Minimization of the Radio Frequency Loss Call Drops

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ABSTRACT

This paper reports of study on minimization of the radio frequency loss call drops in a GSM Network of a well established firm in Colombo. This research progresses to find a solution for radio frequency loss call drops which customers complains most. In this paper first it will give brief introduction to the research. Then it will discuss the literature that supporting this research. Next research methodology will discuss. Then it will give how the necessary data was collected and how the analysis that has been done to these collected data. This research will give the way of minimization of radio frequency loss call drops. Finally discussed the recommendations and further research opportunities. Many research opportunities are available regarding call drops and their uses for the organization are discussed here.

KEY WORDS: GSM Network, Radio Frequency Loss Call

INTRODUCTION

This study was based on mainly minimizing the radio frequency loss call drops. Dropped call is the common term for wireless mobile phone call that is terminated unexpectedly as a result of technical reasons, including presence in a dead zone.

In pursuit of the idea and in order to make more profit and provide better service for customers,GSM Network Planning and Network Optimization is very important part.

There were many customer complain regarding call drops. If the company pay attention to them, they should be able to rectify the failures. Normally it is seen customers complain daily, on RF loss call drops. It is not good for the organization. So Minimization of RF loss call drops has been identified as a very important task.

The problem was first handled by the network and planning division. According to the RF planning engineer, they had received most of the customer complaints regarding call drops. The reputation of the company will be harmed due to this fact. Company gives priority for the customer. Their profit depends on customer base. Customers' ideas were taken by discussing with them. Most of the call drop problems are caused by RF loss. Considering these problems, a decision was taken to do a study to find out call drops due to RF loss and to minimize them.

It is essential to identify the main reasons for the RF loss call drops. And how, that effects to the company. There are number of reasons for call drops. This study mainly focuses to identify reasons and find solutions to minimize RF loss call drops.

LITERATURE REVIEW AND THEORITICAL BACKGROUND

In mobile communication, call drop means loss of call or interrupted call due to certain reasons after the Traffic Channel (TCH) is allocated Call drop, which causes a lot of inconvenience to users, is one of the faults that was complained most.

If network is not in a high quality, it can give rise to call drops.So many subscribers feel echo, unwanted sounds during a conversation. Recently their Caller Line Identification (CLI) is not working properly.

Call drops in GSM network can be caused by the following:

i) Equipment - GSM radios/Combiners can be causes of this. A Mobile Station (phone) can also be a cause.

ii) VSWR (voltage wave standing ratio) - VSWR caused by poor connections on feeders, water penetration, fault on antenna etc.

iii) Transmission problem - If transmission is not perfect, high B.E.R (Bit Error Ratio) or other factors causing inaccuracy of transmission.

iv).Interference - when there's frequency interfere (either co-channel or adjacent channel interference). Co-channel

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interference (CCI) is crosstalk between two different radio transmitters using the same frequency. Adjacent-channel interference (ACI) is caused by extraneous power from a signal in an adjacent channel.

v) .Hand Over - if hand-over between two sectors is not well defined.

Reasons for RF loss call drops

- There exist weak coverage area and radio signal is weak too.

- There exists interference, such as intra-network interference due to unreasonable frequency planning and other external interference, etc.

  - Intra-network interference, i.e. interference within the network.

- Unreasonable radio parameter setting

  -The cell's minimum access level is set too small, which causes Mobile Station call drop in weak coverage area.

- Unreasonable Frequency Hopping (FH) parameter setting.

Frequency hopping is the technique of improving the signal to noise ratio in a link by adding frequency diversity. The base station commands the mobile station to activate frequency hopping as the mobile station moves toward the edge of a cell or into an area of high interference. When frequency hopping is activated in the mobile station, the base station assigns the mobile station a set of RF channels, rather than a single RF channel. A frequency hopping algorithm is also assigned to the mobile and is used to inform the mobile the pattern of the available frequencies it has to use. In a GSM/GPRS/EGPRS network, frequency hopping is specified in individual cells based on the number of frequencies offered by a specific cell. The advantages that frequency hopping offers are:

I. Improved voice quality and prevention of dropped calls in GSM
II. Improved data throughput in GPRS and EGPRS.

- Unreasonable handover parameter setting, which causes mobile station (MS) unable to handover in time in the case of very poor call quality to improve antenna quality, thus call drop occurs.

- Equipment hardware fault, such as low output power of the power amplifier, large difference among different carrier transmission power, carrier transmitter fault, combiner fault, and divider fault, etc.

- Antenna feeder system fault such as,

- Two antennas in the cell have different inclination and azimuth respectively.

- Standing wave ratio (SWR) of antenna feeder is big.

