Optimizing Server Utilization in Cloud Based Datacenter

Kavya S,Malathy G,Parkavi B

***Abstract*—**The main advantage of cloud based data center is dynamic allocation of resources depends on user demands. There are various technical challenges in dynamic allocation of resources such as Virtual Machine migration, server consolidation, scalability, high availability and load balancing. This paper mainly focuses on two main concepts server consolidation, load balancing. VM scheduling algorithm is used to measure and solve uneven utilization of resource in cloud based datacenter.

***Keywords*—**Energy efficient,Live Virtual machine migration, Resource balance, Virtual Machine scheduling.

I.INTRODUCTION

Cloud computing is a practice of using the network of remote servers hosted on the internet to store, manage, and process data, rather than a local server or a personal computer. In traditional datacenter studies have found that servers are often underutilized due to over provisioning of server resources for peak demands. So providers face loss during underutilized resources. But in cloud based datacenter depends on user demand server resources are scaled up and down. This data center uses virtualization concept. Virtualization is a technology used to create virtual machine (VM) for physical machine through Virtual Machine Monitor (VMM). It based on cloud provider to make sure the underlying physical machines (PMs) have sufficient resources to meet VM needs. VM live migration is used in cloud based datacenter to transfer VM from one PM to another PM without interrupting the process. Live VM migration has five steps. Consider host PM is one the VM in currently running and destination PM is one the VM have to migrate.

Step1: Start migration-prepare for migration, including determines the migrating VM and the destination PM.

Step2: Transfer memory-The whole execution state of the VM is stored in memory, sending the VM's memory to the destination PM ensures continuity of the service provided by the PM.

Step3: Stop and copy-suspend VM on host PM and synchronize all remaining VM state to destination PM.

Step4: Commitment-VM state on host PM is released.

Step5: Activation-VM starts on host PM, connects to local devices, resumes normal operations.

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The two goals in Resource balancing algorithm:

1. Load Balancing: Load Balancing happens at two places, first to distribute load evenly across PM and second when VM need more resources.
2. Server Consolidation: Some PM host low-resource-usage VMs. VMs on lightly loaded PMs can be "packed" and migrate to other PMs. This is server consolidation.

II.SYSTEM ARCHITECTURE

The cloud based datacenter is represented in Fig 1.The cloud based datacenter differs from traditional datacenter by virtualizes the resources in datacenter. The cloud user application's resource request is first passed to controller in cloud datacenter. A datacenter has many controllers. Each controller groups homogeneous server. That is all server connected in one controller have same type of resources. The controller check user authentication and make sure the request satisfy Service Level Agreement. The controller is placed in same or different server. Then controller communicates with Local node Manager (LNM).VMM or hypervisor is a host program that allows a computer to support multiple and identical execution environments.

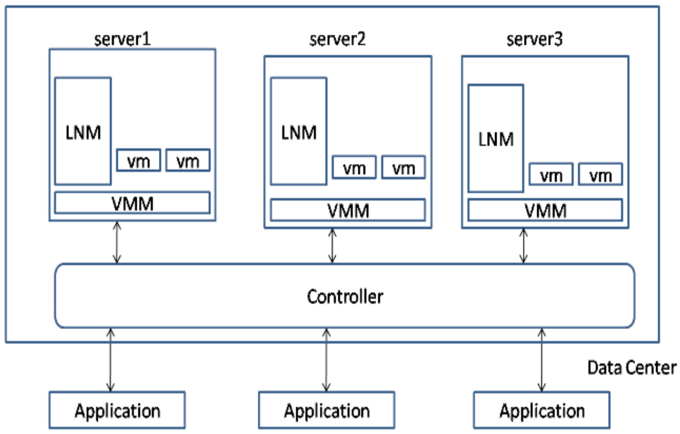


Fig1: Cloud based Datacenter

There are two types of hypervisors available

1) Type 1 VM's run directly on the host's hardware which controls the same and manages the operating system.

