Enhanced Clustering Techniques for Hyper Network Planning using Minimum Spanning Trees and Ant-Colony Algorithm

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Abstract: Problem statement: The process of network planning is divided into two sub steps. The first step is determining the location of the Multi Service Access Node (MSAN). The second step is the construction of subscriber network lines from MSAN to subscribers to satisfy optimization criteria and design constraints. Due to the complexity of this process artificial intelligence and clustering techniques have been successfully deployed to solve many problems. The problems of the locations of MSAN, the cabling layout and the computation of optimum cable network layouts have been addressed in this study. The proposed algorithm, Clustering density-Based Spatial of Applications with Noise original, minimal Spanning tree and modified Ant-Colony-Based algorithm (CBSCAN-SP-ANT), used two clustering algorithms which are density-based and agglomerative clustering algorithm using distances which are shortest paths distance and satisfying the network constraints. This algorithm used wire and wireless technology to serve the subscribers demand and place the switches in a real optimal place. **Approach:** The density-based Spatial Clustering of Applications with Noise original (DBSCAN) algorithm has been modified and a new algorithm (NetPlan algorithm) has been proposed by the author in a recent work to solve the first step in the problem of network planning. In the present study, the NetPlan algorithm is modified by introduce the modified Ant-Colony-Based algorithm to find the optimal path between any node and the corresponding MSAN node in the first step of network planning process to determine nodes belonging to each cluster. The second step, in the process of network planning, is also introduced in the present study. For each cluster, the optimal cabling layout from each MSAN to the subscriber premises is determining by introduce the Prime algorithm which construct minimal spanning tree. **Results:** Experimental results and analysis indicate that the CBSCAN-SP-ANT algorithm was effective, leads to minimum costs for network construction and make the best grade of service. **Conclusion:** Using mobile network to serve the area with low density is decreasing the cost of design the fixed wire network. Also, using the modified ANT algorithm and minimum spanning tree, are helping to construct the cable layout from each MSAN to subscribers when the network is complicated and the number of intersections and streets are large.

Key words: Multi Service Access Node (MSAN), agglomerative algorithm, clustering techniques, network planning, cable layout network, short path, Minimum Spanning Tree (MST), ant-colony algorithm, meta-heuristic, NetPlan algorithm

INTRODUCTION

The goal of a clustering algorithm is to partition a given data set into clusters or groups, which are not predefined, such that the data points in a cluster are similar to each other more than points in different clusters. These groups are formed according to some measures of goodness that differ according to application.

The field of "ant algorithms" studies models derived from the observation of real ant's behavior and uses these models as a source of inspiration for the design of novel algorithms for solution of optimization and distributed control problems (Dorigo and Stulzle, 2004; Gunes *et al.*, 2002; Othman *et al.*, 2007; AL-Salami, 2009).

Ant colony algorithms are a subset of swarm intelligence and consider the ability of simple ants to solve complex problems by cooperation. The interesting point is, that the ants do not need any direct communication for the solution process, instead they