Simulation of WiMax Beam Forming

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Abstract: - Worldwide Interoperability for Microwave Access (WiMax) symbolizes the IEEE 802.16 family requirements to provide wireless high speed internet access for personal and commercial use. Nowadays the 4G technology LTE Long Term Evolution is going on in western world and WiMax have taken the first position among all previous technologies. It can add some qualifications to the wireless technologies like great data rate, extended coverage area and offers several types Support great quality to the clients. The wide ranges of frequency diverge from 2 to 66 GHz, on both registered and free registered band. WiMax technology operates on Orthogonal Frequency Division Multiple Access (OFDMA) that supports Multicast and Broadcast Service with appropriate modulation and coding Scheme. This paper explains the simulation and research of WiMax using the MATLAB, cellplanner and OPNET simulation resources. MATLAB is used to imagine and analyse the performance of a system, while Bit Error Rate (BER) is analysed over Additive White Gaussian Noise (AWGN) channel and Rayleigh faded multipath channel. Also OPNET and Cell Planer tools used to simulate the networks with different values of base frequencies. We used these resources to link and call each other by one WiMax Base Station. The results show that the higher the base frequency the higher the Signal to Noise Ratio, that lead to high throughput, low packet end to end delays.In the same time the results shows that increase in the coverage area will lead to drop in Signal to Noise Ratio which will effect negatively in the quality of voice.

Key-Words: -WiMax, OFDMA, Coverage, CellPlaner, OPNET, MATLAB, LTE

1. Introduction

WiMAX technology is designed to interconnect various devices of remote places that currently utilize satellite for communication. This technology can be operating on both certified and non-certified frequencies. This is a powerful mobile technology but is experiencing some drawbacks mentioned below.

Lack of Quality: Many people trying to get access from the same tower and due to the heavy traffic, it is very hard to maintain high quality of signal.

Range: WiMax offer 70Mbps in range with moving station, but in practice it is always less than that. If a user staying away from the specified range then speed can drop considerably.

Bandwidth: Typical bandwidth of satellite communication is 70 Mbps. But because of heavy traffic and number of users, bandwidth normally is available in the range of 2-10 Mbps.

Expensive network: WiMax network is quite expensive as it consists of satellite, earth stations, antennas etc.

Bad Weather: The quality of services QoS decreases in rainy weather because the weather condition could interrupt the signal, which may cause of bad signal and broadcasting may be interrupted.

Wireless Equipment: If more wireless equipment at the same time utilizes within WiMax network, there will be interferences and could reduce the access speed.

2. Background

WiMAX (Worldwide Interoperability for Microwave Access) is advancement for distant high speed internet and the centers strategy for the fourth-era (4g) distant convenient correspondences. On the other hand it even now dealing with authentic task for low complexness and efficient structure utilization. It supports non-observable process environment with great information rate transmitting and great flexibility up to 125 Km/hr. WiMax obtained OFDM/OFDMA in physical part

for fixed/mobile requisitions independently. Signed up with WiMax design integrating Route evaluation and balance are a powerful area for numerous later questions about. This document shows a design for resembling OFDM WiMax structure in Simulink integrating channel evaluation and leveling subsystems in MATLAB capabilities. Performance has been tried implementing Preservative White Gaussian Disturbance (AWGN) channel for changed structure and Doppler motions because of progressions in great and low comparative speed has been realized and linked with the Simulink channel display for convenient structure. Different repetitive strategies for channel evaluation and leveling have been shown and evaluated. BER compared to SNR turns at great and low Doppler motions have been used for analyzing's these designs.

WiMax technology can be executed by using different types of tool and their parameters. The two different tools are used in this paper to calculate its coverage and simulation that is Cell Planner and OPNET tool.

