Network design: using decomposition-based approaches for a resilience response to uncertainty

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Network design arises in many application domains, like water, gas and oil distribution networks, transportation and telecommunication networks just to mention a few. Once designed and deployed, these networks have to remain operational despite the uncertainty inherent to their environment. Typically, some parts of the networks can fail because of attacks or breakdowns, the customer demand can change, and so on.

We propose two kinds of responses to preserve operation in these networks. The first one favors survivability: the network is supposed to be able to keep functioning without modification even when some of its part fail. Such a strategy usually leads to a large deployment cost. The second one favors resilience, in the sense that the network should be easy to fix when failures occur. In this case, the deployment cost is much less, but some actions (and extra costs) are required whenever a failure occurs.

In this thesis, we consider investigating survivability and resilience of some tributary and backbone architectures used to design networks, as in [1]. These structures consist of selecting a set of nodes as hubs and link them to form the backbone network. The remaining nodes, named terminals, are connected to hubs and define the tributary network. The objective is to find an efficient and cost effective tributary and backbone network. Different tributary and backbone network have been proposed to design networks [2]. We are interested in Ring Star [3] and Hub and Spoke [4] structures, among others, that have many applications in telecommunication and transportation domain.

We plan to design integer linear programming approaches based on decomposition (Benders decomposition and bilevel programming), and dedicated algorithms to produce competitive solutions.

References

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