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Performance Analysis of Computing Clusters with Green Scheduling in Multi-cloud Environment

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Abstract

As cloud computing becomes popular, more and more users are using different cloud services. This technology enables its users to store, process and retrieve their data in an efficient manner. In this way, the users from various organizations can share their resources within their organization and also between enterprises. Though it is efficient to use single cloud service, it is more efficient to use multiple cloud services, which enable its users to have simultaneous access of various resources. In order to achieve the best services with this multi-cloud environment, it is essential to find the performance of the cloud server. In this paper we have evaluated the performance of the cloud server, by finding the optimal server through the load monitoring process in each cluster configuration, which can be allocated with 'N' number of jobs , on throughput basis. Here we have used the Green Scheduling algorithm for scheduling the jobs in the optimal cloud server.

Keywords: *Multi-cloud Environment, Green Scheduling, Cloud Computing, Performance Analysis, Load Monitoring.*

1. Introduction

Cloud computing [1] is a technology for providing different kinds of services to the users of various organization, enterprises and individuals. Basically the cloud refers to a large network, which provides its users an efficient data processing. The users can have access to these cloud services via various cloud based applications and internet [2]. Through this technology, users can store large amount of data to the data centers in remote location, which benefits an individual organization by reducing the amount of data stored in their local sites. A single cloud provider may provide differentiated services to its users. On the other hand, a single user can have access to multiple clouds. The multi-cloud technology enable its users an efficient data processing and resource sharing mechanisms with reliable and fast access to their data. With this multi-cloud concept, users are available with the simultaneous accessing of various cloud resources. Though it is efficient to use single cloud, the use of multi-cloud enables its users with high fault-tolerance by dynamically moving [3] from one site to another, when failure occurs in one site. In this way, it is essential to find the performance of the cloud server in the multi-cloud environment, in order to achieve the best services.

In existing system, they explored the concept of simultaneous resource sharing by deploying the multi-cloud environment. They analyzed the performance of cluster nodes with different cluster configurations of Sun Grid Engine cluster. The cluster nodes were formed by scaling the local nodes with the remote cloud nodes. Here they evaluated the performance using the cluster throughput.

In our proposed work, we analyzed the performance of an optimal cloud server with Green Scheduling, on throughput basis. Also we concentrated on reducing the server power consumption in the multi-cloud environment by using the same algorithm. The main goal of our proposed work is to, create a multi-cloud environment, find the optimal cloud server by performing load monitoring from the client system for each cluster configuration, allocate 'N' number of jobs to the optimal server, implement Green Scheduling Algorithm, evaluate the performance of the server by increasing the number of jobs (throughput) submitted to the optimal cloud server.

2. Related Works

The performance analysis of computing clusters with loosely coupled many task computing applications was explored for the Sun Grid Engine clusters [4]. The multi-cloud infrastructure was deployed with three different cloud sites namely, Amazon EC2 Europe, Amazon EC2 US, and ElasticHosts. Here they analyzed the performance of cluster nodes with nine different cluster configurations using SGE. The performance of each cluster configuration was measured on throughput basis.

As the power consumption of the datacenters in cloud has became the key issue, the use of Green Scheduling algorithm [5] with the design of neural network predictor was optimized the server power consumption by shutting down the unused cloud servers.

The Performance Analysis of Cloud Computing Services for Many-Task Scientific Computing [6] was performed with four commercial cloud computing services namely Amazon EC2, GoGrid, ElasticHost and Mosso. Here they evaluated the performance with three metrics: Wait Time, Response Time and Bounded Slowdown.

The benchmarking Amazon EC2 for high performance computing [7], involved in analyzing the performance of the cluster composed of EC2 compute nodes against a High Performance Computing cluster. They compared the performance of clusters for different hardware specifications of the high-CPU extra large instances.

3. Proposed System

3.1 Load Monitoring

In multi-cloud environment, the process of finding the optimal cloud server in the cluster was performed. To find the optimal server, we performed the load monitoring process.

