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Research Article

ALLOCATION AND BANDWIDTH OPTIMIZATION IN MOBILE COMMUNICATION NETWORK

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ABSTRACT
In today's world of high technology telecommunications is used a lot and this is undoubtedly due to the portability and ease of use of this human made achievement. Of all links Contacts portable, wave distribution has great impact on its performance. To obtain a safe telecommunications link must be sure to simulate the scheme before executing. The purpose of this study is to examine the frequency spectrum in Mobile communication network and to enhance the network parameters after appropriations operations and frequency optimization. To do this hopping techniques are dealt with; also newer and sufficient techniques will be presented and applied as well. To do this hopping a brief introduction of the network is required and hardware and network diffusion patterns which play a vital role be introduced. And then according to the Optima, Asset and kpi Software files Network parameters including Erlang, talk traffic channels and Data, traffic signaling channels, the percentage of disconnected calls, Percentage of HO and Important indicator of CCC be analyzed and their dispute with international standards on the mobile network will be assessed. Satisfaction of Statistical population (at least 000/000/40 persons), which are the first mobile network subscribers, is the ultimate goal of this research. Outlook to future operators which move toward to use the frequency spectrum efficiency and achieve greater bandwidth and the economic justification (financial, Person) will be concluded at the end.

Keywords: *Frequency Hopping, Erlang, Hopping, Asset, Optima, HO*

INTRODUCTION
Before getting into this GSM network it is needed to briefly mention the reason that this subject has been chosen for this research. Theoretical performances will be forgotten over long time and become unusable and rarely occurs that a presentation in long time reach a desired outcome and mostly it will be archived rather than being dynamic.
However, practical application has specific dynamics, so based on my personal interest this type of research is presented in Way for more future research and Most people find it desirable in terms of economic aspects And I believe that it will be developed more in the future, if available since it is one of the newest topics in the world of communication (Mahsa, 2011).

GSM Network Architecture
GSM Network is a digital cellular communication system that started to work with the idea of cellulosing the geographic area and frequency rues [1] and covering a geographic area by the cell. Cellular mobile network because is used by subscribers of mobile phones which are usually in land is called "Public Land Mobile Network" (PLMN [2]).
Frequency rues technique is used considering the lowest frequency interference in GSM Due to lack of frequency and bandwidth.
GSM Network is divided into four main parts, namely:
MS [3] Mobile Station
BSS [4] Base Station Subsystem
NSS [5] Network Switching Subsystem
OSS [6] Operation and Support Subsystem
MS (Mobile Station)
MS includes two main parts:
- Mobile Equipment (ME [7]) SIM card or Subscriber Identity Module SIM [8]

- Subscriber (MS) is capable to do speech and data services by phone. ME is identified by IMEI [9] and IMSI code [10] is used for SIM to identify the subscriber.