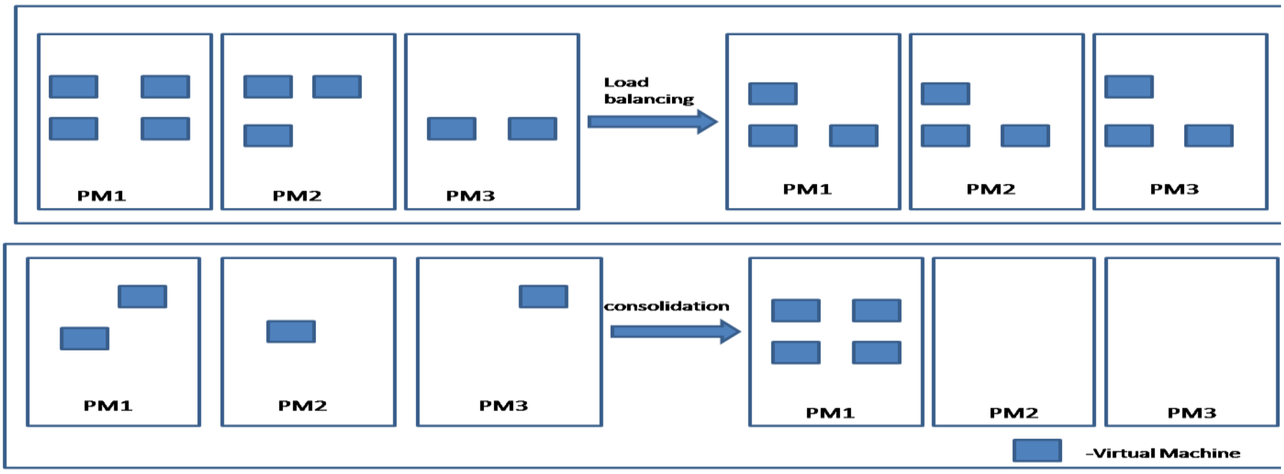
2) Type 2 Hypervisors run within an operating- system environment

LNM act as mediator between VMM and controller. Each server in datacenter has unique LNM.LNM interact directly with VMM to perform management operations such as creating, deleting, and migrating VMs on behalf of the controller. The local node managers also collect resource usage data from the VMMs. There are many VMM such as Xen, VMware and KVM are available. In this paper Xen VMM is used. LNMs report resource usage updates and events notification back to the controller. Events notifications are VM state change, VM operation request, errors and unexpected events.

III. VM SCHEDULING ALGORITHM

VM Scheduling algorithm is used to find the uneven utilization of resource in server. This algorithm is implemented in controller of datacenter.VM scheduling algorithm is invoked periodically and receives the resource demand of VMs, the capacity and the load of server, and the current layout of VMs on servers. Load balancing happens whenImbalance in the load or resource requirements of VMs not fulfilled, in which VMs from theoverloaded PMs aremigrated to lightly loaded PMs. Server consolidationhappens when large number of underutilized PMs are found, in which VMs from the lightly loaded PMs are migrated to more load designated PMs.

The algorithm has five parts: VM creation, Classification of server, Overload PM Migration, server consolidation, consolidated movements.



A. VM Creation

When the user's application requests the resource in cloud based datacenter. Controllers check whether the application has existing VM. If yes, then the resource is included in existing VM. If not the VM is sized according to the resource usage profile of application. This profile has resource details needed for application. For example, the programming application resource usage profile details Eclipse tool, Intel i5 processor and 20GB memory. After VM sizing VMM check for the free or available PM. If available PM is present then VM is initialized there. Otherwise VM takes wait state.

B. Classification of server

In classification servers are clustered as hot spot, normal and cold spot. The hotspot servers are those which do not have sufficient resource to satisfy the resource request of VM i.e. The utilization of any of the resource is above hot threshold. The cold spot servers are those if there is the underutilization of server resource i.e. the utilization of any of the resource is below cold threshold. The normal servers are those which are between hot and cold threshold. The threshold is limit (low or high) for system. Thethresholds are allocated parameters. Different resources have different thresholds. For instance, define the hot thresholds for CPU and memory resources to be 80 and 70 percent, respectively. Thus a server is a hot spot if either its CPU usage is above 80 percent or its memory usage is above 70 percent.

C. Overload PM Migration

Our algorithm first calculates the temperature of all hot spot servers.

$$\text{Temperature (p)} = \sum (r-r_t)^2$$

Where p is the server, r is the set of overloaded resource in server p and r_t is the set of hot spot threshold for respective Resource r. Temperature of hot spot represent the degree of overload. After calculating temperature, using merge sort hot spot servers are arranged in descending order. The hottest server is taken first and decides which VM migration will reduce the temperature. This decision is made by sort the list of VMs in ascending based on the resulting temperature of the server if that VM is migrated away. Before VM migration the free or available servers are checked to initialize the migrated VM. The migration of VMs does not make destination server as hotspot server.

D. Server Consolidation

Server consolidation happens at two places. One is when the utilization of resources of active server is below cold threshold. Other is low resource usage VMs are running in the server and underutilization of resource happens. Now the migration is made on ascending order of VM. The migration of VMs does not make destination server as hotspot server. After all the VMs are migrated from cold spot, the server is turned off.