The load monitoring process involved in finding the optimal server in the cluster, which had high free physical memory and less CPU usage. The load on each server in the cluster was varied depending on the number of applications running on it. When the number of applications running on the server increases, the load also increased and if the number of application running on the server decreases, then the load also decreased. In this way, we fixed one server as an optimal one, which had high available physical memory and less CPU usage. Likewise we fixed one optimal server in each cluster to analyze the performance of the optimal node in different cluster configuration.

3.2 Job Selection & Virtual Machine Allocation

The job selection and virtual machine allocation process is performed in the client system. After finding the optimal cloud server, we allocated various numbers of jobs to that server from the client system.

The client will select the number of jobs to be allocated to the optimal server. Since the job selection is the client side process, the client need to select the number of files to be processed, number of jobs to be done, and the jobs to be performed on those files. After selecting those details, the client will send it to the optimal server for processing the files. Likewise, we performed this job selection process with minimum of four numbers of jobs.

3.3 Job Scheduling

The job scheduling is the server side process. After allocating the jobs to the optimal server, the server will perform the scheduling process. Here, we have used the Green Scheduling algorithm i.e., Shortest Job First (SJF) scheduling algorithm in the server for scheduling the incoming tasks.

The scheduling involved the use of SJF algorithm, which is based on the burst time of each task. For a single file we submitted many number of tasks to the server. Hence in the server, the result of the scheduling was the file that is to be processed first. The result was based on the number of tasks for each file and the total burst time. Finally the file, with less number of tasks and less total burst time, is scheduled first.

3.4 Job Execution and Result Submission

The server, which schedules the incoming tasks, is then process each tasks and sends the results to the client.

3.5 Performance Analysis

The performance of the optimal server has been evaluated on the basis of throughput (number of tasks completed per unit time) analysis.

4. System Model

In our proposed system, we have used the virtualization tools such as ESXi server and VMware Workstation to form the multi-cloud environment.

Fig 1 shows the system model of our proposed work. The ESXi server is the type I hypervisor, which is used for virtualizing the hardware. With the use of this ESXi server, the multiple operating systems called the guest operating system can be run directly on the host systems hardware, without requiring the underlying operating system. The VMware Workstation [8] is a type II hypervisor, in which the guest operating system will be run on host system's operating system.

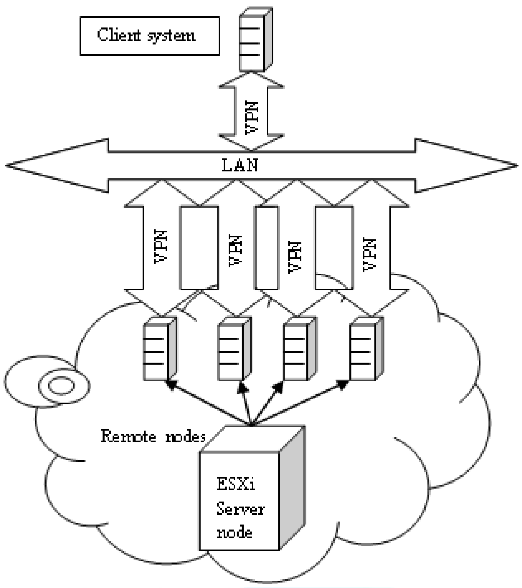


Fig 1.System Model

The cluster with different configuration is created using the ESXi server and VMware Workstation, which is referred as the remote nodes. Both the client system and the remote nodes are connected through the virtual private network (VPN). Initially, we performed the load monitoring process for finding the optimal server in each cluster configuration. After finding the optimal cloud server, the jobs from the client system are allocated to the server. In server side, we have used the Green Scheduling Algorithm for scheduling the incoming tasks to the optimal server. In this way, by increasing the number of jobs (throughput) to the optimal server found in each cluster configuration, the performance of the cloud server will be evaluated.

