Optimizing Green Energy, Cost, and Availability in Distributed Data Centers

Objective:

Main objective of the system is we minimize the cost due to power consumption and server deployment, while targeting a minimum usage of green energy.

Abstract:

Integrating renewable energy and ensuring high availability are among two major requirements for geo distributed data centers. Availability is ensured by provisioning spare capacity across the data centers to mask data center failures (either partial or complete). We propose a mixed integer linear programming formulation for capacity planning while minimizing the total cost of ownership (TCO) for highly available, green, distributed data centers. We minimize the cost due to power consumption and server deployment, while targeting a minimum usage of green energy.Solving our model shows that capacity provisioning considering green energy integration, not only lowers carbon footprint but also reduces the TCO. Results show that upto 40% green energy usage is feasible with marginal increase in the TCO compared to the other cost-aware models.

Introduction:

With increased usage of Internet services, there is a rapid growth in the number of geo-distributed data centers around the world. At the same time, data center operators are under pressure to minimize the carbon footprint. One of the ways to do

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this is to use renewable energy from on-site or offsite sources. Recently, all major distributed data-centers are powered either partially or fully by renewable energy.

The authors of demonstrated how distributed data centers can exploit uncorrelated wind sources to meet 95% of their energy requirement. The work in minimized the cost of building data centers and renewable energy consumption while satisfying constraints on green energy integration, availability and latency. The authors of considered capping carbon footprint while minimizing the operating cost (including utility price, renewable energy cost, battery cost and operational expenditure). For a good survey of the literature dealing with integration of renewable energy in data centers.

Typically, high availability (also termed fault tolerance) is handled by spare capacity provisioning to mask partial or complete data center failure (at a site). While the work in minimizes the cost of spare capacity provisioning by minimizing the number of servers, our previous work showed the need to minimize the operating cost by considering spatio-temporal variation in electricity price . However, none of them considered the cost of green energy procurement while optimizing the operating cost.