can also be automated with intelligent toolsand network elements. 3G Americas is the companyplayed significant role for evolution of UMTS toRelease5 (Rel'5) of 3GPP in 2002 March. UMTSRel'5 offers higher speed wireless data services withvastly improved spectral efficiencies through theHSDPA feature. Addition to HSDPA, UMTS Rel'5introduces the IP Multimedia System (IMS), UMTSRel'5 also introduces IP UTRAN concepts to realizen/w efficiencies and to reduce the cost of deliveringtraffic and can provide wireless traffic routingflexibility, performance and functionality advantagesover the Rel'99 and Rel'4 standards.

2.7 <u>Cell Planning Objectives</u>:

The objective of the cell planning sub-problem depends on the interests of network planners. The following objectives may be the target for a cell planning sub-problem:

1. Minimize network cost;

2. Maximize capacity;

3. Maximize coverage;

4. Maximize signal quality;

5. Minimize electromagnetic field level.

2.8<u>Radio Network Planning</u>:

Achieving maximum capacity, while maintaining anacceptable grade of service and good speech qualityis the main issue for the network planning. Planningan immature network with a limited number ofsubscribers is not the real problem. The difficulty isto plan a network that allows future growth andexpansion. Wise re-use of sitelocation in the futurenetwork structure will save money for the operator.

Various steps in planning process:

Planningmeans building a network able to provideservice to the customers wherever they are. Thiswork can be simplified and structured in certainsteps. The steps are,

For a well-planned cell network planner shouldmeet the following requirements,

- Capacity Planning
- Coverage Planning
- Parameter Planning
- Frequency Planning
- Scrambling Code Planning

WCDMA Radio Network Planning:

WCDMA radio network planning, includingdimensioning, detailed capacity and coverageplanning, and network optimization. Thedimensioning must fulfill the operator's requirementsfor coverage, capacity and quality of service.Capacity and coverage are closely related inWCDMA networks, and therefore both must be

Consider simultaneously in the dimensioningofsuch networks. Capacity and coverage can beanalyzed for each cell after the detailed planning. Theplanning and the optimization process can also beautomated with intelligent tools and networkelements.

2.9Dimensioning:

WCDMA radio network dimensioning is aprocess through which possible configurations andthe amount of network equipment are estimated,based on the operator's requirements related to thefollowing.

Coverage:

- Coverage regions;
- Area type information;
- Propagation conditions.

Capacity:

- Spectrum available;
- Subscriber growth forecast;
- Traffic density information.

Quality of Service:

- Area location probability (coverageprobability);

- Blocking probability;

- End user throughput.

Radio Link Budgets:

There are some WCDMA-specific parameters in thelink budget that are not used in a TDMA-based radioaccess system such as GSM.

- Interference margin: The interference margin isneeded in the link budget because the loading of thecell, the load factor, affects the coverage. The moreloading is allowed in the system, the larger is theinterference margin needed in the uplink, and thesmaller is the coverage area.

- Fast fading margin: Some headroom is needed inthe mobile station transmission power formaintaining adequate closed loop fast power control.This applies especially to slow-moving pedestrianmobiles where fast power control is able to effectively compensate the fast fading.

- Soft handover gain: Handovers – soft or hard –give a gain against slow fading by reducing therequired log-normal fading margin. This is becausethe slow fading is partly uncorrelated between thebase stations, and by making a handover the mobilecan select a better base station. Soft handover givesan additional macro diversity gain against fast fadingby reducing the required Eb/N0 relative to a singleradio link, due to the effect of macro diversitycombining.

b) Load Factors:

The second phase of dimensioning is estimating theamount of supported traffic per base station site.When the frequency reuse of a WCDMA system is 1,the system is typically interference-limited and theamount of interference and delivered cell capacitymust thus be estimated.

c) Capacity Upgrade Paths:

When the amount of traffic increases, the downlinkcapacity can be upgraded in a number of differentways. The most typical upgrade options are:

----more power amplifiers if initially the poweramplifier is split between sectors;

---two or more carriers if the operator'sfrequency allocation permits;

---transmit diversity with a 2nd poweramplifier per sector.The availability of these capacity upgrade solutionsdepends on the base station manufacturer.

All thesecapacity upgrade options may not be available in allbase station types.

These capacity upgrade solutions do not require any changes to the antenna configurations, only upgradeswithin the base station cabinet are needed on the site.

The uplink coverage is not affected by theseupgrades. The capacity can be improved also byincreasing the number of antenna sectors, forexample, starting with Omni-directional antennas andupgrading to 3-sector and finally to 6-sectorantennas. The drawback of increasing the number ofsectors is that the antennas must be replacedincreased number of sectors also brings improvedcoverage through a higher antenna gain.

d) Capacity per km2:

Providing high capacity will be challenging in urbanareas where the offered amount of traffic per km2 canbe very high. In this section we evaluate the maximalcapacity that can be provided per km2 using macroand micro sites.For the micro cell layer we assume a maximum sitedensity of 30 sites per km2. Having an even highersite density is challenging because the other-to-owncell interference tends to increase and the capacity per site decreases. Also, the site acquisition may bedifficult if more sites are needed.

e) Soft Capacity:

Erlang Capacity: In the dimensioning the numberof channels per cell was calculated. Based on thosefigures, we can calculate the maximum traffic densitythat can be supported with a given blockingprobability. If the capacity is hard blocked, i.e. limited by the amount of hardware, the Erlangcapacity can be obtained from the Erlang B model. Ifthe maximum capacity is limited by the amount ofinterference in the air interface, it is by definition asoft capacity, since there is no single fixed value forthe maximum capacity. The soft capacity can be explained as follows.

The lessinterference is comingfrom the neighboring cells, the more channels areavailable in the middle cell, With a low number ofchannels per cell, i.e. for high bit rate real time datausers, the average loading must be quite low toguarantee low blocking probability.

f) Network Sharing:

The cost of the network deployment can be reduced by network sharing.If both Operators have their own core networks and share acommon radio access network, RAN, the solutionoffers cost savings in site acquisition, civil works, transmission, RAN equipment costs and operationexpenses. Both operators can still keep their full Independence in core network, services and havededicated radio carrier frequencies. When the amountof traffic increases in the future, the operators canexit the shared RAN and continue with separateRANs.

2.10 Network Planning Process:

Network planning is not just frequency planning, but a much broader process. The network planning process includes things like traffic estimation, figuring the proper number of cells, the placement of base stations, and frequency planning. First, the amount of expected traffic is estimated, andthen a radio network that can handle this traffic is designed. There are three phases in the design process.

It starts with (1) the preparation phase, which sets the principles and collects data, followed by (2) the high-level network-planning phase (network dimensioning), and (3) the detailed radio-network planning phase.

1 Preparation Phase

The preparation phase sets the principles for the planning process. The first thing to be defined is the coverage the operator is aiming for. One operator may aim to have adequate coverage only in big towns and nothing in the countryside. Another operator may also try to cover the main roads in the rural areas. A third operator may aim for countrywide coverage as soon as possible. The chosen alternative depends on the available resources and the selected marketing strategy.

In a WCDMA cell, the available data rate depends on the interference level—the closer the UE is to the base station, the higher the data rates that can be provided.

Thus, an operator that is aiming to provide 384-Kbps coverage must use more base stations than an operator that is aiming for 64-Kbps coverage.

2 Network Dimensioning

Network dimensioning is a process that aims to estimate the amount of equipment needed in a telecommunications network. In the case of a WCDMA network, this includes both the radio access network and the core network. This process includes calculating radio link budgets, capacity, and coverage, and then estimating the amount of infrastructure needed to satisfy these requirements. The output of the process should be an estimation of the required equipment and a crude placement plan for the base stations.

3 Detailed Radio-Network Planning

The detailed network-planning phase includes the exact design of the radio network. Quite often it is not possible to obtain the optimum cell site. The owner of the site may not want to sell it, or it may be unusable (e.g., in the middle of a pond) or located in a restricted area. Environmental and health issues can also have an impact. Base station towers in an open country landscape may irritate some people. The radiation from base station transmitters is also a concern for some (with or without a good reason, most often without). All these issues have to be taken into consideration.

The number of HOs has to be minimized as they create signalling traffic in the network. This can be done, for example, with large macrocells. Sectorization has to be considered and implemented where required.

This includes the following procedures in this phase:

• Detailed characterization of the radio environment;
• Control channel power planning;
• Soft handover (SHO) parameter planning;
• Interfrequency (HO) planning;
• Iterative network coverage analysis;
• Radio-network testing

2.11 Different Site Solutions:

        - Roof top [RT] Site: Usually in urban area (2100 Mhz)

        - Green Field [GF] Site: Usually in Rural area (2100 MHz)

These two above type of sites may have the following solutions

Figure2.8.1:Green Field Site   Figure2.8.2: Roof Top Site

Fig2.8: Different Site Solution

2.11 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.