3. OPNET

Optimized Network Engineering Tools OPNET Technologies, Inc. is a software business that provides performance analysis for computer networks and applications. Its modeling all network types and technologies (including VoIP, TCP, OSPFv3, MPLS, IPv6, and more) [1]. WiMaxpromises to be one of the wireless access technologies capable of supporting real time applications like video and voice requiring minimum service g in a low price. The transmission range allows using one base station to cover long distances [2]. WiMax operates in outdoor and indoor environments and supports data, voice, and video services. It consists of two layers of the Open System Interconnection (OSI) reference model,the Physical (PHY) layer and the Media Access Control (MAC) layer which provides QoS and security.
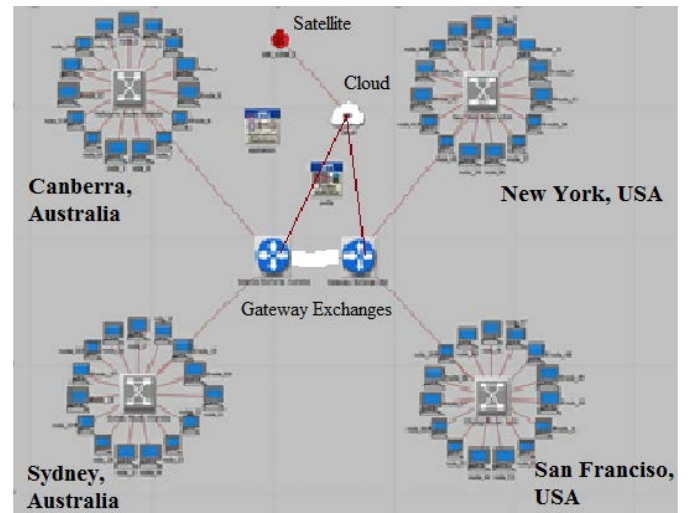

Fig. 1 OPNET Network

- In above network, two different countries like Australia and USA with 2 sub cities can communicate with each other.
- The star topology is used to connect all the network nodes.
- Onerouter is placed for communication within the country while a gateway exchange is connected to share all the data from one country to other.
- The two gateway exchanges are wirelessly connect to the cloud and cloud is attached with satellite.

Devices used:
- Ethernet Switch to communicate within a country
- Gateway Exchange Router for communicating other country.
- The IP-32 cloud for connecting the gateway exchanges.
- Satellite subnet for getting the connection with satellite.
- Application Definition.
- Profile Definition.
- Client servers.

Parameters used:
- Application Definition
- No of rows I used are 3
- Used Video conferencing (Low Resolution)
- Used Voice conferencing (PCM Quality Speech)
- Http (Heavy Web browsing)
- Voice encoder scheme (All schemes)
- Profile Definition
- Operation mode serial (random)

- DHCP Dynamic Host Configuration Protocol:

It is used to configure devices that are connected to a network so they can communicate on that network using the Internet Protocol.

- EIGRP Enhanced Interior Gateway Routing Protocol: It is an advanced distance-vector routing protocolwith optimizations to minimize both the routing instability experienced after topology changes, as well as the use of bandwidth and processing power in the router.
- FDDI Fibre Distributed Data Interface: It is used for optical fibre as its standard underlying physical medium.
- IGRP Interior Gateway Routing Protocol: IGRP was created in part to overcome the limitations of RIP (Maximum hop count of only 15, and a single routing metric) when used within large networks. IGRP supports multiple metrics for each rout including bandwidth, delay, load, MTU and reliability; to compare two routes these metrics are combined together into a single metric, using a formula which can be adjusted through the use of pre-set constants.
- IP Internet Protocol: Every device connected to the public Internet is assigned a unique number known as an Internet Protocol (IP) address. IP addresses consist of four numbers separated by periods.
- Simulation Efficiency
- Traffic
- MANET

