Analysis & Characteristics of 3G GSM Network

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Abstract

This paper includes performance and analysis & Characteristics of 3G GSM network on the basis of KPI report. Performance & analysis of GSM network has following features: 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 Global System for Mobile communications (GSM) is a huge, rapidly expanding and successful technology. Less than five years ago, there were a few 10's of companies working on GSM. Each of these companies had a few GSM experts who brought knowledge back from the European Telecommunications Standards Institute (ETSI) committees designing the GSM specification. Now there are 100's of companies working on GSM and 1000's of GSM experts. GSM is no longer state-of-the-art. It is everyday-technology, as likely to be understood by the service technician as the ETSI committee member. GSM evolved as a mobile communications standard when there were too many standards floating around in Europe. Analog cellular was in use for several years in different parts of world. Even today there are few networks of Analog cellular. 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.

Troubleshooting

Blocked Calls, Poor Quality and Drop calls, Abnormal Handovers, Interference, and Termination Failures**.**

II. BLOCKED CALL TROUBLESHOOTING

Blocked Calls can occur due to: Access Failures, SDCCH Congestion, SDCCH Drop, and TCH Congestion, The best way of analyzing blocked calls, to identify the cause, is from a Layer III protocol log. Paging failure. A paging message always originates from the MSC and is sent to all the BSCs in the Location Area of the MS to be paged. The BSC will then calculate the Paging group of the MS and send a Paging Command to the BTSs controlling the Location Area of the MS. On the air interface there are two cases of Paging Failure, either the Mobile receives no Paging message or it receives a Paging message, but is not able to respond (not able to send a RACH) which could be due errors in the Paging message.

Access Failure

Irrespective of the purpose, for any communication required with the network, a mobile sends a channel Request (for SDCCH) on a RACH and waits for some time for a response which should come from the BTS on an AGCH. A mobile will do several retransmissions of RACHs (pre-defined) and if it still does not get a response, it goes back to idle mode and preferably does a cell reselection. At this stage we call it an Access Failure.

SDCCH Blocked

Once a mobile has sent a Channel Request on a RACH, it expects a response from the BTS on the AGCH. This should be an Immediate Assignment Command to an SDCCH. If an Immediate Assignment Reject comes instead, then this is SDCCH blocking.

TCH Blocked

After the completion of call set-up signaling, a mobile expects an Assignment Command to a TCH so that speech can commence. If no Assignment occurs for a specific period and the Mobile has to return to idle mode, then it is due to TCH congestion.

Blocked Call

Cause troubleshooting: Access Failures, CCCH Overload at the Base Station, Uplink Interference at the Base Station, Low Rx lev at the Base Station, Base Station TRX decoder malfunctioning, Downlink Low Rx lev (Coverage Hole), Downlink Interference, Excess Cell Range

Blocked Call Analysis: SDCCH Congestion Cause, Location Updates to be analyzed with OMC statistics first. If high, determine the source to target cell ratio Drive around the suspected area in the Idle Mode Configure "Delta LAC < > Constant 0" alarms Optimize Location Updates.

Interference

Analyze OMC statistics on "Idle Channel Interference"Carry out Uplink Interference Measurements using Viper, Heavy Traffic Verify from OMC statistics SDCCH Congestion, Carry Call Time measurements Optimize set up time if high, else modify channel configuration.

Blocked Call – Interference

Base Station Measures Uplink Interference on Idle Timeslots, at regular intervals, categorizes Timeslots into Interference Bands. There are Five Interference Bands. Each Interference Band has a range of interference level.

Timeslot – Testing

Activate Cell Barring from OMC, Remove this cell from the neighbor list of other cells, Get the cell configuration, ARFCN's and Timeslots configured for TCH, For BCH carrier select the Timeslot and carry out the Testing, For TCH Carriers: Block the BCH Timeslots from OMC, Carry out Timeslot testing, If more than 1 TCH Carrier is activated, block all others.

III. DROPPED CALL TROUBLESHOOTING

Call drops are identified through SACCH message, a Radio Link Failure Counter value is broadcast on the BCH, the counter value may vary from network to network. At the establishment of a dedicated channel, the counter is set to the broadcast value (which will be the maximum allowable for the connection). The mobile decrements the counter by 1 for every FER (unrecoverable block of data) detected on the SACCH and increases the counter by 2 for every data block that is correctly received (up to the initial maximum value). If this counter reaches zero, a radio link failure is declared by the mobile and it returns back to the idle mode. If the counter reaches zero when the mobile is on a SDCCH then it is an SDCCH Drop. If it happens on a TCH, it is a TCH drop. Sometimes an attempted handover, which may in it have been an attempt to prevent a drop, can result in a dropped call. When the quality drops, a mobile is usually commanded to perform a handover. Sometimes however, when it attempts to handover, it finds that the target cell is not suitable. When this happens it jumps back to the old cell and sends a Handover Failure message to the old cell. At this stage, if the handover was attempted at the survival threshold, the call may get dropped anyway. If on the other hand the thresholds were somewhat higher, the network can attempt another handover.

