Can power hungry data centers meet energy efficiency goals?

Title of the dissertation
Energy Measurement and Modeling in High Performance Computing with Intel's RAPL

Contents of the dissertation
The goal of achieving exaflops computation by 2020 set by the high performance computing (HPC) community and the rapid growth in data generated and analyzed in the scientific computing paradigm have paved the way for an unprecedented increase in the number of server systems in data centers. These big numbers of power hungry servers have increased the energy demand of data centers and, as a result, energy efficiency in HPC, scientific computing, and cloud computing is now a big concern.

This thesis has extensively studied the energy efficiency of such computing environments using the RAPL energy measurement functionality available in new Intel processors. This dissertation has proposed different strategies for modeling power consumption, analyzed data center energy efficiency through history logs, and performed comprehensive analysis of RAPL to identify its pros and cons. This thesis also presents observations on RAPL use in cloud environments, specifically on Amazon EC2. The results obtained in this thesis can be applied in wider scenarios in data center based computing systems to improve the overall energy efficiency. The particular focus of the work has been the scientific computations for the particle physics analysis at CERN (European Organization for Nuclear Research).

Field of the dissertation
Computer Science

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Aalto University School of Science, lecture hall T2, Konemiehentie 2, Espoo

Opponent
Professor Jussi Kangasharju, University of Helsinki, Finland

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