Graphs generated:
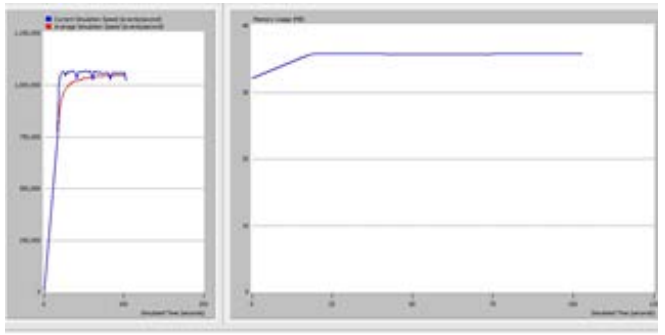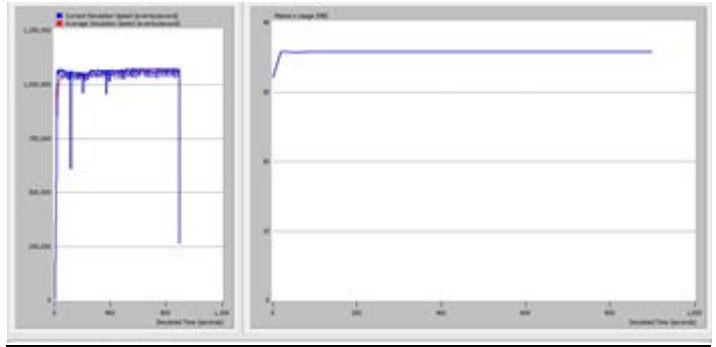

Fig. 2Simulation with no delay
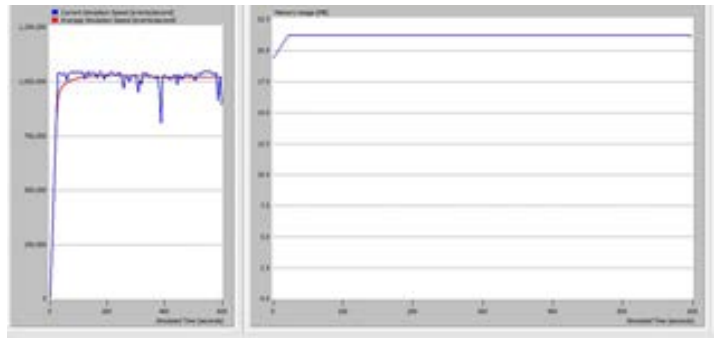

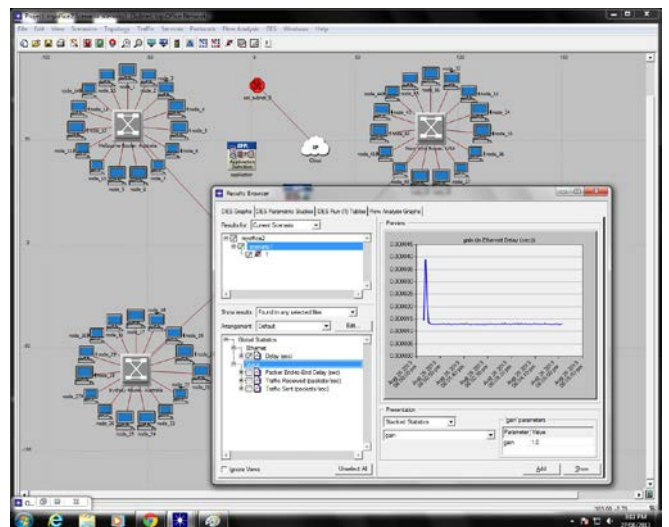Fig.3 Simulation with delay

Fig. 4time is 5-10 minutes

Fig. 5 video, voice and browsing

Analysis:

As the fig.5 is showingin above that there are three applications like video conferencing, voice and http web browsing are executing at the same time.

When assign the duration time less (like 5-10 minutes), so the data transmits frequently as shown in fig. 4 and the delay time of data sending is less.

As the packets transmits at the starting time, so there is less delay because the client server use the data individually but after some time when the data reach at all client server so there is much delay occurred shown in fig.3.

By stopping the simulation during the process, there is much more delay calculated while transmitting.

As the no of client server increases within the country or out of country, so more delay in packet transmitting could be occurred.

