RESOURCE MANAGEMENT ON CLOUD

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***Abstract*— Cloud computing has become a significant research area in large-scale computing, because it can share globally distributed resources. Cloud computing has evolved with the development of large-scale data centers, including thousands of servers around the world. However, cloud data centers consume vast amounts of electrical energy, contributing to high-operational costs, and carbon dioxide emissions. Dynamic consolidation of virtual machines (VMs) using live migration and putting idle nodes in sleep mode allows cloud providers to optimize resource utilization and reduce energy consumption. However, aggressive VM consolidation may degrade the performance. Therefore, an energy-performance tradeoff between providing high-quality service to customers and reducing power consumption is desired. In this paper, several novel algorithms are proposed for the dynamic consolidation of VMs in cloud data centers. The aim is to improve the utilization of computing resources and reduce energy consumption under SLA constraints regarding CPU, RAM, and bandwidth. The efficiency of the proposed algorithms is validated by conducting extensive simulations. The results of the evaluation clearly show that the proposed algorithms significantly reduce energy consumption while providing a high level of commitment to the SLA.**

***Index Terms*— Cloud computing, energy efficiency, service level agreement, virtual machine consolidation, data center.**

I. Introduction

In recent years, cloud computing has become popular because of its ability to offer utility-oriented IT services over the Internet to global users. Cloud computing is a paradigm to develop scalable on-demand virtualized resources based on a pay-as-you-go model. Different types of applications, from scientific to business, can utilize cloud-based services in various forms, including software, hardware, and data. The biggest IT companies, such as Google, Amazon, Microsoft, and IBM, have developed their cloud data centers around the world to support cloud services. Cloud data centers ideally allocate resources to users in a way that satisfies the required Quality of Service (QoS) determined by the cloud subscribers through the Service Level Agreement (SLA). In cloud computing, an SLA is defined as a two-sided contract between the cloud provider and its users, and it determines the content of services provided, level of performance, prices, and penalties for not providing the services. Any breach of the QoS leads to SLA violation, and consequently, a penalty must be paid by service providers.

Consolidation refers to the live migration of VMs between hosts with little in the way of performance interruption. The aim of consolidation is moving the VMs to a minimal number of hosts and switching the idle hosts to power saving modes. Aggressive consolidation of VMs to minimize energy consumption may lead to performance degradation so that the system cannot deliver the expected quality of service, consequently leading to an increase in SLA violations. Hence, the consolidation mechanism should keep possible SLA violations low while decreasing energy consumption as soon as possible.In this paper, we propose a dynamic and adaptive energy-efficient VM consolidation mechanism considering SLA constraints for cloud data centers. The main contributions of the paper are as follows:

_ Develop an overloading host detection algorithm using an iterative weighted linear regression method to determine two utilization thresholds and avoid performance degradation.

_ Develop a power and SLA-aware VM selection algorithm using three different policies to select adequate VMs that need to be migrated to other hosts.

_ Develop a two-phase VM placement algorithm that can be utilized for the effective placement of new VMs and the VMs selected for consolidation.

_ Develop an underloading host detection algorithm using a vector magnitude squared of multiple resources to consolidate active hosts and switch them to a power saving mode.

_ Develop a distributed energy-efficient dynamic VM consolidation mechanism by employing the proposed algorithms according to the utilization of multiple host resources.

II.THE SYSTEM MODEL

A.VM SCHEDULER

VM scheduler run and invoked periodically. LNM (Local Node Manager) demands the history of VMs, capacity and the load history of PMs and the current layout of VMs on PMs. Then it forward the request to the predictor.

B.PREDICTOR

The predictor predicts the future demands of VMs based on the past statistics. The LNM attempts to satisfy the new demands locally by adjusting their weights in its CPU scheduler.