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".

2.12Drive 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 main scopes are-

- Perform periodic measurements.
- Checking coverage (receive level), accessibility (call setup success rate, location updating success rate) and quality (BER, FER, RxQual, Drop Call, Handover performance etc.).
- Test hardware (channel verification) and channel availability.
- Investigate problems that are pointed out by OSS Statistics.
- Respond to Customer complains

Scope of the work of Drive Test group in METRO TELEWORKS includes –

- Routine Drive test in defined route to assess Radio network performance and detect black spot
- Periodic monitoring of Coverage/Quality of a Radio network after high pace roll out
- Highway coverage tracking on regular basis
- Stationary test for packet data
- Assist in new Coverage requirement
- Different kind of problem solution. Ex: Feeder swap, Lat-long Mismatch.
- Critical Customer Complain Handling initiated by RP
- Antenna optimization follow up of Radio network
- Handle Work Request from other section
- Different kind of on field problem & Solution.

For efficient activities, each group has to equip with the following set up –

1. Complete TEMS/Genex setup –
   - TEMS/Genex SW loaded in Laptop with appropriate Handset
   - Test SIM
   - TEMS/Genex Accessories comprising data cable, dongle key etc
2. One GPS
3. Inverter – Input 12 V dc, Output 220 V ac, 400 W
4. Antenna Tuning Tool kit comprising Digital Tilt Meter, Electronic Compass, Binocular etc
5. Antenna Mounting Tool kit –
   - Spanner
   - Screw Driver set
   - Safety Belt
   - Adjustable Wrench
   - Cutting Pliers
   - Measuring Tape
   - Safety shoe
   -
6. One dedicated vehicle
7. LAN Connectivity

Each branch of the Drive Test group have predefined routes to cover all major streets of that region and defined time schedule to perform Drive test. Each of the routes is rated with priority to be covered by Drive test.

PART THREE: Job Description

My responsibilities included:

    * Basic 3Gfeature study

    * Radio network Tuning and preliminary optimization

    * To study and participate in overall Cell design Process

  * Site Surveys

    * Drive test

3.1Basic GSM & WCDMA feature study :

The very first feature of my training was to know all the details regarding the radio planning (RP) department, like what this department does? What are the basic things to know to work with a radio planning team? I was working with Rest Radio planning department of the Metro Teleworks.

As Metro works on both GSM& WCDMAtechnology, so it was quite obvious that I had to learn all the details of the GSM& WCDMA technology. 1st and 2nd week of my training was all about knowing the pros and corns about 3G. My supervisor gave me a training book name "3G SYSTEM OVERVIEW" which is specially designed for the Radio planning and also some PDF files about the 3G system. Some of the chapters that I have covered during my training from this book are:

- ➢ Introduction to Mobile Telecommunication and 3G
- ➢ Overview of HUWEI GSM Systems
- ➢ Wireless Concepts
- ➢ Channel Concepts
- ➢ Base Station System
- ➢ Mobile Stations
- ➢ Cell Planning
- ➢ The future of WCDMA.

It was very handy and informative. Here I would like to mention one thing. During the 3rd week of my training, Radio Planning department organized a 2 days workshop for the new employees of the RP department. I was lucky enough to be a part of it and enhanced my knowledge.

3.2 **Radio network Tuning and preliminary optimization:**

Radio network Tuning and preliminary optimization includes:

➤ Neighbours tuning

➤ Handover performance.

During my 4th week of my training, I was assigned to work practically to see how a cluster works. How much capacity a cluster can bear and how all those parameter can check by doing drive test. In below I add some snap from my field experience.

3.3 Cluster Information

Items	Details
Cluster Name	Sunamgonj
Cluster Type	Sub-Urban
Sites Number	3
Cells Number	9
On Air sites	3
District Name	Sunamgonj
Serving/Cluster Area	Sunamgonj
RNC Name	RNSL01

Table 1 Cluster information

3.4 Test Information

Drive test start date (Pre)	25-Nov-15	Drive test finish date (Pre)	28-Nov-15
Drive test start date (Post)	2-Nov-15	Drive test finish date (Post)	5-Nov-15

3.5TestMethod

Car	MS	Network	Test Equipment	Test Type	Test Type	Duration	KPI Measured
Car1-Laptop1	MS1	3G only	Scanner	Mobility	Active Set	Idle	RSCP, Ec/Io
Car1-Laptop1	MS2	3G only	UE	Mobility	Short Call	Voice-short call (45s, 15s idle)	Voice CSSR, DCR,Service Access Time CS
Car1-Laptop1	MS3	3G only	UE	Mobility	long call		Active Set, SHO
Car2- Laptop2	MS4	3G only	Data card	Mobility		download >1GB	HSDPA CSSR&DCR , HSDPA throughput, HSDPA handoff, Packet Retransmission
car2- laptop2	MS5	3G only	Data card	Mobility		upload >1GB	HSUPA CSSR& DCR, HSUPA throughput, HSUPA Handoff
Car3－Laptop3	MS6	3G only	UE	Static	Video call	10 points	Video DL CS BLER(CS64), Video CSSR,DCR
Car3－Laptop3	MS6	Free Mode	UE	Static	3G reselect to 2G 2G reselect to 3G	check border	3G-2G Service Interrupt Time
Car3－Laptop3	MS6	3G only	Data card	Static	ping test		HSDPA Ping test
Car3－Laptop4	MS7	3G only	Data card	Static	HSDPA Mobility		HSDPA Mobility
Car3－Laptop4	MS7	3G only	Data card	Static	HSUPA Mobility		HSUPA Mobility

Table 2 Test method

3.6Cluster Drive test KPI:

| KPI	Target	Achieved KPI	Result	Remark
Ec/Io	EcIo>-11dBm for>=95% samples @No load EcIo>-13dBm for>=92% samples @50% load EcIo>-15dBm for>=85%	EcNo>-11 for 98.05%(Sub-Urban)	Pass	
RSCP	RSCP>-80dBm for>=95% samples (DU) RSCP>-85dBm for>=95% samples (U) RSCP>-90dBm for>=95% samples (SU) RSCP>-95dBm for>=95%	RSCP=>-90 for 99.4%Sub-Urban)	Pass	
Active Set	<=3 for >= 95% samples	100%	Pass	
LU Success rate	> = 99%	100%	Pass	
3G CS (12.2 kbps voice AMR& 64K Video)	98%	Voice:100%, Video: 100%	Pass	
HSDPA & PS Context Activation	99% for DU & U; 97% for SU & Rural	100%	Pass	
HSUPA PDP Activation	99% for DU & U; 97% for SU & Rural	100%	Pass	
Drop call rate: 3G CS (12.2 kbps voice AMR& CS64K Video call)	<2%	0%	Pass	
PS/HS Drop call rate	<2%	0%	Pass	
3G_PSData_Latency(Continuous)	< 0.15s R99/ HSPA (HSDPA+HSUPA):	41.46 ms	Pass	
Service Access Time CS	< 6 Sec	1.6s	Pass	
DL Cell Edge Throughput	> = 1 Mbps	6378.62 kbps	Pass	
UL Cell Edge Throughput	> = 128 Kbps	2749.09 kbps	Pass	
DL CS BLER (CS64)	<=1.5%	0.13%	Pass	
3G-2G Service Interrupt Time	<=10 s	10 ms	Pass	
Packet Drop	<1%	0%	Pass	
Packet Retransmission	<0.5%			
Soft/Softer handover success rate CS(voice+video)	> = 98%	100%	Pass	
Soft handover success rate PS	> = 98%	100%	Pass	
Voice 3G-2G HO (Both ways)	Success Rate >=98.5%	100%	Pass	
HSDPA Mobility	>=98%	100%	Pass	
HSUPA Mobility	>=98%	100%	Pass	
3G/HSDPA mobility	>=98%	100%	Pass	
3G/HSUPA Mobility	>=98%	100%	Pass	

3.7 DT Route :

According to the agreement of Airtel and Huawei, below is the DT routes for Sunamgonj Cluster-1.

