

A Practical Approach to Improve GSM Network Quality by RF Optimization

Giriraj Sharma, Ashish Kumar Bansal

Abstract:- All GSM service provider uses KPI to monitor their QOS performance. Report generated from OMCR terminal & customer feedback are considered in further network improvement activity. RF optimization and drive test is the tool to keep continue watch on network QOS .In this paper some practical cases and solutions are adopted to improve the network QOS during drive test & post processing. Major QOS parameter Handover, call drop, congestion, interference reasons and solutions are discussed. drive test tool Ascom TEMS 10.2.1 is used to perform drive test. if optimization done continuously it will attract more and more customers due to service satisfaction.
Index term:- GSM,RF optimization ,Drivetest, TEMS drive test tool, BSC,BTS,TRX,QOS

I. INTRODUCTION

In competitive environment, especially in India & china where telecom density is very high, high quality of service is a competitive advantage for a service provider. Service providers must continually try to improve their quality of service if they want to keep customers. If too much time is spent simply waiting for customer complaints, there may not be enough time to improve overall service quality. Due to MNP(Mobile number portability) customer may change their operator without changing their mobile number. Therefore, Service providers need the ability to fix complaint-producing problems quickly. Hence RF Optimization is a very important process in any service providers operating lifecycle. By gathering and analyzing network data and revising network parameters and using proper RF Planning and Optimization desired QOS may be achieved. As we move further ahead the need for better technologies and reliability of services, integration and cost effective practical solutions have become a necessity for service providers. If the optimization is successfully performed means we achieve the QoS, reliability and customer satisfaction.

GSM stand for Global system for mobile communication.GSM network usually called as cellular network as the whole coverage area is divided into different cells and sectors. A mobile Station (MS) is connected to the Base Transceiver Station (BTS) via air interface. BTS contains Transceiver (TRX), which is responsible for the transmission and reception of several radio frequency (RF) signals. BTS is then connected to the base station controller (BSC) via abis interface.

Manuscript published on 30 April 2014.

* Correspondence Author (s)

Giriraj Sharma, Sub Divisional Engineer, Bharat Sanchar Nigam Limited, Kota (Raj), India

Ashish kumar Bansal, Junior Telecom Officer, Bharat Sanchar Nigam Limited, Barmer (Raj), India

© The Authors. Published by Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP). This is an [open access](http://creativecommons.org/licenses/by-nc-nd/4.0/) article under the CC-BY-NC-ND license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

BSC usually handles radio resource management and handovers of the calls from one Cell to the other cell equipped in it. BSC is then connected to Mobile Switching Centre MSC. Inter BSC Handover is done by MSC.

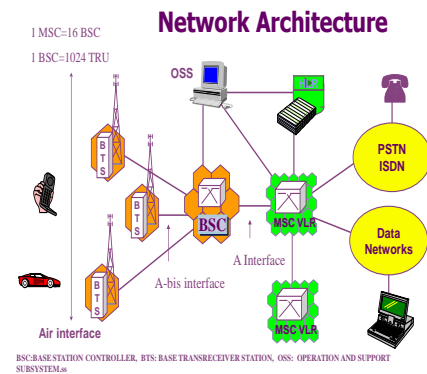


Fig-1

MSC is further connected with HLR. As there are limitation of frequency spectrum hence frequency reuse principle is adopted. In GSM we are using 890-915 Mhz and 935-960 Mhz Band.

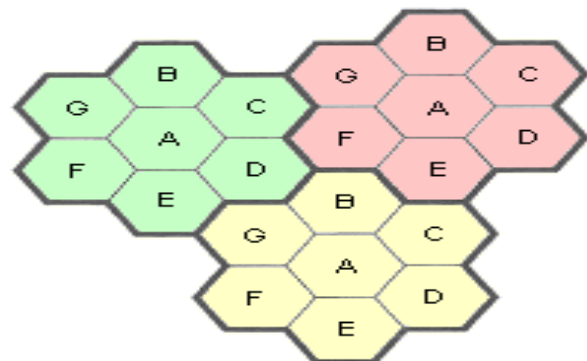


Fig-2 Frequency reuse

II. RF OPTIMIZATION

Activity of achieving and maintaining the required quality as designed is RF Optimization. Every live Network needs to be under continues control to maintain/improve the Performance. Optimization is basically the only way to keep track of the network by looking deep into statistics and collecting/analyzing drive test data. It is keeping an eye on its growth and modifying it for the future capacity enhancements. It also helps operation and maintenance for troubleshooting purposes



Objective of RF optimization

- To improve the existing network coverage and capacity.
- To improve the offered service quality for fulfillment of customer demands.
- To maintain the KPIs under pre-defined threshold.

Normally following points are considered in RF optimization

- Non-working sites /sectors or TRXs,
- Improper function of radio network features like frequency

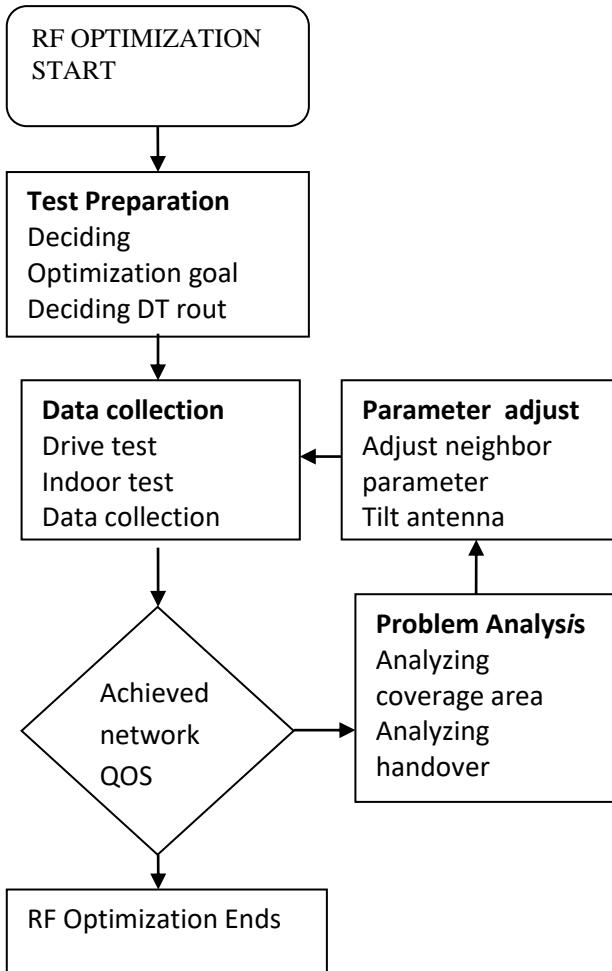


Fig-3 RF flow chart

Hardware Optimisation

- Handover parameters
- Antenna Down tilt

- Antenna Relocation
- Antenna Height adjustment
- Frequency planning

Cell parameter optimization

- Neighbour list reconfiguration
- Power planning
- Antenna Reorientation

III. DRIVE TEST AND ANALYSIS

The quality of the network is ultimately determined by the satisfaction of the users of the network, the subscribers.

Drive tests give the 'feel' of the designed network as it is experienced in the field. The testing process starts with selection of the network where the tests need to be performed, and the drive testing path.

Before starting the tests the RF engineer should have the appropriate kits that include TEMS mobile equipment, drive testing software on a laptop, and a GPS (global positioning system) unit. When the drive testing starts, mobile is used to generate calls with a gap of few seconds. It makes one continuous call, and if this call drops it will attempt another call. The purpose of this testing to collect enough samples at a reasonable speed and in a reasonable time. During DT HO failure, RX Level, speech quality are observed. If there are lots of dropped calls, the problem is analyzed to find a solution for it and to propose changes

In BSNL we are using Ascom TEMS drive test tool kit. OMCR report are taken in consideration before performing the drive test.

Drive Test Route Planning

Primary route(street level) -Includes all major roads, highways and wide thoroughfares-

Secondary route(street level) - Includes all streets, subdivisions and compounds when accessible -

Miscellaneous routes (in-building and special locations) Includes golf courses, beach resorts, shopping malls, department stores, convention centers, hotels and resorts

Performance Problems that often encountered:

- Cell Dragging,
- Dropped Call,-
- Ping-Ponging,
- System Busy,
- Handover boundary

Cell Dragging –

Calls may drag a cell beyond the desired handover boundary. This might result dropped calls or bad Rx quality.

Suggestions:

- Create an appropriate neighbour cell list
- Change HO parameters such as thresholds, margin, cell baring, etc
- Check servingcell's cell identifier in the neighbour cell's neighbour list
- Check neighbour cell BCCH, BSIC, LAC, CellID, etc

Dropped Calls - Caused by either RF environments or incorrect system parameters

Suggestions:

- Check if an appropriate neighbour cell list is defined
- Check HO parameters
- Existing or new coverage holes
- Interference, Co-channels, Adjacent channels or External interference
- Serving cells might go down, coverage smaller as before
- Abnormalities such as call setup failure

Ping Ponging -

Serving cell keep changing and as a result of bad audio quality

Suggestions:

- Check if an appropriate neighbour cell list is defined
- Check HO parameters
- Interference, Co-channels, Adjacent channels or External interference
- Lack of dominant server
- Poor coverage
- Not optimal antenna configuration

System Busy –

System busy on several call attempts and site appears consistently on the traffic report

Suggestions:

- Short Term
 - Reduce the traffic on the congested cell/site. However, the proposed changes MUST NOT create any unacceptable problems such as coverage holes, dropped calls, etc
 - Shot term solutions are re-design the antenna configuration,
 - Add additional RTs, Change BTS configuration
- Long Term
 - Build a new cell site to off-load traffic

Handover Boundary - Handovers do not occur at the desired HO boundary, the result is an imbalance in traffic distribution across the system

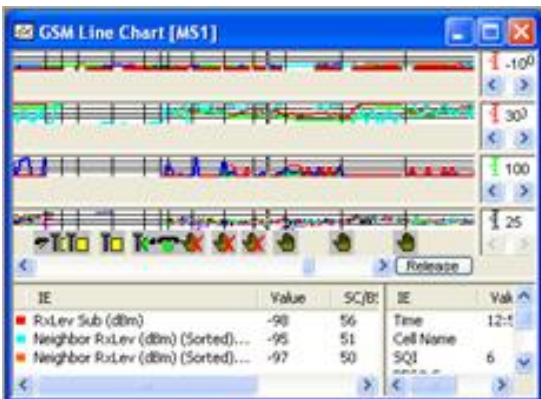
Suggestions:

- Check if an appropriate neighbour cell list is defined
- Check HO parameters
- Inappropriate antenna configurations of the serving and neighbour cells
- Interference, Co-channels, Adjacent channels or External interference
- No TCH available (neighbour cells congestion)

Following & even more windows appears in Drive test .

1. GSM line chart:-

Handover success and handover failure report are shown. cross hand shows that handover failure. Handover failure may be due to congestion on neighbor, frequency & neighbor missing. Accordingly Handover are defined. RX level of serving cell
RX level of Neighbour sites are displayed

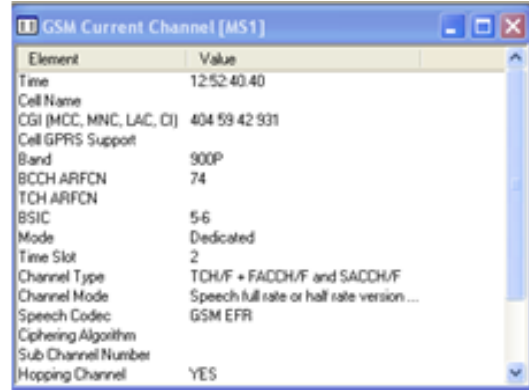


2. GSM current channel:-

In this window cell Id, CGI, BSIC, Hopping, time slot, channel type etc are displayed.

CGI stands for cell global identity CGI = MCC + MNC + LAC + CI (404-59-1125-254)

BSIC stand for Base station identity code



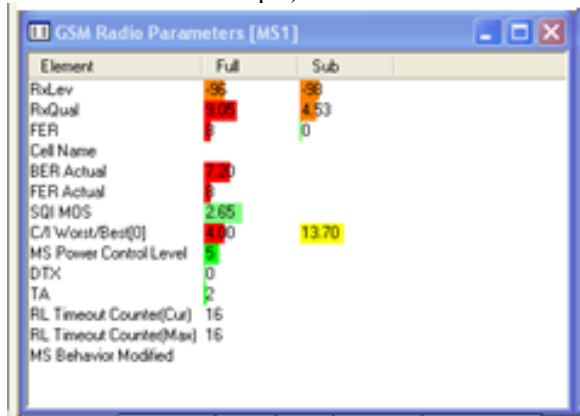
3. GSM Radio parameters:-

In this window RX level, RX quality, BER, SQIC etc are displayed. RX level parameters shows receive level of signal.

RX level	strength	colour on screen
> -65dbm	Very good strength	green colour
-65dbm to -85dbm	Good	Yellow colour
< -85dbm	poor	Red colour

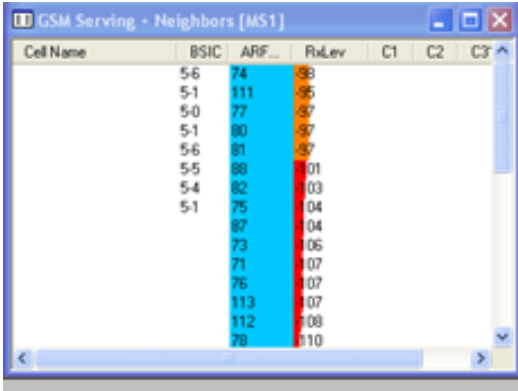
RX quality < 3 good

TA-Timing advance (1 means we are apprx 550m away from tower and in multiple)



4. GSM serving neighbour:- Cell Name, BSIC, ARFCN ,RX level etc are displayed.

ARFCN –Absolute radio frequency channel number



In addition to above following parameters are also observed
 Signal intensity, Signal quality, Interference, Dropped calls,
 Blocked calls, Anomalous events, Call statistics, Service
 level statistics, QoS information, Handover information,
 Neighbouring cell information, GPS location co-ordinates.
 Conduct the Drive Test – covering all sectors by observing
 the following Parameters:

- Rx Level
- Rx Quality
- Interference on BCCH & Hopping Frequencies.
- Call setup failure reasons
- Observe whether the nearest sector is serving or not.

Drive test report analysis:-

During drive test log file are save during drive test.after
 completion of drive test these files are processed and result
 are obtained. Following parameters are

Handove failure, Handove attempt, outgoing call attempt,
 OG call success, incoming call setup, IC call success etc.

IV. ANALYSIS AND FINDINGS

(A) Handover failure , call drop and interference:-

(1) Issue observed :-

Subscriber complain regarding call drop problem of
 TON005 site coverage

Steps to resolve issue :-

- Check neighbor 2G sites handover – found OK
- Check BCCH and BSIC frequency

Drive test report analysis :-

In drive test report analysis it is found that BCCH frequency
 are same of nearby site

Cell Id	BSIC	BCCH
TON005A	62	111
TON006B	68	111

Action taken:-

Change the BCCH frequency planning

(ii) Issue observed:-

Customer complain regarding call drop while in coverage
 site TON010

Analysis & findings:-

- Handover checked with neighbor - Ok
- BSIC and BCCH frequency checked - OK

While analysis DT report it is observed that new 3G site was
 installed and IRAT handover was not defined

Action taken:-

Inter RAT (UMTS and GSM) handover defined and
 problem resolved

(B) VSWR & RX diversity:-

Issue observed:-

Very Low traffic on particular sector of a site DHO001B
 OMCR generated daily NQR report showing that in
 DHO00B there was almost zero traffic while good traffic in
 other sector of same site.

Analysis & findings:-

During drive test it is observed that Receive level of
 DHO00B is lery low and coverage shrinked. While
 measured VSWR was very high(3.1). By VSWR meter
 distance shown 5 m and at that distance there were joint of
 jumper and feeder.

Action taken

When opened the joint there was water in joint. Joint again
 made and VSWR was Normal and coverage was good.

Cell Name	DHO001A	DHO001B	DHO001C
Site Name	TE_MAIN	TE_MAIN	TE_MAIN
No. of TCHs	44	44	44
No. of SDCCChs	23	23	23
TCH Traffic (Erlang)	30.21	0.79	16.01
Total Calls (TCALLS)	2659	132	1674
TCH DROP(%)	0.65	0.78	0.48
TCH Blocking (%)	0	0	0
TCH Availability Rate	100	100	100
Incoming HO Success Rate	98.67	96.2	98.72
Outgoing HO Success Rate	98.51	96.63	98.29

(C) Congestion :-

(1) issue observed

Daily NQR report generated shows that congestion on
 sector UNI001A increased.

Analysis & findings:-

Some TCH may be blocked-Ok

Hardware(TRX) may be faulty- swapped with good TRX

Half rate implementation – Already implemented

During DT it is found that coverage of UNI001A was there
 instead of MLA001A where previously coverage of
 MLA001A.

Action taken:-

Antenna orientation of MLA001A and UNI001A was done.
 Due to heavy wind or other reason antenna of UNI001A was
 tilt and coverage was disturbed.



V. CONCLUSION & SUGSTION

Primary object of any GSM service provider is to provide best QOS to customer so that they can attract maximum no of customer .In this paper by RF optimization & drive test so that best KPI can be achieved.RF & DT not only solution for present network but also suggest best future network.I have discussed some common practical solutions which are common causes of poor KPI.

The overall objectives of any RF design depend on a number of factors that are determined by the needs and expectations of the customer and the resources made available to the customer. Due to the mobility of subscribers and complexity of the radio wave propagation, most of the network problems are caused by increasing subscribers and the changing environment. These reports also help to plan operators to enhance coverage, improve quality and increase capacity in the days to come Radio Network Optimization is a continuous process that is required as the network evolves. Radio network optimization is carried out in order to improve the network performance with the existing resources. The main purpose is to increase the utilization of the network resources, solve the existing and potential problems on the network and identify the probable solutions for future network planning. Through Radio Network Optimization, the service quality and resources usage of the network are greatly improved and the balance among coverage, capacity and quality is achieved.

Moreover, the issues discussed here are quite helpful for the analysis and performance evaluation of different cellular networks. Optimization teams use QoS reports in order to detect bad service quality areas.. A mobile operator can also set its own QoS targets based on the KPIs in order to ensure end user satisfaction. QoS reports based on different KPIs are duly beneficial for Management team to compare network performance with the competitor's one and to plan network evolution and strategy.

Today is smart phone era. Drive test apps shows RX level, Speech quality and other parameters may be used. So that every time not necessary to carry drive test tool.

REFERENCES

- [1] TEMS investigation user's manual, 11.0, Ascom- 2010.
- [2] Bilal Haider, M Zafrullah Khan, M.K.Islam: Radio Frequency Optimization and QOS in operational GSM network.
- [3] Syed Imran Basha, Idrish Shaik: Reducing Handover Failure Rate by RF Optimization
- [4] Wireless Communications, Principles and Practice, 2nd edition, Theodore S. Rappaport, Pearson publications.
- [5] [2] ITU-T recommendation G.1000 (2001), Communication quality ofService: A framework and definition.



Sh. Ashish Kumar Bansal BE(Electronic & com Engg) in 1994 is working as Junior Telecom officer in Bharat snachar Nigam Limited(BSNL),Barmer. He is working in the field of GSM and having more than 16 year of experience. He also served as Lecturer Maulana Engg college,Ambala for 6 year



Giriraj sharma BE(Electrical Engg) from Jai Narain Vyas Univ.,Jodhpur in 2000 is working as subdivisional Engineer (MSC) in Bharat snachar Nigam Limited(BSNL),Kota He is working in the field of GSM and having more than 12 year of experience. He also served as Guest faculty in Govt. Engg. College, Ajmer for 1.5 year. He is member of Institution of engineers of India(MIE).