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Dynamic Resource Allocation in Cloud Computing using Virtualization Technology

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Abstract: ***Cloud computing is the technology used for the easy management of the huge data. Virtualization is the way we are using for allocating cloud resources efficiently. In this paper we are using Skewness algorithm for measuring and ultimately reducing the uneven utilization of cloud resources. Green computing is achieved by minimizing the load by migrating the loads on servers which are underutilized.***

Keywords: Virtualization, Hot Spot, Cold Spot, Skewness, Resource Management.

1. Introduction

Cloud Computing is the popular technology in today's computing world which provides the management and ease of access of computing resources. It promises a cost effective utility of the resources. It allows customers (cloud users) and cloud service providers to use resources as pay-as-you-go and self-service basis resulting in an easy management and utilization of cloud utilities. In this paper we are measuring the uneven utilization of the resources using Skewness algorithm and trying to reduce it.

The Xen is the Virtual Machine Monitor which maps the Virtual machines to physical resources. It is the responsibility of the cloud provider to manage the resources. User is completely unknown from the backend activities. Users of Amazon EC2 [6] are not at all aware of where there instance is running on. The technology which is called as VM live migration [7] [8] helps us to change the mapping between VMs and PMs while running applications.

2. Related Work

Zhen Xiao [1] gives the strategy for dynamic resource allocation with Skewness and load prediction algorithm. He uses Xen hypervisor Usher controller. The merits in his system are no overheads, high performance. It requires less number of migrations and residual resource is friendly to virtual machines. It improves the scheduling effectiveness. The demerit of the system is it is not cost effective.

T.Wood [2] gives the Black and Grey box strategies with BG algorithm. He used Xen hypervisor and finds with Nucleous and monitoring engine, Grey-box enables proactive decision making. While it has the limitation as, Black-box is limited to reactive decision making and BG algo requires more number of migrations.

A. Singh [3] introduce the integrated server storage virtualization (Vector dot algorithm) using Configuration and performance manager. It has less complexity but its prediction is not convincing. Also uneven distribution of residual resource makes it hard to be fully utilized in the future.

3. Problem Statement

"To develop resource allocation system that can avoid overload in the system effectively while minimizing the number of servers used and improve the performance of system by using load prediction algorithm by minimizing average number of hot and cold spots migrations."

4. Proposed System Model

The system architecture is described in the following figure.VM scheduler consists of four components- Predictor, Hot spot solver, cold spot solver and migration list. Predictor [1] collects the historical statistics and predicts current and future resource needs of VMs and ultimately the load on PMs. Hot Spot Solver observes the PMs and compare its utilization with the hot threshold temperature. If it is above the hot threshold then it migrate it away by sending this case to migration list otherwise to the cold spot solver for further observations. Cold spot solver does the same with PM resource utilization by comparing it with cold spot threshold or green computing threshold and if it found to be less than it that PM is migrated to the efficient one PM and original PM is potentially turns off to achieve green computing [1]. Migration list is compiled and result is sent to the Usher CTRL for further execution. Then each PM runs Xen hypervisor which is a Virtual Machine Monitor. It has privileged domain 0 and more than one domain U. Domain U can run more applications like web server, remote desktop, mail, Dns, etc.

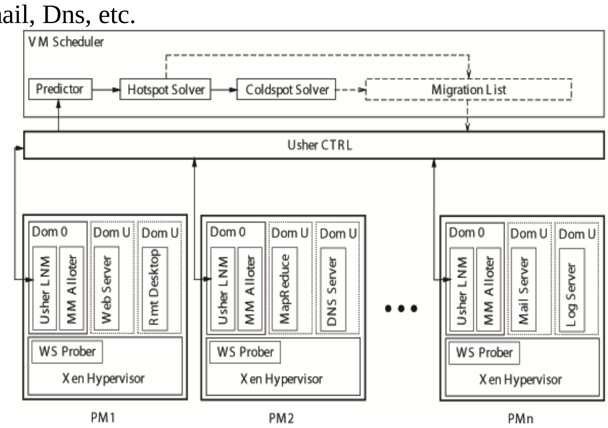

Figure 1: System Architecture

In the Usher framework, the multiplexing of VMs to PMs is well managed. On domain 0 of Xen hypervisor, each PM runs a Usher local node manager (LMN). This LNM aggregates all the statistics of resource on particular node. For example, the CPU and networking resource utilization of a PM is calculated by monitoring scheduling events on it. This statistics is then sent to the Usher CTRL (Usher Central Controller) where scheduler is running. The scheduler is invoked after some period of time and these observed statistics are compared and further managed by several Scheduling components.

5. Design Goals

1. To design a new innovative load prediction algorithm for measuring and minimizing the load on servers.
2. To develop highly secure VM selection system for minimizing the skewness considering Trust Level and SLA.
3. Improve system performance by performing more VM migration in each run.
4. Reduce decision time criteria for Hot Spot Migration.
5. Use Load prediction algorithm to Minimize Average number of Hot Spot and Cold Spot Migrations.

6. System Design and Methodology

6.1. Skewness Calculation

We are calculating the skewness of server P that is the uneven utilization of the resources using following formula:

Skewness (P) = $\sqrt{\sum_{i=1}^{n} (\frac{ri}{\bar{r}} - 1)2}$

Considering the n number of resources, let ri be the i[th] Resource utilization. $\bar{r}$ is the average utilization of the resources on Server P. minimizing the skewness we can reduce the overall workload on the system improve the utilization of server resources.