-The SWR of an antenna is a measure of how efficiently radio is radiating the energy it produces when transmits. SWR meter is needed for check the Antenna feeder system fault.

- The signal level for an ideal call is,

  Transmit +43 dB
  Receive -60 ~ -80 dB

Some times while receiving call, due to path loss or shadowing, if receiving signal level is -95 dB, then call will be dropped.

During the site survey, site selection is very much important to avoid the effect of path loss and shadowing. During handover, if the interference from the neighboring BTS is too high the call might be dropped.

- Sometimes Slow Associated Control Channel (SACCH) and Fast Associated Control Channel (FACCH) signaling channels are not available to provide a TCH channel. In that case call might be dropped.

-The full rate channel in GSM is identified as a 22.8Kbps gross bit rate channel. This channel is bidirectional enabling the transfer of speech or circuit switched data. Signalling associated with this traffic channel will be carried on either the SACCH or the FACCH. The latest releases of GSM include Enhanced Data rates for Global Evolution (EDGE) functionality which increases the gross rate.

- Sometimes it might happen that MS is too far from the center of base transciever station (at the cell boundary). At that time, it might face problem to make a call as the transmitted signal. (Signal from MS will not reach BTS).

RESEARCH APPROACH AND METHODOLOGY

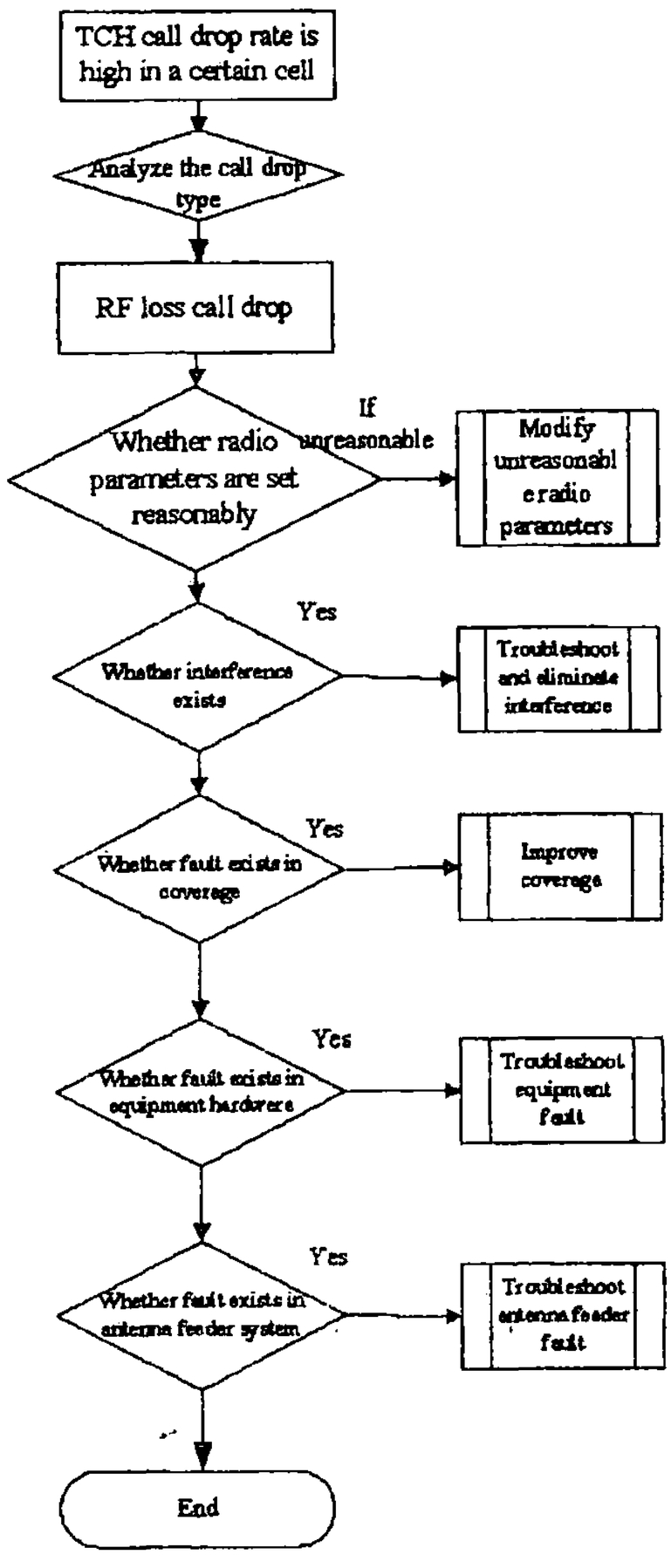

Figure 1 Flow chart of minimizing RF loss call drops

In the case of RF loss call drop, it is advised to handle the problem in the following steps:

i). Check radio parameter setting and modify unreasonable radio parameter setting.
ii). Check indices such as B.E.R and idle interference band grade to reduce radio interference.
iii). Check if there exists coverage problem through drive test. Especially troubleshoot hardware fault for cell with weak coverage; and especially troubleshoot power parameter, handover parameter, and antenna lower inclination for cross-cell coverage.
iv). Troubleshoot the equipment hardware fault. Replace the faulted boards.
v). Check the antenna feeder system and replace or trouble shoot the faulted part.