5. Result Analysis

5.1 Load Monitoring

The load monitoring process involved in finding the optimal cloud server in the cluster. The server which had high available physical memory and less CPU usage was fixed as an optimal one. The load on each machine was varied with respect to number of applications running on it. To implement the load monitoring process, we configure three different clusters, each having four nodes. The nodes in each cluster varied in size of physical memory. The Fig. 2(a), 2(b), 2(c) represents the available physical memories of nodes in three different cluster configurations. The amount of free physical memory was expressed in terms of Megabytes.

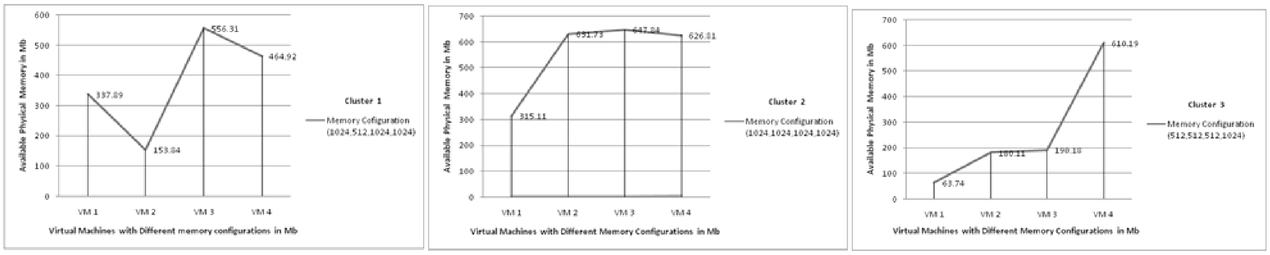
The Fig. 3 represents the CPU usage of virtual machines in three clusters, expressed in percentage. The CPU usage of a node increased, when there was increase in number of applications running on it. The amount of memory allocated for each virtual machine is expressed in Megabytes.

5.2 Performance Analysis

The performance of optimal cloud server was evaluated based on the throughput analysis. Fig.4 shows the throughput analysis of optimal node in each cluster, which is measured with four different jobs. The job completion time for the optimal cloud server is represented in milliseconds.

6. Conclusions

Our proposed work involved in evaluating the overall performance of an optimal cloud server, with three different cluster configurations, based on the throughput analysis. The server load monitoring has been done for finding the optimal cloud server, which had high free physical memory and less CPU usage, in each cluster configuration. The job selection and virtual machine allocation involved selection of multiple files and number of jobs to be performed for each file. The selected files and their corresponding jobs were then allocated to the virtual machine (optimal server) for processing. The job scheduling is done in optimal server, based on shortest job first scheduling, by calculating burst time for each incoming job. The jobs are executed in server node and then the results are sent back to the client.



(a) (b) (c)

Fig 2. Load Monitoring (Available Physical Memory) in Three Different Clusters

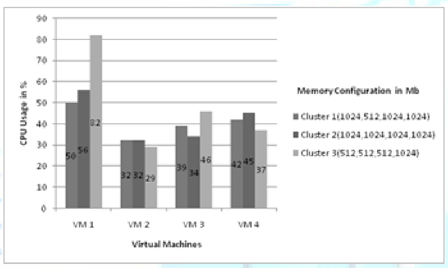


Fig 3. Load Monitoring (CPU Usage) in Three Different Clusters

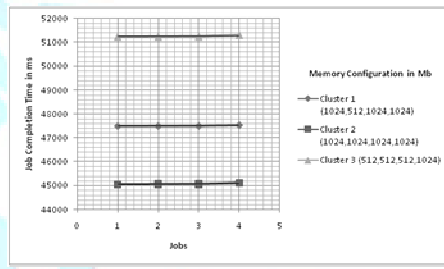


Fig 4. Throughput Analysis

The performance analysis process involved finding the performance of the optimal cloud server based on the throughput analysis. Further we planned to extend our work with Green Scheduling Algorithm for minimizing the energy consumption of datacenters in the multi-cloud environment.

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