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VM Consolidation Technique for Green Cloud Computing

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Abstract-Virtual Machines (VMs) signify to the software implementation of a computer that continues its own OS and applications as if it was a ordinary machine (OM). Live migration of VMs allows a server administrator to progress a running virtual machine or application among different a ordinary machine without disconnecting the client or application. This defines the concept of an extensive machine. The strict differentiation of priorities has significant influence on the portability of the user software, modification and testing of operating systems etc. When a VM is transfer, it is important that this arise in a manner that balances the requirements of minimizing both the downtime and the total transfer time.

This potential is being increasingly utilized in today's enterprise environments to provide proficient online system maintenance, reconfiguration, load balancing and active fault tolerance. They provide attractive features to meet requirements of computing resources in recent computing systems, together with server consolidation, performance isolation and simplicity of management. As a result, many implementations are presented which support the feature using different functionalities. This paper surveyed and implemented procedure for VM migration. We provide particular attention to the designer's goals such as movement of memory and network. We also look into the security and performance section of VM migration.

This paper presents a broad survey of different VM consolidation challenges such as host under-load detection, host overload detection, VM selection, VM live movement and VM placement algorithms. The paper deliberate these VM consolidation challenges and shows a comparison between different VM consolidations algorithms.

Keywords
Cloud computing; Energy consumption; Cloud Computing; Migration; Virtualization; Virtual Machine; Virtual Machine; Migration Resource Management.

1. .INTRODUCTION

As cloud computing offers services to many users' worldwide, general applications from customers are hosted by large-scale data centers. In such platforms, virtualization technology is engaged to multiplex the underlying physical resources. Since the incoming loads of different application differ significantly, it is important and acute to manage the placement and resource allocation arrangements of the virtual machines (VMs) in order to guarantee the quality of services.

It provides an approach to deliver the infrastructure, platform, and software as services accessible to consumers in a pay-as-you-go manner [1]. Such usual commercial service providers include Amazon, Google, and Microsoft. In cloud computing environments, large-scale data centers [2] are usually the crucial computing infrastructure, which is comprised of adequate number of physical nodes with various virtual machines running upon them.

Cloud computing is a new example for the dynamic provisioning of computing services supported by modern data centers. With the development of cloud computing, the data centers are growing at a unique rate. However, average data centers require as much energy as 25,000 household and it was predictable that the energy consumption from data centers would have accounted for two percent of the worldwide energy consumption by 2020.

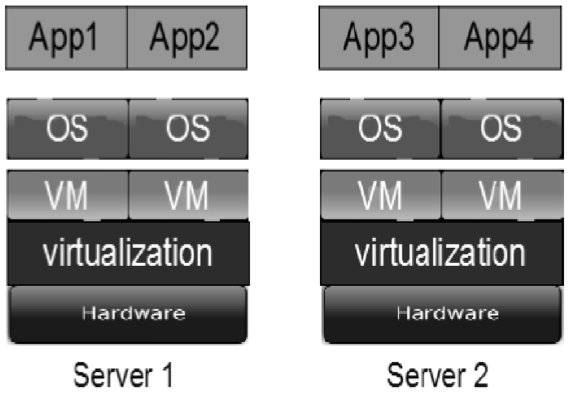
Resource provisioning plays a crucial role in ensuring that cloud provides adequately achieve their obligations to customers while boosting the utilization of the original infrastructure. An efficient resource management scheme would require dynamically distributing each service request the minimum resources that are needed for acceptable fulfillment of SLAs, leaving the access resources free to organize more virtual machines. The provisioning selections must adapt to changes in load as they arise, and respond gracefully to unanticipated demand floods. For these reasons, the datacenter resource among the many hosted applications is a challenging task.

In this work we influence live migration of VMs and propose

Heuristics for dynamic reallocation of VMs according to recent resources requirements, while ensuring reliable Quality of Service. The objective of the reallocation is to minimize the number of physical nodes serving existing workload, whereas idle nodes are switched off in order to decrease power consumption. Many researches have been done in power efficient resource managing in data centers, e.g. [3], [4].

Virtualization [5] is the key technology in cloud computing. Virtualization is the powerful tool used in today's computing. Over virtualization multiple operating system can made running on one physical machine. With the help of virtualization number of VM can be formed on the server with multiple OS running on it and on single OS one application can run well. Even if a virtual machine not working, other OS running on other virtual machines running on same host will not be affected and work continuously. Virtualizations are implemented through hypervisor, which create the virtual machine for each user. One or many VM are created to one user and numbers of virtual machine are hosted in a single host.

