Chapter 7

Optimization of Mobile Network

Optimization of Mobile Network

1. Introduction

In a fiercely competitive environment, a good Quality of Service (QoS) is a competitive advantage for a service provider. QoS can be characterized, by such factors as contiguity of coverage, accessibility of the network, speech quality and number of dropped calls. Service providers have to continually strive to improve QoS in order to retain the customers.

In a mobile network customers may face any unwanted situations like call drop, one way talk, echo, access failure, mute etc due to interference and inaccurate parameter definitions & that may cause subscriber dissatisfaction. To overcome these situations optimization of GSM network is required. So the optimization is a continual process for improvement of QoS of the network.

2. Optimization Process-

Optimization is an important step in the life cycle of a wireless network and is an ongoing process. The important steps in the network optimization process are-

1. Data collection for network problems.
2. Analysis of Data for identification of reasons for network problems.
3. Taking actions for resolving network problems.
4. Again checking the QoS and going back to step 1.

The primary tool used by most service providers to solve network problems is a drive-test system. A conventional drive-test system is comprised of a test mobile phone, software to control and log data from the phone, and a Global Positioning System (GPS) receiver for position information. A test mobile gives a customer's view of the network, but can only indicate the type of problem that exists. It cannot show the cause of the problem.

The Optimization process using Drive Test Tool is illustrated in the diagram below-