Fig3.1: DT Route
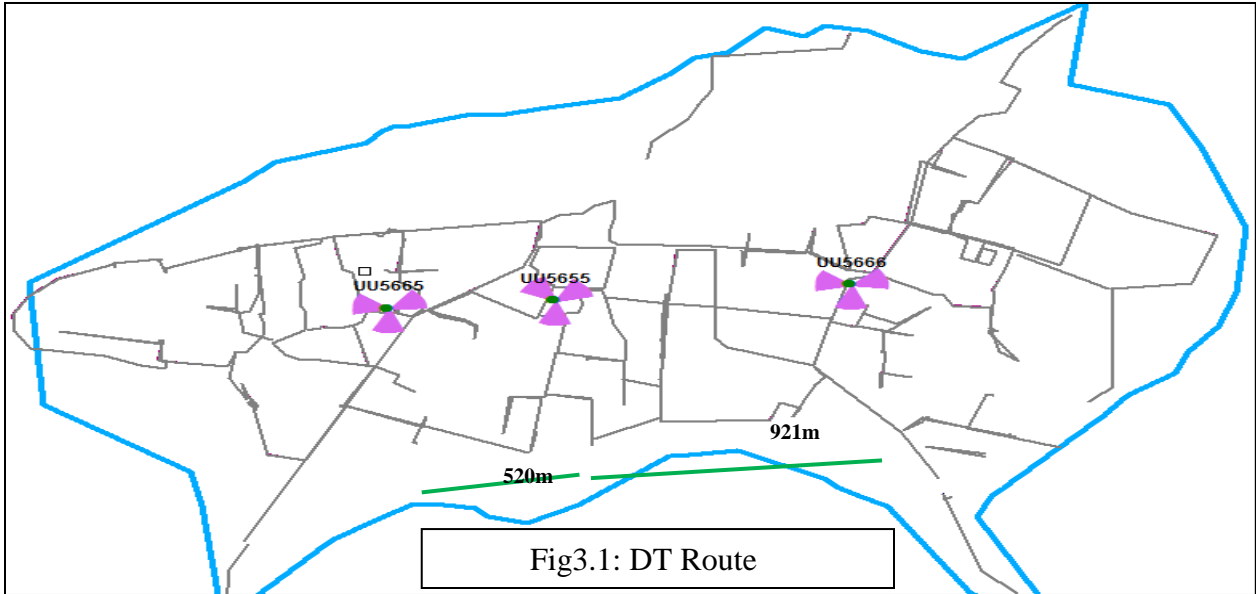
3.8 RSCP Plot and Graph:

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 :
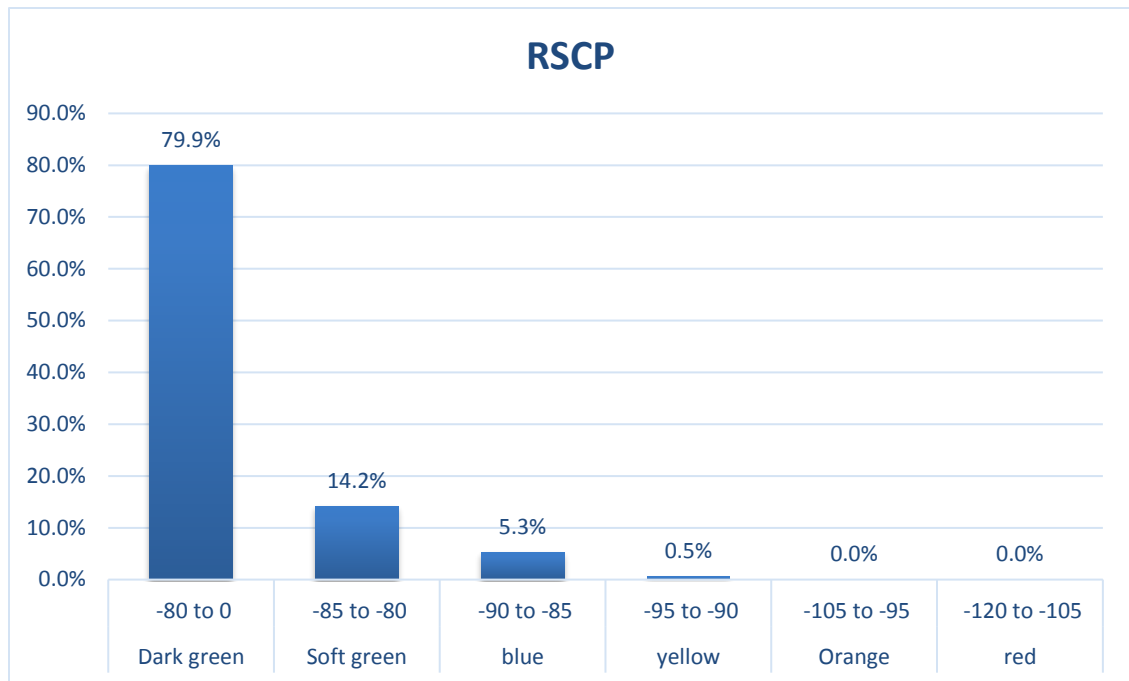

Fig3.2: RSCP Plot & Graph
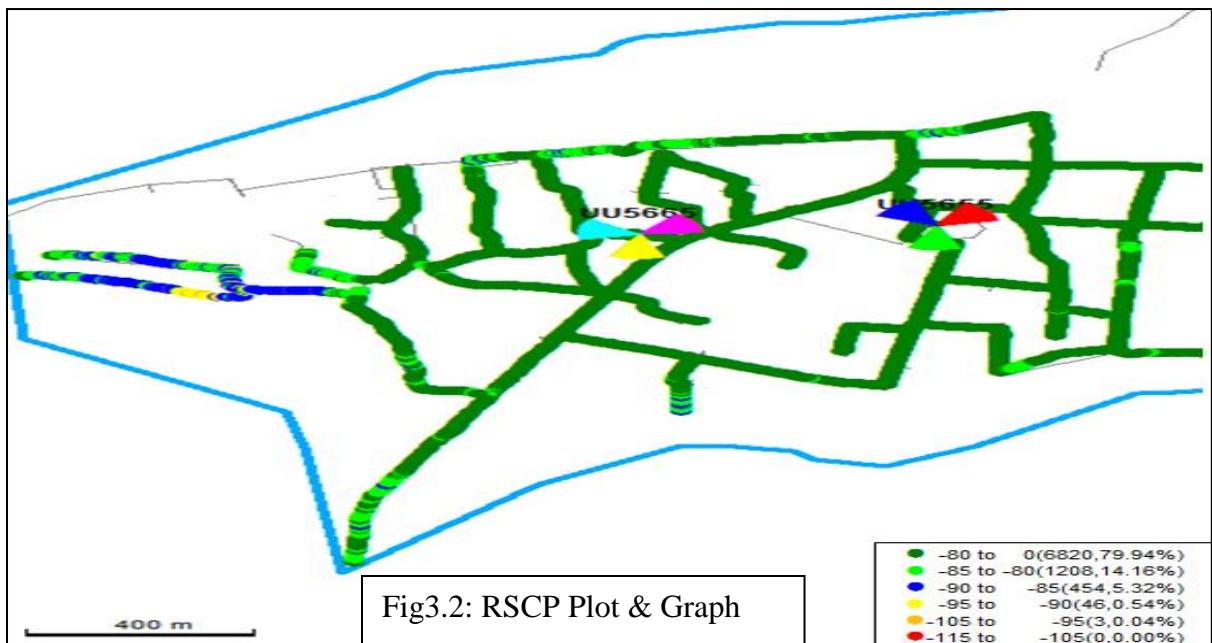
Follow is RSCPGraph for whole cluster:

Fig3.3: RSCP Graph

5.3 Problem Areas Explanation:

PA1: Poor coverage explanation due to long distance serving Cell:

Fig3.4:Poor coverage explanation due to long distance call

3.9 Ec/No Plot and Graph:

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 :

