Enterprise Network Topology Design with Fuzzy Logic Based Preferences

A Thesis Submitted in Partial Fulfillment of the Requirements for the Master Degree in Information Technology

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Abstract

The design of an enterprise networks consists of a number of network elements which are interconnected in a hierarchal structure in order to design the network. These network elements include local area networks from different geographical locations, routers, and layer 3 switches. Such network topology design is an NP-hard problem. This network topology design consists of simultaneous optimization of several design criteria such as monetary cost, network delay, number of hops between two nodes, and network reliability. Since some of these criteria are in conflict with each other, the problem can be considered a multi-objective optimization problem. In this thesis, fuzzy logic has been employed to address the multi-objective nature of the problem. A specific fuzzy operator, namely, Einstein operator has been utilized to aggregate the aforementioned design criteria into a scalar optimization function. The operator is combined with two optimization algorithms which are Simulated Evolution and Ant Colony Optimization. The study has four major purposes: the first is to propose a multi-objective Simulated Evolution (SE) algorithm to maintain Pareto optimal solutions. The second is to investigate the application and performance evaluation of the Einstein's operator for the enterprise network topology design problem, in the context of SE and Ant Colony Optimization algorithm (ACO). The third is to evaluate the sensitivity of Einstein operator in presence of preferences among criteria. Finally, the fourth purpose is to mutually compare the performance of both algorithms. Results indicated that ACO algorithm was able to produce better results for larger test cases in terms of quality of solution. Furthermore, with respect to analysis of preference, ACO also produced better results than SE algorithm.