4. Cell Planner

In the fig.6, the BTS is place in middle of that region shows the coverage of particular area and near to BTS the Cell Sites also executing the signal coverage by spiriting the cell area to increase the capacity and coverage.
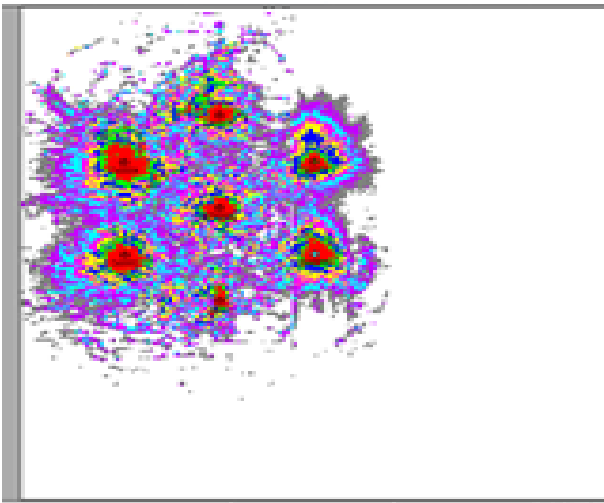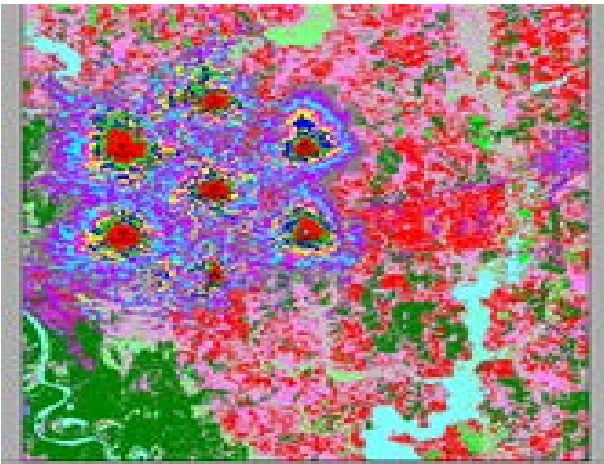

Fig.6 BTS placement

Fig.7 by creating morphology
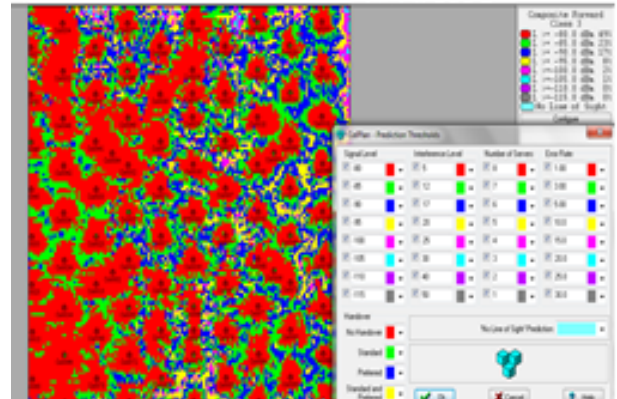
Fig.8 network strength

Analysis:

Fig.8 shows the signal strength which is showing in red colours. Different colours are showing the interference level, no of servers, Line of Sight (LOS) and errors. No co-channel interference between base station BS and respective cell sites CS observed during the execution shown in fig.9 and fig.10 below.