Fig3.5:Ec/No Graph

Legend:
- -9 to 0(7374,86.44%)
- -11 to -9(991,11.62%)
- -15 to -11(166,1.95%)
- -40 to -15(0,0.00%)
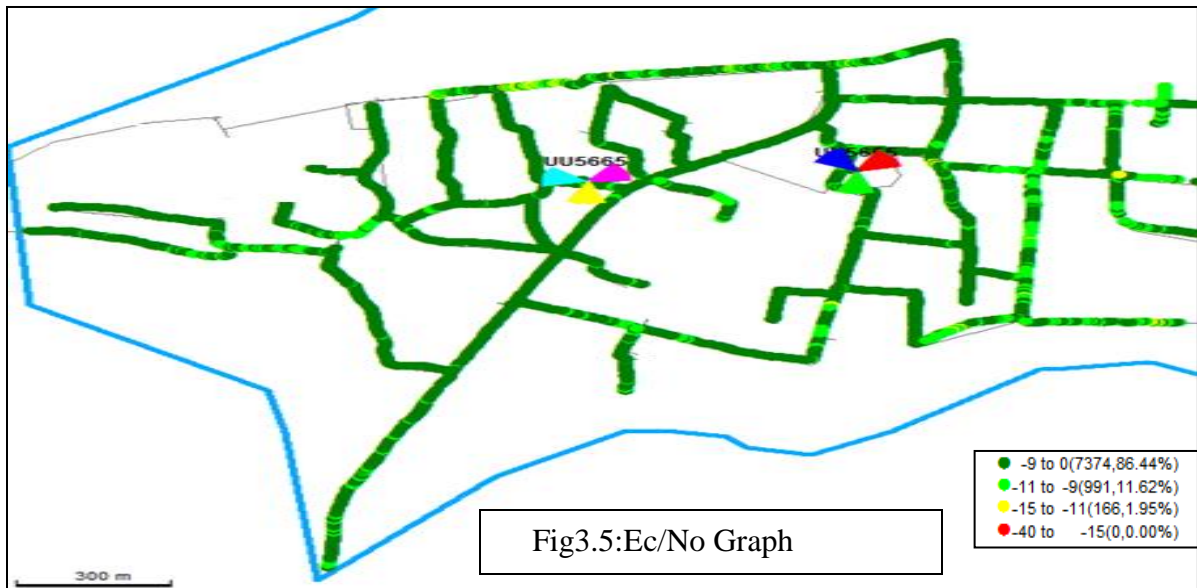
3.10 Best Server Plot:

Best server is measured by MS1, which is in idle mode during the test. In **Sunamgonj Cluster-1**, best server is OK in all the area. Follow is best server plot:


Fig3.6:Best Server Plot
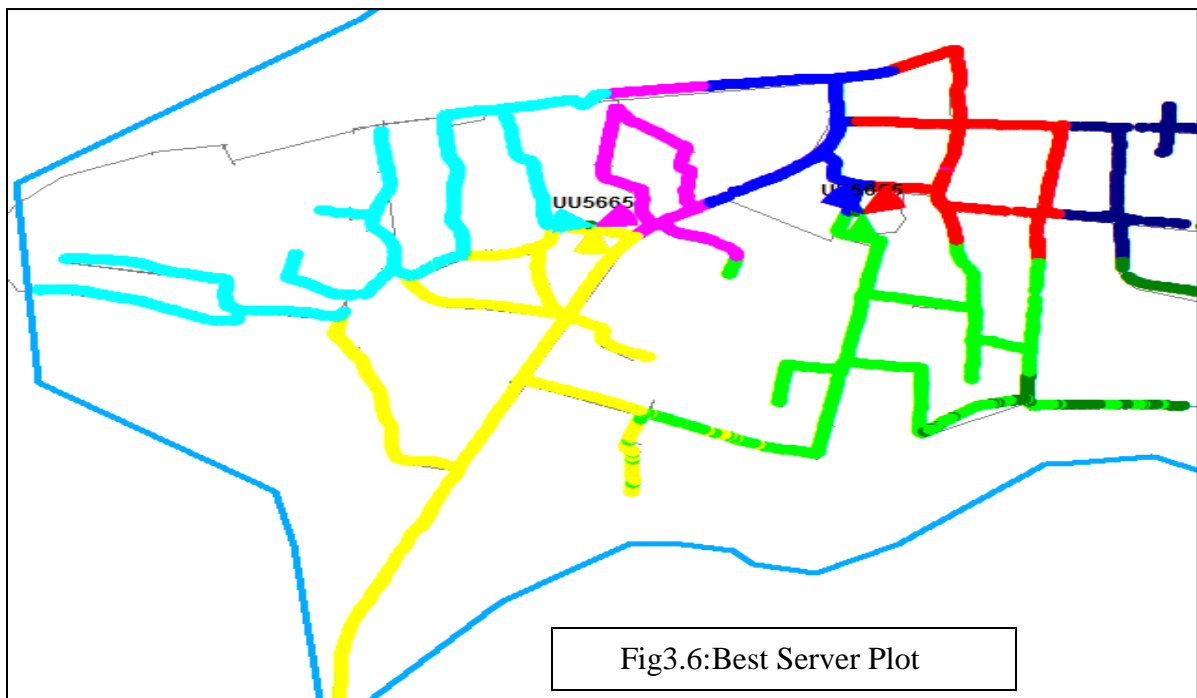
3.11Call Accessibility Plot:

Call accessbilityis measured by MS2, which is in cycle mode(45s call,15s idle) during the
test.In **Sunamgonj Cluster-1**, call acess is OK in all the area.
Follow is call attempt and fail plot:

Fig3.7:Call Accessibility Port
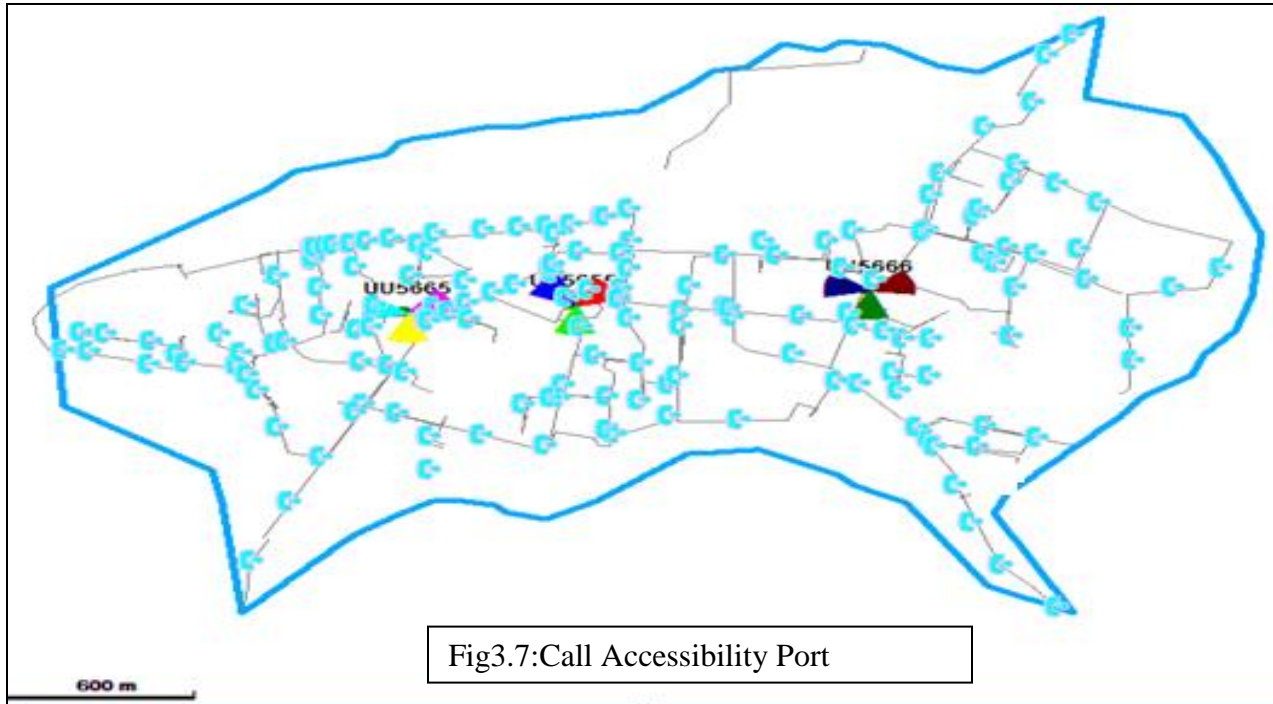
3.12Call Retainability Plot

Call retainability is measured by MS2, which is in dedicated mode during the
test.In **Sunamgonj Cluster-1**, call retainability is OK in all the area.Follow is call
success and drop plot :

