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An proficient approach for load balancing in cloud computing using hybrid techniques

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Abstract
Cloud computing is next generation of computing and a developing computing paradigm in the modern industry, either may be government organizations or the public organizations. In simple words we can say that Cloud Computing is set of different servers that cater to need of different clients based on their demands. Clouds have very powerful data centers to handle large number of user's requests. Cloud as a platform provides dynamic pool of resources and virtualization. Load Balancing is required to properly manage the resources of the service contributor. Load balancing is a technique to distribute the workload among many virtual machines in a Server over the network to achieve optimal resource consumption, decrease in data processing time, decrease in average response time, and avoid overload. The objective of this paper is to propose effective and efficient and enhanced composite scheduling algorithm that can be used to maintain the load and provides efficient resource allocation techniques. In this paper Composite approach is applied for load balancing using Equally Spread Current Execution (ESCE) and Throttled algorithms.

Keywords: cloud computing, load balancing, simulation, virtual machine, cloudsim, cloud, ESCE, throttled

1. Introduction
Cloud computing is a new software system technology, which allows dynamic resource allocation on consolidated resources using a combination of different techniques from parallel computing, distributed computing, as well as platform virtualization technologies [1]. It has influenced every entity in the digital industry, whether it is government or the private sector. "The USA administration's budget for the 2013 Fiscal Year (FY) is clear that the deployment of cloud computing solutions will remain in precedence for U.S. Government Departments and Agencies moving ahead" [1]. The latest trends show that a large number of medium and large scale businesses are shifting to cloud. The service providers are increasing day by day and provides services at lower costs.
The Objective of Cloud Computing is to shift the computation services from desktop to the internet that is moving computation, services offered by them and data off-site to an external, internal, location that is not visible to main contractor. This model is often referred as "pay-per-use model" [3].
Cloud computing possess distributed technologies to satisfy a variety of applications and user needs [15]. The main interest of cloud computing are to share hardware resources, software resources, information resources through internet to reduced overall cost of the system, to provide better performance in terms of average response time and average data processing time, maintain the system consistency and to provide future adaptation in the system [16]. Basically there are different challenges that needs to be handled like scalability, throughput, availability, Virtual machine relocation, fault tolerance, but main issue is the load balancing, it is the process of distributing the load among various nodes of a distributed system in order to minimize the communication delay and to minimize the resource utilization and also avoiding a situation when some of the machines have large amount of data and consuming excess time while others have huge amount of load while other nodes are doing nothing or idle with very little work.

1.1 Types of cloud computing
Cloud computing provides three types of services:
- **Infrastructure as a Service (IaaS):** It provides access to fundamental resources within the cloud i.e. virtual machines, storage etc. In this users need not to buy required servers or network resources of their own. The users pay only for the time duration they are using the service [7].
- **Platform as a Service (PaaS):** It helps to provide runtime environment to build an application. In this model, Cloud computing provides a way where resources are available and users can create the required applications by themselves.
- **Software as a Service (SaaS):** It allows the users to use software applications as a service from various cloud providers through the internet [9]. In this type elasticity makes a cloud application different from another application.

2. Load Balancing
Cloud computing is one of the fastest adopted and implemented technology in various sectors. Many companies are implementing and setting up clouds, due to its flexible architecture which results in the increase in number of users reaching cloud. Although clouds are categorized as public, private and hybrid models but still there may be problem of reliability in these clouds [4, 5]. Cloud computing has been used by most of the organization such as, social networking websites, online applications design by Google doc and

Several clouds are also used for online software testing [14].
Cloud computing is transforming the way with which we interact with the resources via Internet [18]. Virtualization is an important and core technology for cloud computing. It allows the abstraction of fundamental elements of computing such as hardware, storage and networking. Virtualization technology has helped the cloud data centers to effectively increase resource utilization, reduce electricity costs and ease management complexities.
Load balancing is one of the most important aspect in cloud computing environment that can purposeful improve resource utilization, performance and save energy by properly assigning/reassigning computing resources to the incoming requests from users. Therefore how to schedule virtual machines (VMs) effectively by considering various parameters that can influence its decision becomes an important research point for cloud computing.
Different load balancing algorithms are compared and combined to find the best suited algorithm for load balancing of virtual machine. The paper includes the two basic algorithms for load balancing that are Equally Spread Current Execution and Throttled. These algorithms are used for load balancing in cloud environment [2, 11]. Load balancing works on the principle of shifting the load from heavily loaded virtual machine to lightly loaded virtual machines and help in deciding which virtual machine is in steady state and which virtual machine is in busy state. Load balancing results in reducing the bandwidth usage which results in decreasing the cost of machine and maximizing the services offered by the service providers.

3. Existing Load Balancing Algorithms for Cloud Computing

To distribute workload among multiple network links among multiple virtual machines and to achieve maximum throughput, minimize response time. We use two algorithms to distribute the load.

