

Optimal Energy Procurement for Geo-distributed Data Centers in Multi-timescale Markets

Submitted by [Zhenhua Liu](#) on Mon, 10/31/2016 - 7:08pm. Contributor:
[Zhenhua Liu](#)

Multi-timescale electricity markets augment the traditional electricity market by enabling consumers to procure electricity in a futures market. Heavy power consumers, such as cloud providers and data center operators, can significantly benefit from multi-timescale electricity markets by purchasing some of the needed electricity ahead of time at cheaper rates. However, the energy procurement strategy for data centers in multi-timescale markets becomes a challenging problem when real world dynamics, such as spatial diversity of data centers and uncertainties of renewable energy, IT workload, and electricity price, are taken into account.

In this work, we develop energy procurement algorithms for geo-distributed data centers that utilize multi-timescale markets to minimize the electricity procurement cost. We propose two algorithms. The first algorithm provides provably optimal cost minimization while the other achieves near-optimal cost at a much lower computational cost. We empirically evaluate our energy procurement algorithms using real-world traces of renewable energy, electricity prices, and the workload demand. Our empirical evaluations show that our proposed energy procurement algorithms save up to 44% of the total cost compared to traditional algorithms that do not use multi-timescale electricity markets or geographical load balancing.

Zhenhua Liu

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