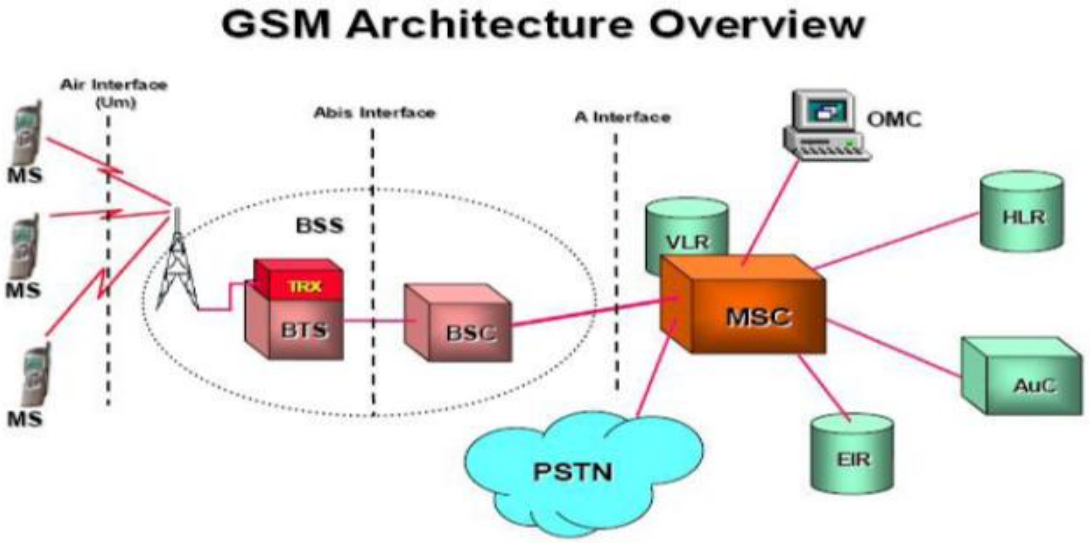

Figure 1: GSM Network Architecture

[1] Frequency Reus
[2] Public Land Mobile Network
[3] Mobile Station
[4] Base Station Subsystem
[5] Network Switching Subsystem
[6] Operation and Support Subsystem
[7] Mobile Equipment
[8] Subsciber Identity Module
[9] International Mobile Equipment Identity
[10] International Mobile Subscriber Identity

BSS

This section's task is entrusted with the radio system and controls MS radio communication. It is formed of two parts of BSC and BTS and applies interface Abis between BSC and BTS and also applies interface A between BSC and MCS.

BTS

BTS is responsible for radio communication with the mobile unit as well as the exchange and control of information with BSC. A BTS Includes independent transceivers that provide air and radio communication with mobile units and BTS is the smallest Single service provider in the mobile radio network which can cover a certain area of the network called with radio wave and each BTS can arrange from one to six TRX due to the density of subscribers in a cell. Usually for each BTS Due to its design of cover three sectors can be considered.

Major Tasks of BTS Include

- Frequency Hopping
- Encrypting and decrypting data on the radio path
- Empty traffic channel quality report
- Send directly measure the power of MS to BSC
- Co-operation between the MS and Related BTS
- clarifying the train of pulses received from apparent random access different MS
- Management line signaling between BSC and MS
- Implement and enforce coding bit rate transmission

Physical and Logical Channels in GSM

Physical Channel and its Characteristics

For a combined channel time slots and frequency of physical channel in order to uplink and downlink is considered. Each physical channel in GSM system can be mapped at different times of the different logical channels. Time duration of each frame is 4.654 ms, which is divided into 8 time slot that each of these time slots are used by independent user. Time duration of a direct channel is 577 micro-seconds that is fully demonstrated in figure (1-7), every physical channel carries data and control traffic in the form of Burst (John, 2010).

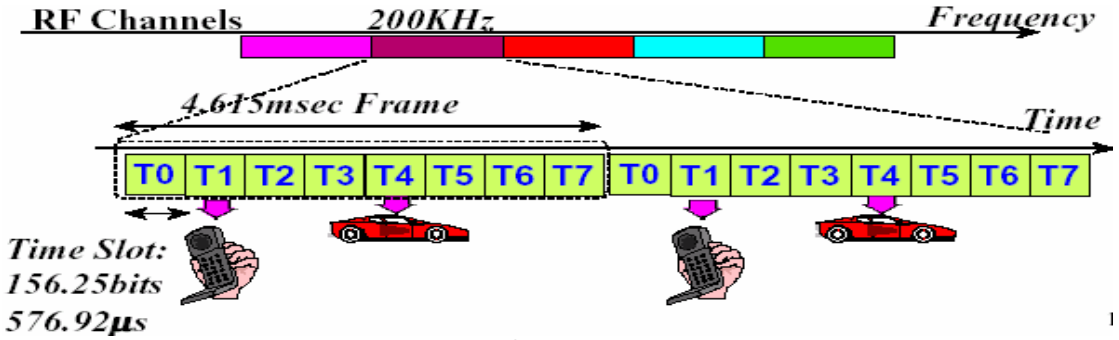

Figure 2: The image of time slots in physical channel

Pulse train is the information sent during a time slot.