DATA COLLECTION & ANALYZING

This research was carried and with the primary data collection strategy. Primary data were collected by interviewing and providing a data collection sheet. Interview was conducted with the RF planning engineer of the company and main factors were identified.

Interviews & Questionnaires

The following questions were asked by personnel in the department.

I. What are the items maintaining/repairing?
II. What are the causes, is it a hardware problem, factory fault or software problem?
III. What suggestions to minimize this problem?
IV. Should the part be replaced or could repair in most of the cases?

From these interviews the main factors were identified. After identifying those factors, data collection sheet was prepared with the intention of doing a survey within that selected period.

Details of Data Collection

Data were observed from visited sites.Five sites were selected for preparing data collection sheets. They are, Maharagama Town, Dehiwala, Pepiliyana, Gangodawila and Makumbura. Measurement reports were used to obtain data.

Operation and Maintenance Centre (OMC)

In mobile networks, OMC is the central location to Operate & Maintain the Network. Measurement reports available In Operation and Maintenance Centre (OMC-R).

User Label	Object	data time	TCH call attempt total number	TCH dropped call total number (RF loss)
Maharagama	Bsc5-Site3	0:00-1:00	428	11
Dehiwala	Bsc5-Site27	0:00-1:00	377	5
Pepiliyana	Bsc5-Site28	0:00-1:00	908	9
Gangodawila	Bsc5-Site32	0:00-1:00	511	23
Makumbura	Bsc5-Site2	0:00-1:00	364	4

Table 1: Format of part of the performance report.

Data Analysis Strategy(s)

First the observed data were analyzed. Then TCH RF loss call drop rate Vs time were plotted for each sections.
The following equation was used to calculate TCH RF loss call drop rate.

$$\text{TCH RF loss call drop rate} = \frac{\text{No. of RF loss call drop}}{\text{No. of TCH call ttempt}} \times 100\ \%$$

Call drop rate were calculated for 0.00 to 24.00 hrs.

User Label	Object	time	Call drop rate (%)	Calll drop rate (%)	Call drop rate (%)	Call drop rate (%)	Call drop rate (%)
Maharagama	Bsc5-Site3	0:00-1:00	3.1	0.9	2.7	3.5	5.0
Maharagama	Bsc5-Site3	1:00-2:00	0.9	2.7	0	6.9	2.1
Maharagama	Bsc5-Site3	2:00-3:00	0	0	2.5	3.8	4

Table 2: the call drop rate in Maharagama town.(for 5 days in 0.00 to 3.00 hrs)

Basic concept of Frequency Planning

- The following equation is used to estimate frequency reuse distance:

$D = 3N * R$
D - frequency reuse distance
R - cell radius
N - frequency reuse factor.
N=9 for "3 × 3"
N=12 for "4 × 3"
For "3/9" frequency reuse, D=5.2R
For "4/12" frequency reuse, D=6R

"4 × 3" frequency reuse pattern is that each site is divided into 3 sectors. 12 frequencies form groups which are distributed to 4 different sites. Each site owns 3 frequencies.

"3 × 3" frequency reuse pattern is that each site is divided into 3 sectors. 9 frequencies form groups which are distributed to 3 different sites. Each site owns 3 frequencies.

Principle of frequency planning

- The frequency in same site can not be reused.
- In same cell, the frequency distance between broad cast control channel (BCCH) and TCH is at least 400 kHz.
- The frequency distance of TCH should be more than 400 kHz if frequency hopping (FH) is not adopted.
- Frequency can not be reused in its directly adjacent sites if it is not 1*3 patterns.
- Try to avoid using the same frequency when the two sites are relatively near.

RESULTS AND DISCUSSION

The figure 2 shows the RF loss call drop rate before checking radio parameter setting.

