IJIRSET
International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

e-ISSN: 2319-8753 | p-ISSN: 2347-6710

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 2, February 2024

ISSN INTERNATIONAL STANDARD SERIAL NUMBER INDIA

Impact Factor: 8.423

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International Journal of Innovative Research in Science, Engineering and Technology (IJIRSET)

|e-ISSN: 2319-8753, p-ISSN: 2347-6710| www.ijirset.com | Impact Factor: 8.423| A Monthly Peer Reviewed & Referred Journal |

|| Volume 13, Issue 2, February 2024 ||

| DOI:10.15680/IJIRSET.2024.1302064 |

Energy Efficient Resource Utilization in Cloud

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ABSTRACT: The advent of cloud computing has revolutionized the way organizations manage and deploy their IT infrastructure. Cloud services offer flexibility, scalability, and cost-efficiency, but they also consume a substantial amount of energy and contribute to environmental concerns. This abstract provides an overview of the research conducted on energy-efficient resource utilization in the cloud, focusing on strategies to reduce energy consumption while maintaining optimal performance and resource utilization. The primary objective of this research is to address the growing concern of the environmental impact of cloud computing by proposing and evaluating various energy-efficient techniques and strategies. These strategies encompass multiple layers of the cloud infrastructure, including data centers, virtualization technologies, workload management, and resource allocation. In data centers, we explore techniques for optimizing cooling systems, power distribution, and server hardware, all aimed at reducing energy consumption. Virtualization technologies are a key component in cloud computing, and we investigate methods for efficient virtual machine placement, consolidation, and migration to make better use of the available resources and minimize energy consumption. Workload management strategies involve the dynamic allocation of resources to workloads based on demand. We propose intelligent resource allocation policies that consider factors such as workload characteristics, energy profiles of hardware components, and Quality of Service (QoS) requirements. These policies help in achieving an optimal trade-off between performance and energy consumption.

KEYWORDS: Cloud Computing, Energy Efficiency, Resource, Utilization, Green Cloud Computing, Energy-Aware Cloud, Data Center Efficiency

I. INTRODUCTION

Energy-efficient resource utilization in the cloud has become a critical concern in recent years due to the significant growth of cloud computing and its environmental impact. This concept revolves around the optimization of energy consumption while effectively utilizing the available computing resources in cloud data centers. Here's some background information on the topic: Cloud Computing: Cloud computing is a paradigm that allows users to access and use computing resources, such as servers, storage, databases, networking, software, and more, over the internet. It offers scalability, flexibility, and cost-effectiveness, making it an attractive option for businesses and organizations. Energy Consumption in Data Centers: Data centers are the backbone of cloud computing services, hosting vast amounts of hardware and software resources. They consume enormous amounts of electricity to operate, which has led to growing concerns about the environmental impact, high energy costs, and the sustainability of cloud services. Resource Utilization: Efficient resource utilization in the cloud is about ensuring that computing resources are utilized optimally to meet performance requirements while minimizing waste. This includes CPU, memory, storage, and network resources. Virtualization: Virtualization technologies, such as server virtualization, play a key role in resource utilization in the cloud. They enable multiple virtual machines (VMs) to run on a single physical server, consolidating workloads and reducing idle resource capacity. Energy Efficiency Measures: Data Center Location: Choosing data center locations with access to renewable energy sources can significantly reduce the carbon footprint. Power Management: Implementing power management techniques like dynamic voltage and frequency scaling (DVFS) and server consolidation. Efficient Cooling: Efficient cooling systems, like hot/cold aisle containment and liquid cooling, help reduce energy consumption. Energy-Aware Scheduling: Intelligent scheduling algorithms can distribute workloads to minimize energy consumption. Energy-efficient Hardware: The development of energy-efficient processors and hardware components can reduce energy usage. Green Computing: Green computing is a broader concept that encompasses energy-efficient resource utilization. It involves the design and use of computing resources in a way that reduces their environmental impact. Regulations and Environmental Concerns: Governments and environmental agencies are increasingly implementing regulations and guidelines to limit energy consumption and carbon emissions from data centers. Businesses also face growing pressure from customers and stakeholders to adopt environmentally friendly practices. Economic Benefits: Energy-efficient resource utilization is not only environmentally responsible but also economically advantageous. It reduces energy bills and can lead to long-term cost savings. Challenges: There are

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challenges in achieving energy-efficient resource utilization, including the need for more energy-efficient hardware, complex management and optimization strategies, and the trade-offs between performance and energy efficiency.

II. LITERATURE REVIEW

Sumita Bose et al.: 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.

Mohammed Alaa et al.: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.

Zhuo Tang et al.: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.

Abdullah Lakhan et al.: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.

Abdullah M. Alqahtani et al.: 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.

Anton Beloglazov et al.: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.

Young Choon Lee et al.: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.

Archana Soni et al.: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. Shally et al.: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.

Zubair Sharif et al.: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

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III. CONCLUSION

Energy-efficient resource utilization in the cloud is a critical consideration in today's digital age. As the demand for cloud services continues to grow, so does the environmental impact and operational costs associated with data centers and cloud infrastructure. Energy-efficient resource utilization in the cloud is not only an environmental and cost-saving imperative but also a technological and business opportunity. Embracing energy efficiency in cloud computing can lead to a more sustainable, cost-effective, and competitive digital landscape while mitigating the environmental impact of IT infrastructure. As the cloud industry continues to evolve, prioritizing energy efficiency will remain a crucial aspect of its growth and development.

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