We will examine the potential causes behind call drops and some solutions to combat them.

Coverage

Poor non-contiguous coverage will reduce C/N and hence will reduce the Ec/No and will result into call drops.

Network Initiated Drops

Certain network features, like preemption, can kill an ordinary call to provide connection to an emergency class subscriber. A handover is the key to survival from dropping calls. But if there are problems in the Handover process itself, then this will not avoid a drop. Dropped calls can be effectively reduced by improving coverage, detecting and reducing interference, setting appropriate Handover Margins, thresholds for handovers and the correct selection of neighbors. Use of DTX and dynamic downlink power control will also reduce average interference which should lead to some improvements.

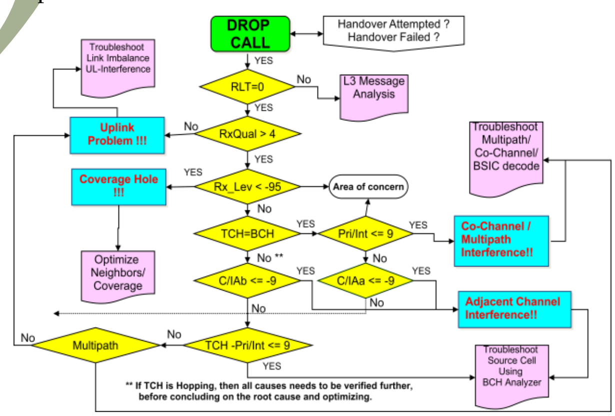

Fig1: Flow Chart of Dropped Call Troubleshooting

SDCCH Drop

Coverage, Co- Channel Interference, Adjacent Channel Interference, SDCCH Drop - Uplink TCH Drop – Coverage, Co-Channel Interference, Adjacent Channel Interference, Uplink Problem, Handover Failure.

Poor Quality

Poor Speech Quality could be due to , Patchy Coverage (holes), No Target cell for Handover, Echo , Audio holes, Voice Clipping, Interference like as , Co-channel, Adjacent channel, External, Multipath, Noise.

IV. SPEECH QUALITY PARAMETERS

Rx- QUAL

Measured on the midamble, Indicates poor speech quality due to radio interface impairments

FER

Measured on the basis of BFI (Ping -Pong effect) Preferred under Frequency Hopping situation

Echo and Distortion

Generally caused by the Transmission and switching system.

Audio holes

Blank period of speech, due to malfunctioning of Tran coder boards or PCM circuits.

Voice Clipping

Occurs due to improper implementation of DTX.

Mean Opinion Score (MOS)

ITU standard for estimating speech quality.

V. SPEECH QUALITY TROUBLESHOOTING

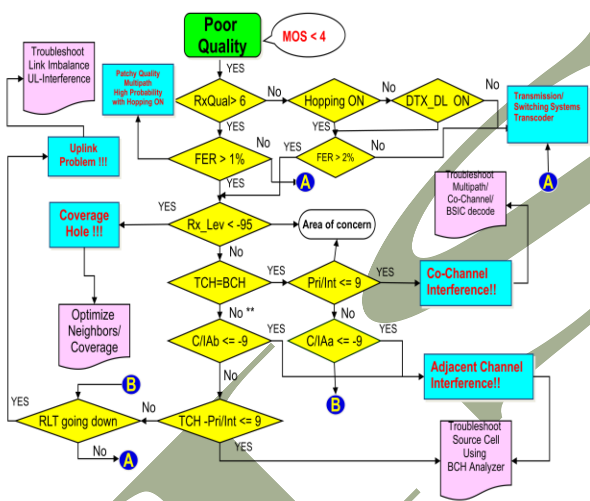

Fig 2:Flow Chart of Speech Quality Troubleshooting

If TCH is in Hopping, then all interference causes needs to be verified further, before concluding on the root cause and optimizing.

