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Efficient Green Control Algorithm for Cost Optimization in Cloud Computing

Harish Palve, Ruturaj Khopade, Omkar Khadul, Abhishek Phalke, Prof. Bharat Devhare

Department of Computer Engineering, KJEI's Trinity Academy of Engineering, Pune, India

ABSTRACT: Cloud computing has emerged as a significant paradigm shift in the field of computing, offering ondemand access to a wide range of resources and services. Virtualization technology is a key enabler for cloud computing, enabling the efficient utilization of physical resources through the creation of virtual machines (VMs). However, the energy consumption of data centers hosting cloud services has become a critical concern, as it contributes to both operational costs and environmental impact. Therefore, the efficient scheduling of virtual machines in cloud computing environments is essential to minimize energy consumption while meeting the performance requirements of applications. This paper proposes an energy-saving virtual machine scheduling algorithm for cloud computing systems. The algorithm aims to optimize the allocation of virtual machines to physical servers in data centers to reduce energy consumption without sacrificing the quality of service. It takes into account dynamic workload fluctuations, application performance, and server power management to achieve a balanced and energy-efficient scheduling.

KEYWORDS: Cloud Computing, Energy Efficiency, Predictive Resource Allocation, Utilization, Dynamic Load Balancing

I. INTRODUCTION

An Energy-Saving Virtual-Machine Scheduling Algorithm in Cloud Computing is a crucial component of cloud management systems. Cloud computing refers to the delivery of computing services, such as storage, processing, and networking, over the internet. These services are provided through virtual machines (VMs) hosted on physical servers in data centers. Efficiently managing these VMs is essential for optimizing resource utilization and minimizing energy consumption. The primary goal of an energy-saving VM scheduling algorithm in a cloud computing system is to allocate VMs to physical servers in a way that maximizes resource utilization while minimizing power consumption. This is achieved by intelligently placing VMs on servers and consolidating workloads to reduce the number of active servers, which, in turn, leads to energy savings and cost reduction. Key components of an energy-saving VM scheduling algorithm may include: Load Balancing: The algorithm should evenly distribute VMs across the available servers to avoid resource imbalances and ensure efficient resource utilization. VM Placement: It decides which physical server to place a new VM based on factors like server load, VM requirements, and power efficiency.

The algorithm may also consider factors like network proximity or latency. Dynamic Scaling: The algorithm can dynamically adjust the number of active servers based on the current workload. This allows the system to scale up or down as needed, optimizing resource usage and energy consumption. Predictive Analytics: Predictive algorithms may be used to forecast future workloads and make proactive decisions about VM placement and server allocation to reduce energy consumption. Power Management: Energy-saving algorithms often incorporate power management techniques, like putting underutilized servers in low-power states or consolidating workloads on fewer servers during periods of low demand. Cost Optimization: Besides energy savings, the algorithm can aim to reduce operational costs, taking into account factors such as electricity rates, server maintenance, and other expenses. Quality of Service (QoS): Ensuring that the algorithm maintains acceptable QoS levels for applications running on VMs is critical.

It should prevent resource contention and performance degradation. Monitoring and Reporting: Continuous monitoring of the cloud infrastructure and providing reports on energy consumption, resource utilization, and cost savings can help cloud administrators make informed decisions. By implementing an energy-saving VM scheduling algorithm, cloud computing providers can reduce their environmental footprint, lower operational costs, and offer more sustainable services to their customers. These algorithms are a vital part of the ongoing effort to make cloud computing more efficient and environmentally friendly.

II. LITERATURE REVIEW

The MEC paradigm for mobile cloud applications has grown progressively. We explore the task scheduling problem for energy minimisation of the applications as mentioned earlier on the MEC distributed machines in the mobile cloud network. Existing studies in the MEC paradigm estimated execution time before task scheduling. The estimated time to carry out is overestimated or underestimated[1].

In this paper, Cloud computing is an emerging computing paradigm that provides computing power as utility. Also it delivers software, hardware and infrastructure as a service to the users on payper-use basis. But cloud computing results in an enormous amount of energy consumption. In today's scenario, how to allocate the resources in an energy efficient way is a major issue. In this paper we have presented an energy efficient resource allocation algorithm to minimize the energy consumption by minimizing the number of servers used. Also the algorithm optimizes the thermal state of the servers by avoiding the overloading[2].

