

Load Balancing in Hybrid Cloud Computing

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ABSTRACT

Hybrid Cloud is a composition of private and public clouds, which can assist an application to utilize the advantages of distinct clouds and achieve high availability, scalability and robustness. Despite the benefits, hybrid cloud can present special challenges such as cloud heterogeneity, inconsistent interface, communication overhead between clouds and etc. In this paper, load balancing in hybrid cloud and the private and public cloud individually is being proposed. To evaluate the effectiveness and performance of this approach, results of all the three types of clouds are compared. Different values for the load have been given at different point of time to experiment how individual system and hybrid cloud works. The results show that processing time is lesser in case of hybrid cloud than private and public cloud individually.

1. Introduction

According to NIST(National Institute of Standards and Technology), **cloud computing** is a model for enabling convenient, on-demand network access to a shared pool of computing resources that can be rapidly provided with minimal management efforts [1]. Cloud Computing is divided into four types, in private Cloud, Information is operated by single organization. Data is secured. In Community Cloud, Information is operated by specific community having some common concerns. In Public Cloud, Information is owned by an industry group, general public or government organization and available for open use. Hybrid Cloud is a combination of two or more clouds. It is generally used when data is large and private cloud is not enough to be used because of cost issues. So, we use composition of private cloud (for important data) as well as public cloud (for concurrent data). [4]

Load balancing in cloud computing helps to distribute the dynamic workload across multiple nodes to ensure that no single node is overloaded. It helps in proper utilization of resources. It also improves the performance of the system. [6]. Load balancing is performed at two levels in cloud computing. One is at the level of virtual machine; the mapping is made between applications that are loaded on the virtual machine. Second is at host level; a mapping between the virtual machine and host resources that allow processing of several incoming application requests [8].

Objectives

To analyse the existing load balancing algorithms and to utilize the advantages of using different clouds by using hybrid cloud is the main objective here.

2. Related Work

Katyal et al. (2013) analyzed a comparative study of load balancing algorithms in cloud computing environment. They discussed various load balancing schemes, each having pros and cons. On one hand static load balancing scheme provide easiest simulation and monitoring of environment but fail to

model heterogeneous nature of cloud. On the other hand, dynamic load balancing algorithm are difficult to simulate but are best suited in heterogeneous environment of cloud computing. It also compares different types of load balancing scenarios. It specifies the knowledge base, usage and drawbacks of each type of algorithm and issues addressed by these algorithms.

Fahim et al. (2014) proposed the load balancing improvement of a data centre by a hybrid algorithm in cloud computing. They proposed a new environment of load balancing by hybrid algorithm that takes into account the current load of a virtual machine of a data centre and the status of its tasks during execution, in order to overcome the problems caused by static algorithms. The hybrid algorithm allows cloud service providers to improve the performance, availability and maximize the use of virtual machines in their data centres.

Kaur et al. (2016) proposed a hybrid approach of load balancing through VMs using ACO, Min-Max and Genetic algorithm. The various traditional load balancing algorithms does not perform well and they do not consider SLA parameters while selecting virtual machine for migration. So, hybrid approach using various methods like ACO, Min-Max Ant system as well as GA is proposed. In this, virtual machines are migrated from one host to another by using ACO scheduling algorithm. It overcomes the problem of stagnation of traditional load balancing technique. The various performance parameters are CPU cost, memory cost, configuration time and distance cost.

Huang et al. (2017) proposed an application deployment approach based on Hybrid cloud. In this, they proposed a novel prediction model, to automatically adjust the scale of applications according to real time resource monitoring, for the concern on scalability issues of applications in hybrid cloud. To evaluate the effectiveness and performance of their approach, they implement a prototype of hybrid cloud architecture which

is capable of resource monitoring, auto scaling, and virtual-machine-level load balancing and unified management. Applications can achieve high scalability with a tolerable overall overhead provided by resource monitoring, auto scaling and load balancing.