Fig3.8:Call retainability plot
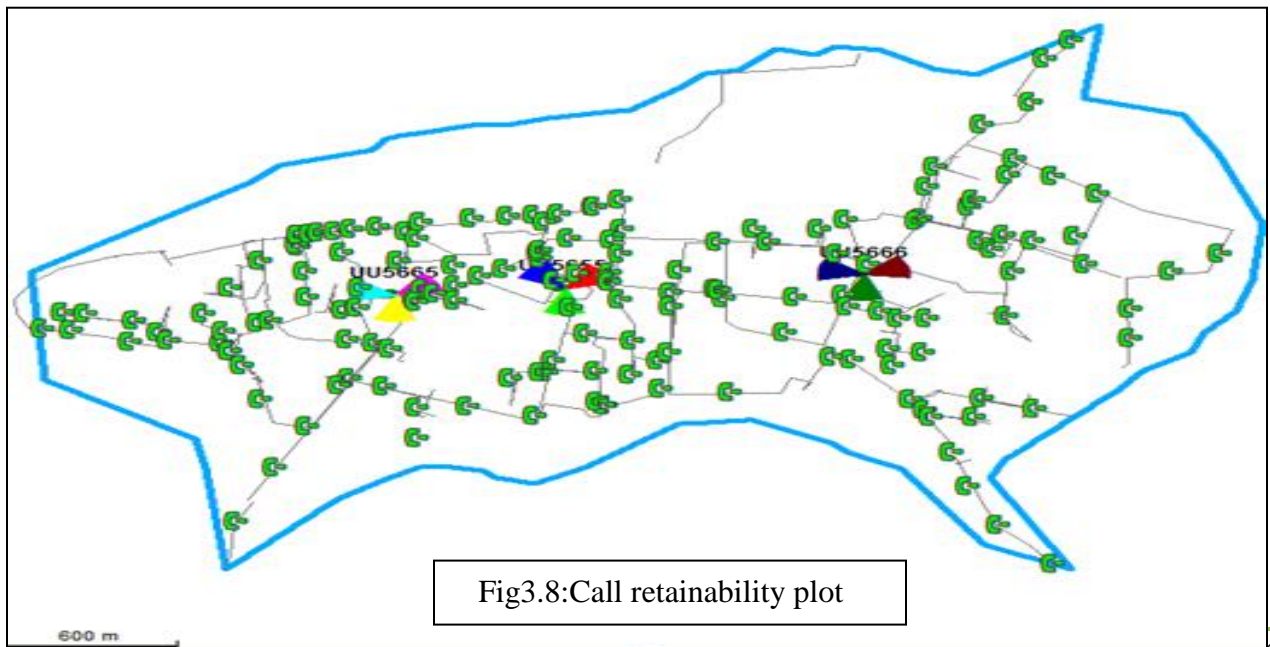
3.13 Handover Plot:

Handover is measured by MS3, which is in dedicated mode during the test.In Sunamgonj Cluster-1, handover is OK in all the area.Follow is handover plot :
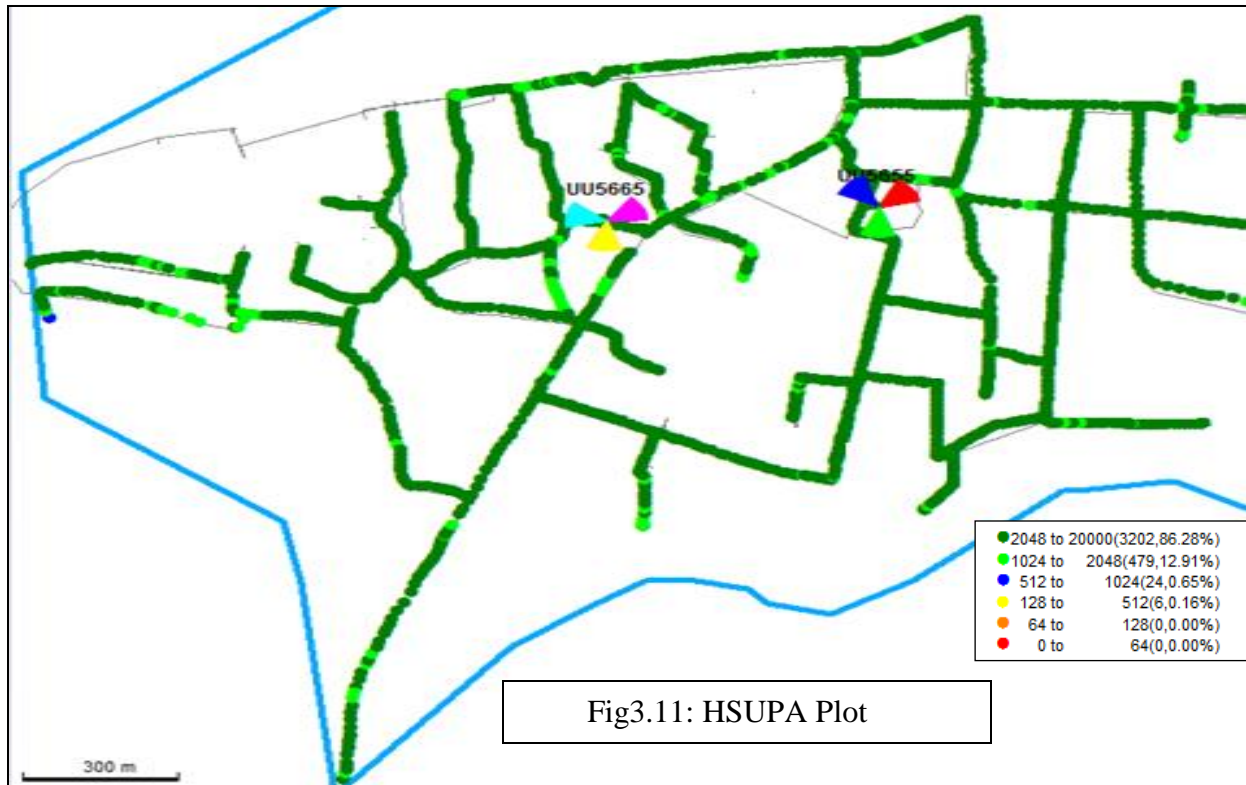

Fig3.8: Handover plot
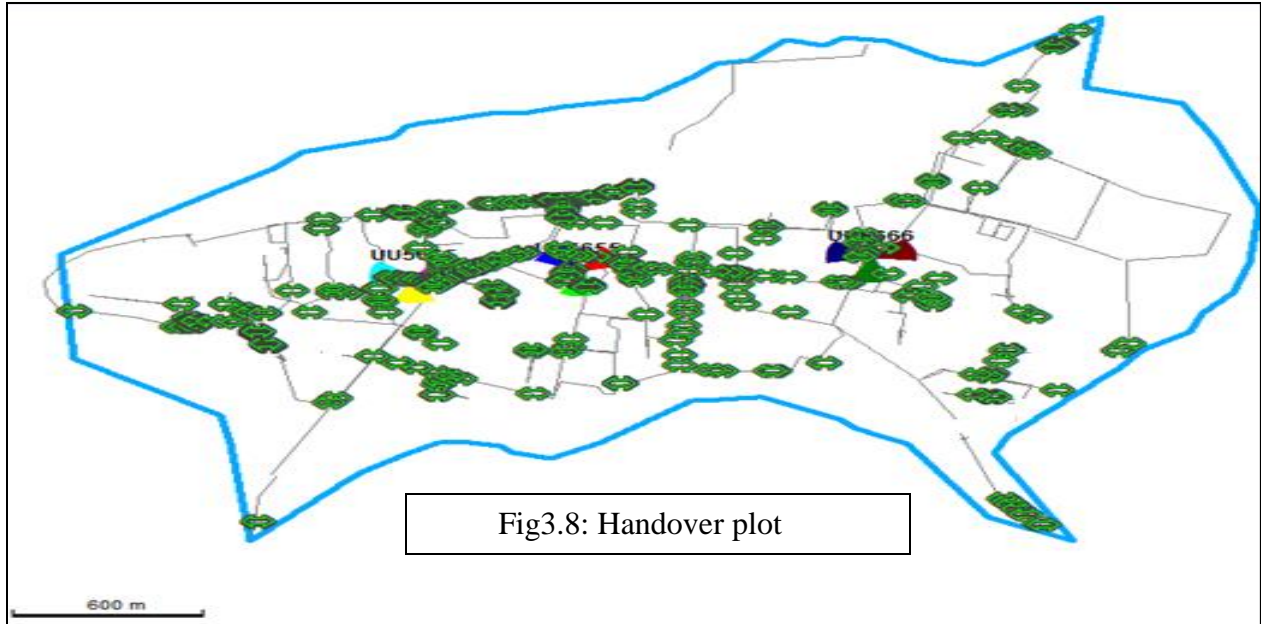
3.14 HSDPA Plot:

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 :

