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Comparative Analysis of Different 3G GSM Network Sites

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Abstract: Paper includes the caparison between different GSM sites of mobile networks. 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. The features or parameters on the basis of Performance of GSM network can be as follows: 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.

Keywords:

I. INTRODUCTION

A cellular network or mobile network is a wireless network distributed over land areas called cells, each served by at least one fixed-location transceiver, known as a cell site or base station. In a cellular network, each cell uses a different set of frequencies from neighboring cells, to avoid interference and provide guaranteed bandwidth within each cell. The cellular frequencies are the sets of frequency ranges within the ultra high frequency band that have been allocated for cellular phone use. 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.

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 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 [1] [2].

Troubleshooting

Troubleshooting can be done on the basis of: Blocked Calls, Poor Quality and Drop calls, abnormal handovers, Interference, and Termination Failures. These are the real variables on which a call can be dependent.

II. BLOCKED CALL TROUBLESHOOTING

Let's read about some parameters where a call can be blocked or it can be said that on which a call can be blocked: Access Failures, SDCCH Congestion, SDCCH Drop, and TCH Congestion, A blocked call is a request that is rejected due to unavailability of resource. The best way of analyzing blocked calls, to identify the cause, is from a Layer III protocol log, it's a 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 which could be due errors in the Paging message [1] [2] [3].

Access Failure

Access is an ability of the user to access the system during busiest hour. Irrespective of the purpose, for any communication required with the network, a mobile sends a channel Request 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 [4] [5] [6]. 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

Network initiated drops means, sometimes a network do kill some processes to provide connection to some emergency subscriber calls. 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.

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.

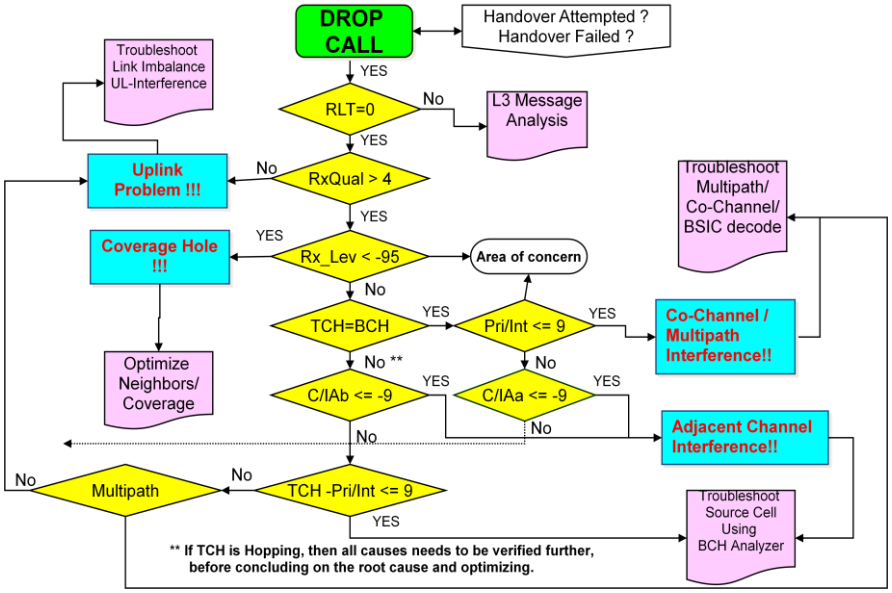

Fig1: Flow Chart of Dropped Call Troubleshooting

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.

Table 1:Represent Receiving Signal Vs Timing Advance

Description	Measured Results						Pass/ Fail
Change in Rx Level with distance	TA	> -65	-65 to -75	-75 to -85	-85 to -95	<-95	PASS
	0-2	13250	4327	317	0	0	
	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	

Rx- QUAL

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

IV. SPEECH QUALITY PARAMETERS

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.

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.

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.