According to the prediction, the algorithm first calculates required dynamic workload on the servers. Then unrequired servers are switched off in order to minimize the number of running servers, thus minimizing the energy use at the points of consumption to offer benefits to all other levels. Also, several servers are added to help guarantee service-level agreement. The lowermost line is to protect the environment and to decrease the total cost of ownership while ensuring quality of service.
A VM consolidation algorithm that focuses on balanced resource utilization of servers for different resource types.



The rest of the paper is organized as follows: Section II presents VM migration overview. Section III gives summary of all the existing methods of energy efficient with server consolidation based on the model, with their used tools and possible improvements. Section IV concludes the paper.

2. VM MIGRATION

The software layer offers the virtualization is called a Virtual Machine Monitor (VMM) or hypervisor. It virtualizes all of the resources of a physical machine, thus defining and supporting the execution of multiple virtual machines. Virtualization can provide major benefits in cloud computing by enabling VM migration to balance load across the data centers.

2.1 Migration Goals

Migration is mainly prepared for dynamic resource Management [6]. Its main goals are as follows:
Load balancing: This reduces the variation of resource usage levels across all the OMs in the cluster. This prohibits some machines from getting overloaded in the occurrence of lightly loaded machines with sufficient superfluous capacity. Migration can be used to balance the system. The overall system load can be balanced by migrating VMs from overloaded OMs to lightly-loaded OMs.
Server Consolidation: In order to reduce server collapse in data centers, server consolidation algorithms are required. These algorithms are VM packing heuristics which undertake to pack as many VMs as possible on a OM so that resource usage is improved and vacant or under-utilized machines can be turned off. Consolidation will result in reduced power consumption and thus reducing complete operational costs for data centre administrators. Migration of VMs could achieve this. Based on the load conditions, lightly-utilized machines having resource usage below a threshold and overloaded machines having resource usage above a specific threshold are identified, and migrations are initiate to tightly pack VMs to increase overall resource usage on all OMs and free up resources if possible.
Hotspot & Cold-spot Mitigation: The finding of hotspots and cold-spots are always created on thresholds which are set by the data center owner or depend on the Service Level concurrence specified by the clients. Frequently, a higher resource usage value close to extreme is set as the upper threshold and a very low resource usage value is set as the lower threshold. PMs devising resource usage values beyond the upper threshold are said to have made hotspots, whose usage values is below the lower threshold are said to have produced cold-spots. The earlier implies over-utilization and the last implies under-utilization, applicable across any resource dimension. These conditions are essentially taken care of the above mentioned consolidation and load balancing algorithms.

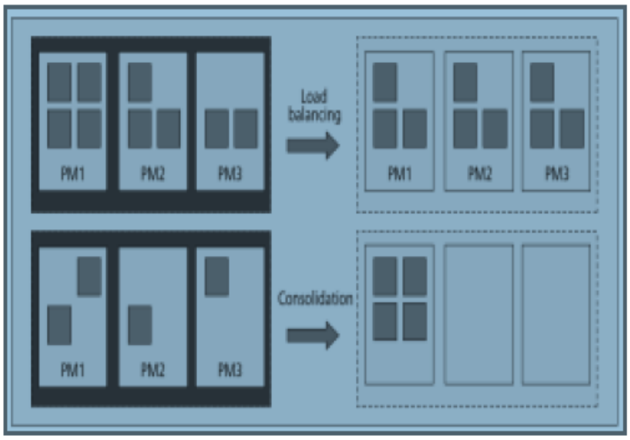


Fig. 1 Load balancing and consolidation scenarios

2.2 Task Consolidation Problem

The task consolidation problem is the process of turning over a set of tasks (service requests) to a set of cloud computing resources with the purpose of maximizing resource utilization and ultimately to minimize energy consumption. Time restrictions are directly related to the resource usage coupled with the tasks. In the task consolidation problem, the resource allocated to a particular task must adequately provide the resource usage of the given task. Task consolidation means the effective usage of cloud resources by consolidating a set of tasks into a little number of virtual machines. The advantage of effective resource usage is to reduce efficient cost by reducing: (a) amount of virtual machines; (b) labors essential to maintain virtual machines; (c) floor space; and (d) energy consumption.
There is a correlation between energy consumption, system structures, performance and task workload in the virtual machines. When jobs are running in the virtual machines resources are employed such as CPU, memory, disk, network bandwidth which direct to energy consumption.

