

Survivable Multi-Layer Multi-Level Network Design

Abstract: I started addressing mathematical issues of telecommunication network design more than twenty years ago when I collaborated with Clyde Monma at Bell Communications Research. Fiber optic technology started being deployed. Due to the high bandwidth of fiber cables, initial network topologies were very sparse, "tree-like", making these networks vulnerable to disruptions. Survivability, i.e., protection against failures of network components - at least cost, of course - became an important issue. I will survey some of the survivability concepts that arose over time and that have, in the meantime, evolved into very complex mixed integer programming models with which various aspects of protection against failure scenarios can be captured. Examples of solutions of real world network design problems will illustrate the development. The "solution technology" is based on a combination of LP technology, polyhedral combinatorics, and heuristics and can provide today optimal or provably near optimal solutions of large scale network design problems. Integrating all aspects, such as multiple layers and multiple levels, into one MIP model is still a challenge. I will outline the current state of the art of modeling and of solution approaches for such network design tasks.