WIMax is technology which is executed by placing the Base Station using the surrounded user's capacity. By using different types of networking tools so cell planner is one of them to place more BS and then we divide the cell sectors to spread out the signals over the region.
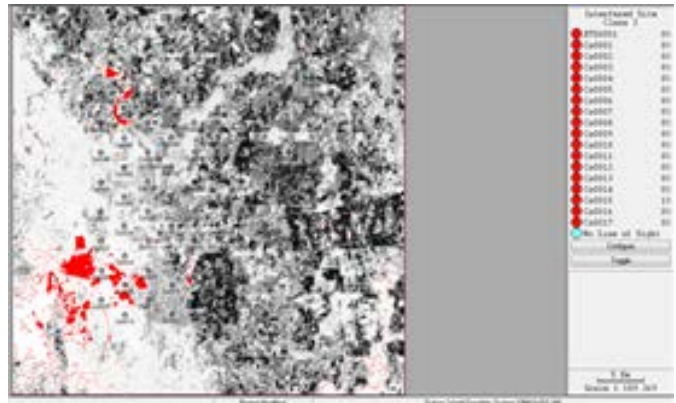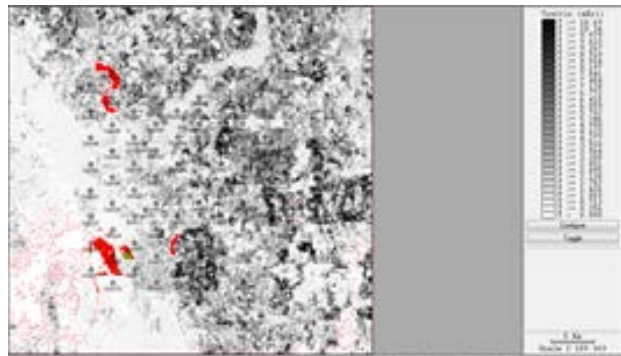

Fig.9 Co-channel interference

Fig. 10 Co-channel interference

Parameters:
− Data Base Directories

In data base directories, different parameters like antenna types, topology, morphology, images are assign to the path for saving the directories in PCC and PCI folders shown in below figure.
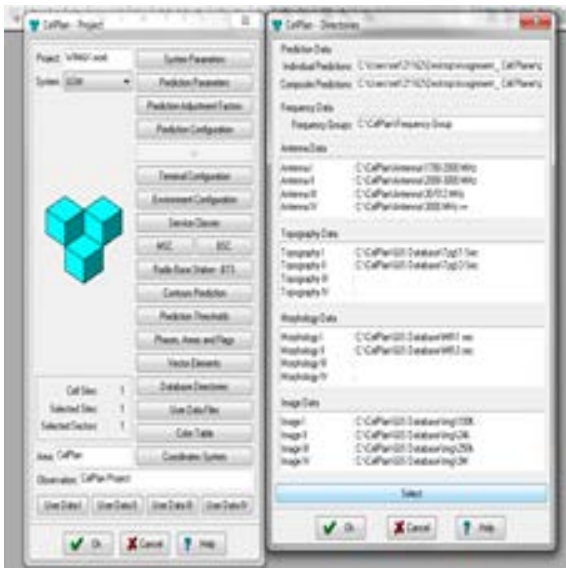

Fig.11 data base directories

Antenna ranges that we use
− 1700-2000 MHz
− 2000-3000 MHz
− 30-512 MHz
− 3000 MHz ++

Topography
− 1 Sec
− 3 Sec

Morphology
− 1 Sec
− 3 Sec

System Parameters
− We use GSMR39 because it uses more frequency channels.

Fig.12 selection of GSMR39

BTS Radio Base Station: In this tab, different parameters are assign like selection of antenna type which want to be use, the BTS location by putting the latitude and longitude, selection of antenna azimuth like 0-120-240 degrees etc. Furthermore, it is need to select the frequency channel by pressing the tab button frequency.Antenna type DR851704PL2Q is selected shown in fig.13.
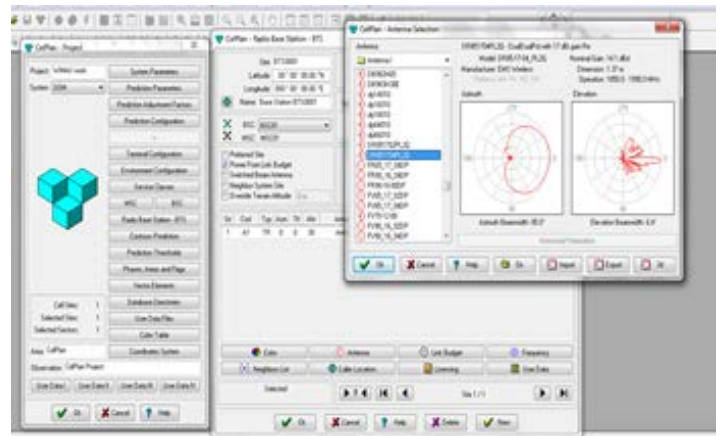

