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Review Article

VARIOUS STRATEGIES FOR 4G CELLULAR TOWER PLACEMENT: A REVIEW

Prabhdeep Singh[1]* and Janish Jindal[2]

*Corresponding Author: **Prabhdeep Singh,** ✉prabhsingh13@gmail.com

This paper addresses the problem of optimal distribution of base tower placement (BTS) while maintaining acceptable quality of service. The rising number of cell phone users and the custom of cell phones in remote spans have commanded the web ability providers to rise their coverage and spread it to all places. Various approach for optimal tower placement is discussed here.

Keywords: Cellular tower placement, Optimal tower locations, Optimization, Allocation of tower, Base tower placement

INTRODUCTION

Cellular network planning is a multi-objective optimizationproblem, which involves deciding on the number of BSs, their configuration such as power, type of antennae, height of the tower, etc, and locating BSs in the geographical area.The rising number of cell phone users and the custom of cell phones in remote spans have commanded the web ability providers to rise their coverage and spread it to all places. Price of allocating a cell tower depends on the height and locale, and as it can be extremely luxurious, they have to be allocated strategically to minimize the cost. The numbers of ability providers have increased manifold in the last decade and the contest amid them has necessitated in discovering an effectual algorithm to locale their towers in a crucial way. Moreover, the optimal height of a tower being allocated demand to be sensibly computed as the height of the tower not merely affects the coverage of the tower but additionally affects the price of its placement.In order to optimally design the base station placement, the feasible sites of base station locations, the region to be covered (we call it the design space), and the distribution of mobile communication traffic have to be considered together. For example, a region with high density communication traffic requires more basestations than one with low

[1] Assistant Professor, Department of Electronics and Communication, RPIIIT, Bastara, Karnal.

[2] xxxxxxxxxxxx, Department of Electronics and Communication, RPIIIT, Bastara, Karnal.

communication traffic. But up to now (to our knowledge), the design of the base station placement has always focused on the consideration of the reception quality and doesn't take into account the communication traffic.In this paper, we discuss various approach to determine the base station positions and transmission power levels so as to maximize the minimum throughput among the mobiles.

GENERALISED VORONOI PARTITION

In generalization of Voronoi partition, where in place of usual distance measures used in the standard voronoi partition and its variations, a set of node functions were used. A framework for formulating and solving the problem of optimal placement of base stations for a cellular network, using the generalized Voronoi partition, was presented. Here, the locations of the BSs are used as nodes or sites and the functions modeling the effectiveness of BSs are used as node functions. The proposed optimal deployment framework can be combined with other aspects of the cellular network planning problem such as optimizing the number ofbase stations and choosing the operational parameters of base stations, such as, transmitting power, antenna type, antennaorientation, etc.

MOBILITY MODEL

It consider the problem of selecting both the base station locations and transmission powers of a cellular communication system based on the information of communication traffic distribution. The objective is to maximize the minimum throughput among the mobiles. The mobility model for each mobile is assumed to be a random walk and independent of other mobiles. The maximum throughput region and the scheduling policy which can have such a throughput region are characterized. Then the optimal locations and powers of the base stations are solved numerically.

It considers a wireless network with a fixed number of base stations to support the communication traffics. Only uplink traffic is considered in this paper. To make the main idea clear, only one common channel is shared by each base station. This assumption is not essential but simplifies the analysis.

PATTERN SWARM OPTIMIZATION

This optimization approaches the problem in two stages:

First, minimize distance of BTS to the furthest MS while keeping the path loss below 140 dB. This distance, is used to determine how many BTS are necessary to cover an area. Minimization is done using Pattern Swarm Optimization(PSO). The PSO algorithm works by simultaneously maintaining several candidate solutions in the search space. During each iteration of the algorithm, each candidate solution is evaluated by the objective function being optimized, determining the fitness of that solution. Each candidate solution can be thought of as a particle "flying" through the fitness landscape finding the maximum or minimum of the objective function. PSO has no overlapping and mutation calculation and calculations in PSO are simple as a result is take a short time to evaluate a function.

Second, BTS are then distributed among the population using fuzzy c-means (FCM) which is a highly efficient method of clustering data. Clusters are assigned based on distance between data points and clusters.

DIGITAL ELEVATION MODEL

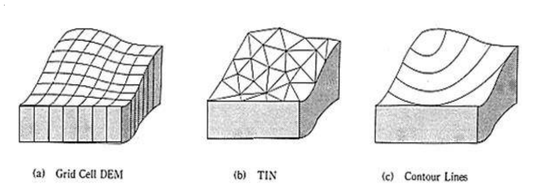
Cellular telephony is the next and perhaps the most representative example of mobile communication systems. The cellular phone system is characterized as a system ensuring bidirectional wireless communication with mobile stations moving even at high speed in a large area covered by a system of base stations. The cellular system can cover whole country. Moreover, a family of systems of the same kind can cover the area of many countries. Initially, the main task of a cellular system was to ensure the connections with vehicles moving within a city and along highways. The power used by cellular mobile stations is higher than that used by the wireless telephony and reaches the values of single watts.

Spatial Databases Spatial databases are databases that, in addition to usual data, store geographical information like maps, and global or regional positioning. Such spatial databases present new challenges to data mining algorithms. Spatial data mining is a process to discover interesting, potentially useful and high utility patterns embedded in spatial databases. Efficient tools for extracting information from spatial data sets can be of importance to organizations which own, generate and manage large spatial data sets.