Logical Channels

Based on the functions that are performed by the canals, channels are divided into two types of logical channels.

- Traffic channel (TCH)
- Control channels (CCH)

Traffic Channels (TCH)

Traffic channels are divided into two major categories of speech and data channels that each of them is divided into two types of message based on sending rate.

Full bit rate (FULL RATE)

Half the bit rate (HALF RATE)

Control Channels (CCH)

These channels are used for the transmission of signaling information or for synchronization and are divided into three categories:

[1] Uplink & Downlink

[2] Control Channel

- Broadcasting Channels (BCH)
- Common Control Channels (CCCH)
- Dedicated Control Channels (DCCH)

Broadcasting Channels (BCH)

These channels are divided into the following three categories:

- Frequency Correction Channel (FCCH)
- Simultaneous Channels (SCH)
- Branch Channel (BCCH)
- Mahsa Memarzadeh-(201)

Propagation Models

Calculating the power of a signal received by a mobile phone is not easy. Often mobile phone receiver cannot see the base station and the signal strength is largely determined through reflection (which is also called scattering) and fracture. Various environments facing radio waves mean that the distance between the base station and the mobile phone is not the only parameter influencing the path loss. Engineers have

different methods through which they can calculate the path loss with speed and accuracy. It is vital that engineers chose a method to calculate the confidence before designing network. (watten hofer,2010)
Why do we need a propagation model?
Mobile telecommunication is made of multi-path propagation.
Radio frequency is analyzed, refracted and weakened.
Propagation model calculates the loss path between sender and receiver.
Propagation model is necessary to calculate the power requirements power budgets.
It is a model used for setting up and optimizing a system after that.