C.HOTSPOT SOLVER

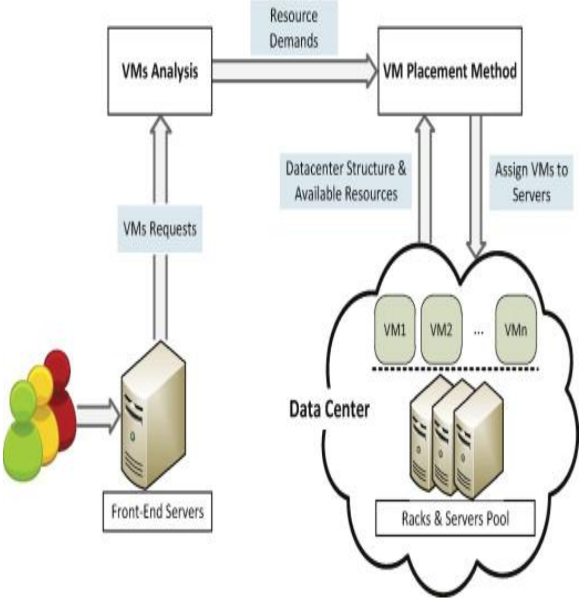
Detect the resource utilization of any PM is above the hot threshold (i.e., a hot spot).VMs running on them will be migrated away to reduce their load. Then it can give the request to coldspot solver.

D.COLDSPOT SOLVER

The coldspot solver checks if the average utilization of actively used PMs (APMs) is below the cold threshold. If so, some of those PMs could potentially be turned off to save energy. It identifies the set of PMs whose utilization is below the cold threshold (i.e., a cold spot) and then attempts to migrate away all their VMs then it forward request to migration list.

E.MIGRATION LIST

When migration list can receive the request from coldspot solver and it can compiles list of VMs and migration list cases it response to the user controller for execution.



THE SYSTEM MODEL

III. THE PROPOSED VM CONSOLIDATION MECHANISM

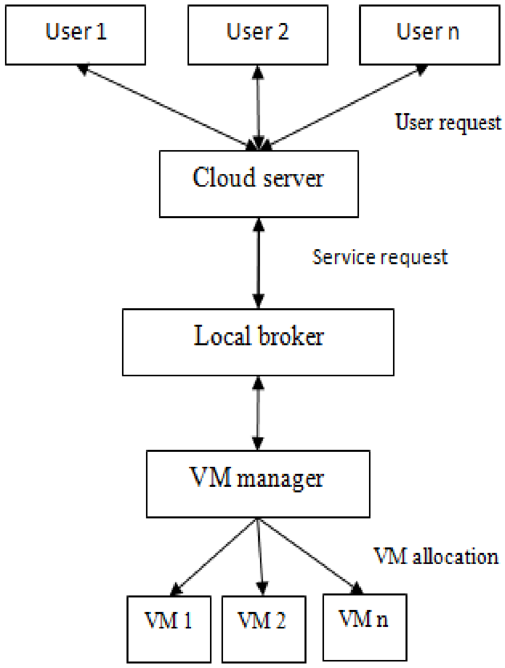
Using VM consolidation, cloud providers can optimize their resource utilization while reducing power consumption of data centers. Our proposed VM consolidation mechanism includes four algorithms, as follows:

_ Overloading host detection: Distinguishes when hosts should be considered overloaded, in which case one or several VMs are reallocated to other hosts to reduce host utilization.

_Under loading host detection: Distinguishes when hosts should be considered underloaded, in which case all the VMs are consolidated to other hosts; then, the host is switched to the sleep mode.

_ VM selection: Chooses the most suitable VMs to be migrated from overloaded hosts.

_ VM placement: Discovers the most suitable destination host for the selected VMs.



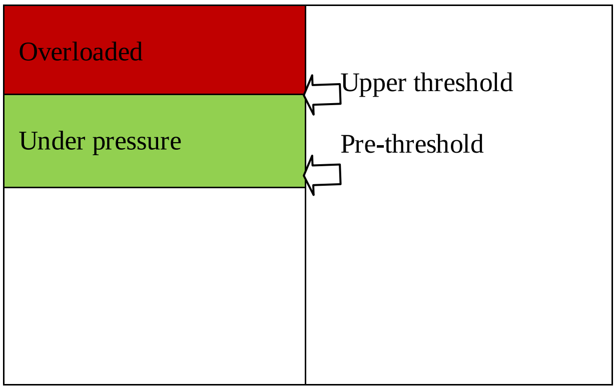
IV.ALGORITHM

A. OVERLOADING HOST DETECTION ALGORITHM

The objective of the overloading host detection algorithm is to recognize when a host is overloaded. Each host executes this algorithm periodically. Detection is based on the usage of host resources which are CPU, RAM, and bandwidth. Whenever the algorithm is invoked, it initiates the IWLR algorithm to dynamically determine the utilization thresholds for each of the three resources. In the event a host is overloaded, one or several VMs are selected for migration to other hosts, hence bringing the utilization under acceptable thresholds. Because the proposed consolidation mechanism is an adaptive mechanism for different types of workload, an adaptive method to detect overloaded hosts is proposed.