Fig3.10:HSDPA Plot
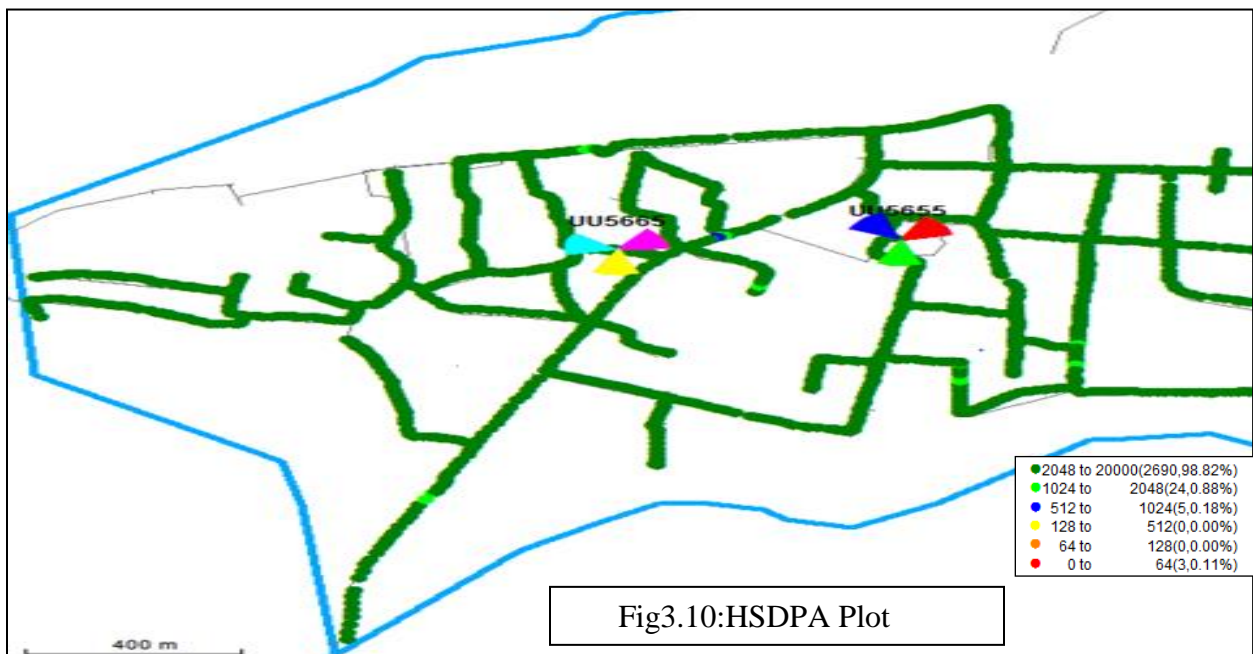
3.15HSUPA Plot:

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:

●	2048 to 20000(3202,86.28%)
●	1024 to 2048(479,12.91%)
●	512 to 1024(24,0.65%)
●	128 to 512(6,0.16%)
●	64 to 128(0,0.00%)
●	0 to 64(0,0.00%)

Fig3.11: HSUPA Plot

HSPA and R99 Handoff:

HSPA and R99 handoff is measured by data card , which download files from Airtel ftp server, and perform handoff between HSPA cell and R99 cell.This function works normal.

3.16 HSDPA to R99 handoff:

UE establish PS call in HSPA cell, then move forward to R99 cell,UE reconfigured from HSDPA state to R99 state.The throughput decreased.
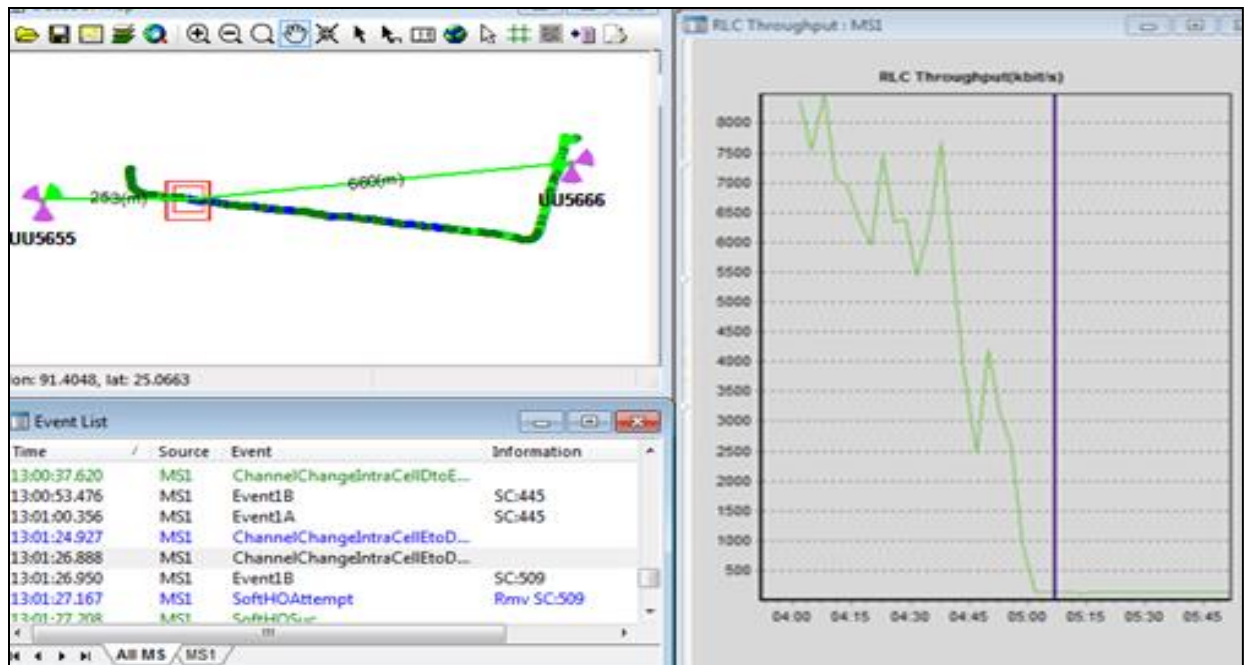

Fig3.12: HSDPA to R99 Handoff

3.17 R99 to HSDPA handoff:

UE establish PS call in R99 cell, then move forward to HSPA cell,UE reconfigured from R99 state to HSDPA state.The throughput increased.
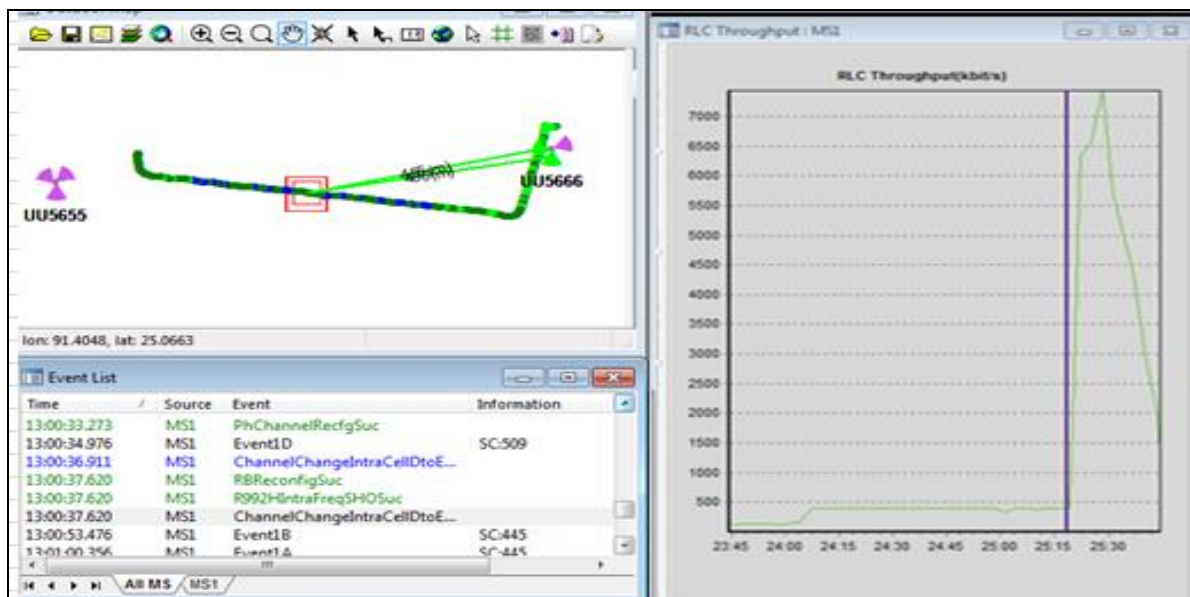

