International Journal For Technological Research In Engineering
Volume 4, Issue 11, July-2017 *ISSN (Online): 2347 - 4718*

OPTIMIZATION OF RF SIGNAL FOR THE EFFICIENT COMMUNICATION

Khushboo Singla[1], Tilak Raj[2]
[1]PG Student, [2]Assistant Professor, ECE Department, S(PG)ITM

ABSTRACT: Wireless networks are increasingly complex. Cell site architectures and infrastructure have evolved over four generations of technology. The amount of traffic they support is staggering. Base station and microwave antenna technologies have evolved to match the increased usage demands. According to one report, the most important thing wireless operators can do to keep their users happy is to ensure superior network performance. Base station antennas are one of the most important components in the radio access network. They radiate the RF signals that communicate with mobile devices. To support the enormous amount of traffic today, wireless networks repeatedly re-use frequencies or codes throughout the network to increase capacity and throughput. One way to decrease a cell site's coverage area is to lower the height of the antenna radiation center. However, this is often a poor option since it could position the antenna below nearby obstacles such as buildings or foliage that interfere with the signals. A second way of reducing the coverage area is to tilt the vertical pattern of the antenna downward, thus shrinking the coverage on the horizon where interference to adjacent cell sites occurs. In this thesis we optimize the RF signal of different antenna for different areas for efficient communication. There are different parameters to look into for optimized network. It includes the Proper handoff occuring between two antenna or between two sectors of same antenna, no null zone present, min. Rx level should be there, min. Interference and many others. There are different methods to optimize network like electrical and mechanical antenna tilt and antenna angle which are written here for different areas , drive test analysis whose results are also presented here, proper handoff defined between antennas which is again shown in results.

I. INTRODUCTION

3G systems are planned to gather all existing mobile services (cellular, cordless, paging etc.) into one single network. The multiplicity of services and features of the system will make it possible for the users to choose among multiple terminals and service provides. Terminals will become smarter and will be able to support several radio interface with the help of software radio technology. Among the objectives that have been assigned to 3G system designers are : voice quality as with fixed networks, satellite services for non covered areas, low terminal and services costs, high bit rate mobile multi-media services (2 Mbps for indoor and reduced mobility users, 384 Kbps for urban outdoor , and 144 Kbps for rural outdoor), multiple services per user (speech at 8 Kbps, data at 2,4 or 6 x 64=384 Kbps, video at 384 Kbps and multimedia, security and antifraud features against access to data by non-authorized people or entities. The development of the W-CDMA and TDD radio technologies and their associated radio access networks (RANs) would take a significant amount of time and effort. This factor, combined with proposals to develop completely new core networks and architectures would have severely delayed the availability of third generation communications and consequently a pragmatic approach to the core network architecture was taken . The ensuing architecture grafted the new UTRAN aspects on to the 'front end' of an 'evolved' GSM/GPRS phase 2 + core network, comprising mobile switching centers (MSCs) and GPRS support nodes (GSNs). This solution enables operator who have GSM networks, and also suppliers who have core network product lines offering GSM capability, to minimize the technical changes from the contemporary GSM infrastructure. This approach also re-applies the tried and tested GSM roaming, charging, signaling and service mechanisms to UMTS. A completely new access network architectures was developed for the revolutionary radio access mechanisms which took on board the high-speed switching capabilities of ATM, the evolvable support for both W-CDMA and TDMA, as well as delivering standard open interfaces. The basic functional blocks of the UTRAN architectures are the node B and the radio network controller (RNC).The node B functions include the radio and modulation/spreading aspects along with channel coding(forward error correction) and some of the combining/splitting functions for soft handover.The RNC is responsible for controlling the resources associated with a number of nodes B and for negotiating with the core network for aspect such as bearers and quality of service (QoS).