Chernenkaya et al. (2018) proposed load balancing in cloud computing. In this, various algorithms are analyzed using an analysis tool, namely, cloud analyst. Comparison is also made for algorithms load balancing. In this comparison is made between the results of round robin algorithm, active load balancing monitoring and throttled load balancing algorithm. The simulation and analysis for the performance of the three load balancing algorithms are performed using the 'Cloud Analyst' tool. It allows the user to run multiple simulations with small parameter changes, and also allows you to customize the location of users who create the application and the location of the data centres.

3. Methodology

Methodology is the systematic study of methods that are, can be, or have been applied within a discipline. To achieve the laid down objectives, a step by step procedure is to be followed. The research methodology is the experimental study in which a framework is designed to store data securely. The description of steps is as follows:

Setting up the Cloud Simulators: For Hybrid environment, we need two clouds. One will act as private cloud and the other will act as public cloud. Here, in this research, assumption has been made that 'DCSIM' cloud simulator will act as private cloud and 'Cloudsim' will act as public cloud. Netbeans IDE 8.2 has been used as a platform for that in this research, which is the latest version. We have used Cloudsim 3.0.3 version as public cloud.. 'Eclipse Java Photon' has been used as platform for this.

Performing load balancing individually: Load balancing helps to distribute the dynamic workload across multiple nodes to ensure that no single node is overloaded. It helps in proper utilization of resources. There are different layers in cloud simulators [9].

There are 3 data centres in private cloud that is DCSIM and there are 5 data centre in public cloud that is Cloudsim. Each data centre is having different number of hosts and have to process different number of users. The performance of each host depends upon the CPU performance and the way each simulator handles the load while balancing it. The processing time of each user can be calculated as follows:

$Processing\ time = size\ of\ cloud / processor\ speed$
 Processor speed is in million instructions per second (MIPS)
 And processing cost can be calculated as
 $Total\ cost = amount\ of\ data * expenses * processing\ time;$
 $Expenses = (Cost\ per\ VM / (60 * 60)) + Memory\ cost + storage\ cost + Data\ transfer\ cost$

Setting up the Hybrid Cloud Environment: Hybrid Cloud is a composition of private and public clouds, which can assist an application to utilize advantages of distinct clouds

and achieve high availability, scalability and robustness. Hybrid cloud reduces the cost of application development and maintenance, ensures application availability and enhances user experience. [4] When the information from both the clouds is collected, it has structural inconsistency. DCSIM is working on Netbeans in which java is implemented and Cloudsim is working on Eclipse in which also java is implemented. But the information may or may not be in the same structure. So to have structural consistency we used JSON (JavaScript Object Notation).

JSON is a lightweight data interchange format. It can be easily parsed by browser which supports JavaScript and is widely used in data transmission. [4]

Prediction and Threshold Setting: There are two possibilities of missing prediction: overestimation and underestimation. Overestimation means that we overestimates the load of the actual system and the instruction to recycle virtual machine has not been sent, which results in waste of cloud resources, decline of resource utilization and increase of maintenance cost. Underestimation means that the actual system is under high load condition, while there is no expanding instruction. In this case, some user requests cannot be responded immediately, which leads to decline of user experience and even system crash. [4]

In order to avoid overestimation and underestimation, introduce threshold value for this. There are three levels of virtual machines: free, normal and overloaded. [4]

Its purpose is to share the load when the application is under overload. There are two kinds of deployment approaches. The first one is that load balancing module runs in private cloud without any extra configuration, because private cloud can directly access public cloud through VPN (Virtual Private Network). The second one is that deploy load balancing modules both on private and public clouds. The traffic will be decided to transmit to private cloud or public cloud by calculating the load on both the clouds. In this research, second approach is used to do the load balancing on hybrid cloud. [4]

Load Monitoring

Time	Availability of VMs on Private Cloud(DCSIM)	Availability of VMs on Public Cloud(Cloudsim)	Incoming users
1 PM	18	115	310
3 PM	46	230	120
5 PM	0	190	56
7 PM	14	0	270
9 PM	67	90	70
11 PM	0	34	45

Table 1: Getting availability of the virtual machines

Load on each cloud is calculated individually and the availability of the virtual machines is calculated by calculating the number of processes being completed on each host of the data centre. The load of incoming users is being transferred to the cloud where load is less and more availability is there.