3. Related Work

In[7]Task consolidation is a way which brings many benefits such as higher use of resources, rationalization of maintenance, IT service customization, QoS and efficient services, etc. In spite of this, maximizing resource utilization does not mean efficient energy usage. Some research works try to decrease resource utilization for saving energy while some try to find the equality between resource utilization and energy consumption. In this paper, an energy-aware task consolidation (ETC) technique is offered aims to optimize energy consumption of virtual clusters in cloud data center. Conforming a large amount cloud systems, a 70% principle of CPU utilization is proposed to manage task consolidation among virtual clusters. The simulation results demonstrate that ETC can drastically reduce power consumption in managing task consolidation for cloud systems.

Sujesha Sudevalayam and Purushottam Kulkarni [8] disagree that network affinity-awareness is required in resource provisioning for virtual machines. Authors have computed their work of benchmarking of link network procedure for both Xen and KVM virtualization methodologies. Authors have also attentive on building affinity-aware models that can predict CPU resource requirements based on its location comparative to its communicating set of virtual machines – upon collocation and dispersion of virtual machines.

In [9], authors deliberated energy efficient utilization of resource in the cloud computing systems. The cloud computing system drives virtualization technologies where tasks can be simply consolidated which is an effective method to raise resource utilization and sequentially reduces energy consumption. They proposed task consolidation Maximum rate Utilization (MaxUtil). MaxUtil looks behind the more energy efficient resources in terms of resource utilization. The energy model is created on the basis that processor utilization has a direct relationship with energy consumption.

The task consolidation problem is displayed as a bin packing problem where virtual machines characterize bins, tasks are objects to be packed in the bins and CPU resource deployment represents bin dimension. They proposed 100% resource utilization rule for virtual machines and build task consolidation decision based on the resource utilization which is a key pointer for energy efficiency. The advantage of this technique is to decrease number of virtual machines in the cluster which resulted in diminish energy consumption in the cloud computing system.

However, the shortages of the proposed MaxUtil model are: (a) it suppose energy consumption is direct to resource utilization focused on CPU usage without taking into account other resources utilization such as disk, network bandwidth, memory etc.; (b) the incorporation of job migration increased energy consumption for the reason that migrated tasks tend to be with tiny remaining processing time and these tasks are most possible to postponed the consolidation of a new arriving task (c) the migration of job from one virtual cluster to another is not modeled

In [10], a dynamic consolidation method is proposed sequentially to reduce energy rate and SLA violation of datacenter and so-called Reinforcement Learning---based Dynamic Consolidation (RL-DC) algorithm. RL-DC can vigorously adjust a number of active hosts to the variable workload. An significant part of the consolidation algorithm, is to make a decision whether (1) additional host are required to provide proficient resource utilization with an growing workload, or (2) redundant hosts can be put into sleep to save energy or (3) the current amount of hosts is adequate. To make this decision, a learning agent is understood as an essential part of RL-DC. The parts of the proposed consolidation algorithm are offered, Compared with the current dynamic consolidation approaches in CloudSim simulation, the proposed reinforcement learning-based dynamic consolidation process is capable of minimize energy cost and SLA violation rate efficiently.

Adel Nadjaran Toosi, Srinivasa K .Gopalaiyengar, Rajkumar Buyya[11]This paper, deliberated how current cloud datacenters are facing the difficulty of underutilization and incurring extra cost. This marks the problem harder, meanwhile it is not stress-free to predict how much capacity of a server should be allocated to each VM. Therefore, this paper, proposed a novel technique that take full advantage of the utilization of datacenter and permits the execution of heterogeneous application workloads, mainly, transactional and non- interactive jobs, with different SLA requirements. So the author approach to dynamically assign VMs in such a way that SLA signed with customer is encountered without any penalty. The paper also described how the proposed technique can be effortlessly integrated with the control and facilities such as auto-scaling offered by cloud providers. By performance evaluation, it is evaluated that the proposed mechanism MWAP reduces the number of servers utilized by 60% over other approaches like consolidation and migration with the little SLA violation. The main reason here is that MWAP is able to accomplish different workload and abuses their usage patterns and QoS requirements to accomplish efficient utilization of datacenter properties. Thus, we determine that for designing more effective dynamic resource provisioning mechanisms, it is to consider different types of SLAs laterally with their penalties and the mix of workloads for improved resource provisioning and utilization of datacenters; otherwise, it will not only experience unnecessary penalty to cloud providers but can also lead to under utilization of resources

