Design of Survivable IP-over-Optical Networks

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Abstract

In the past years, telecommunications networks have seen an important evolution with the advances in optical technologies and the explosive growth of the Internet. Several optical systems allow a very large transport capacity, and data traffic has dramatically increased. Telecommunications networks are now moving towards a model of high-speed routers interconnected by intelligent optical core networks. Moreover, there is a general consensus that the control plan of the optical networks should utilize IP-based protocols for dynamic provisioning and restoration of lightpaths. The interaction of the IP routers with the optical core networks permits to achieve end-to-end connections, and the lightpaths of the optical networks define the topology of the IP network. This new infrastructure has to be sufficiently survivable, so that network services can be restored in the event of a catastrophic failure. In this paper we consider a multilayer survivable network design problem that may be of practical interest for IP-over-optical neworks. We give an integer programming formulation for this problem and discuss the associated polytope. We describe some valid inequalities and study when these are facet defining. We discuss separation algorithms for these inequalities and introduce some reduction operations. We develop a Branch-and-Cut algorithm based on these results and present extensive computational results.