When both the clouds are busy in the processes and storage then other user processes are in waiting state. When there is availability then these processes are assigned to the virtual machines.

Performing load balancing on hybrid environment:

These steps are followed:

- Round-Robin algorithm is implemented individually on the DCSIM and Cloudsim.
- Availability of virtual machines is predicted as we discussed above.
- Load is assumed to for the balancing results under different system and different clouds.
- Then according to the availability of the virtual machines, the load is being transferred to the cloud which is less loaded.

There is also task dependency in it. Dependent tasks are those whose execution is dependent on one or more sub-tasks. They can be executed only after completion of subtasks on which it is dependent. Therefore, scheduling of such tasks prior to the execution of sub-tasks is inefficient. But it is not considered this in this research.

Performance parameters: The performance parameters are the parameters with which we measure and test the profitability and the performance of several static or dynamic load balancing algorithms. These parameters are: stability, error tolerance, overloads detection, cooperation, task migration, nature of load balancing, centralization or

decentralization, allocations and compatibility of the calculated results with the values generated after the execution.

Execution time and number of tasks executed are also the performance parameters for the hybrid cloud. The main focus should be on the total execution time of the tasks given to the computing environment. There can be prioritized or non-prioritized requests. The prioritized requests are executed within the deadline and non-prioritized requests are also handled in an efficient manner.

Table 2 shows settings of data centre created. Other data centres are also created similarly. These configurations may be different for different clouds or different data centres. Hence the performance evaluation is also different for different cloud.

Name	DC1
Physical Hw Units	5
Arch	X64
OS	Windows 10
Cost per VM \$/hr	0.1
Memory Cost \$/s	0.05
Storage Cost \$/s	0.1
Data Transfer Cost \$/GB	0.1

Table 2: Data Centre Settings

4. Results

In this, comparison of various performance parameters for different clouds and its results has been discussed.

(a) Processing Time: It is the time used to process a task or execute a task by virtual machine.