GIS, continuous surface such as terrain surface, meteorological observation (rain fall, temperature, pressure etc.) population density and so on should be modeled. Grid at regular intervals: Bi-linear surface with four points or bi-cubic surface with sixteen points is commonly used. Random points: Triangulated Irregular Network (TIN) is commonly used. Polynomial is also used. Contour lines: Interpolation based on proportional distance between adjacent contours is used. TIN is also used. Profile: Profiles are observed perpendicular to an alignment or a curve such as high ways. In case the alignment is a straight line, grid points will be interpolated. In case the alignment is a curve, TIN will be generated.

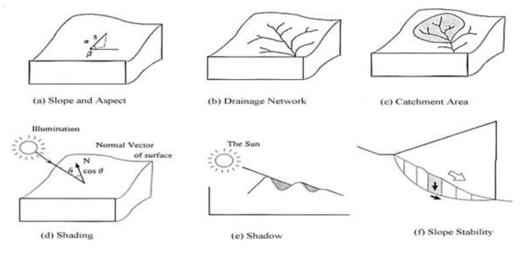
A DEM is a digital representation of topographic surface with the elevation or ground height above any geodetic datum. Followings are widely used DEM in GIS, see Figure.

Figure 1: DEM Models



A DTM (Digital Terrain Model) is digital representation of terrain features including elevation, slope, aspect, drainage and other terrain attributes. Usually a DTM is derived from a DEM or elevation data. Several terrain features including the following DTMs. Slope and Aspect, Drainage network, Catchment area, Shading, Shadow and Slope stability, see Figure 2.

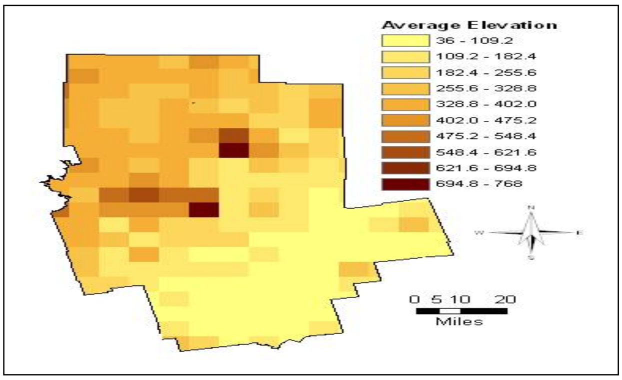
Figure 2: DTM Models



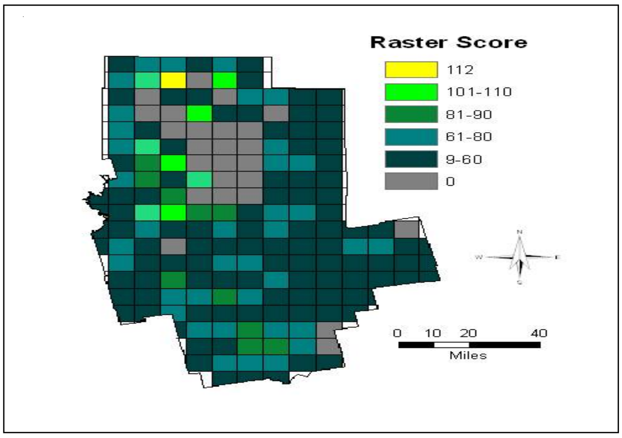
GEOGRAPHICAL INFORMATION TECHNIQUE

Analysis of tower placement factors was based on the estimated coveragerange for each tower and the quality of the area it covered. Four factors went into determining the quality of the newly covered area: current coverage, population density, conservation regulations, and roads. Current coverage was determined by creating a viewshed based on current tower locations throughout Maine. The viewshed takes into account each tower's height and determines every point visible from the top of that tower. Population density, conservation areas, road maps, and elevations were all taken from the sources listed under information. Raster analysis was used to divide the areas into simplified grids, with each grid receiving a score foreach factor. Current coverage was considered most important, as the areaswith little to no coverage are the areas most in need of cell phone reception. Zero coverage was given a score of 10, low coverage a score of 6, medium coverage a score of 4, high coverage a score of 2, and very high coverage a score of 1. Population density was considered the next most important. A score of 1-8 was given to each grid based on population density.

Next was the road systems. There are three main classes of roads, given scores of 2, 3, and 4 based on how large the road system was. From the sum of these three factors, each grid was given a **raw score**. Next, if the grid was mostly comprised of conservation land, it is illegal to build there and the grid was given a final score of zero. Otherwise, elevation was the next factor to consider. Using the elevation grid to the left, the **final score** of each grid was the raw score + the raw score of all grids surrounding that were lower in elevation than the grid. This is to show that towers will cover space outside of their grid, unless they are blocked by areas of higher elevation. The highest final scores were used to determine the best areas for new cell phone tower placement.



The highest scores show the areas best fit for building a new cell phone tower. The low scoring grids show placements that are either already well covered or would not reach enough of the population to be considered useful. The results themselves show strong tendency towards northern Maine, where the coverage is very low to non-existent. As to be expected, areas in valleys or next to high elevations received much lower scores than those on peaks or adjacent to similar elevations.



RESULTS

Various cellular placement strategy is discussed here in this paper. Towers being luxurious needs to be strategically allocated, to cut cost. Moreover, the optimal height of a tower being allocated demand to be sensibly computed as the height of the tower not merely affects the coverage of the tower but additionally affects the price of its placement. Henceforth, possible tower locations have to be ambitious in each given area. And merely the best and most vital ones that are demanded to cover maximum clients in the span, have to be selected alongside alongside their corresponding optimal height.

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