Planning of Hybrid Fiber-VDSL Access Networks with Fuzzy Genetic Algorithm

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Abstract

In the last decade DSL Access Network has become one of the most efficient access technologies to provide higher bandwidth for the end users over existing twisted pairs. Simultaneously, Very high bit rate DSL (VDSL), as an important member of the DSL family, has been strongly developing by many network operators and researchers. A Hybrid Fiber-VDSL (HFV) access network consists of two parts: the distribution network between the Central Office (CO) and Street Cabinets (SCs), and the "last 100 meters" network between SCs and subscribers. Considering the existing structure of the "last 100 meters" network, this work focuses on the planning and optimization of the distribution partition in HFV access networks, i.e. finding out a suitable intermediate level and optimal connections within all network nodes.

Similar to other classical hierarchical topology designs, this paper addresses the optimization problem of clustering and linking for HFV access networks subject to costs, demands, capacity and reliability. However, the multi-dimensional characteristics of problem and the nondeterministic network topology make this planning complex, such as multifarious cost factors, constraints of network elements and additional requirements for Quality of Service, etc. In previous approaches, some heuristic algorithms have been investigated to solve this NP-hard problem. The optimization time and the quality of solution are taken as two most important criterions to evaluate these methodologies. In the last years Genetic Algorithms (GAs) and other evolutionary algorithms have been extensively adopted in various application areas and also in network optimization problems. Anyway, slow search speed and possible premature convergence become two major obstacles for GA. It is well known that Fuzzy Systems can efficiently model expert knowledge for some specific problems, such as clustering and estimation. This work combines the strengths of GA and Fuzzy-Systems to improve the optimization performance of GA and obtain a near-optimal structure of HFV access networks in a shorter time. The effectiveness of the Fuzzy Genetic Algorithm is illustrated with a numerical study.