Traditional mobile service was structured similar to television broadcasting: One very powerful transmitter located at the highest spot in an area would broadcast in a radius of up to fifty kilometers. The Cellular concept structured the mobile telephone network in a different way. Instead of using one powerful transmitter many low-powered transmitter were placed through out a coverage area. The cellular concept employs variable low power levels, which allows cells to be sized according to subscriber density and demand of a given area. As the populations grows, cells can be added to accommodate that growth. Frequencies used in one cell cluster can be reused in other cells. Conversations can be handed over from cell to cell to maintain constant phone service as the user moves between cells.A cell is the basic geographic unit of cellular system. Cells are base stations transmitting over small geographic areas that are represented as hexagons. Each cell size varies depending upon landscape. Because of constraint imposed by natural terrain and man-made structures, the true shape of cell is not a perfect hexagon. A group of cells is called a cluster. The spectrum allocated for a cellular network is limited. As a result there is a limit to the number of frequencies or channels that can be used. Radio channels can be reused provided the separation between cells containing the same channel set is far enough apart so that co-channel interference can be kept below acceptable levels most of the time.

II. HANDOFF AND ANTENNA TILT

Handoff refers to a process of transferring an ongoing call or data session from one channel connected to the core network to another. The channel change due to handoff may be through a time slot, frequency band, codeword, or combination of these for time-division multiple access (TDMA), frequency-division multiple access (FDMA), code-division multiple access (CDMA), or a hybrid scheme. Handoff is conducted due to: To avoid call termination when the phone is moving away from the area covered by one cell and entering the area covered by another cell. When the capacity for connecting new calls of a given cell is used up. When there is interference in the channels due to the different phones using the same channel in different cells. Handoffs are classified into two categories – hard and soft handoffs. A hard handoff is essentially a “break before make” connection. Here the link to the prior base station is terminated before or as the user is transferred to the new cell’s base station. This means that the mobile is linked to no more than one base station at a given time. A hard handoff occurs when users experience an interruption during the handover process caused by frequency shifting. A hard handoff is perceived by network engineers as event during the call. These are intended to be instantaneous inorder to minimize the disruption of the call. Hard handoff can be further divided as intra and inter-cell handoffs.

Soft handoff is also called as Mobile Directed Handoff as they are directed by the mobile telephones. Soft handoff is the ability to select between the instantaneous received signals from different base stations. Here the channel in the source cell is retained and used for a while in parallel with the channel in the target cell. In this the connection to the target is established before the connection to the source is broken, hence this is called “make-before-break”. The interval during which the two connections are used in parallel, may be brief or substantial because of this the soft handoff is perceived by the network engineers as state of the call. Soft handoffs can be classified as Multiways and softer handoffs. Handoff fails for many reasons like, if no channel is available in the candidate cell. One of the ways to reduce the handoff failure rate is to prioritize handoff. Handoff algorithms try to minimize the number of handoffs which give poor performance in heavy traffic situations. In such situations, a significant handoff performance improvement can be obtained by prioritizing handoff. Two basic methods of handoff prioritization are guard channels and queuing of hand off.

Guard Channels

Guard channels improve the probability of successful handoffs by reserving a fixed or dynamically adjustable number of channels exclusively for handoffs. An adaptive number of guard channels can help reduce this problem.

Queuing of Handoff

Queuing is a way of delaying handoff. The MSC queues the handoff requests instead of denying access if the candidate BS is busy. The probability of a successful handoff can be improved by queuing handoff requests at the cost of increased new call blocking probability and a decrease in the ratio of carried-to-admitted traffic since new calls are not assigned a channel until all the handoff requests in the queue are served.

Antenna Tilt

The efficiency of a cellular network depends on its correct configuration and adjustment of radiant systems: their transmit and receive antennas. The tilt represents the inclination or angle of the antenna to its axis. The tilt is used when we want to reduce interference and/or coverage in some specific areas, having each cell to meet only its designed area. There are two possible types of Tilt (which can be applied together): the Electrical Tilt and Mechanical Tilt. The mechanical tilt is tilting the antenna, through specific accessories on its bracket, without changing the phase of the input signal. The electrical tilt is obtained by changing the characteristics of signal phase of each element of the antenna.

Drive Test for Optimization

A basic objective of GSM RF performance engineering is to drive test the coverage area and investigate performance problems. GSM is a common frequency system.

GSM system is an inflexible which requires area-wide or cluster testing of coverage. Adjustments made to coverage power, antenna geometry or RF call processing algorithm parameters will impact all sectors sharing the spectrum image. In addition, outside or distant noise sources must be surveyed, controlled or removed if possible.

The tester must resist the localized changes but focus on changes that improve the overall cluster of cells – area wide coverage quality.

