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Heuristics for Optimizing Power Consumption in the Smart Grid

Authors : Zaid Jamal Saeed Almahmoud

Abstract : Our increasing reliance on electricity, with inefficient consumption trends, has resulted in several economical and environmental threats. These threats include wasting billions of dollars, draining limited resources, and elevating the impact of climate change. As a solution, the smart grid is emerging as the future power grid, with smart techniques to optimize power consumption and electricity generation. Minimizing the peak power consumption under a fixed delay requirement is a significant problem in the smart grid. In addition, matching demand to supply is a key requirement for the success of the future electricity. In this work, we consider the problem of minimizing the peak demand under appliances constraints by scheduling power jobs with uniform release dates and deadlines. As the problem is known to be NP-Hard, we propose two versions of a heuristic algorithm for solving this problem. Our theoretical analysis and experimental results show that our proposed heuristics outperform existing methods by providing a better approximation to the optimal solution. In addition, we consider dynamic pricing methods to minimize the peak load and match demand to supply in the smart grid. Our contribution is the proposal of generic, as well as customized pricing heuristics to minimize the peak demand and match demand with supply. In addition, we propose optimal pricing algorithms that can be used when the maximum deadline period of the power jobs is relatively small. Finally, we provide theoretical analysis and conduct several experiments to evaluate the performance of the proposed algorithms.

Keywords : heuristics, optimization, smart grid, peak demand, power supply
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