Plot of testing BTS Cluster

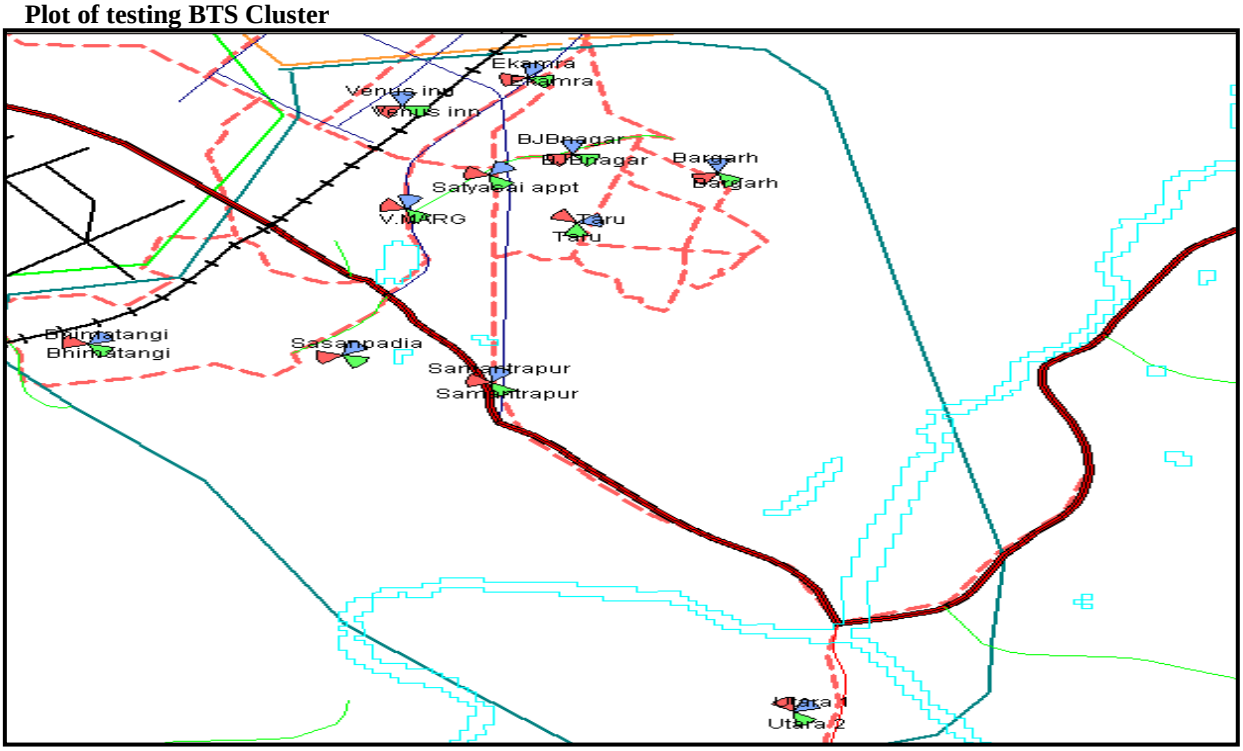

Fig 3: Plot of testing Represent BTS Cluster

Note: For Hilly Region TA consideration will be different

VII. COVERAGE ANALYSIS

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

Table 2: Rx Level Vs Samples

Description	Measured Results	Remarks/ Recommendations
% of sample >-65 (dBm)	74%	PASS
% of sample -65 to -75(dBm)	24%	

% of sample -75 to -85(dBm)	2%	
% of sample -85 to -95(dBm)	0%	
% of sample < -95(dBm)	0%	

VIII. QUALITY OF SFH & NON-SFH NETWORK

Table 3: Represent Quality of 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 4: Represent Quality of 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.

IX. DROP CALL RATE

Table 5: Represent Drop Call rate During call forwarding

Description	Measured Results	Pass /Fail	Remarks/Recommendations
Drop call rate should be less than or equal to 2%	0%	Pass	