6.2 Hot and Cold Spots

We are illustrating the concept of Hot and Cold Spots in this section. First we are setting the Temperatures for hot and cold spots as Hot threshold and green computing threshold respectively. The thresholds reflects the degree of overload. Server has zero temperature if it is not hot spot. We say the server as Hot if utilization of any of its resource temperature is above the hot threshold. We say server as cold spot if utilization of all of its resources are below the cold or green computing threshold. Warm threshold is the level of utilization which is enough high to stay the server in running state. Our aim is to eliminate all hot spots or maintain their temperature as low as possible. There are various technologies to deal with this cases but we are using Migration technology. Temperature [1] of the Spot P can be given as,

Temperature(P) = $\sum_{r \in R}(r - rt)2$

In this case if the predictor finds the resource temperature is high then we migrate its load on to the warm or cold resources but that warn should not become hot after accepting it. If the temperature of the cold spot is below the cold threshold then that server is potentially turned off.

6.3 Hot and Cold Spot Migrations

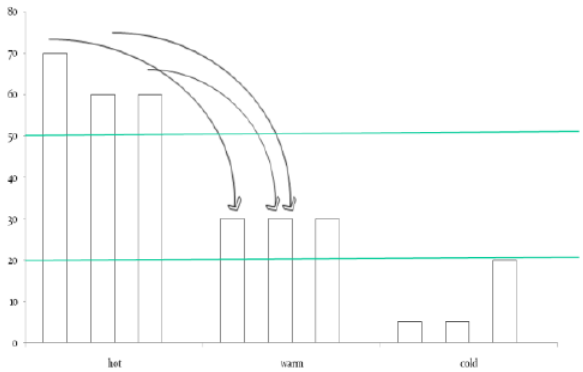

Figure 2: Migration of load from hot to warm spot [5]

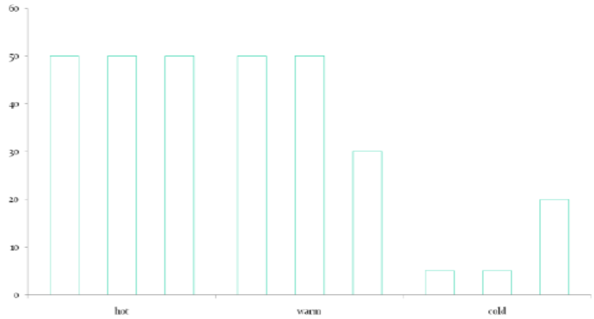

Figure 3: After migration of load from hot to warm spot [5]

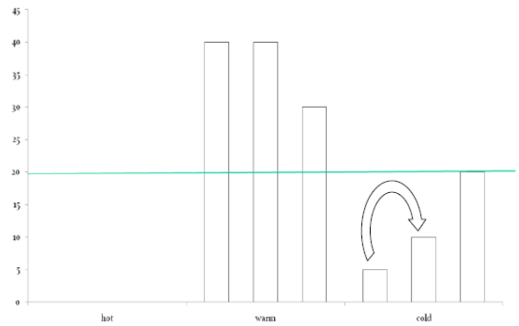

Figure 4: migration of load from cold to another cold spot

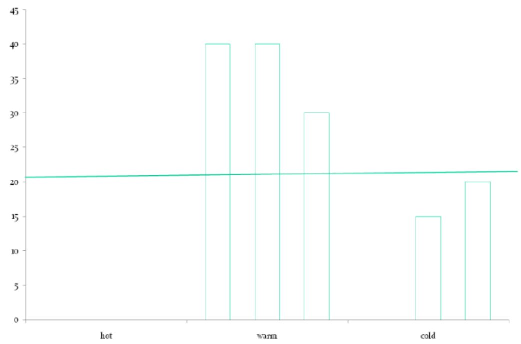

Figure 5: migration of load from cold to another cold spot

6.4 Mathematical Formulation

The mathematical formulation [10] is designed to minimize the Skewness i.e. uneven utilization of the resources. Consider i=1 to m denoting the requests for resources. Then j=1 to n as servers which fullfils the need for resources, k=1 to l is the virtual machine with the given processing capacity, a_j is the total CPU capacity of the server j and b_i is the total CPU capacity required for request i. C_{ijk} is the per unit cost of utilization of resource by i^{th} request when it is executed on k^{th} VM on ^{jth} server.X_{ijk} is the amount of the CPU capacity being utilized by i^{th} request when it is executed on k^{th} VM on jth server. Thus we got the expression as,

Minimize F= $\sum_{i=1}^{m}\sum_{j=1}^{n}\sum_{k=1}^{l}(Cijk\ Xijk)$

Subjected to $\sum_{j=1}^{n}\sum_{k=1}^{l}(Xijk) = ai, i = 1,2,\dots,m.$

6. Experimental Setup

We are developing our system in java and using Mysql database system. We used Skewness algorithm for measuring uneven utilization of the resources. Also we used Live Migration technology for load balancing. Virtual machines migrations are considered under the live migrations. We are retrieving the performance thesis with the help of chart system to easily observe the load on each machine or server.

7. Conclusion

Cloud computing can solve complex set of tasks in shorter time by proper resource utilization. To make the cloud to work efficiently, best resource allocation strategies have to be employed. Utilization of resources is one of the most important tasks in cloud computing environment where the user's jobs are scheduled to different machines. A number of extensions to dynamic resource allocation problem have been proposed in the literature. However they have not been utilized for resource allocation purpose in cloud environment. Proposed system multiplexes virtual to physical resources adaptively based on the changing demand. System uses the skewness metric to combine VMs with different resource characteristics appropriately so that the capacities of servers are well utilized we achieve green computing by migrating the loads on the servers.

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