GSM drive-testing is performed using a phone connected to a portable computer. Cellular and PCS subscribers view the performance of their service on the basis of the network coverage or the call quality. The drive-test tool uses a phone to re-create the problems that a subscriber is experiencing. For example, if a subscriber’s call is dropped while operating in a moving vehicle in a particular location; the drive-test should be able to duplicate this problem.

Equipment

- Data Collection Tool (Examples: TEMS)
- 1 or 2 Phones interconnected with the PC-Laptop
- GPS receiver interconnected with the PC-Laptop
- PC-Laptop with Data Collection and other software applications
- Power Supply to power up equipment
- Carrying case to fit every piece of equipment

Parameters of Drive Test

- CELL ID including BSIC, LAC, and time slot

- RXLEVEL for the serving and the neighbour cells
- RXQUALITY for the serving cell
- BCCH, BSIC for the serving and the neighbour cells
- TIMING ADVANCE
- TRANSMIT POWER
- GPS POSITION DATA
- TIME STAMPS

Performance Problems that often encountered

- Cell Dragging: Calls may drag a cell beyond the desired handover boundary. This might result dropped calls or bad Rxquality
- Dropped Calls: Caused by either RF environments or incorrect system parameters
- Ping-Ponging: Serving keep changing and as a result of bad audio quality
- System Busy: System busy on several call attempts and site appears consistently on the traffic report
- Handover boundary: Handovers do not occur at the desired HO boundary, the result is an imbalance in traffic distribution across the system

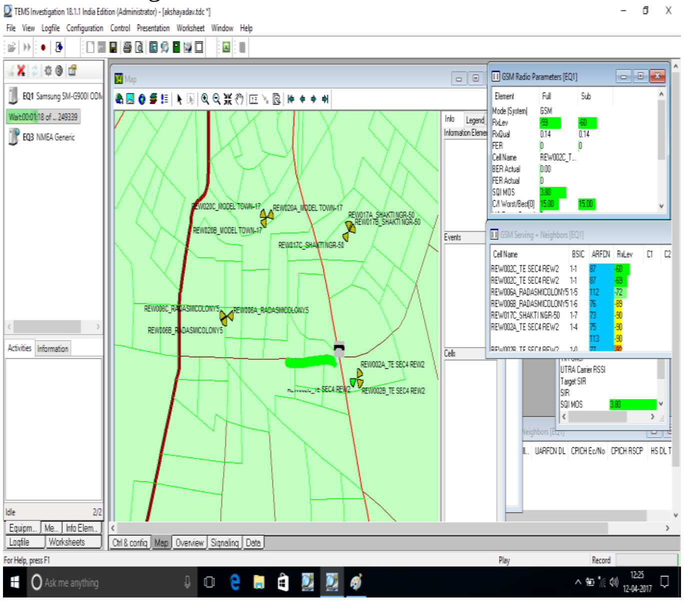
Optimization Results

Antenna parameters for optimization of different areas of Rewari and nearby:

