Stability Analysis of Real-World P2P Networks

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Real-world P2P networks, that inherently rely on unreliable peers, are being subjected to various kind of attacks such as DDoS. Analyzing resilience of such large-scale real-world P2P networks has been a major challenge because of (a) huge network size and (b) lack of understanding of parameters that influence network's resilience. We use tools from complex network and percolation theory to develop a generalized framework that can be used to understand the impact of node removals on the network topology and different network parameters. Our preliminary analysis shows that the stability of real-world P2P networks is largely influenced by the degree-degree correlation existing in it. For a network under attack, we derive analytical expressions for predicting (a) degree-distribution (b) degree-degree correlation (c) critical condition for stability. We focus our analysis on P2P networks with Superpeer architecture and validate our theories on real-world network Gnutella snapshot data. Using the framework we have been able to identify some critical parameters tuning which design engineers can improve P2P network's resilience.