Fig3.13:R99 to HSDPA Handoff

3.18 R99 to HSUPA handoff:

UE establish PS call in R99 cell, then move forward to HSPA cell,UE reconfigured from R99 state to HSUPA state.The throughput increased.
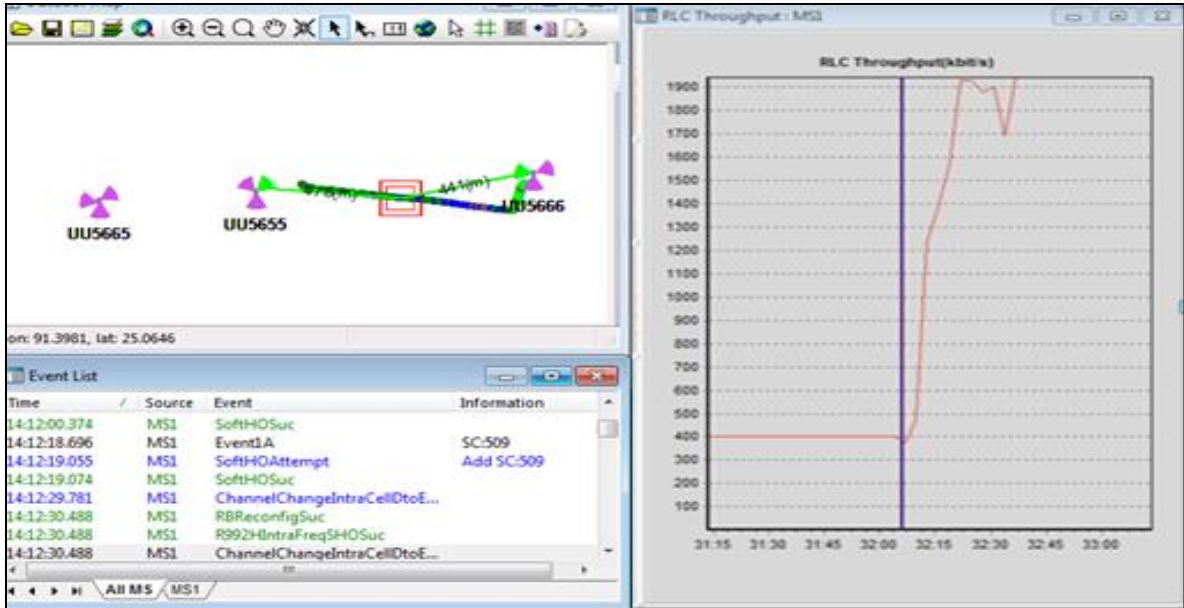

Fig3.14:R99 to HSUPA Handoff

3.19 3G PS Data Latency:

UE establish PS call,ping 100bytes package to Airtel ftp server for 100 times,the package lost ratio is 0%, average time delay all below 41.46 ms.This function works normal.
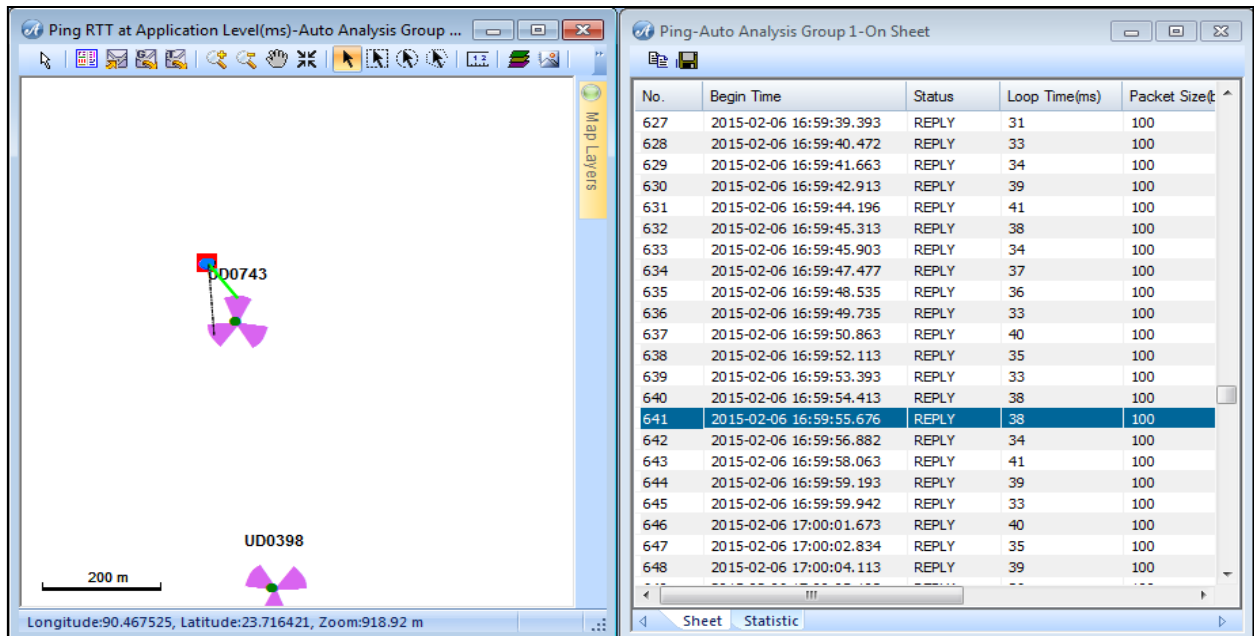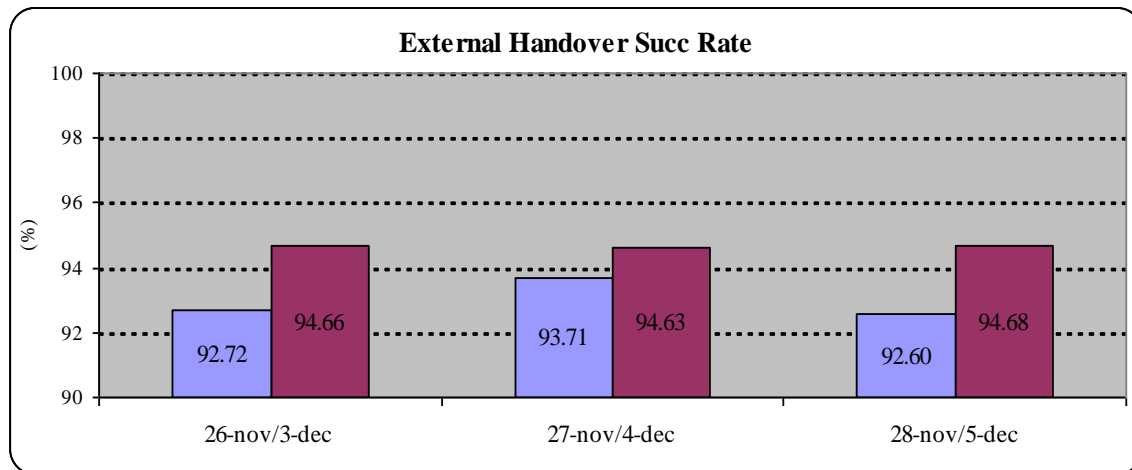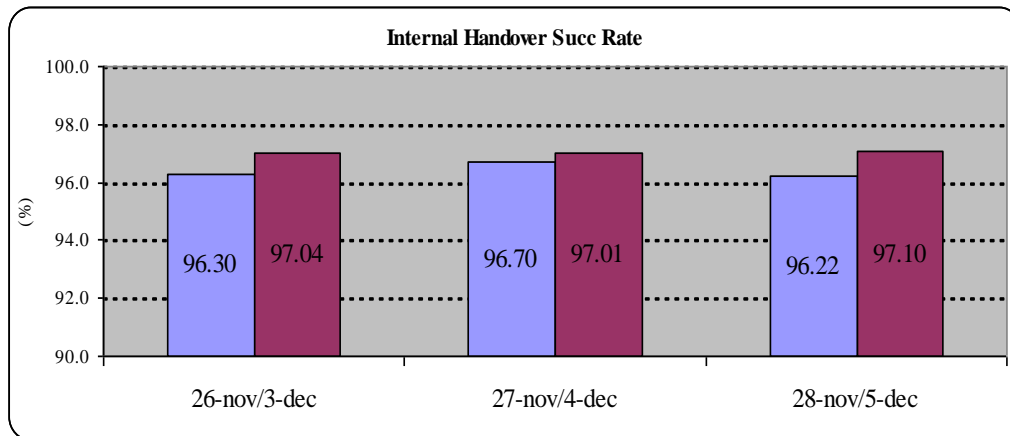

Fig3.15:3GPS Data Latency

From above figure we can easily notice the PS 3G data latency.

Internal Handover Succ Rate

External Handover Succ Rate

From the above figure we see that Handover performance has improved a lot.

HO attempts and success rate of some potential missing neighbors add in this projectare given below: (HO attempts >4000 in a day)

After performing the above tasks, we observe that SS drops improvement is very much significant over the cluster which is expected by addition of potential missing neighbors. Significant numbers of HO attempts along with good success rate are observed over the added neighbor relations hence improving the SS drop and Quality drop due to undefined neighbor relation.

