Planning and Optimisation for Hybrid Fibre-VDSL Access Networks with Tabu Search

Rong Zhao, Sebastian Götze
Chair for Telecommunications, Dresden University of Technology
Mommsenstr. 13, 01062 Dresden, Germany
Phone: +49 351 463-38612 Fax: +49 351 463-37163
E-mail: zhao@ifn.et.tu-dresden.de

***Index Terms* – Network planning and optimisation, Hybrid Fibre VDSL access networks, Tabu Search, Time delay.**

Abstract

In the last years “Last Mile Technology” has gradually become a highlight to solve the bottle-neck problem between high speed backbone network and SOHO (small office and home office). Until today, some different solutions of broadband access networks have been proposed and even partially put into operation over the world. One of the most potential strategies is Hybrid Fibre-VDSL (HFV) access networks exploiting the existent copper networks.

Similar to PSTN network, central office (CO), street cabinets (SC) and end users (EU) compose a hierarchical infrastructure of HFV access networks. Its two main partitions are distribution network (CO->SC) and “last meter” network (SC->EU), which are connected with the optical fibre and the existing twisted pair, respectively. Although the traffic of end users plays an important role on the network design, we focus on planning and optimisation of distribution network due to the fixed connection within the “last meter” area. To improve network operation performance, the hierarchical structure in distribution network has been proposed subject to constraints of network elements, such as Edge Router, Branch Micro Switch and Leaf Micro Switch.

In consideration of the complexity of the networks, some heuristic algorithms have been investigated to solve this NP-hard problem. This paper explores the planning and optimisation of HFV access networks with Tabu Search. Tabu Search is an efficient and effective meta-heuristic algorithm widely applied in various fields since 1990s. To overcome the local optimal solution, Tabu Search makes use of a Tabu List to forbid the previously visited search space. Based on short term and long term memory, the advanced solution can be simultaneously kept track. However, the fixed Tabu List could lead the optimisation to be in trouble with a search cycle. In this case, Tabu List with adaptive length has been approached to enhance the quality of optimum. In addition, Tabu Search takes advantage of deterministic conditions to accelerate the search process. This feature is verified through the optimisation results of HFV access networks in comparison with other heuristic algorithms like Simulated Annealing.

Furthermore, this work addresses the minimal cost of network and also takes time delay and reliability into account. Referring to the characteristics of IP-Packet and M/M/1 system, the average P2P time delay of HFV access networks has been studied. Up to now, this work with Tabu Search adopts the constraints of physical property to basically guarantee the reliability of network operation. Therefore, the next approach is to provide high survivability and restoration during the network design for HFV access solution.