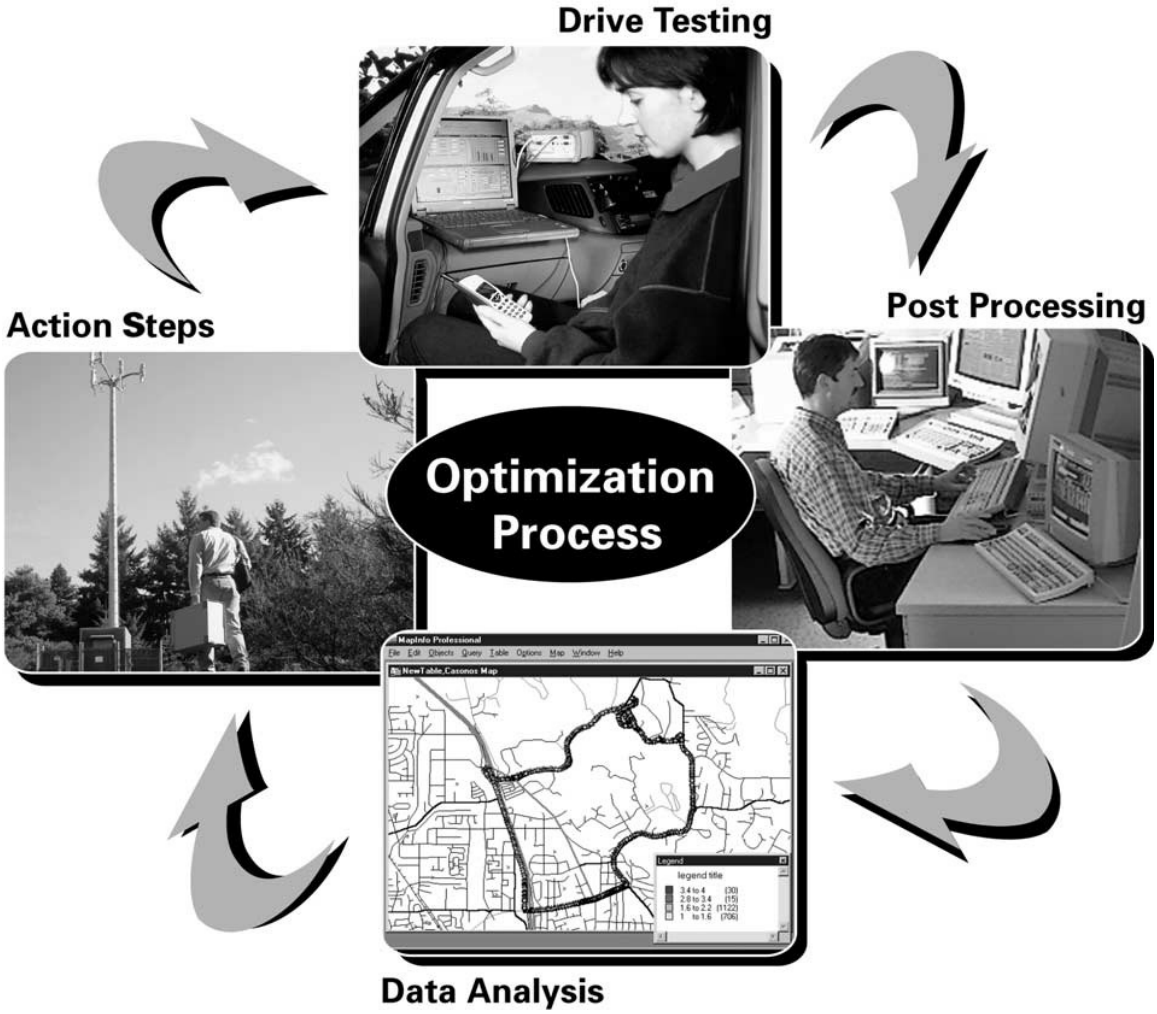

Figure 1 – Optimization process using Drive Test Tool

A GSM cell will have one or more carriers depending on mobile traffic requirements. One of the carriers in the cell is configured as a Broadcast Channel (BCH) carrier. Timeslot 0 of the BCH carrier is dedicated to several logical control channels, including the Frequency Correction Control Channel (FCCH), Synchronization Channel (SCH), Broadcast Control Channel (BCCH) and Common Control Channel (CCCH). These logical channels are used by the mobile when it camps on a cell, and also for establishing calls. All other carriers in the same cell are referred to as Traffic Channel (TCH) carriers.

A key difference between BCH and TCH carrier is that a BCH carrier has continuous transmission at a constant power on all timeslots, whereas a TCH carrier has bursty transmission with power levels that can be different in different timeslots.

3. Inputs for optimization-

Inputs for optimization come from

1) **QOS Parameters**:- QoS parameters like Call Success rate, Call Drop Rate, Handover success rate etc. are indicators of the Network Quality. These parameters have to be continually monitored at cell site, BSC and Network level. If any abnormality is observed or if any deterioration is seen in any of the parameters optimization process has to be initiated.
2) **OMC alarms**:- Any problem in the Network results in a alarm at the OMC. Whenever an alarm is observed at the OMC it must be carefully analyzed to determine if there is a network problem and if it is required to initiate optimization process.
3) **Routine Drive Testing:-** coverage plots, Quality plots generated from drive test may indicate whether optimization is needed or not
4) **Customer feedback**:- These information are used to target areas requiring optimization and to verify coverage against the RF design.

4. How to perform Optimization of GSM network

For optimization of GSM network Drive test are performed. Reports generated by making calls during drive test are recorded with location data in the attached laptop.
System generated OSS reports are very useful and are analyzed using optimization tools like Netact Planner, Planet to give insight into network problems.

Equipment Necessary for Drive testing are

a) Vehicle,
b) AC Power Arrangement.
c) Drive test mobile phone (e.g. Ericsson TEMS),
d) GSM Receiver
e) External vehicle mounted GPS,
f) Laptop with drive test software and GPS connection capability.

A GSM receiver provides several capabilities, including independent network analysis, faster scanning, spectrum analysis, interference management, CW and channel power measurements.

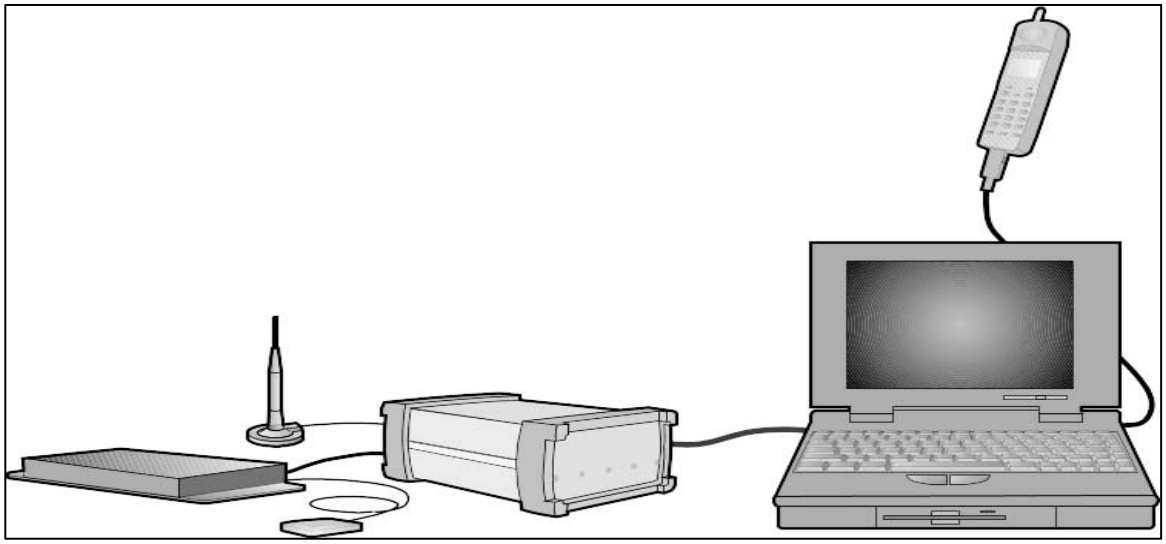

Figure 2 - Integrated drive-test solution consisting of a digital receiver and phone. A GPS receiver provides location information.