Fig.13 Antenna selection

Azimuths:
− Antenna 1 is 0 degree
− Antenna 2 is 120 degree
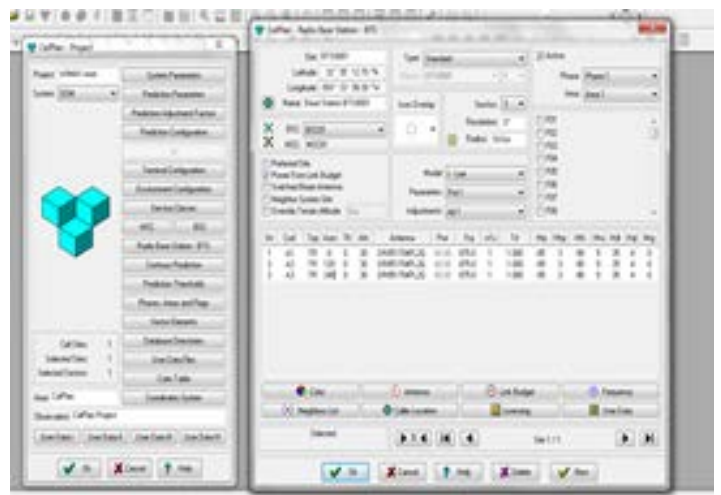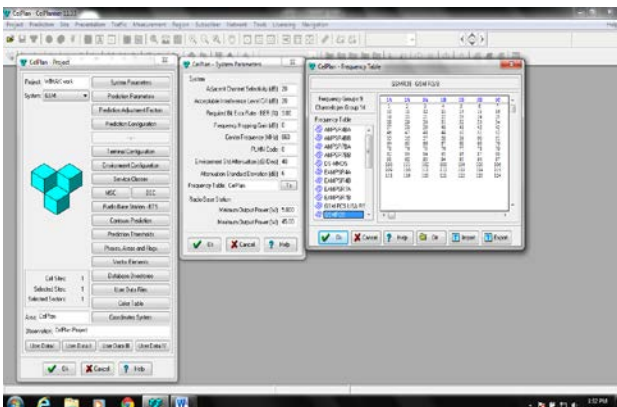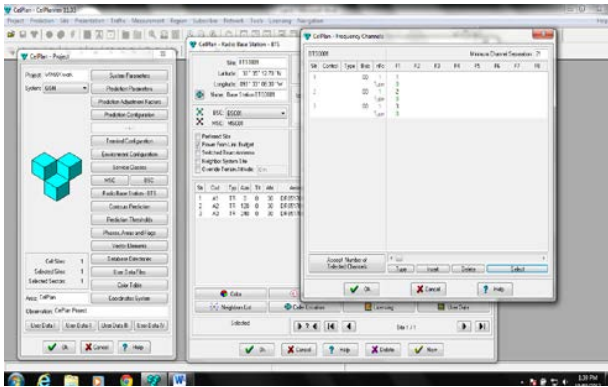− Antenna 3 is 240 degree

Fig.14 Antenna azimuth

Fig.15 frequency channel selection

Different frequency channel can be select by using this tab which is shown in above figure.

