BSC Location in a Wireless Communication Network with MSCs and Cells Fixed

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Abstract

A wireless communications network consists of a group of cells covering the service area. Each cells is represented by a fixed base tranceiver station (BTS) servicing for a number of mobile stations (MS). And BTSs are controlled by a mobile switching center (MSC), which is the central coordinating element for all cell sites within each service area. The recent increase of the mobile communication subscribers desires a great need of the capacity expansion of cellular systems. In order to accommodate the increasing number of subscribers, the cell size will have to become much smaller than the current one. The technological advance for microcells leads to overload the traffic of MSC. Therefore, to minimize the load of MSC and to interconnect the signaling more faster, it is necessary to introduce base station controllers (BSCs).

Although such BSCs are important for wireless communication network under the real situation, all the previous research on the wireless communication network design problem have ignored all such BSCs in controlling and concentrating on the traffic. To minimize the load of MSC and interconnect the signaling more faster under the more realistic situation, the BSC location problem is proposed in this article.

As commonly used in modeling the queueing delay phenomena in communication networks, it is assumed that each of BSC and MSC has a finite capacity for transmission, and that the arrival process of messages to the network follows a Poisson distribution. It is also assumed, for simplicity, that BSC and MSC have no message processing delay. The queueing and transmission delays of messages are modeled as in the M/M/1 queues, in which BSCs are treated as servers whose service rates are proportional to BSC capacity, but traffic messages are treated as customers. Moreover, the setup cost of BSC and the cabling cost will also be incorporated in the problem as done in the various network design problems of the literature. Therefore, the queueing

delay cost and the sum of the setup cost of BSC and the cabling cost will lie in a trade-off relation. The locations of MSC and BTS are fixed, while the possible locations of BSCs and the traffic arrival rate are known in advance. BSCs and MSCs have their own fixed capabilities.

In the problem, the three issues of (i) constructing BSCs among possible locations (ii) connecting BSCs to MSC (iii) connecting each BTSs to BSC, are jointly determined to minimize the sum of the average queueing delay cost and the cabling cost and the setup cost of BSC.

The proposed problem is formulated as a nonlinear binary integer optimization problem, which is NP-complete. Therefore, a heuristic solution algorithm based on the Lagrangian relaxation and subgradient optimizations method is developed. To test the performance of this algorithm, a computational experiment is performed with randomly-generated numerical problems. The results show that the Lagrangian heuristic gives good solutions within a reasonable amount of computational time, and so it may be used effectively for practical problems.