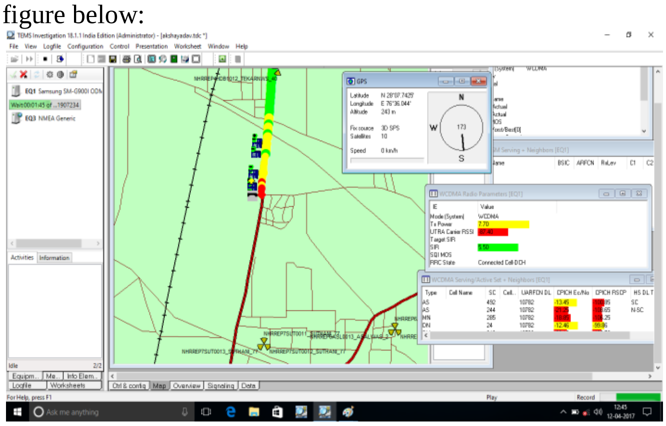
S.no.	Region	Antenna type	Antenna 1 Angle	Tilt	Antenna 2 Angle	Tilt	Antenna 3 Angle	Tilt
1	Mandi	2G	30	2	110	2	220	1
		3G	11	0	125	0	225	1
2	Jotahen	2G	0	2.5	130	1	250	2
		3G	15	1	130	1	250	2
3	Kavi	2G	350	1	100	2	220	2
		3G	10	1	50	1	120	1
		CDMA	35	1	110	1	220	1
4	Hazipur	2G	20	2.5	145	2	260	1
		3G	20	1.5	145	2	260	1
5	Pathrawas	2G	78	1	151	1	357	2
		3G	11	0	151	1	306	1
6	Satnauli	2G	30	1	157	0	288	1
		3G	75	0	214	0	303	0
7	Jarwa	2G	48	0	211	0	354	0
		3G	67	0	191	0	358	0
8	Barda	2G	27	1	161	1	316	1
9	Nawan	2G	84	1	280	1	344	1
		3G	71	1	157	1	326	1
10	Dalanwas	2G	25	1	109	1	357	1
		3G	340	1	74	1	247	1
11	Narnaul	2G	50	1	140	2	296	1
		3G	129	2	252	2	320	2
12	Nallapur	2G	28	1	74	1	234	1
13	Kharkhan	2G	134	1	182	1	350	1
		3G	150	1	220	2	350	1
14	Mohalla Kolian	2G	42	1	159	1	346	0
		3G	42	1	159	1	346	0
15	Devasthan	2G	161	1	219	1	327	1
		3G	180	1	240	2	350	1
16	Neerpur	2G	59	1	166	1	351	1
		3G	66	1	187	1	344	1
17	Bachod	2G	92	2	240	1	318	1
		3G	52	1	161	1	240	1
18	Chandpura	2G	47	1	66	0	290	2
		3G	11	0	122	0	290	0

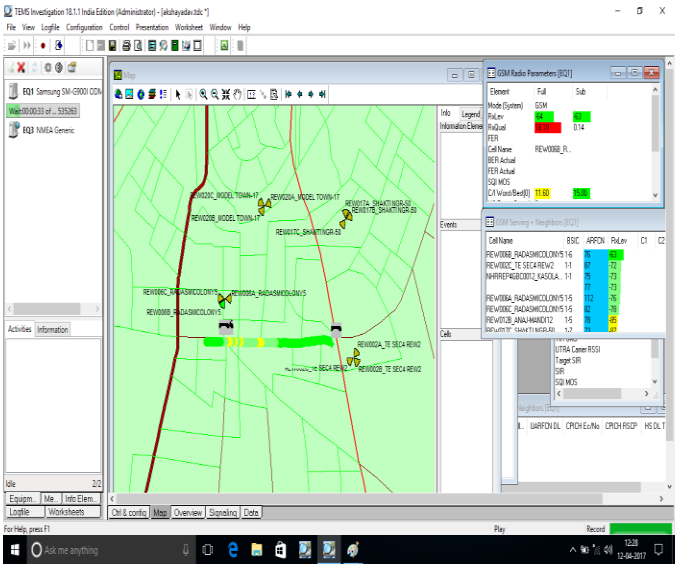
Drive Test Results

A) Successful Handover from one tower to another tower. Call running on REW002C_sec4 tower as shown in figure 10 and successfully handover to REW006B_radhaswami tower as shown in figure11.



Call handover to REW006B_radhaswami tower as shown in figure below:





B) Auto and successful switchover of call from 3G tower to 2G tower as network of 3G tower goes down.

Fig. 12

Switchover to 2G as shown in figure below:

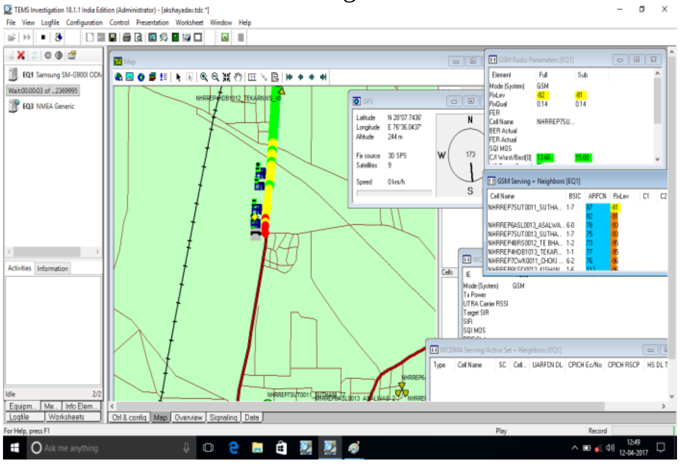


Fig. 13

To solve the above problem the 3G antenna tilt was adjusted mechanically from 0 tilt to 2 tilt and call again swithover to 3G antenna as shown in figure below:

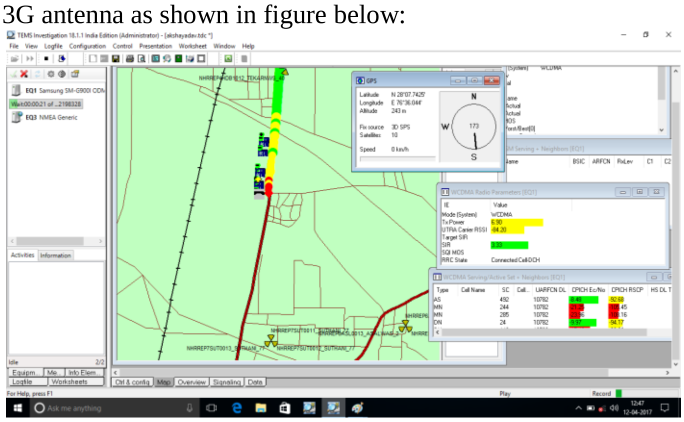


Fig.14

III. CONCLUSION AND FUTURE WORK

As we are moving towards the third generation mobile systems, the need for improving coverage, systems capacity and service quality becomes more and more important. In order to reduce call terminations, interference in the network we need to efficiently handle handoffs in cellular systems. Thus, handoff is the heart of mobile communications. Drive Test is a common and efficient technique for evaluating the network. Analyses made through the information of data collected in the field represent a true picture of network conditions, and can be used in decision making in several areas, from planning and design through optimization and maintenance of the system, always with the goal of maximizing Quality, Capacity and Coverage in the network. In our research work we investigate that for optimum signal on mobiles frequency of signal should be appropriate which can be handled by changing antenna tilt and antenna angle and defining proper handoff for different antenna. Also there should not be any Null Zone which can be tested by drive test. 4G is the next step toward the generation of radio technologies designed to increase the capacity and speed of mobile telephone networks.The main advantages 0f 4G are high throughput, low latency, plug and play, FDD and TDD in the same platform, an improved end-user experience and a simple architecture resulting in low operating costs. 4G will also support seamless passing to cell towers with older network technology such as GSM, cdmaOne, W-CDMA (UMTS), and CDMA2000.

REFRENCES

[1] The GSM system for mobile communication-Michel Mouly & Marie- Bernadette Pautet.

[2] GSM system Engineering-Asha Mehrotra (Artech House Publisher).

[3] haug, T.,"Developing GSM standard," pan-European Digital Cellular Radio Conf., Nice, France, 1991.

[4] Mouly, M., and pautet Marie-Bernadette,"Current Evolution of the GSM system," IEEE Personal Communications, October 1995, PP.9-19.

[5] Beddoes, E, W., "GSM Network Architecture," GSm Seminar, Budapest, October 1990, Session 2.1.

[6] ETSI standard ETS 300303 July 1994 on ISDN, ISDN-GSM, PLMN signalling interface

[7] Wireless communications: Principles and Practice (2nd Edition), Theodore S. Rappaport, Prentice Hall, 2002

[8] WCDMA for UMTS: HSPA Evolution and LTE by Harri Holma and Antti Toskala, Wiley Publishers, 5th Edition, 2010",

[9] IS-95 CDMA and CDMA2000: Cellular/ PCS System Implementation by Vijay K. Garg, Prentice Hall, 1st Edition, 1999

[10] CDMA: Principles of Spread Spectrum Communication by Andrew J. Viterbi, Addison Wesley, 1st Edition, 1995

[11] A generalized Rake Receiver for Interference Suppression, by Gregory E. Bottomley, Tony Ottosson and Yi-Pin Eric Wang, IEEE Journal on Selected Areas in Communications, Vol. 18., No. 8, August 2000.

[12] Field Strength and its variability in VHF and UHF Land Mobile Radio Service by Okumura, Ohmori, Kawano and Fukudu, Rev. Elec. Comm. Lab, vol. 16.

[13] Empirical formula for propagation loss in land mobile radio services by M. Hata in IEEE Transactions on Vehicular Technology, Vol. 29.