1) ITERATIVE WEIGHTED LINEAR REGRESSION (IWLR)

Regression is a statistical method for quantitative data analysis that is used to predict the future values of data. Regression is widely used for predictions in various fields. Regression can be used in two models: simple regression in the case of one input and multiple regression for more than one input. The target of regression is approximating a regression function (linear or non-linear), which estimates the relationship between input variable X and output variable Y by the regression line. The proposed algorithm uses a simple weighted linear regression to predict future host utilizations.



B. VM SELECTION ALGORITHM

The first parts of consolidation mechanism, all the overloaded hosts are detected. Then, one or several VMs will be selected from each detected host using VM selection algorithm so that host utilization drops below the threshold. This algorithm is iterative and after selecting each VM, the utilizations of the host resources are checked again. In the case the host is still overloaded, more VMs will be selected. Three policies are proposed for this algorithm in this section.

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1) MAXIMUM POWER REDUCTION POLICY

The Maximum Power Reduction (MPR) policy selects and migrates a VM *v* that reduces the host power consumption after migration more than other VMs allocated to the host. Let *VMj* be a set of VMs allocated to the host *i*, then the MPR.

2) TIME AND POWER TRADEOFF POLICY

The Time and Power Tradeoff (TPT) policy selects and migrates a VM *v* that has the best trade-off between the least migration time and the most power reduction after migration relative to the other VMs allocated to the host. Let *VMj* be a set of VMs allocated to the host *i*, then the TPT policy tries to find a set *V* 2 *VMj* defined in.

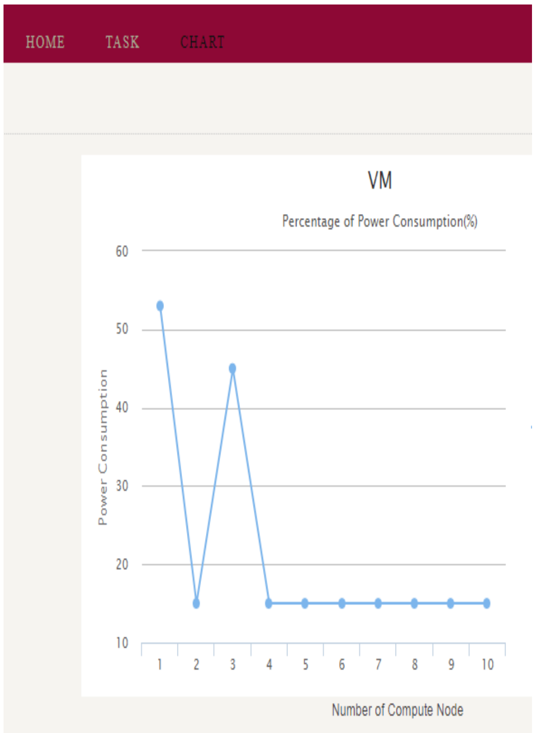
$$V = \begin{cases} \left\{ \begin{array}{l} L \mid L \in VM_j,\ u_i - \sum_{v \in L} u(v) < T_{up},\ |L| \to min, \\ \left|P\,|u(v)|\right| \to \max \ \&\ t(v) \to min \end{array} \right\}, & \text{if } u_i > T_{up} \\ \emptyset, & \text{otherwise} \end{cases}$$

Where *ui* is the utilization of the host *i*, *Tup* is the upper threshold, *u* . *v*/ is the fraction of CPU utilization allocated to *v*, *P* j*u*(*v*)j is the power consumed by *v* in the host *i*, and *t* .*v*/ is the migration time of *v* defined in

$$Migration\ time = \frac{RAM(v)}{BW_i}$$

C.UNDERLOADING HOST DETECTION ALGORITHM

After detecting the overloaded hosts, selecting the VMs, and sending them to the other hosts, then in this step, the underloaded hosts are determined. Because the proposed consolidation mechanism is a dynamic mechanism for different types of workload, an adaptive method is needed to determine the lower threshold and to detect underloaded hosts.



V.CONCLUSION

Monitoring the VM's communications and then more efficient allocation of VMs. Cloud environments consist of heterogeneous servers with different characteristics and capacities which provide various levels of performance. A performance-aware strategy which can deal with various workloads provided by the applications running on the system can improve energy-efficient VM consolidation mechanism in cloud data centers. Allocate VM machine based on energy conception.

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