Creation of CELL Sites CS

The CS cell sites can be created by placing all the values like coordinates of particular area, antenna height and direction shown in fig.16 below.
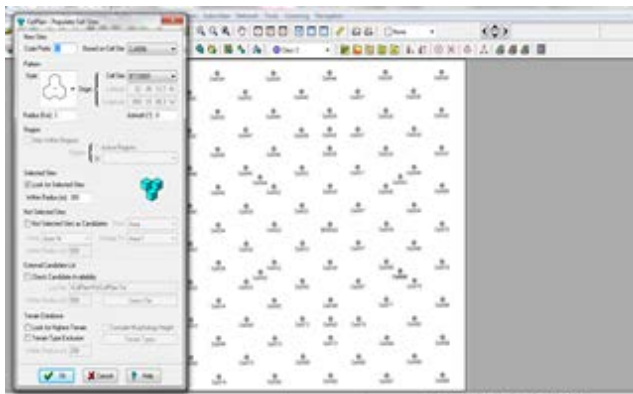

Fig.16 CS creation

By executing composition

It is showing that the red colour is the signal strength that spreads throughout the complete area.
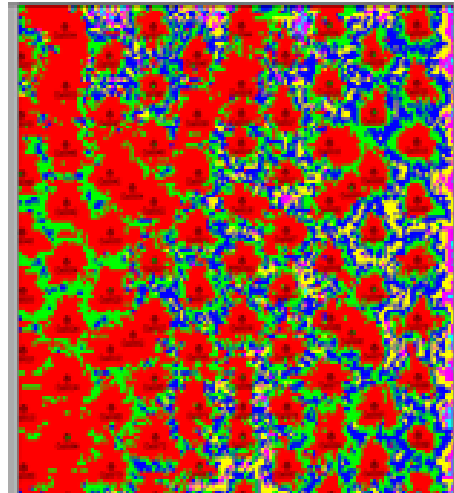

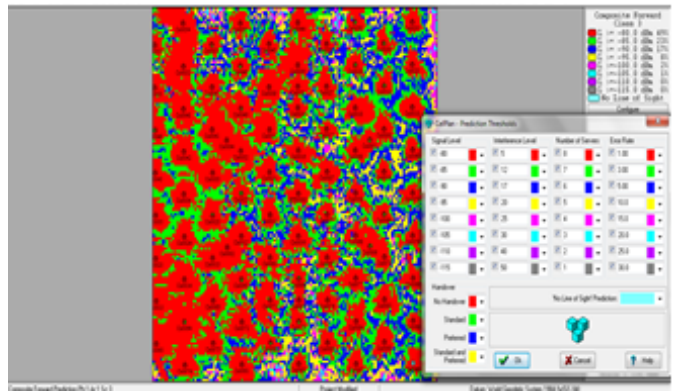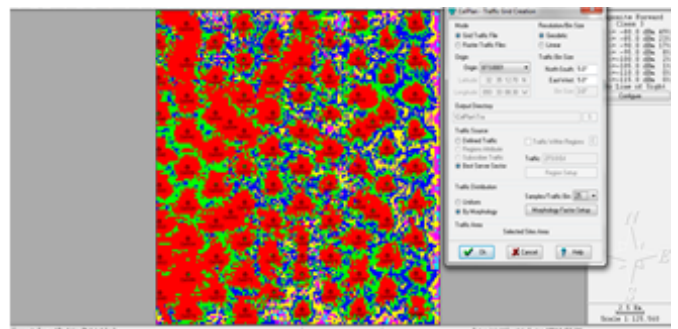Fig.17 execution

Predicted analysis

Fig.18 Prediction

Fig.19 Prediction

The above figures are showing the no of BTS located at the particular area with the Cell Sites CS. The red colour shows the signal strength covers the area that I assigned for the BTS.As increased the no of CS with in a BTS range, the signal strength will be improved to increase the capacity.

The different colours show in fig.18 for different types of servers, interference, LOS, Error rates and signals strength throughoutthe area.

5. Conclusion

To conclude, that how the network strength is improved or reduced, possibilities of getting mistakes and failures can be carried out whenever it offers with Wimax technologies.By increasing more no of base station BS, improves the overall network coverage to utilize more no of clients but it is highly coast effective.

Cell Planner is most efficient and geographically tools for complex network including network dimensioning, traffic planning, site configuration, frequency planning, and network optimization.

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