Some vendors provide Network Health reports which provide you list of bad performing sites with poor sites and possible causes for the problems.

One powerful tool provided by all operators is the call trace tool. This feature enables us to put a trace on a call and collect all data related to the call Through this call trace we can accumulate data for call being made throughout the cell - indoor and outdoor environment – to gives us the correct picture regarding the performance of a cell.

Protocol analyzer is also used to analyze the SS7 and LAPD signaling messages between the MSC, BSC and the BTS. It may indicate the problems which may originate either in the Radio part or the MSC e.g. paging problems etc.

5. Coverage Plot – RXLEV and RXQUAL-

A coverage plot of a service area is obtained by placing the test mobile of the drive-test system in the idle mode and driving through the service area measuring the received signal level (RXLEV). RXLEV is then plotted against GPS information to obtain a coverage plot.

GSM phone-based coverage measurements alone often do not show the complete picture of coverage contiguity. This is because of the way a phone operates and the rate at which measurement samples are taken. A network-independent digital receiver, when combined with a phone-based tool, can provide more complete and accurate results.

A GSM mobile phone's receiver is not always on in the idle mode, due to the use of Discontinuous Reception (DRX). With DRX, a mobile phone will only turn on its receiver during its paging group, and will also measure the neighbour cells' RXLEV in the same period. It will also turn on the receiver when it is decoding the Broadcast Control Channel (BCCH).

Quality of the received signal (RXQUAL) is a key parameter for evaluating network performance. RXQUAL is the Bit Error Rate (BER) derived from the 26 bits midamble on the TDMA burst. RXQUAL levels characterize speech quality and dropped calls, where 0 indicates the highest quality and 7 the worst. If we are doing a drive-test in a trouble zone with a phone, we can easily locate poor quality spots by monitoring RXQUAL. However, we may want to identify the cause of poor RXQUAL. RXQUAL can be poor because of poor RXLEV (coverage), low carrier-to-noise ratio (C/N), co-channel interference, adjacent channel interference or multipath. A phone-based system will report RXLEV, but will not provide adequate information about the other potential problems.

If RXQUAL is poor and RXLEV is good, then it is generally assumed that the cause is interference. However, interference can exist in several forms, including co-channel, adjacent channel, multipath and external.

6. Optimization Solutions

Once the problem has been analyzed a solution has to be provided. Common solution to problems are

1) **Database Parameter Changes**
   Many problems can be solved by changing some database parameters like Handover parameters and thresholds, Maximum transmit power of BTS, Paging parameters, SDCCH Parameters,
2) **Antenna Orientation and Height Adjustment -**
   This includes changing of antenna height, tilts, orientations, positions. Sometimes the antenna may also be changed.
3) **Frequency Changes**
   Frequency changes help us to control the interference in the network.
   However one should be careful when doing these changes so that this changes do not affect the other sites adversely. If there are a lot of changes it is advisable to change the whole frequency plan. A careful study of cell coverage area and server area helps in making those changes.
4) **Neighbour List Updating**
   Many problems arise due to wrong neighbor definitions or missing neighbors. Neighbor definitions must be reviewed on a regular basis. Statistics and drive tests provide good inputs for this purpose.
5) **Formation Of New Location Areas**
   Sometimes to solve paging load problems it might be required to for new location areas.
6) **Addition of new cell sites**
   Sometimes to solve coverage hole problems we need to add more site (normally micro or pico cells) or splitting of the existing cell sites is required. Special In-Building Solutions (IBS) may be required to fill the coverage holes.

Review Questions-

1. Explain the need for optimization of mobile networks.
2. Mention any five factors that constitute QoS of a mobile network.
3. Briefly explain the Optimization process.
4. What are the main components of a Drive Test system ?
5. What are the limitations of a phone only Drive Test Tool ?
6. What is meant by an Integrated Drive Test Tool.
7. Explain RXLEV and RXQUAL.
8. What type of Drive Test Tool is required to have a correct assessment of RXLEV coverage?
9. What could be causes for poor RXQUAL?
10. What are the commonly adopted Optimization Solutions ?

xxxx