3.20To study and participate in overall Cell design Process:

In cell design processes following things are included:

➢ Why/when new site requirement triggered

➢ Best option judged

➢ Designing new site - key consideration

➢ Coverage prediction.

Based on the traffic and the quality of the signal, new sites are created. One of the most important parts of the cell design process is to define cell parameters for new sites. For the 900 MHz frequency GP has (89-124) channels for frequency allocation system.

This process is important in terms of avoiding co-channel interferences and adjacent interferences and also to define the potential neighbors' cells.

Site Surveys

During my whole training period, I had the opportunity to do site surveys with the system engineers of the team that I was associated with. First phase was to know the proper settings for the site surveys. The software's that we used were Planet EV, Google Earth and Map source. 1st of all we find the potential site from where most of the traffic are generated then we do our research with that with the help of Planet EV and Google Earth.

Then on the day of survey, we go to the site with the help of GPS. Then we collect data from that Place and talk with common people. It was quite exciting because every time I went for site survey, I have been too many new places and most importantly get to know many people from different parts of the society.

The most important thing that I have learnt by doing this that I have to know the place and the people for whom I am designing a site or optimizing a new site.

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3.22 Drive test:

Though I hadn't much of time to do drive test but it was well enough to have an idea regarding drive test. There are basically 2 types of analysis for DT.Route and data analysis, for the recording purpose and to create log files we used the route analysis and to read and investigate we used data analysis.

While attending one of the drive tests along with the drive test engineer of Dhaka, I have learnt how to create the log files, how to use MS1 and MS2 for the dedicated and idle mode, in fact the whole set up.

By doing the data analysis on the log files, we got the idea about the signal strength on a particular area. Then we can decide about what are the changes that need to do to sustain a good quality network. Now I got a bit of idea about drive test which will definitely help me for my future works.
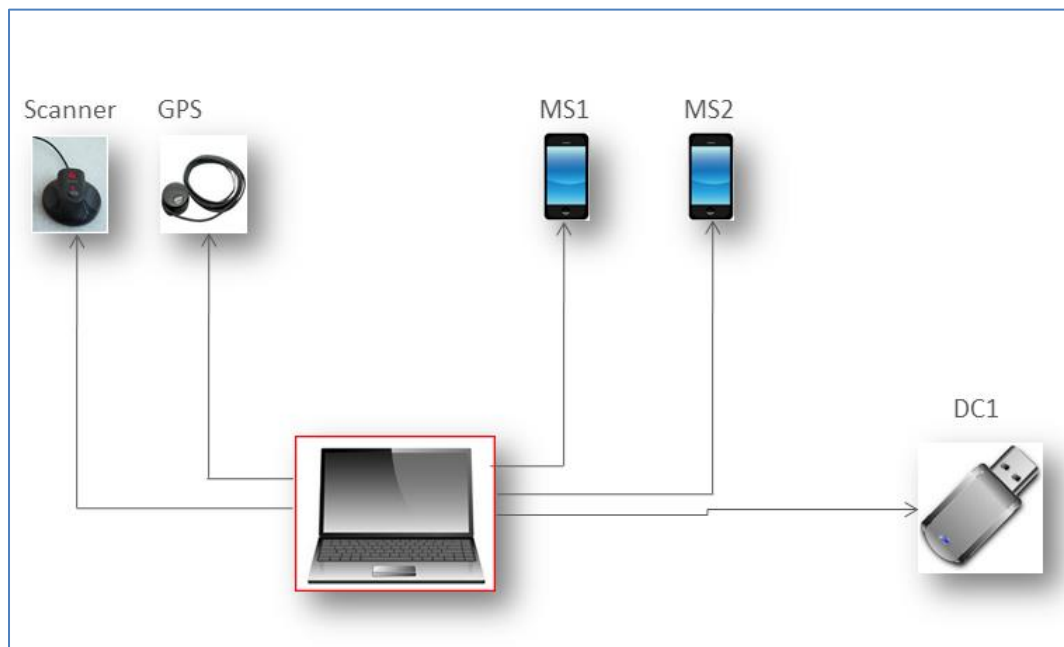
Physical Connection diagram

Fig3.16: Physical Connection

Equipment	Technology	Usage	Procedure
MS1	3G Locked	Short Voice Call	60 second call with 10 second wait and then repeat
MS2	Dual Mode	Long Voice Call	Long ongoing call. If dropped, reconnect in 5 sec. 60Sec duration will be treated as 1 call for calculations
DC1	Dual Mode	FTP Download and Upload	50MB Download, Wait 5Sec, 10MB Upload and repeat

Color range

RSCP	Color
better than/equal -65	🟩
-75 to -65	🟦
-85 to -75	🟨
-95 to -85	🟪
-105 to -95	🟥
'worse than -105	⬛

Ec/No	Color
better than/equal -9	🟩
-12 to -9	🟦
-14 to -12	🟨
'worse than -14	🟥

RSSI	Color
better than/equal -65	🟩
-75 to -65	🟦
-85 to -75	🟨
-95 to -85	🟪
-105 to -95	🟥
'worse than -105	⬛

UE Tx Power	-Color
Greater than/equal 20	🟥
0 to 20	🟨
-20 to 0	🟦
better than -20	🟩

PART FOUR: FINALE

4.1 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 verity 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 Teleworks LTD** will be of great value in any future carrier that I do – it taught me a lot of good practices and techniques.
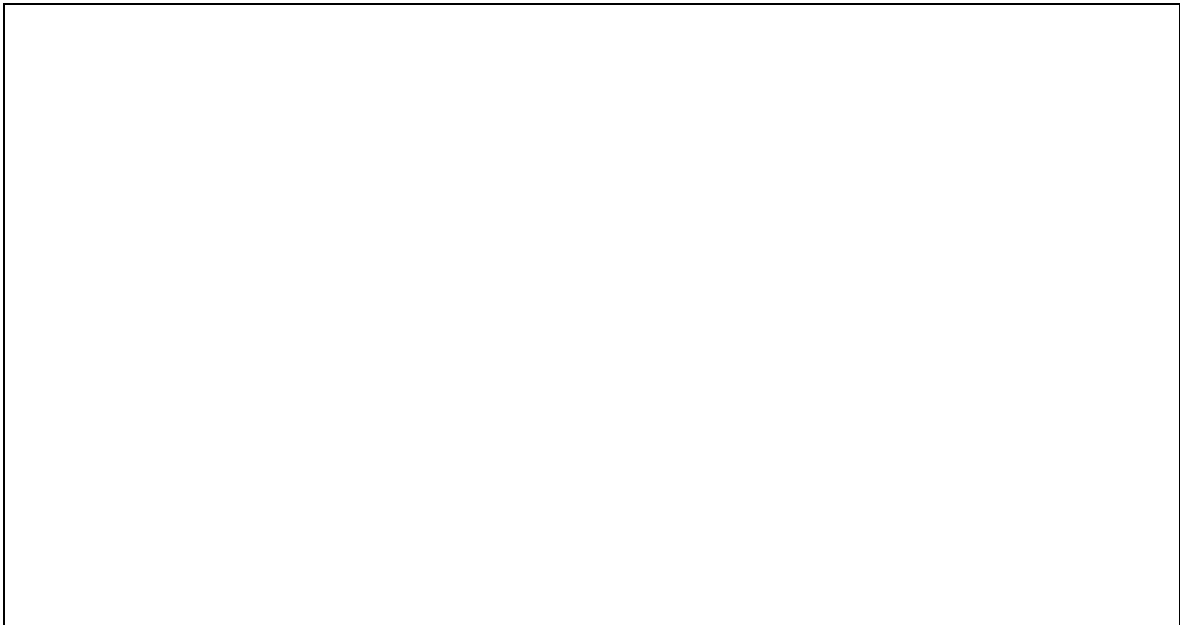
4.2 Conclusion

As a leading telecommunication survey provider company in Bangladesh, I believe that METRO Teleworks Ltd. has been able to provide me such a kind of unforgettable experience for the 2.5 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 the leading telecommunication survey provider of my own country. 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.

4.3 References_____

- "*WCDMA SYSTEM OVERVIEW*" Training, HUWEI Technologies LTD.

- www.gsmera.com

- *"Foundations of Mobile Radio Engineering" by* Michel DaudYacoub.

- *"Introduction to Radio Propagation for Fixed and Mobile Communications"* (Artech House Mobile Communications Series) by John Doble

- *"Fundamentals of Cellular Network Planning and Optimisation: 2G/2.5G/3G... Evolution to 4G"* by Ajay R Mishra

Supervisor's endorsement_____

Mohammad Faijulislam
Manager
Operation &Delivery
Metro Teleworks Ltd.

Signature: _____   Date: