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Comparision and Development of Algorithm for Different 3G GSM Network Sites

Abhilasha Sharma ,Dr. Naveen Choudhary, Dr. Dharm Singh

Department of CSE,College of Technology and Engineering,
MPUAT, Udaipur, India

Abstract- Paper includes the network implementation parameters of different mobile network sites. It has been analyzed that how SFH and Non SFH networks will control the quality of calls, and how BTS and BSC will automatically control the power of network. This can be said that there are different GSM networks and analysis is done on these networks on the basis of different network parameters with the help of KPI report.

An algorithm is prototyped on the basis of these network implementation features like Blocked Call Analysis, Drop Call Analysis, Speech Quality Parameters, and Speech Quality Analysis, Handover Analysis, Coverage Analysis, Quality of SFH & Non-SFH network, Drop Call Rate, Call setup success rate, Blocked Call Rate, Hopping C/I.

I. Introduction

The cellular frequencies are the sets of frequency ranges within the ultra high frequency band that have been allocated for cellular phone use. Now there are 100's of companies working on GSM and 1000's of GSM experts. GSM is no longer state-of-the-art.

Coverage in GSM network stands for the geographical area covered by the network from which mobile is accessible to the network.

In GSM Coverage area is planned in division of cells. Each cell covers a particular geographical area, the size of which depends on the terrain and other system configurations. Generally the more the number of cells, the better the coverage ,but by just creating cells may not give good quality of coverage.

Each cell has a Base Station Transceiver (BTS) at the chosen site. The location of BTS site depends upon several factors.

1. Coverage in prime localities / hot spots is the most important criteria in choosing the BTS site.
2. Terrain - Type of buildings in the area to be covered.
3. Availability of proper site - COST factor
4. Availability of open space, power supply, security
5. Nearby installations of Cellular / other transmitters.
6. Access to the network - leased lines / Microwave link / Optical link.

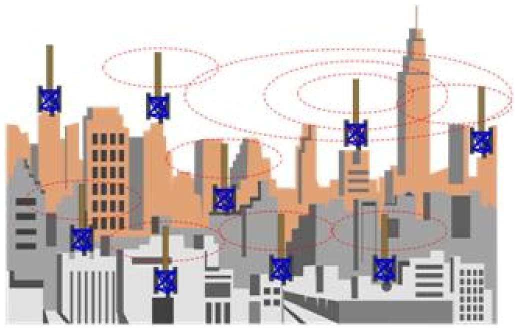

Fig: 1 Cluster of Base Stations

The experience of analog cellular helped in developing specifications for a Digital Cellular standard. The work on GSM specs took a complete decade before practical systems were implemented using these specs. GSM is quickly moving out of Europe and is becoming a world standard. In this presentation we will understand the basic GSM network elements and some of the important features. Since this is a very complex system, we have to develop the knowledge in a step by step approach [1] [2].

II. GSM Architecture

MSISDN: (Mobile Station International Dialed Number) : This is the human identity associated with the Mobile Phone. This identity is used by the users to identify their subscription numbers and also by others to call Mobile Phones. This identity is not stored anywhere in the Mobile Phone. It is available in the Network database (HLR).

The Mobile Station has two identities associated with it:

The objective of this identity is to route the call over the fixed and Mobile Phone network. It is made up of CC (Country Code) which provides uniqueness in routing calls to GSM operations country.

Within the country, the NDC (National Destination Code) provides unique identification of each operator. Finally the SN (Subscriber Number) discriminates each subscriber within a network.

IMEI (International Mobile Equipment Identity) : This is a unique number stored inside the ROM of the Mobile Phone. Its uniqueness lies in the TAC (Type Approval Code) which is allotted by the MOU to a new mobile which has passed the confirmation specifications. After which, the manufacturer may discriminate individual phones by FAC (Final Assemble

Code), SNR (Serial Number) and also, by the SP (Spare digit) typical used for software version control.

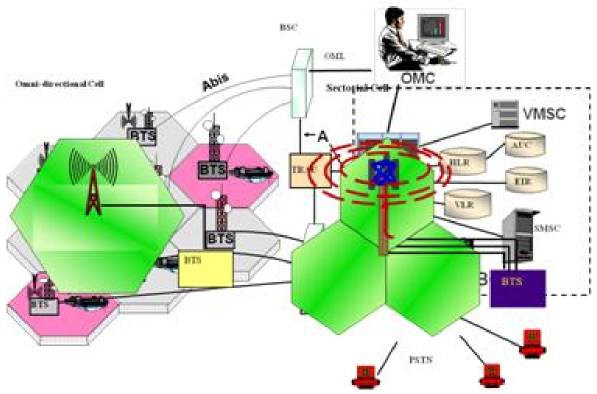

Fig: 2 GSM Architecture

III. RF ACTIVITIES IN CELLULAR SYSTEMS

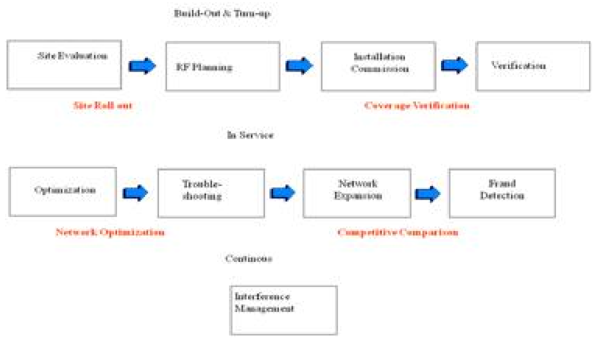

Fig: 3 Radio Frequency Activity Steps

Steps:

- Site Evaluation
- Frequency Planning
- BTS Installation and Commissioning
- RF Coverage Verification
- Optimization
- Competitive Comparison

IV. COVERAGE PLANNING

Coverage in GSM network stands for the geographical area covered by the network from which mobile is accessible to the network. In GSM Coverage area is planned in division of cells. Each cell covers a particular geographical area, the size of which depends on the terrain and other system configurations. Generally the more the number of cells, the better the coverage ,but by just creating cells may not give good quality of coverage.

Mobile Communications Propagation:

Mobile Communications propagation is impacted by:

1. Path Loss
2. Reflection
3. Diffraction

Cluster details

Sector	**Clutter type**	**Drive-test routes/Hotspots/Landmarks as given by RTL**
405-11364	Dense area	Market place near site, Residential area
405-21364	Dense area	Market place near site, Residential area
405-31364	Dense area	Market place near site, Residential area

VII. HANDOVER TROUBLESHOOTING

Weak Neighbors: Total Attempted Calls, Total Dropped Calls, Total Blocked Calls, RxQUAL Full, RxLeve Full, RLT Current Value, ARFCN, Neighbor Cell Measurements, RR Message, Phone State, Sequency number.

Plot of testing BTS Cluster

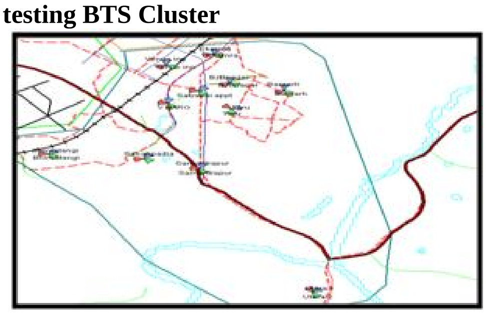

Fig 3: Plot of testing Represent BTS Cluster

Note: For Hilly Region TA consideration will be different

Rx Level Vs TA Results

Description	**Measured Results**						**Pass/Fail**
	TA	**> -65**	**-65 to -75**	**-75 to -85**	**-85 to -95**	**<-95**	
Change in Rx Level with distance	0-2	13250	4327	317	0	0	PASS
	3-4	0	0	0	0	0	
	5-6	0	0	0	0	0	
	7-8	0	0	0	0	0	
	9-10	0	0	0	0	0	
	11-12	0	0	0	0	0	
	13-14	0	0	0	0	0	
	>14	**0**	**0**	0	0	0	

V. Critical Network Implementation Features

There are some ITU standards for estimating speech quality. There are some critical network implementation features. They should be first considered and then network implementation or network analysis will start Dynamic

- Power Control
- Discontinuous Transmission
- Frequency Hopping
- Intra-cell Handover

Dynamic Mobile Power Control: Mobile is commanded to change its Transmit Power and then the power will be changed with the proportionate to the path loss and the change in power is done in the steps of 2 DBs. In that case the dynamic MS power control will be maximum.

VIII. Quality Of SFH & Non-SFH Network

Non-SFH network

Description	Measured Results	Pass /Fail	Remarks/ Recommendations
95 % of bins should have RxQual equal to or less than 4	NA	pass	

Table 3: Represent Quality of Non-SFH network

Quality of SFH network

Description	Measured Results	Pass /Fail	Remarks/ Recommendations
95 % of bins should have FER less than or equal to 2 OR SQI should be better than 20	SQI-83%FER-99%		SQI goes down due to forced Half Rate implemented in Sites.