Authers Wenying Yue and Qiushuang Chen[12]studies the dynamic placement of virtual machines (VMs) with deterministic and stochastic demands. In order to guarantee a quick response to VM requests and increase the energy efficiency, a two-phase optimization scheme has been proposed, in which VMs are organized in runtime and consolidated into servers periodically. Based on an enhanced version of multidimensional space partition model, a modified energy efficient algorithm with balanced resource utilization (MEAGLE) and a live migration procedure based on the basic set (LMABBS) are, respectively, developed for each phase. Experimental results have revealed that under different VMs' stochastic demand variations, MEAGLE assurances the availability of stochastic resources with a defined probability and diminishes the number of required servers by 2.49% to 20.40% compared to the benchmark algorithms. Also, the difference between the LMABBS solution and Gurobi solution is fairly negligible, but LMABBS significantly best in computational efficiency. MENGLE algorithm will achieve a specified quality-of –services.

Heena Kaushar, Pankaj Ricchariya, Anand Motwani,[13]This paper emphases on energy-efficient computing and present:(a) survey on “SLA and Energy-Efficient Dynamic Virtual Machine (VM) Consolidation”; (b) analysis of VM consolidation algorithms founded on various heuristics; (c) comparative analysis and results by conducting a performance evaluation study of several energy efficient VM consolidation techniques by means of real world workload traces. The comparison is through on various parameters and with DVFS policy. Current Cloud data centers host applications having heterogeneous requirements, from customers distributed over world and these requirements may vary over time. Cloud Providers want to provide strict QoS guarantees, which are recognized in the form of SLAs. The resource consolidation techniques in a data center directly influences whether the SLAs are encountered. While varied application requirements of cloud customers create scheduling and VM consolidation algorithms multipart, they can be destroyed to improve energy-efficiency. The focus of this effort is to study energy and QoS efficient VM consolidation approaches that can be useful in a virtualized data center by a Cloud provider.

Buyya R, Beloglazov A, Abawajy J[14]This paper offering vision, challenges, and architectural elements for energy-efficient management of Cloud computing environments. author focus on the development of dynamic resource provisioning and allocation algorithms that think about the various data center infrastructures (i.e., the hardware, power units, cooling and software), and work to boost data center energy efficiency and performance. In detail, this paper proposes (a) architectural values for energy-efficient management of Clouds; (b) energy-efficient resource allocation policies and scheduling algorithms allowing for quality-of-service opportunity, and devices power usage characteristics; and (c) a new software technology for energy-efficient management of Clouds. They have validated this approach by conducting a set of accurate performance evaluation study using the CloudSim toolkit. The results demonstrate that Cloud computing model has huge potential as it offers significant performance gains as regards to response time and cost saving under dynamic workload scenarios.

In [15] Dynamic consolidation of virtual machines (VMs) with migration and switching idle nodes to the sleep mode allow Cloud providers to minimize resource usage and reduce energy consumption. Conversely, the obligations of providing high quality of service to customers make possible the necessity in dealing with the energy-performance trade-off, as destructive consolidation may bring about performance degradation. Due to the inconsistency of workloads experienced by modern applications, the VM placement should be optimized always in an online manner. To understand the consequence of the online nature of the problem, author conduct competitive analysis and prove competitive ratios of optimal online deterministic algorithms for the single VM migration and dynamic VM consolidation difficulties. In addition, author proposes novel adaptive heuristics for dynamic consolidation of VMs established on an analysis of historical data from the resource usage by VMs. The proposed algorithms considerably reduce energy consumption, while promising a high level of adherence to the Service Level Agreements (SLA).

4. CONCLUSION

With the increase in the attractiveness of cloud computing systems, virtual machine migrations across data centers and various resource pools will be greatly beneficial to data center administrators. Virtual machine migration is an essential tool for dynamic resource management in recent day data centers. consolidation is an successful technique seriously enabled by virtualization technologies, which facilitate the concurrent execution of numerous tasks in virtual machines and in turn reduce the energy consumption. Consolidation in cloud computing presents a significant prospect for energy optimization. This paper surveyed various existing task consolidation technique to minimize energy consumption in the virtualized cloud computing situations. The main objective of cloud users is to develop resource provisioning and management solutions that diminish energy consumption while assuring Service level Agreements. As a result, this survey can be used to expand the energy consumption models by designing energy optimization models, energy consumption monitors and energy prediction models for the cloud schemes. This paper presents a survey of the current research efforts on live virtual machine migration. But this process takes extensive amount of migration time and downtime. A new model for live migration of VMs should be deliberate with reduced overheads of downtime and migration time.

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