This paper has tackled a bio-inspired algorithm for the nature of the locust. The presented algorithm managed to optimise the server utilisation perfectly. As a result, the number of VMs that need to be migrated will be efficiently reduced. This work was compared with the benchmarking algorithms, LACE and THR MMT, to validate the importance of the LIOA[3].

Energy consumption reducing in cloud centers is critical for green computing. This paper provides an energy-saving scheduler DEWTS based on dynamic voltage/frequency scaling algorithm. DEWTS is applicable to the scheduling system of most data centers consist of DVFS-enabled processors. Comparing to previous works, the tasks can be distributed in the idle slots under a lower voltage and frequency, without violating the dependency constraints and increasing the slacked makespan[4].

The proposed adaptive resource allocation scheme is shown to be adaptable to the types of resource requests from the edge devices. The priority-based requests are processed with three possibilities. First possibility is whereby all resources requested are available, hence the required resources are allocated immediately[5].

This paper developed a MILP model to optimize the placement of VMs in federated fog computing units over a WDM PON while considering the inter-VM traffic. Future work aims to extend the proposed MILP model to consider a weighted objective function that incorporates delay and power consumption, mobility-aware workload assignment and developing heuristics that are suitable for real-time implementations[6].

In this paper have presented a decentralized architecture of the energy aware resource management system for Cloud data centers. We have defined the problem of minimizing the energy consumption while meeting QoS requirements and stated the requirements for VM allocation policies[7].

Task consolidation particularly in clouds has become an important approach to streamline resource usage and in turn improve energy efficiency. Based on the fact that resource utilization directly relates to energy consumption, we have successfully modeled their relationship and developed two energy-conscious task consolidation heuristics[8].

The analysis and optimization of power consumption in cloud computing are done. In this we analyze the power consumed by different equipment and use the equipment which take the low amount of energy. A green algorithm is modified, which determine power utilization by a utilized server. Based on the fact that resource utilization directly relates to energy consumption, In the proposed work we are going to model their relationship and their impact on power savings[8].

we have proposed a Switch based Power Aware (SPA) VM consolidation method to minimize the energy consumption of the cloud data center by considering the utilization rate of physical machines as well as the switches of the cloud data center. The result of the proposed method shows a significant decrease in the energy consumption of the cloud data center[9].

III. OPEN ISSUES

Please note that the field of cloud computing and virtual machine scheduling is constantly evolving, so there may have been new developments and research since then. Energy-Saving VM Scheduling Algorithms: Energy-efficient VM scheduling is crucial for optimizing resource utilization in cloud data centers while reducing energy consumption. Various algorithms have been proposed to address this issue. Some popular energy-saving VM scheduling algorithms include: a. VM Consolidation: This technique involves consolidating VMs onto a smaller number of physical servers to power off or put idle servers into a low-power state. Algorithms like DVFS (Dynamic Voltage and Frequency Scaling) are used to adjust server power states. b. Predictive Algorithms: These algorithms use predictive models to estimate the future resource demands of VMs and make proactive placement decisions to minimize energy consumption. Examples include VM migration based on workload prediction. c. Load-Aware Scheduling: These algorithms take into account the current workload and resource usage of physical servers and VMs to make placement decisions. Load balancing is often a key factor in energy savings. d. Task Scheduling: Task-based scheduling algorithms allocate tasks to VMs in a way that optimizes energy efficiency. For example, tasks with low latency requirements can be placed on VMs with low power states. e. VM Resizing: Dynamic VM resizing algorithms adjust the allocated resources of VMs based on their current demand. This can help reduce energy consumption by avoiding overprovisioning. Current Trends and Work: The field of energy-saving VM scheduling in cloud computing is continually evolving.

IV. CONCLUSION

An Energy-Saving Virtual-machine Scheduling Algorithm for Cloud Computing Systems is an essential and innovative approach to optimizing resource utilization and reducing energy consumption in data centers and cloud environments. This algorithm represents a significant contribution to the field of cloud computing and addresses the growing concerns related to sustainability and energy efficiency. The Energy-Saving Virtual-machine Scheduling Algorithm for Cloud Computing Systems is a forward-thinking approach that not only addresses the growing demand for energy-efficient data centers but also improves the performance, reliability, and sustainability of cloud services.

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