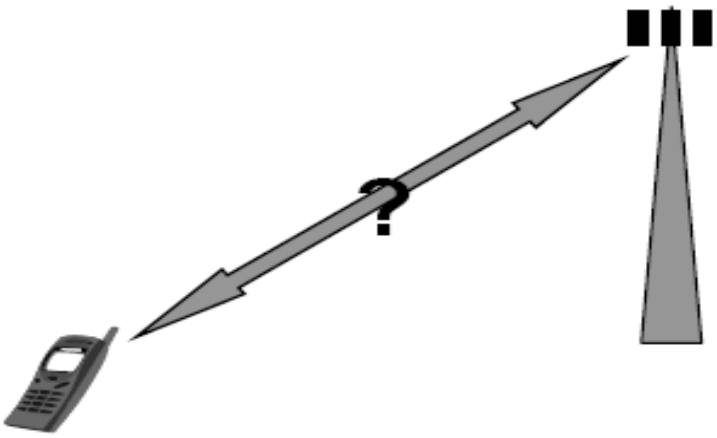

Figure 3: Flat surface model Plane Earth Mode

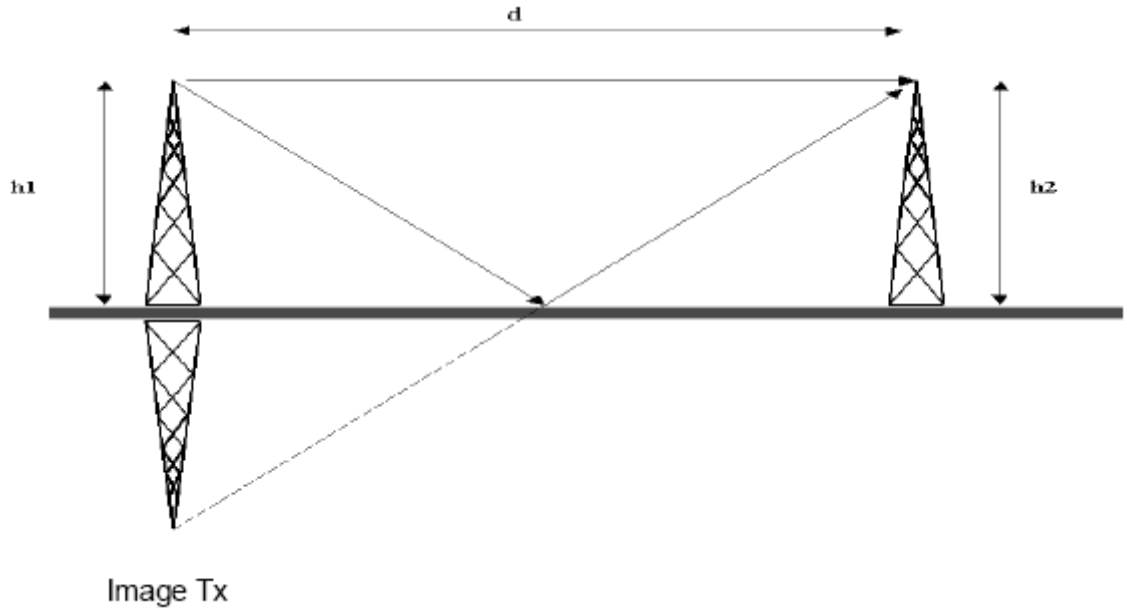

Figure 4: Extended Signal strength through a reflection

Signals in Rx May have constructive or destructive interference at different levels that are dependent on the following parameters: antenna height (h1, h2) distance relationship d, wavelength, the reflection coefficient of the ground, the simplest model to consider reflections is known as a flat surface model that directly calculates the sum of the received signal and the signal reflected from the flat surface of the earth. Relevant input parameters include antenna height, length, operating frequency and reflection coefficient of the ground (Watten, 2010).

Diffraction Effects

Sometimes earthly obstacles block the path to the Line of Sight (LOS) between the base station and mobile. Effectiveness of a barrier depends on the following factors: the amount of the line of sight path which is blocked by an obstacle, the obstacle distance to the end of the path on both sides, and also the frequency of operations. Four parameters can be expressed in terms of a parameter which can be expressed as Fresnel. Fresnel region defines a three-dimensional ellipse in space. If you connect from anywhere on the end of each level Ellipse, distance of half a wavelength is more than the total distance of a straight line between the two end. Radius of the ellipse is the radius of the first Frensel (lmrich, 2010).

Frequency Planning Theory

Interference

Definition of C / A: ratio of signal intensity between adjacent carrier to distributor carrier, and an adjacent carriers is defined. Ratio is calculated by the following formula:

(dBm) Adjacent Signal intensity - (dBm) Signal intensity

Distributor = C / A (d B)

Adjacent carriers can be placed in both sides of distributor carrier and in various indices. These indices represent the number of offset ARFCN of a carrier.

GSM Requirements

GSM index 05:05 regulates performance requirements of C / A on a GSM mobile phone in terms of non-compliance adjacent channel. Indeed, these traits show that to what extent an adjacent carrier without interference from distribution carrier because of absence of recipient filter can be strong. If the power level on the adjacent carrier is too high, filter cannot eliminate all the power and that will be shown as interference in a receiver which distributes distributor carrier's signal (Ecomara and Hata, 2011).

Frequency Reuse and Reuse Patterns

Frequency re-use means the use of radio channels on the same carrier to cover different regions which are separated by appropriate intervals to reduce the common channel interference. These would be possible due to the characteristics of the radio environment in which the average power received from a transmitter anywhere is weakened and based on this fact distance separation power is between the sender and receiver (Brid, 2011).

