Research on dynamic power management techniques for cloud computing system infrastructure

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Abstract: This thesis investigates dynamic power management techniques for cloud computing infrastructure, addressing the critical challenge of balancing energy efficiency with performance guarantees. As data centers consume substantial global electricity, static power allocation leads to significant waste during low-demand periods. This research proposes a novel framework integrating real-time workload prediction, virtual machine consolidation, and dynamic voltage/frequency scaling (DVFS). A predictive model, based on historical usage patterns, forecasts resource demand to proactively adjust server power states. The framework employs a heuristic algorithm for live migration of virtual machines, minimizing active servers while adhering to Service Level Agreements (SLAs). Experimental evaluation on a simulated cloud environment, using real-world workload traces, demonstrates that the proposed technique reduces total energy consumption by up to 28% compared to conventional static provisioning. Crucially, this is achieved with minimal impact on application performance, maintaining an SLA violation rate below 2%. The findings provide a scalable and effective solution for enhancing the energy proportionality of modern cloud data centers.

Keywords: Dynamic power management, cloud computing infrastructure, energy management techniques, cloud computing systems