Telecommunication Network Design with Two Hierarchy Survivability Conditions

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Abstract

A recent trend in telecommunication network is the emergence of fiber optic technology as one of the major components in the "network of the future". This transmission medium is cost effective, reliable, and provides nearly unlimited capacity. These very large capacities of the optical fiber links are important for the new telecommunication services such as broad-band ISDN services requiring large amounts of bandwidth.

Survivability is an important factor in the design of fiber optic telecommunication networks since the desire to design cost effective networks could lead to very sparse tree-like network designs using extremely high capacity of fiber optic cables. But if the telecommunication networks has a lower level of redundant connectivity then it results a worse network survivability. This leads to the problem of designing a minimum-cost network that meets certain connectivity constraints.

Many recent works provide good approaches for designing survivable telecommunication networks but they do not consider the hierarchy of the network which is essential for economic deployment and operation of the real telecommunication networks. In this paper we consider the survivable network design problem where each regional subnetwork should be designed to satisfy the survivable conditions for the local connections and the long distance links should be designed to satisfy the survivable conditions for the long distance connections.

We propose a graph theoretical model for the survivable network design with two hierarchy structure and derive the related integer program. We also study some properties to describe the structure of the

optimal feasible networks for the problem. Using this characterization, we decompose the problem into two phase problems. Several heuristics for phase 1 problem are developed and an exact approach for phase 2 problem is discussed. Further research topics including the design problems for the reconfigurable telecommunication networks and the topology optimization problems for the future telecommunication transmissin networks are also discussed.