This can be expressed by the following equation:

$$P_r = p_0 \{\frac{d}{d0}\}^{-n}$$

Signal-to-interference Ratio

Signal-to-interference ratio (SIR or S / I) is defined to express co-channel interference with frequency reuse. This ratio is the ratio of desired signal power to the sum of power of the signal and the common channel interference. These ratios can be obtained from following equation:

$$SIR = \frac{S}{\sum_{i=1}^{C} Li + N\,o}$$

Multiple reuse patterns**:**

Multiple reuse patterns (MRP) is the way to achieve maximum capacity, using close frequency reuse and frequency hopping.

This method can be applied to different clusters, each associated with a reuse distance. This method uses FH in order to combine in a medium cluster. The medium cluster has more capacity than a primary cluster (larger). It also has greater reuse distance than the other clusters (smaller). (prof.bird,2011)

Spectrum Efficiency

Spectrum efficiency is defined in terms of traffic, which can be transferred by a given frequency in a particular area, and therefore it can determine how effective the use of frequency spectrum is.

$$\text{Spectrum –Efficiency} = \frac{Traffic}{Area * used\_Spectrum}$$

Spectrum efficiency is: [ERL / km2 x MHz]

Considering the density of the site, spectrum efficiencies can be used to compare different operators' network design (Qiang, 2010).

Interference Reduction

By Applying the Selection Process

- Frequency Hopping
- Power Control (dynamic)
- VAD / DTX

By Optimizing Physical and Database Parameters

- Selecting the appropriate base station sites (so far during the planning phase)
- Fine tuning of the antenna (elevation, slope and axis)
- Changing the type of antenna (reducing the width of the beam)
- Optimization of Limiting parameters of output power
- Optimization of controller parameters of regions posts
- Optimization of the frequency plan (Ecomara and Hata, 2011).

Frequency Hopping

Using frequency hopping (FH), a user is displaced from one carrier to another carrier within an existing group of Frequency. Frequency hopping is well known and helps to improve immunity against interference. Frequency hopping is used to reduce the effects of Raily. And it is also used to increase frequency diversity and decrease C / I.

During s hopping, the mobile station (MS) does not excessively remain on fluctuation of the peak. Hence, the final result of the rapid attenuation is decreased. Moreover, because each frequency has a different level of interaction spaces of different frequencies and in different times when hopping Interference is disrupted by all channels, and consequently the probability that a user face an unacceptable amount of interference is decreased (Qiang, 2010).

Frequency Planning and Introduction GSM Features and Their Utilization in Order to Optimize

Given the importance of the fourth season, it appears to me important to simplify main content, although they will be explained later again and now they will be understood better.

Cell: The smallest radio unit that includes a number of TRX.

Site: Every three adjacent cells covering 360 degrees constitute a site.

Cluster consists of a number of sites (cells) that all licensed frequencies of network have been used in it once.

Example: $\frac{3}{9}$ Pattern : each cluster consists of Site 3 sites and 9 cells.

Pattern $\frac{4}{12}$: each cluster consists of 4 sites and 12 cells.

C/I: signal strength of the confinement frequency interference from other cells.

Frequency Reuse: To increase network capacity (with a fix bandwidth), putting similar clusters aside (frequency repetition) the entire city is covered with radio frequency, thereby network capacity is increasing depending on the number of clusters.

For a given surface area, the more the number of the clusters the more will be the network capacity. And so under this condition size of the clusters and cells should be decreased. If using various methods we can reduce the level of interference number of cluster size can also be reduced so costs are lowered (Nokia, 2010).

Optimization and the Algorithm of Optimal Process

What is Optimization?

Purpose of optimization is ensuring optimal network performance within the standard of practice in Quality of Service (QOS) which is already defined.

An optimized network is obtained by applying procedures to solve problems that are determined by the analysis of parameters monitored by the Performance Management (Performance Management).

The main reasons that optimization process must be done in the networks are as followed: (Aircom, 2010).

