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Report on Research Progress

Genetic Approaches for Dynamic RWA in Optical WDM Networks

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Purpose
Optical networks using Wavelength-Division-Multiplexing (WDM) technology have been generally regarded as the most promising technology for building the next-generation Internet backbone, because they can provide a huge bandwidth that is not achievable in conventional networks. In such networks, data are routed in optical channels called lightpaths. The Routing and Wavelength Assignment (RWA) problem concerns in determining path and wavelength to establish lightpaths for connection requests. This problem plays a critical role in enhancing the performance of the WDM networks, therefore we mainly aim at finding out efficient algorithms to solve this problem.

Our approach
The RWA problem may be either static or dynamic. In a static model, a set of requests is known in advance and the objective is to minimize the network resources. This problem has been proved as NP-complete. In a dynamic model, requests arrive and depart over time; therefore the problem becomes more difficult and challenging, and hence it is usually solved by heuristic algorithms. The dynamic RWA problem is considered in our research.

Genetic Algorithms (GAs) are a class of search strategies based on the mechanism of biological evolution and be able to reduce search space, as well as converge to a global good solution of the involved problem. Therefore, GA is one promising approach to solve the dynamic RWA problem in WDM network. However, available GA-based routing algorithms are not efficient enough because they usually are time-consuming in generating the first population.

Mobile agents are small programs that can move themselves from node to node, and cooperate with others to perform complex tasks. Currently, applying mobile agent technique to the dynamic RWA in WDM networks usually results in a high blocking probability.

To reduce the time consuming process of generating the first population in GAs while retaining the GA’s attractive ability for achieving a significantly low blocking probability, we propose novel hybrid algorithms based on the combination of mobile agent technique and GA for solving the dynamic RWA problem.

Research process
To fully understand the feasibility of combining mobile agent technique and GA to solve the dynamic RWA problem, we have been solving the RWA problem step by step in the following contexts:

(1) The network without/with sparse wavelength conversion;
(2) When the failure may happen in the network and the requirement of connections is dependable, the problem is called the dynamic survivable routing problem;

(3) Different from (1) and (2), in which data is transmitted in an one-to-one manner, here data are required to be transmitted from one node to multiple node - this is called multicast routing problem.

Future direction

As having shown in the obtained results, applying hybrid algorithms, which based on the combination of mobile agent technique and GA, to solving the dynamic RWA problem in WDM networks yields a lower blocking probability than most promising algorithms available in literature. Thus, we expect that the proposed approach can be extended to sovle the dynamic RWA problem in Ad-hoc networks.

Publications


