Green Networking With Packet Processing Engines: Modeling and Optimization

Abstract:

With the aim of controlling power consumption in metro/transport and core networks, we consider energy-aware devices able to reduce their energy requirements by adapting their performance. In particular, we focus on state-of-the-art packet processing engines, which generally represent the most energy-consuming components of network devices, and which are often composed of a number of parallel pipelines to "divide and conquer" the incoming traffic load. Our goal is to control both the power configuration of pipelines and the way to distribute traffic flows among them. We propose an analytical model to accurately represent the impact of green network technologies (i.e., low power idle and adaptive rate) on network- and energy-aware performance indexes. The model has been validated with experimental results, performed by using energy-aware software routers loaded by real-world traffic traces. The achieved results demonstrate how the proposed model can effectively represent energy- and network-aware performance indexes. On this basis, we propose a constrained optimization policy, which seeks the best tradeoff between power consumption and packet latency times. The procedure aims at dynamically adapting the energy-aware device configuration to minimize energy consumption while coping with incoming traffic volumes and meeting network performance constraints. In order to deeply understand the impact of such policy, a number of tests have been performed by using experimental data from software router architectures and real-world traffic traces.