Maintaining or increasing the quality of service in current position

Efficient use of available resources instead of increasing the resources that are added to a network without operating
Network problems solving and response to public complaints
Attract new customers through provide better services

Optimization Purposes

The main purpose of network optimization is increasing the total quality of the current mobile network. This increase in quality comes with the following items.
Identify network problems through KPI analysis (Key Performance Indicator)
Separation of sources that have low performance
Correct identified problems using optimization methods which are summarized in the following sections
Ensuring about the network performance that it's Quality of Service (QOS) should be above standard level.
Designing a network with high quality and efficiency that enables us to develop high-quality network with minimum resources (Watten, 2010).

Optimization Reasons

One reason is to correct identification of the network with low efficiency and lack of efficacy. Like parts of the network that has Drop call Or Handover Fail or Tch or high congestion and using the optimization algorithm they will reach to an acceptable level and standard GSM.
Preparation for the implementation and execution of new service
Network efficiency to achieve business requirements and competition
Implementing measured changes in the operating parameters of the network (Watten, 2010).

Network Performance Management Cycle in Optimization Process

Optimization process as shown in Figure (5) reveals that basic processing functions are performed by the management of each of these sections which will be explained in detail.

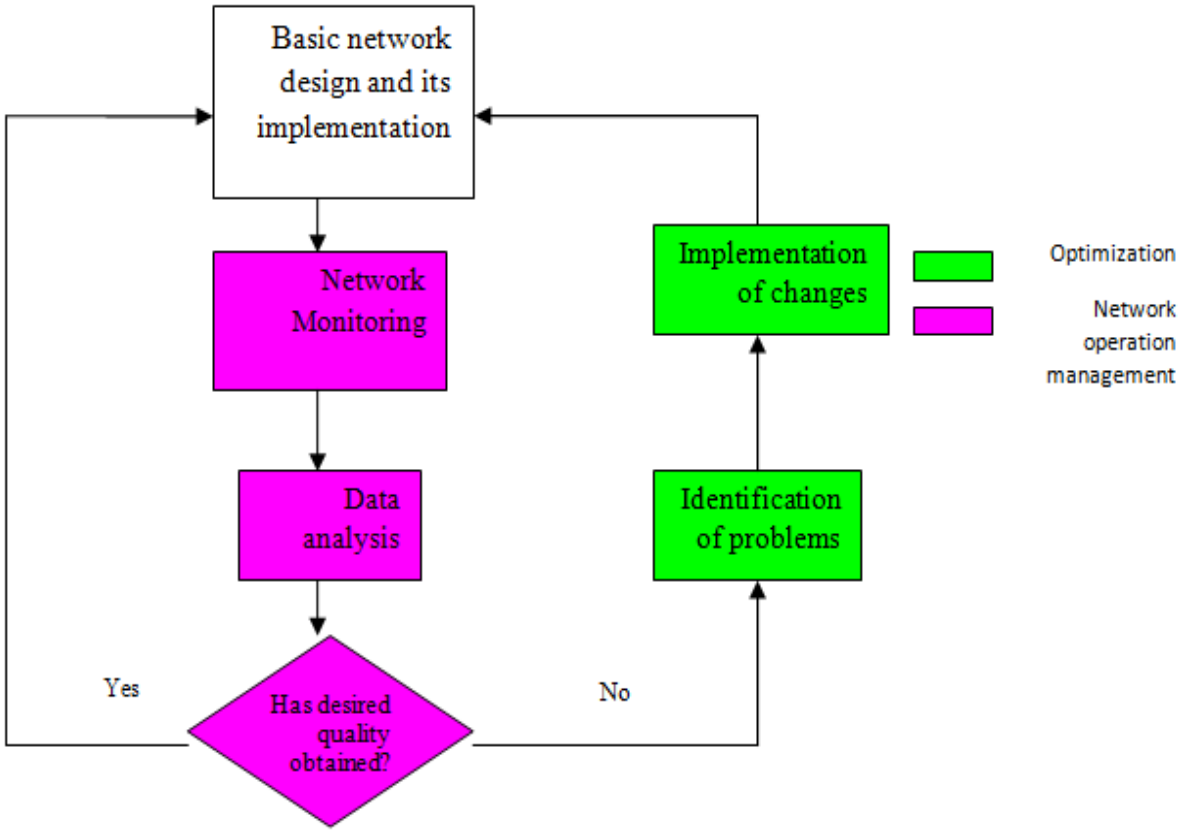

Figure 5: Performance Management with Optimizer Flowchart (Prof.bird-fal2011)

Network performance Management's Discussion arises in several Phases which are as follows:
- The basic design of network and its implementation
- Network Monitoring
- input data analysis including BSC Log files of and Network KPI[1]
- KPI Extraction and Comparison with pre-defined parameters and providing output information to optimization section to identify and solve problems.

The Basic Design of the Network and its Implementation

Initial network design must occur with the limit on the network quality standards required to cover the ease traffic problems. One of Initial tools for primary designs and simulating design environment is ASSET Software. Using this software we can investigate coverage area and its interference caused by the activation of this website in our network design.

