Multicriteria Dynamic Routing in All-Optical WDM Networks: An overview of recent results and algorithms

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Extended Abstract:

All-optical networks based on wavelength division multiplexing (WDM) have emerged as a promising technology for network operators to respond to an increased demand for broadband service. All-optical networks consist of optical fiber links and nodes. Each node has a dynamically configurable optical switch or router, which supports wavelength based switching or routing. Configuring these optical devices across the network enables one to establish all-optical connections, or *lightpaths,* between source and destination nodes.

In order to establish a lightpath, the network needs to decide on the route and the wavelength(s) for the lightpath. Given a set of connections, the problem of setting up lightpaths by routing and assigning a wavelength to each connection is called the Routing and Wavelength-Assignment (RWA) problem. There are two variations of the problem: static and dynamic. In the static case the set of desired connections is known beforehand; in the dynamic case the connection requests arrive based on some stochastic process. The RWA problem can be simplified by decoupling it in two subproblems: the routing subproblem and the wavelength assignment subproblem.

All-optical WDM networks are characterized by multiple metrics (hop-count, cost, delay, delay jitter, available bandwidth, loss probability, reliability), but generally routing protocols only optimize one metric, using some variant of shortest path algorithms (e.g., the Dijkstra and Bellman-Ford algorithms). On the other hand, the design of real networks usually involves multiple, even competing objectives and constraints. The multicriteria RWA problem has been solved combining the relevant metrics or objective functions. This is achieved by defining integrated link cost functions (which embed the different metrics) or using a single cost objective function defined as a weighted sum of objective functions. Another approach has been the use of additional constraints on the optimization problem to satisfy GoS requirements. This presentation provides an overview of this type of routing models.

The final solution of these methods heavily depends on the selection of weights (for obtaining the integrated link costs or the single objective function). When there exist many competing objectives in RWA, this dependence will become problematic because the best set of weights is not previously known. Furthermore, this type of approaches only gives a single solution in each iteration, which will not clearly uncover the trade-offs among competing objectives.

So, it seems particularly interesting the development of a multicriteria model capable of explicitly representing the different performance objectives and the associated resolution methods. We highlight possible metrics to incorporate in such a model and possible performance evaluation measures.