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Analyzing the Signal Flow and RF Planning in GSM Network

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Abstract: *RNS (Radio Network Sub-system) is one of the important subsystem in GSM (Global System for Mobile communication) architecture. It connects the mobile user to the GSM backbone for switching. This project involves in a study on the functions carried out by each part of the system and how the nodes or equipments involved in GSM Radio network are connected to each other designing of air interface in GSM is one of the vital parts in GSM planning. This project involves in a study of how the air interface in mobile environment is planned and engineered.*

Keywords: *Frequency planning, cell planning; BCCH, BSIC, HSN, MAIO, TCH Drop.*

I. INTRODUCTION

Wireless communication plays a key role to transmit enough information to the longer distance, now a day's research in wireless communication is increasing towards effective frequency planning for a cellular network in a city. A GSM (Global System for Mobile Communication) is an open, digital cellular technology used for transmitting mobile voice and data services. It digitizes and compresses data, then sends it down through a channel with two other streams of customer data, each in its individual time slot. GSM deals with 900 and 1800MHz uplink and downlink frequency. The information taken from customer complaint, drive test and traffic statistics of cellular network helps to optimize using relevant tools and by fine parameter tuning, one can increase the KPI's [1]. A practical implementation of handover success rate and voice quality are improved by participating over several BTS sites during BBH (Bouncing Busy Hour) and NBH (National Busy Hour) period [2]. QoS (Quality of Service) reports based on different key parameters such as CCSR(Call set up success rate) ,HSR(Handover Success Rate),CDR(Call Drop Rate) and TCH (traffic channel) congestion rate are duly beneficial for management team to compare network performance with the competitor's one called as benchmarking and to plan network evolution and strategy [5]. From the survey above, some authors have suggested several ideas to improve the KPI of GSM networks. However, some ideas had not implemented in live GSM network. In this paper, the analysis of signal flow is made and RF planning is done using ATOLL tool to a particular range of area. The results are shown using ATOLL tool as comparative screenshots between existing and designed areas. The remainder of this paper is as follows: Section 2 depicts the architecture model and description of the network layout and rules of planning. The comparative results obtained are discussed as well as matlab results are shown accordingly in Section 3. At last, the conclusion remarks are presented in Section 4.

II. Architecture Model

RF Planning is the process of assigning frequencies, transmitter location and parameters of a wireless communication system to provide sufficient coverage and capacity for the services required.

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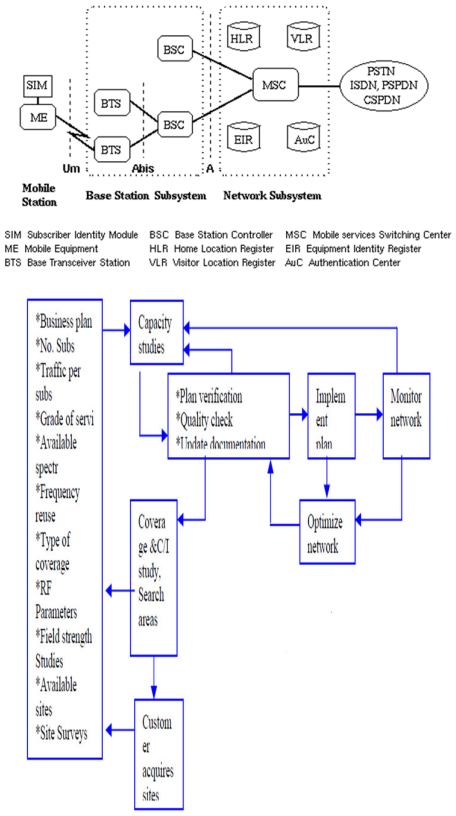


Fig. 2: Simple planning process

The effective RF planning should follow:

A. Capacity Planning

The capacity that a network can handle is measured in terms of the subscribers or the traffic load. Here, the Erlang is calculated for 20 BTS coverage area, which gives the number of traffic channels for different number of carriers.

B. Coverage Planning

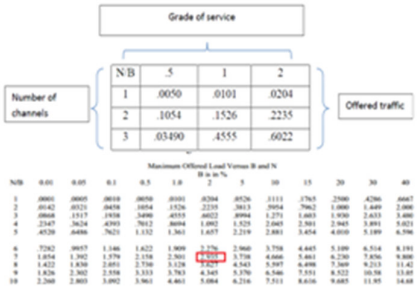
The objective of coverage planning phase is to find a minimum amount of cell sites with optimum locations for producing the required coverage for the target area. It is normally performed with prediction modules on digital map database.