One of the other arguments on Implementation of the plan will be a need to strong oversight in order to reduce conflict with the network plans; if this is not observing in optimization process a long amount of time will be wasted on adapting plan and administration. An investigation in Iranian networks reveals that one of the main problems is the incorrect implementation (Bird-fal, 2011).

Ways of Measuring Performance Network

Ways of measuring performance Network are:

Drive test

KPI Calculation through Data Extracted from OMC

Evaluation of signaling messages through the analyzer protocol

Network Specifications, Definition and Network Problems Identification

Network Specifications

In designing a mobile network, the main requirements are:
- Coverage
- Capacity
- Quality of Service

When a mobile network is designed, the first step is to provide coverage for the area and to achieve this it is important to select location of the geographical site to have both appropriate cover and also due Overshooting do not Interference on other sites.

Second step is to identify the traffic channel capacity for the area in which we assess allocation.

Third step, in addition to the coverage and suitable capacity a pre-defined service quality should be given to the network.

BSS Problems are mainly as a result of the interference, frequency design, measured traffic sources, Maintenance, database parameters, and more. non- BSS Problems may be caused by the radio access link; Problems making calls, location update recruitment Requests and etc..

BSS Coverage

Coverage Problems may cause conversations missing or error handover and etc.

The main factors that can be involved in coverage problems include:
- Cell Balancing
- Arrangement and structure of end
- Equipment Efficiency

Balancing Arrangement of Antennas

Horizontal directional antennas should consider the angle and tilt set up in order not to cause interferes in other cells, since this interference results in a decrease in quality of service and an increase in call missing percentage.

If in the original design direction of the antenna is a special arrangement considering the development of network elements to become micro cells, each cell is divided into several cells. We can arrange antenna by same the angle as it is shown in figure (6).

