

## Constant Factor Approximation Algorithm for p-Median Network Design Problem with Multiple Cable Types

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**Abstract :** This research presents the first constant approximation algorithm to the p-median network design problem with multiple cable types. This problem was addressed with a single cable type and there is a bifactor approximation algorithm for the problem. To the best of our knowledge, the algorithm proposed in this paper is the first constant approximation algorithm for the p-median network design with multiple cable types. The addressed problem is a combination of two well studied problems which are p-median problem and network design problem. The introduced algorithm is a random sampling approximation algorithm of constant factor which is conceived by using some random sampling techniques from the literature. It is based on a redistribution Lemma from the literature and a steiner tree problem as a subproblem. This algorithm is simple, and it relies on the notions of random sampling and probability. The proposed approach gives an approximation solution with one constant ratio without violating any of the constraints, in contrast to the one proposed in the literature. This paper provides a  $(21 + 2\epsilon)$ -approximation algorithm for the p-median network design problem with multiple cable types using random sampling techniques.

**Keywords :** approximation algorithms, buy-at-bulk, combinatorial optimization, network design, p-median

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