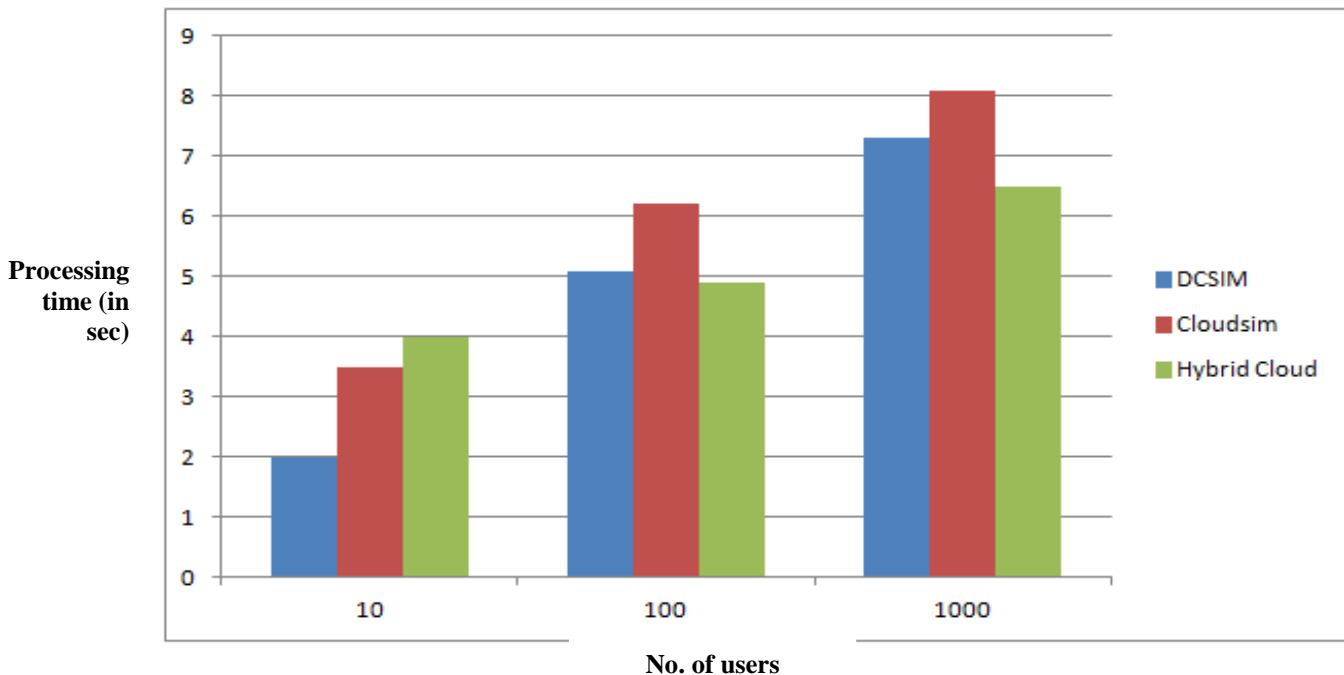


Fig. 1: Comparison of processing time of different clouds

(b) Total Cost: It is the total cost involved for the cloud including cost per virtual machine, memory cost, storage cost and data transfer cost. We can see graphically as

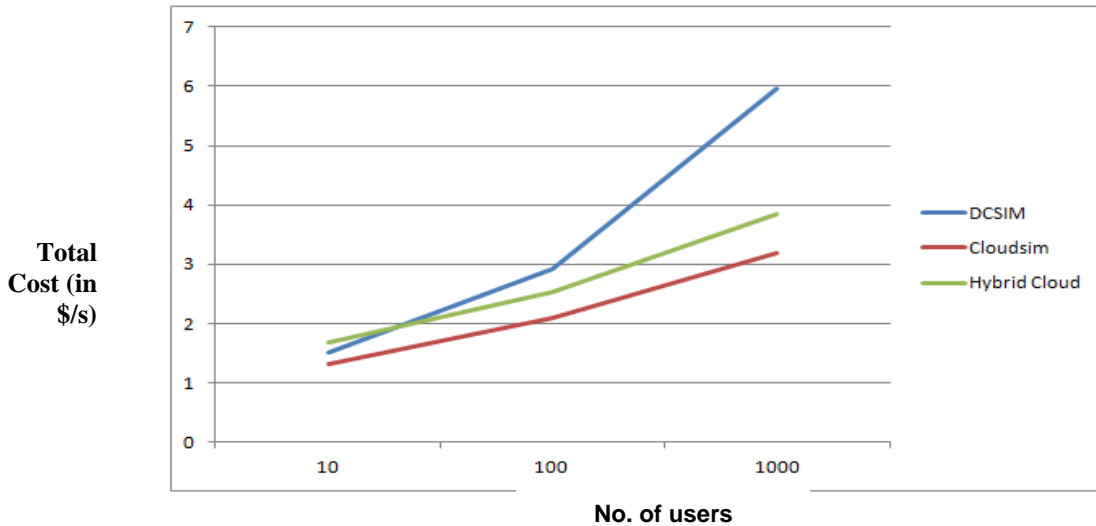


Fig. 2: Cost involved graph

Cost involved is less when number of users and tasks increases in hybrid cloud. It gives the average cost.

(c) Response Time and Waiting time: Response time is the time it takes to respond to a task or process and waiting time is the time a process or task takes to get the CPU currently in waiting state.