C. Frequency Planning

The main objective of the frequency planning task is to increase the efficiency of the spectrum usage by keeping the interference under some predefined level in the network. Therefore it is always related to interference predictions. The frequency assignment problems can be solved by two basic approaches:

- Frequency reuse patterns
- Automatic frequency allocation

Table I Erlong Analysis



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III. Results and Discussion

The results are presented in the form of screenshots obtained from ATOLL tool. The network layout is Chennai city and the particular area is taken for RF planning. The planning results in low interference and higher signal strength.

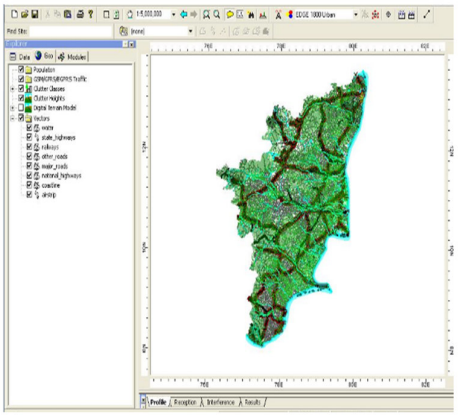

Fig. 3: Digital terrain model

The fig. 3 shows the digital terrain which has latitudinal and longitudinal information of the area to be frequency planned.

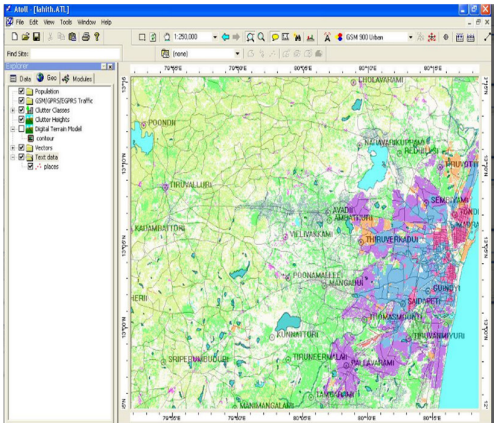

Fig. 4: Area chosen for planning in Chennai city

The frequency planning of 4BTS covers in and around areas of Guindy, which covers about 1kms approximately. The frequency planning of 20BTS covers from Avadi in the north to Thambaram in the south of about 35kms approximately.

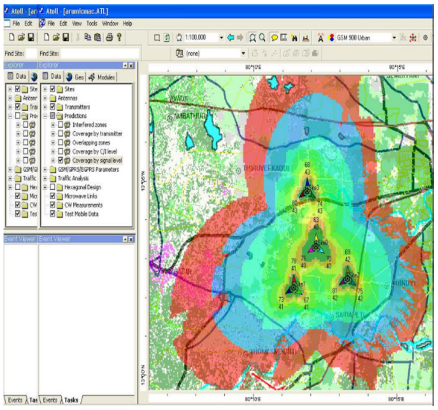

Fig. 5: Signal level of 4BTS

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The fig. 5 shows the signal level of 4 BTS in GSM network.The value of the signal level varies between -43 to -110dBm. The green color depicts the very good signal strength of the network that is around -43dbm. The blue color is the optimum signal strength of the network.The red colordepictsthe poor signal strength of the network that is below -110dBm.The higher the value will higher be the signal strength.

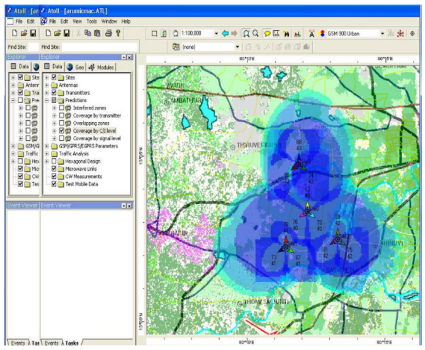

Fig.6: C/I level of 4BTS

The fig.6 shows the channel to interference level of 4 BTS in GSM network. Generally, a standard value for best C/I level is >=9dB whereas in practical it is found to be >=12dBas a best result. Here, the dark blue represents the lowest interference range. The light blue depicts the optimum C/I level of the network. The green color depicts the area where highest interference occur.

Conclusion

The report focuses on reviewing the concept of frequency planning and neighbor management in GSM mobile network. RF Network planning is the foundation of a mobile communication network, especially the wireless parts in a mobile communication network. Network Dimensioning (ND) is usually the first task to start the planning of a given cellular network. The main result is an estimation of the equipment necessary to meet the capacity, coverage and quality. The capacity of the frequency is calculated by using the Erlang table. Coverage planning and site selection are performed on parallel with the site acquisition in interactive mode. The main goal of the frequency-planning task is to increase the efficiency of the spectrum usage, keeping the interference in the network below some predefined level.

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