E. Consolidated Movements

The migrations in each step above are not executed until all steps have finished. The list of migration is then combined. So each VM is migrated at most once. For example, overload PM migration decides a VM to move from server A to server B, while server consolidation decides it to move from server B to server C. In the final execution, the VM is migrated from A to C directly.

IV.ALGORITHM EFFECTIVENESS

For overload PM migration, let Hbe the number of hot spots in the system during a decision time. Sorting hot spot based on their temperature takes O (H*log (H)). For each hot spot, sort the set of VMs running on it. In practice, the number ofVMs that run on a PM are typically limited to a small constant. Hence, the sorting takes a less amount of time. For eachVM, it is need to measure the rest of the PMs to find a suitable destination for it, which takes O (n). n is the number of server. The overall complexityof this algorithm is thus O (H*n).when compared to black box and gray box algorithm its migration time is reduced.

V. RESULT

Effectiveness of VM scheduling algorithm in load balancing and server consolidation are evaluated. First with a small scale experiment consisting of four server and six VMs are established. Consider all four servers have eclipse tool, 100 GB of memory and processor. All six applications are taken as programming application which requires eclipse tool, Intel i5 processor and 30 GB memory initially. When the application request resource through internet, VMs are created in datacenter. Now PM1 have3 VMs, PM2 have three VMs and other two PM are inactive state. Increase the memory load of VM1 to 15 GB. Now VM1 is migrated from PM1 to PM3.

TABLE I
THRESHOLD VALUE PARAMETERS

Resource	Hot threshold	Cold threshold
CPU	99MIPS	20MIPS
Memory	98GB	5GB

VI RELATED WORK

One of the first works, in which power management has been applied at the data center level, has been done by Pinheiro et al. [9]. In this work the authors have proposed a technique for minimization of power consumption in a heterogeneous cluster of computing nodes serving multiple web-applications. The main technique applied to minimize power consumption is concentrating the workload to the minimum of physical nodes and switching idle nodes off. This approach requires dealing with the power/performance trade-off, as performance of applications can be degraded due to the workload consolidation. Requirements to the throughput and execution time of applications are defined in SLAs to ensure reliable QoS. The proposed algorithm periodically monitors the load of resources (CPU, disk storage and network interface) and makes decisions on switching nodes on/off to minimize the overall power consumption, while providing the expected performance. The actual load balancing is not handled by the system and has to be managed by the applications. The algorithm runs on a master node, which creates a Single Point of Failure (SPF) and may become a performance bottleneck in a large system. In addition, the authors have pointed out that the reconfiguration operations are time-consuming, and the algorithm adds or removes only one node at a time, which may also be a reason for slow reaction in large-scale environments. The proposed approach can be applied to multi-application mixed-workload environments with fixed SLAs. Elnozahy et al. [10] have investigated the problem of power efficient resource management in a single web-application environment with fixed SLAs (response time) and load balancing handled by the application. As in [12], two powersaving techniques are applied: switching power of computing nodeson/off and Dynamic Voltage and Frequency Scaling (DVFS). The main idea of the policy is to estimate the total CPU frequency required to provide the necessary response time, determine the optimal number A. Beloglazov et al. proposed physical nodes and set the proportional frequency to all the nodes. However, the transition time for switching the power of a node is not considered. Only a single application is assumed to be run in the system and, like in [9], the load balancing is supposed to be handled by an external system. The algorithm is centralized that creates an SPF and reduces the scalability. Despite the variable nature of the workload, unlike [10], the resource usage data are not approximated, which results in potentially inefficient decisions due to fluctuations. Nathuji and Schwan [12] have studied power management techniques in the context of virtualized data centers, which has not been done before. Besides hardware scaling and VMs consolidation, the authors have introduced and applied a new power management technique called “soft resource scaling”. The idea is to emulate hardware scaling by providing less resource time for a VM using the Virtual Machine Monitor’s (VMM) scheduling capability. The authors found that a combination of hard and soft scaling may provide higher power savings due to the limited number of hardware scaling states. The authors have proposed an architecture where the resource management is divided into local and global policies. At the local level the system leverages the guest OS‟s power management strategies. However, such management may appear to be inefficient, as the guest OS may be legacy or power-unaware.

VII. CONCLUSION

In this paper a system that uses virtualization technology to allocate data center resources dynamically based on application demand is implemented. TheVM scheduling algorithm achieves Load Balancing by migrate the VM from overloaded server and server consolidation by packing VM from underutilized server. The advantage of this algorithm is underutilized server are turned off so that energy can be efficiently used.

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