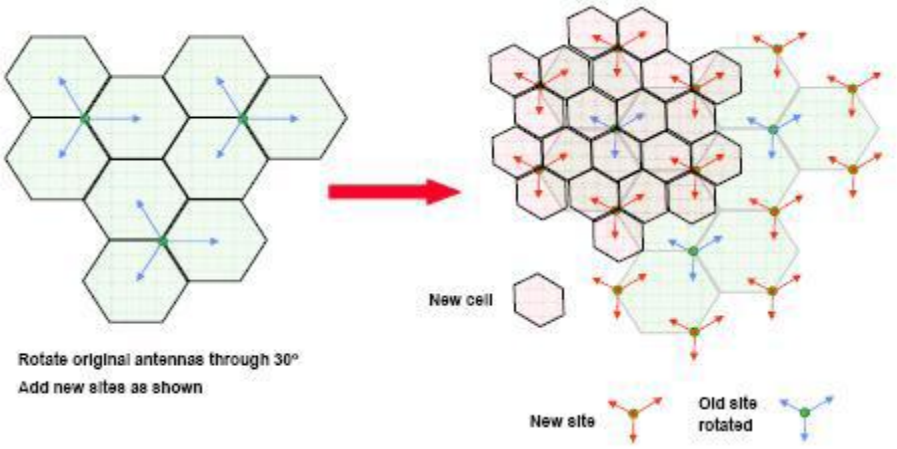

Figure 6: Antenna arrangement after cell division according to the above arrangement of antennas the interference effect is considerably reduced

Quality of Service (QOS)

Decrease in the quality of network service becomes apparent from two Sources.
- Network monitoring through KPI and Drive test
- Public complains

The Major factors that affect quality of network Include:
- Frequency design
- Error in establishing a conversation
- Long Time to communicate
- Conversation missing
- Inadequate lining Network

The Main Parameters of Quality of Service (QOS)

Three main parameters indicative of the quality of service in the network include:
- Drop Call Rate (DCR)
- Blocking considering the Service Level of GOS
- Erlang (amount of carried traffic)

Providing Solutions for Optimization of Parameters

Detection and Solving Hardware Problems

One of The important factors in declining network quality and bad efficiency and high Conversation drop are due to hardware problems. Identifying hardware problems can be done through the following ways:
Investigating KPI and separating those sites that have bad KPI that these indicators are:
High TCH Assign Faikur
High Drop Call Rate
TCH_Available Inconsistent With Capacity TRX
High SDCCH_Congestion
Through the alarms appeared in BSC and observing alarm number Document is referred to the company and its reason is detected.
By drive test in area observing bad quality and obstruction of traffic channels if there is a Channel Comment Examples of hardware problems: Not adjustability of antennas and tilt direction (causes interference and with inappropriate coverage) Bad feeders and jumpers (reduces output power, reduces coverage, cell imbalance, distortion, high VSWR, high loss of injection, the definitive voice, Handover ailure)
Poor Performance of Transmission Line (water entrance, gradual deterioration, physical deterioration and reduced output power) Poor TRX performances Improper arrangement of combiners Clock Site Collide Lack of BSC clock synchronization, which leads to a lack of conclusive conversations

that the example of the problem that has arisen in the BSC 051E and after a large restart of the BSC this problem is solved, and 8 percent of DCR is improved (Halsted, 2010).

Identify and Solve Problems in the Frequency

In optimization activities using prepared software frequency problems can be extracted and taken toward correcting problems. Frequency problems include:

- Interference caused by the same frequency of the BCCH
- Interference caused by the overshooting and great coverage
- Interference from neighboring channels
- Interference by the TCH

Ways in which the frequency problems can be solved include:

- Adjusting cell coverage using DOWNTILT and height reduction and output power reduction
- Change the design of the sites that are located in the high places of city with the interference of overshoot.
- The use of frequency hopping
- Using a range of spatial diversity of country
- The use of polarization diversity in the city because of polarization changes of the wave collisions with buildings
- Using DTX feature
- Extracting High Site List (sites have long height) and height reduction

Results of Ooptimization Algorithms and Software Design

Using previously mentioned flowchart optimization can be done and extract network problems and present a solution.

Items that are required to optimize operations include:

Input

- Print and saved files in different systems at work including Ericsson, Nokia, Siemens, for the neighboring and parametric files and the site conditions and database to evaluate the quality of network
- Doing drive tests Because through analysis files stored software or any other indicators

Analysis

Analysis and recognition of parametric datasheet problems and analyzing drive test files using neighboring soft wares and interfering spots in order to extract parametric problems and presenting input file analysis through designed software.

Solution

Visit the site and take a test drive and provide solutions to correct the hardware problem (and tilt angles and antenna height from the ground and back problems) and extraction of channels blocking sites that have high traffic and fix the problem.

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