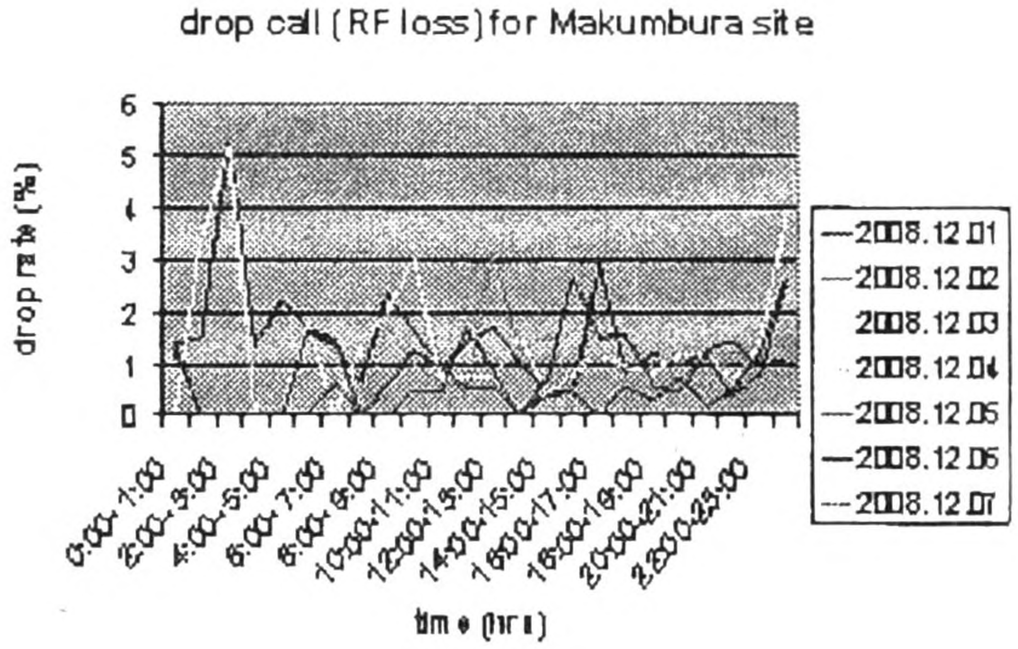

Figure 2 The graph of drop rate Vs Time

According to the graph, in several occasions RF loss call drop rate exceeds **1.5 %** mark. It is the standard in telecommunication field. That amount should be reduced. RF loss call drop rate varies between 0 and 5.49 %.

- In the case of RF loss call drop, to minimize the problem the following steps were taken:

1. Checked the radio parameter setting and modified unreasonable radio parameter setting. (Used TEMS software.)

2. Checked if there exist coverage problem through drive test. (Used GPRS technology).

3. Troubleshoot the equipment hardware fault and replaced the fault boards.

4. Checked the antenna feeder system and troubleshoot the faulted part.

- Comparisons of frequency points before and after modification are shown in following table 3.

This result clearly shows that the difference between before and after modification frequency points. It clearly shows reduction of the RF loss call drop rate after modification. Data were obtained from 9.00 a.m - 10.00 a.m for each day.

Before modifying frequency points

Date	Site name	Total RF loss call drop (TCH)	No. Of TCH call attempt	RF loss Call drop rate of TCH (%)
2008-12-01	Makumbura	66	1161	5.68
2008-12-02	Makumbura	32	870	3.67
2008-12-03	Makumbura	42	1038	4.04
2008-12-04	Makumbura	53	1153	4.59
2008-12-05	Makumbura	29	842	3.44

Table 3: Comparison of Frequency points before and after modification.

After modifying frequency points

Date	Site name	Total RF loss call drop (TCH)	No. Of TCH call attempt	RF loss Call drop rate of TCH (%)
2008-12-06	Makumbura	4	1057	0.37
2008-12-07	Makumbura	4	865	0.46

Table 4: Comparison of Frequency points before and after modification.

CONCLUSION

Experiencing too many dropped calls is a common customer complaint received by wireless service providers. They have attempted to address the complaint in various ways, including expansion of their home network coverage, increased cell capacity, and offering refunds for individual dropped calls. A great amount of money and time is invested by wireless operators in order to improve the network quality of service (QOS) to acceptable values. Dropped calls along with congestion are the two most important customer perceived problems that affect the quality.

There is high competition among Telecommunication firms today. They always try to provide good service for the customers. By minimizing RF loss call drops, reputation of the company is increased. This study helps the organization where the training was carried out to join this new trend. It costs very less and useful one. This study was carried out to minimize radio frequency loss call drops on the basis of customer complains.

While doing this study another two types of call drops were identified. They are,

- Handover failure call drop.
- LAPD link broken call drop.

Due to time limitation they were unable to handle. They are very useful for minimizing call drops. As a further study this type of call drops can be examined.

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