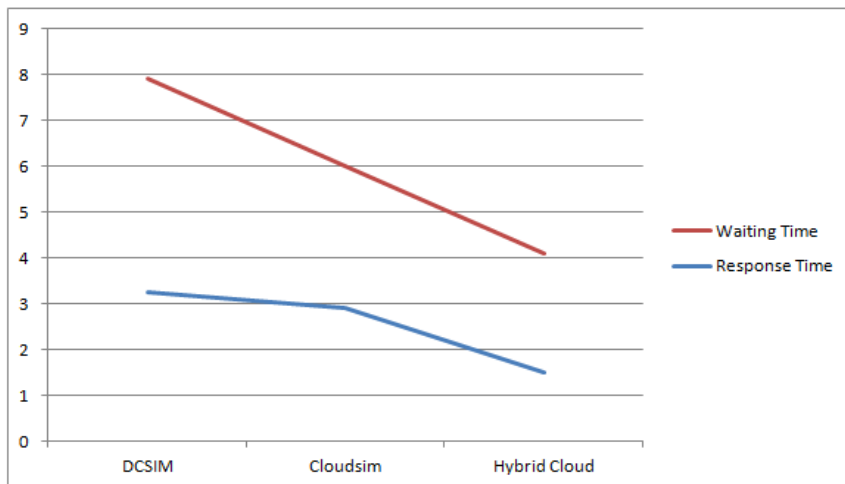


Fig. 3: Graphical representation of time involved for different clouds

(d) Performance Analysis: The overall performance can be measured by taking measures like processing time and cost involved. We can clearly see it graphically how it works

individually. Performance analysis is the basis of finding what should be used according to the data.

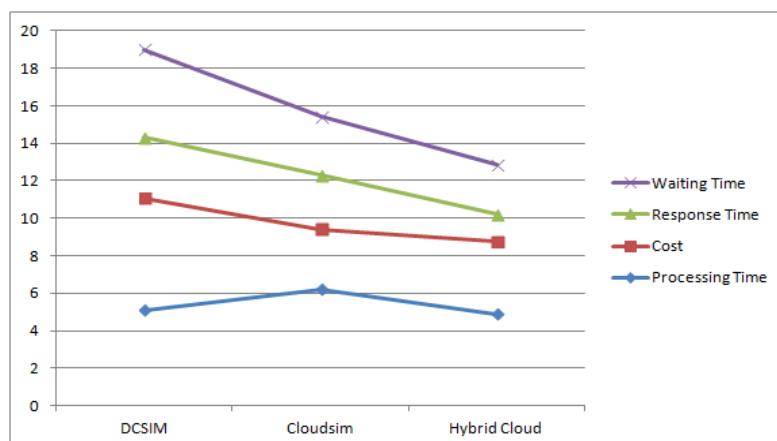


Fig. 4: Graphical representation of overall Performance Analysis

When the users are 1000

	% improvement from Private Cloud	% improvement from Public Cloud
Processing time	10.96	19.75

Table 3: Improvement when using Hybrid Cloud

5. Conclusion & Future Scope

This is a hybrid cloud that runs Round Robin scheduling algorithm for load balancing which is performed by taking DCSIM as private cloud and Cloudsim as public cloud. Comparison of these three has been taken considering various performance measures. Hybrid cloud helps in utilization of resources and response time. This study is concentrated on the tasks and load balancing. The suggested cloud is helpful in efficient utilization of time and resources. It improves the performance, the availability and maximizes the use of virtual machine during processing. For the future work, there are

some interesting points that need investigation. These results are on simulator; it may work more good in real time environment. Second there are limited number of users and load. A real time application like e-learning can be made through hybrid cloud for further research. Further in this research, migration of the load is the key issue. We can also implement other scheduling algorithm for load balancing to check how the result changes accordingly. There are other unresolved problems that are transferring large file, accessing databases between private and public clouds etc.

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