VI. 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.

Table 1:Represent Receiving Signal Vs Timing Advance Plot of testing BTS Cluster

Description	**Measured Results**						**Good/ Bad**
Change in Rx Level with distance	TA	> -65	-65 to -75	-75 to -85	-85 to -95	<-96	Good
	0-2	27663	17589	6778	259	0	
	3-4	275	395	414	93	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	

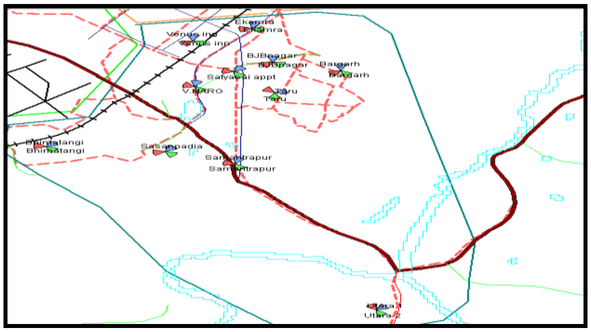

Fig 3: Plot of testing Represent BTS Cluster

VII. COVERAGE ANALYSIS

The coverage test measurements include the following parameters that are collected to as certain that the network quality and performance.

Description	Measured Results	Remarks
% of sample >-65 (dBm)	53%	
% of sample -65 to -75(dBm)	34 %	
% of sample -75 to -85(dBm)	12 %	Good
% of sample -85 to -95(dBm)	1 %	
% of sample < -95(dBm)	0 %	

Table 2: Rx Level Vs Samples

VIII. QUALITY OF SFH & NON-SFH NETWORK

Quality of Non-SFH network

Description	Measured Results	Good/Bad
95 % of samples should have RxQUAL equal to or less than 4	-- NA --	Good

Table 3: Represent Quality of Non-SFH network

Quality of SFH network

Description	Measured Results	Good/Bad
95 % of samples should have FER less than or equal to 2% or SQI should be better than 18	SQI --- 40 % FER --- 98 %	Good

Table 4: Represent Quality of SFH network

IX. DROP CALL RATE

Description	Measured Results	Good/Bad
Drop call rate should be less than or equal to 2%	0 %	Good

Table 5: Represent Drop Call rate During call forwarding

X. CALL SETUP SUCCESS RATE

Description	Measured Results	Good/Bad
Call setup success rate should be greater than or equal to 99%	100%	Good

Table 6: Represent Call Setup Success Rate after call mature

XI. BLOCKED CALL RATE

Description	Measured Results	Good/Bad
Blocked Call Rate should be less than or equal to 1%	0 %	Good

Table 7: Represent **Blocked Call rate if Call not Sucess**

Plots of Coverage Analysis

1. Rx Level.
2. Rx Qual.
3. SQI.
4. FER.

Rx Level plots

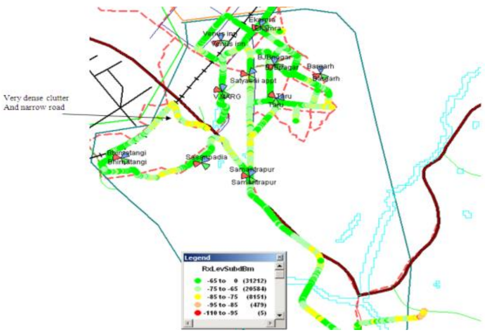

Fig 8: Represent plots of Rx Level Sub

Rx Qual Plot

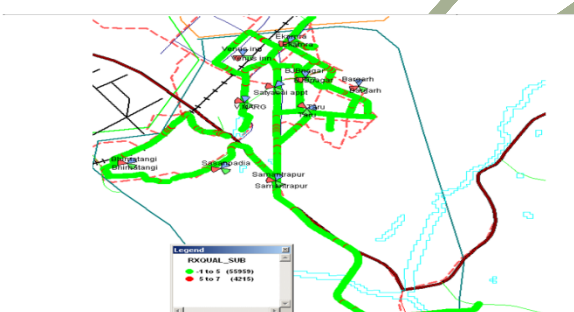

Fig 9: Represent plots of Rx Quality Sub

Speech Quality Index Plot

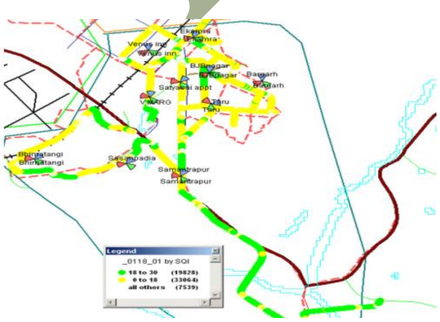

Fig 10: Represent plots of Speech Quality Index (SQI)

Frame Error Rate Plot

Fig 11: Represent plots of Frame Error Rate (FER)

XIII. CONCLUSION

BAD Spot 1 has poor quality and Call Drop, this spot is covered by Cell 47450, Poor Coverage. Level below -97 dbm , But Call should not Drop, the other Problem is Interference, 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, Channel 84 is also suffering from Interference, No Adjacent Channel on 84 and 99, This means there is Co-Channel on 84 also., It could also be multipath issue on 84.

XIV. REFERENCES

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