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Bounds on Service Quality for Networks Subject to Augmentation and Attack

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Abstract
Assessing a network's vulnerability to attack and random failure is a difficult and important problem that changes with network application and representation. We furnish algorithms that bound the robustness of a network under attack. We utilize both static graph-based and dynamic trace-driven representations to construct solutions appropriate for different scenarios. For static graphs we first introduce a spectral technique for developing a lower bound on the number of connected pairs of vertices in a graph after edge removal, which we apply to random graphs and the power grid of the Philippines. To address the problem of resource availability in networks we develop a second technique for bounding the number of nominally designated client vertices that can be disconnected from all server vertices after either edge or vertex removal (or both). This algorithm is also tested on the power grid and a wireless mesh network, the Internet AS level graph, and the highway systems of Iowa and Michigan. Dynamic networks are modeled as disruption tolerant networks (DTNs). DTNs are composed of mobile nodes that are

intermittently connected via short-range wireless radios. In the context of both human and vehicular mobility networks we study both the effect of targeted node removal and the effect of augmentation with stationary relays.