X. CALL SETUP SUCCESS RATE

Table 6: Represent Call Setup Success Rate after call mature

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

XI. BLOCKED CALL RATE

Table 7: Represent Blocked Call rate if Call not Sucess

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

HOPPING C/I

Average C/I on hopping carriers = 19.0

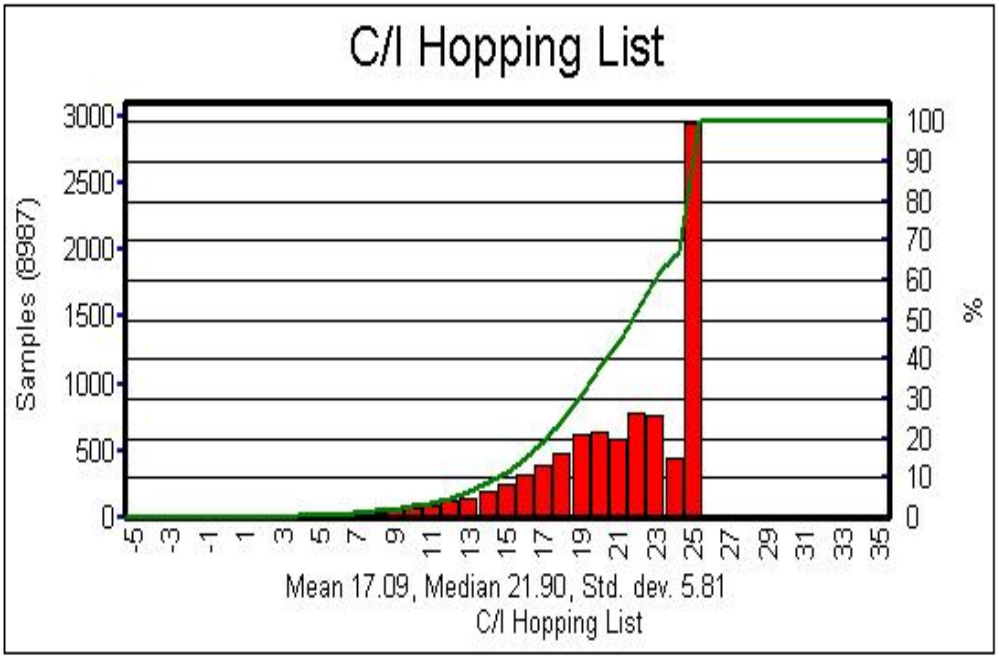

Fig- Represent C/I Hopping ListVs Samples Rate

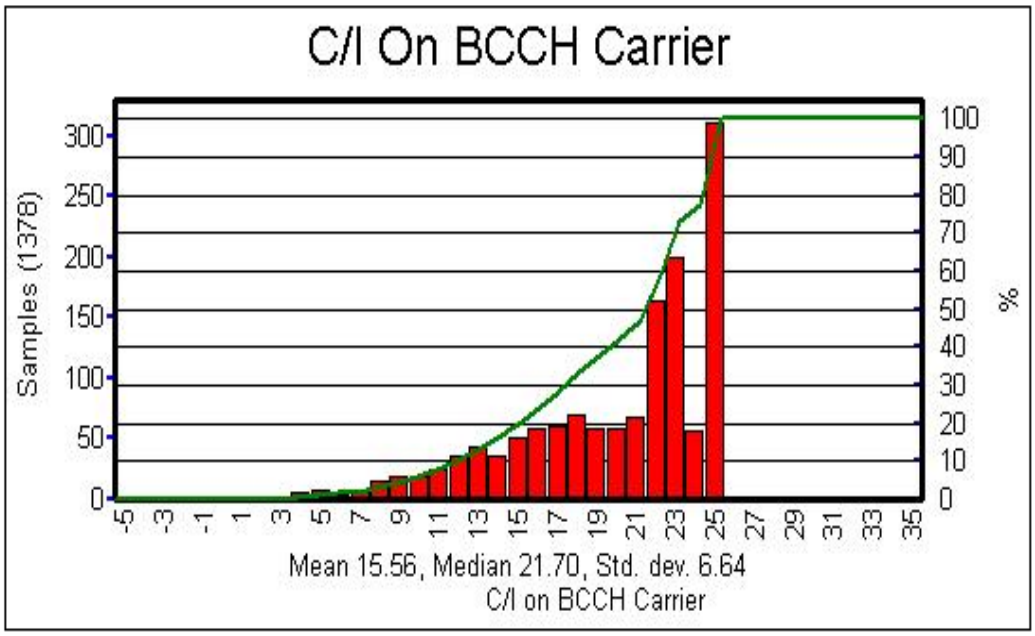

Fig- Represent Co-channel interference on BCCH CarrierVs Samples Rate

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

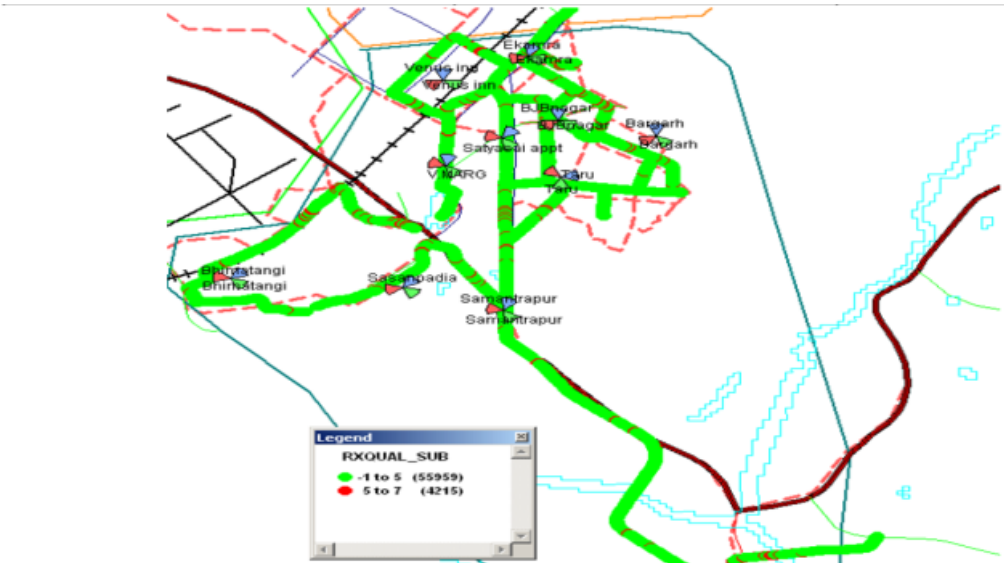