Table 4: Represent Quality of SFH network

HOPPING C/I

Average C/I on hopping carriers = 19.0

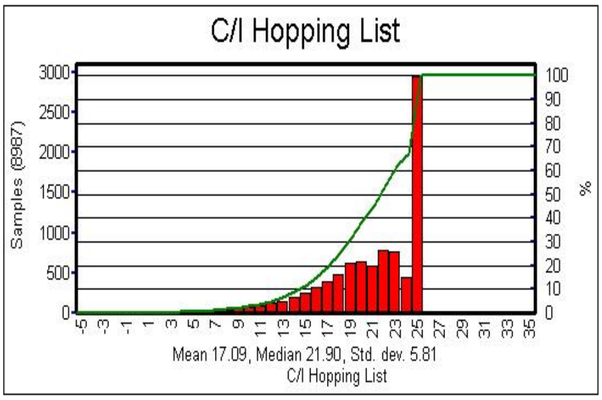

Fig- Represent C/I Hopping ListVs Samples Rate

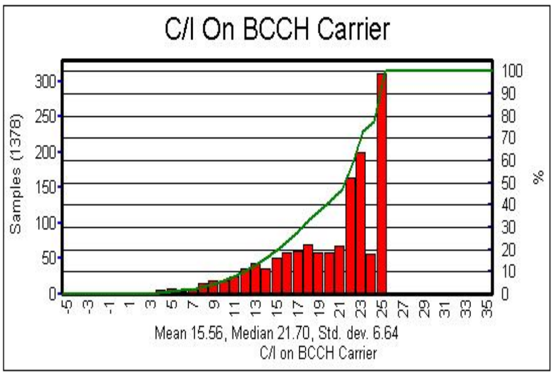

Fig- Represent Co-channel interference on BCCH CarrierVs Samples Rate

Power Control Benefits

The objective of power control is to reduce average interference level of the network. The algorithm only works on measurement reports send by MS. It cannot be applied to BCH carriers. And, if Adjacent ARFCN's are used in adjacent cells, then, both adjacent ARFCN TRXs should have the same mode.

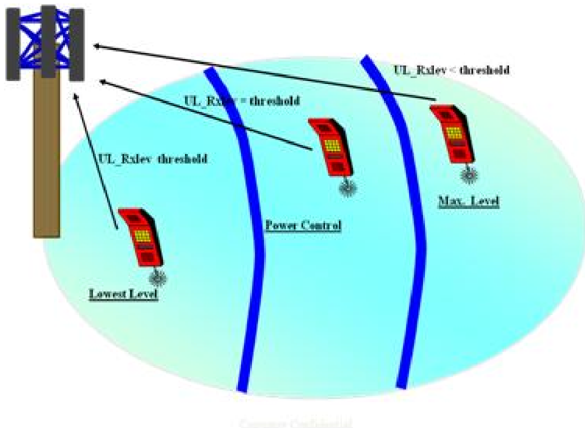

Fig: Power Control

Rx Level plots

Fig 8: Represent plots of Rx Level Sub

Rx Qual Plot

Fig 9: Represent plots of Rx Quality Sub

VIII. PROPOSED ALGORITHM

Algorithm

1. Threshold that is a set of Rx values, has been decided (Max. Set as Thp for increase in power and Ths as decrease in power).
2. BTS expects a threshold Rxlev and Rxqual in uplink (Value of Th for uplink).
3. In every 480ms BTS sends a report of Rxlev and Rxqual to BSC (Set as R).
4. BSC compares reports with threshold after a set period (Compare Rx values among R).
5. Make one Set of reports that are on poorer side (Set as Pr).
6. If (Pr > Thp)
7. Then, Increase in Power and go to step 3.
8. Else, Make one set of reports that are on stronger side (Set as Ps).
9. If (Ps > Ths)
10. Then, Decrease in Power and go to step 3
11. Else, goto step 3.
12. The Threshold for decreasing power will be different.
13. Uplink Rxlev Threshold Range : - 73 dBm to -104 dBm

XI. CONCLUSION

On the basis of data that has been collected for different sites of 3G wireless mobile networks, analysis can be done on Rx values, power control, Coverage, call drop and handover. Network has been analyzed on the basis of quality of calls. After analysis we have found an algorithm for power increasing and decreasing of mobile network. It will be automatically supervised by the BTS and BSC. Mobile is Hopping on 99 and 84, 99 is also the BCH, Co-Channel on BCH is very high., 50% of the time quality will be poor, But Poor Quality is consistent.

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