Dynamic Virtual Machine Hardening Estimation Considering Changing Energy Use

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Abstract-Virtual machine consolidation (VMC) is an effective way to solve the problems of high-power consumption and low utilization in cloud data centers. However, large-scale virtual machine migrations (VMMs) can result in additional workloads, service-level agreement violations (SLAVs), and considerable energy consumption (EC). Existing studies have made great progress in this respect, but the following problems remain: first, the potential overload of the physical host is not considered in the load detection of the physical host; second, the resource-demand scaling of physical hosts is not considered during virtual machine (VM) placement, which results in the lack of accuracy in selecting suitable hosts. In view of the above problems, this study firstly constructs a virtual resource consolidation model based on green energy conservation (GEC-VRCM), which defines the specific process and related attributes of VMC, which is beneficial to improve the consolidation efficiency of virtual resources. Second, based on this model, we propose a dynamic virtual machine consolidation algorithm based on balancing energy consumption and quality of service (EQ-DVMCA) to achieve efficient consolidation of virtual resources.

I. INTRODUCTION

Generally, due to various reasons such as network equipment, server utilization, and the low efficiency of the data center cooling system, data center energy is wasted.

An effective and common method to solve this problem is virtual machine (VM) consolidation (VMC).VMC refers to placing VMs on fewer servers through virtual machine migration (VMM) according to their resource requirements and then changing some servers to sleep state, to reduce the energy cost of the data center. Virtual Machine (VM) migration increases the demand for computing resources, leading to higher costs. Additionally, large-scale VM migrations can result in added workloads, the risk of violating service-level agreements (SLAs), and increased energy consumption (EC). During the migration process, service interruptions are inevitable, which may reduce the overall quality of service (QoS). Extended migration periods can further degrade QoS.This method can improve the service resource utilization of the data center and reduce the energy cost, to realize the demand of energy conservation and the environmental protection of the data center. Aiming at the above problems, this paper constructs a virtual resource consolidation model based on green energy conservation (GEC-VRCM), which defines the specific process and related attributes of virtual resource consolidation. Secondly, based on this model, we propose a dynamic virtual machine consolidation algorithm based on balancing energy consumption and quality of service (EQ-DVMCA) to achieve the efficient consolidation of virtual resources. The relationship between VM hardening (security) and energy consumption has not been sufficiently explored in the existing literature. While research has focused on energy-efficient scheduling and management in virtualized data centers, there is a lack of comprehensive studies that investigate how dynamic hardening decisions (such as applying additional security controls) influence the energy consumption of VMs

II.RELATED WORK

"Energy-aware virtualization in cloud data centres" by Ghosh et al. (2012). This paper investigates energy-aware scheduling policies in virtualized cloud environments, which could be relevant for understanding energy implications when hardening VMs**.**

"A Comprehensive Survey on Energy-Aware Scheduling in Cloud Computing" by R. Ranjan et al. (2016), provides an overview of energy-aware scheduling, which can be related to dynamic VM configurations.

Security in Virtual Machine Environments" by M. Sharif et al. (2009). This paper outlines common security issues and the importance of VM hardening to mitigate vulnerabilities in cloud infrastructures.

"Cloud Security and Privacy: A Comprehensive Survey" by S. Subashini et al. (2011), which examines security challenges in the cloud and how dynamic hardening can be applied.

"The trade-off between security and energy consumption in cloud environments" by D. B. M. Javed et al. (2019). This paper discusses how adding security layers impacts energy efficiency, which can be crucial for estimating the effects of hardening on VM energy use.

"Power-aware virtual machine placement for energy-efficient data centers" by S. J. Lee et al. (2011). It looks at how VM placement and resource scaling can optimize energy consumption, which could be influenced by hardening policies.

III.METHODOLOGY -ALGORITMS USED

1.Green Energy Conservation Virtual Resource Consolidation Model (GEC-VRCM)

The first contribution of this study is the development of the Green Energy Conservation Virtual Resource Consolidation Model (GEC-VRCM). This model serves as the foundation for the virtual resource consolidation process, incorporating energy conservation strategies and VM placement techniques that minimize the environmental impact of data center operations.

Virtual Resource Consolidation (VRC): The model defines the specific process of Virtual Machine Consolidation (VMC), including resource allocation, VM migration, and consolidation planning. By consolidating workloads onto fewer physical machines, it reduces the number of active Physical Machines (PMs) and Virtual Machine Monitors (VMMs), directly decreasing the energy consumption of the data center.

Green Energy Focus: The model integrates green energy conservation strategies by emphasizing the use of renewable energy sources. It considers the availability of renewable energy when scheduling and consolidating VMs, ensuring that VMs are placed on servers that are powered by sustainable energy sources. This contributes to reducing the carbon footprint of the cloud infrastructure.