Fig 9: Represent plots of Rx Quality Sub

Speech Quality Index Plot

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

Frame Error Rate Plot

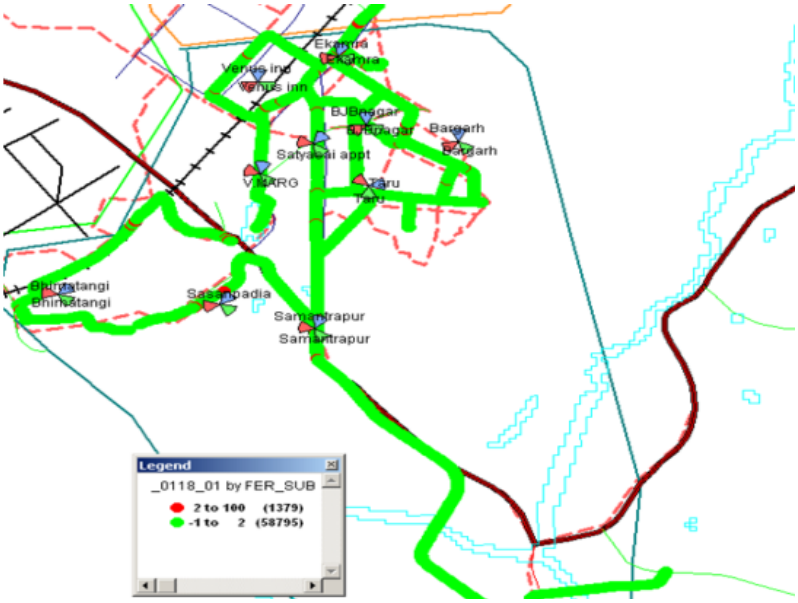

Fig 11: Represent plots of Frame Error Rate (FER)

XI. CONCLUSION

Different sites of 3G wireless mobile network has been analyzed on the basis of call drop troubleshooting and quality of calls. After analysis we have found that bad Spot 1 has poor quality and Call Drop, this spot is covered by Cell 47450, Poor Coverage. Level below -97 db, 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.

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