2.Dynamic Virtual Machine Consolidation Algorithm (EQ-DVMCA)

The core of this study is the Dynamic Virtual Machine Consolidation Algorithm (EQ-DVMCA), which aims to balance energy consumption (EC) and QoS during the consolidation process.

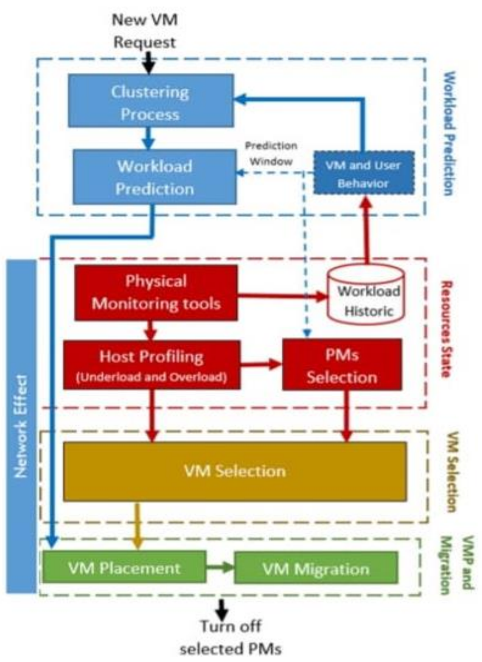
Energy Consumption Reduction: The algorithm dynamically consolidates virtual machines onto a smaller number of physical machines based on their current resource demands and energy consumption patterns. By reducing the number of active servers, it minimizes the total energy usage of the system. The algorithm ensures that power-hungry servers are switched off or put into low-power states when not required.

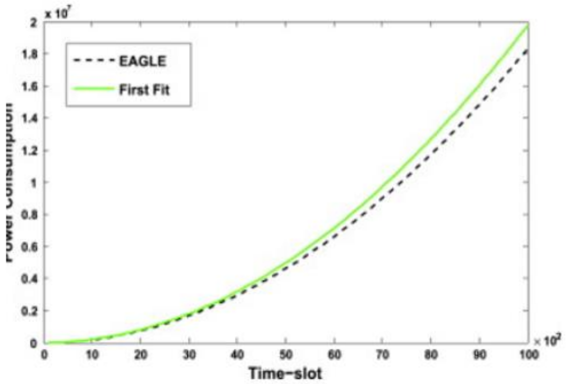
Quality of Service (QoS) Maintenance: Despite the focus on energy conservation, EQ-DVMCA places a high priority on maintaining a high level of QoS. The algorithm considers factors such as response time, throughput, and latency, ensuring that VMs are consolidated in a manner that does not degrade service quality. It uses performance-based metrics to determine the optimal placement of VMs on physical machines, ensuring that all VMs meet their QoS requirements.

IV.RESULTS

ADVANTAGES OF PROPOSED SYSTEM

High Security, Multiple levels of access and security, Low computation cost. EQ-DVMCA is a dynamic algorithm that adapts in real-time to changes in workload characteristics, VM resource demands, and energy availability. If certain VMs are underutilized, they can be migrated to more energy-efficient machines, thereby reducing overall energy consumption without sacrificing service quality.





V. CONCLUSION

This study introduces an approach to virtual machine consolidation that not only focuses on reducing energy consumption but also maintains a high level of service quality. By combining the Green Energy Conservation Virtual Resource Consolidation Model (GEC-VRCM) and the Energy and QoS Balancing Dynamic Virtual Machine Consolidation Algorithm (EQ-DVMCA), this research proposes an advanced solution for optimizing cloud resource management. The ability to dynamically balance energy consumption with QoS requirements while incorporating green energy strategies is a significant step forward in achieving more sustainable and efficient cloud computing environments. VMC is one of the most effective methods to solve the high power consumption and low utilization of cloud data centers. However, large-scale VMM can result in additional workloads, SLAV, and considerable power consumption. Therefore, efficient VMC is one of the hotspots of current research. Existing studies have made great progress in this respect, however, the following problems still exist: first, the potential overload is not considered in the load detection of physical host; second, the resource-demand scaling of physical hosts is not considered during VM placement, which results in a lack of accuracy in selecting suitable hosts. In order to solve the above problems, this paper first constructed the GEC-VRCM model, which defines the specific process and the related attributes of VMC. GEC-VRCM is beneficial to improve the consolidation efficiency of virtual resources. Secondly, on the basis of this model, we propose EQ-DVMCA to realize the efficient consolidation of virtual resources.

VI.REFERENCES

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