3.1 Equally Spread Current Execution Algorithm (ESCE)

The load balancer tries to preserve equal load to all the virtual machines connected with the data centre. In Equally spread current execution algorithm, the processes are handled with load priorities. It distributes the load to virtual machine by checking the load at current time and transfer of the load to that virtual machine which is lightly loaded and handles that request easily and result in less time taken, and give maximum possible throughput. It is spread spectrum technique in which the load balancer spreads the load into multiple virtual machines. This load balancer maintains an index table of Virtual machines as well as number of requests currently assigned to the Virtual Machine (VM) [7, 8]. When all the virtual machines are currently loaded and if the request comes from the data centre to allocate the new VM, it scans the index table for least loaded VM. If in case there are more than one VM is found than first come first serve algorithm is used and first identified VM is selected for handling the request of the client/node, the load balancer also returns the id of the virtual machine to the data centre controller. The data centre communicates the request to the VM identified by that id. After each allocation the index table is updated by increasing the allocation count of identified VM. When VM completes the task, it is informed to data centre which is further notified by the load balancer. The load balancer again updates the index table and result in decreasing the allocation count by one but in this there is an additional overhead of scanning the queue again and again.

3.2 Throttled Load Balancing Algorithm (TLB)

In TLB algorithm, an index table is maintained by load balancer which contains virtual machines as well as their states (Available or Busy). On receiving a request from client data centre firstly tries to find a suitable virtual machine (VM) to perform the requested task. The data centre broker queries the load balancer for allocation of the VM. The load balancer scans the index table from top until the first available VM is found or the index table is scanned fully. If the status of any VM is Available, then VM id is send to the data centre. The data centre then allocates the request to the VM identified using the throttled algorithm. Also, the data centre updates the index table and set the state of Vm to Busy. But during processing the request of client, if no VM is found, the load balancer returns -1 to the data centre [7, 8]. The data centre queues the request of the client with it. When a certain VM completes its task, a request is sent to data centre to update its index table. The total execution time can be estimated in three phases. During first phase there is formation of the virtual machines and they will be idle waiting for tasks, once tasks are allocated, the virtual machines in the cloud will start processing their assigned tasks, which is considered as the second phase, and finally during the third phase after completion of their dedicated tasks the virtual machines are de-allocated. The throughput can be considered as the total number of jobs executed within a time span without considering the virtual machine formation time and de-allocation time The proposed algorithm will try to improve the performance by providing the resources on demand, which may result in increase in number of task executions and thus decreasing the rejection in the number of jobs submitted. One of the algorithms is selected by load balancer as shown in figure 1.

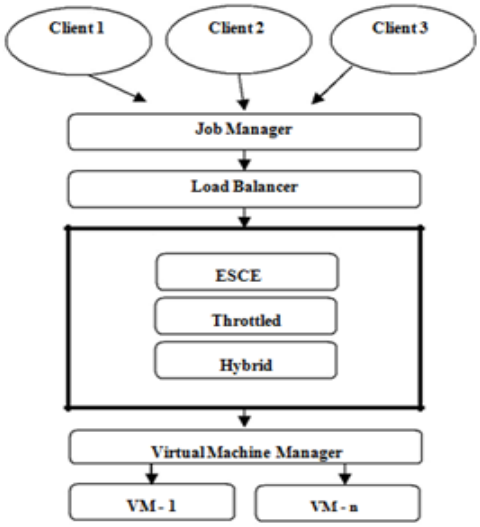

Fig 1: load balancing Algorithms

4. Proposed Work

The composite algorithm is combination of two algorithms i.e. ESCE and throttled. The algorithm contains the advantages of both the algorithms.

Firstly a Hash map is maintained which contains the number of virtual machines with their states (BUSY or AVAILABLE). Then throttled algorithm is used as when some request of client comes to data centre the load balancer scans the entire hash map list from top to bottom until first available virtual machine is found, if some virtually machine has state AVAILABLE then the request is allocated to that machine. If there is no virtual machine available then the request is queued.

Now we utilize ESCE algorithm. In ESCE technique load balancer makes attempt to preserve equal load to all the virtual machines connected with the data center. In this technique load balancer gets number of virtual machines by maintaining an index table and queue of number of requests currently assigned to the virtual machine. If currently no virtual machine is available then Esce algorithm it looks for machine with minimum load and allocates the load to that virtual machine

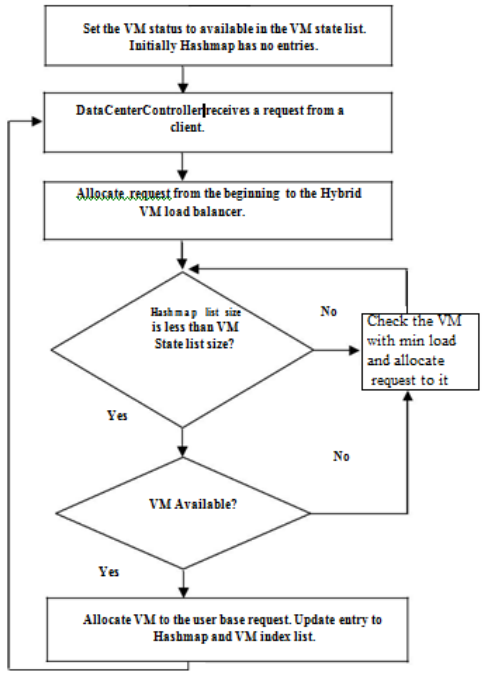

Fig 2: Flowchart for Hybrid VM load balancer

a) Hybrid Algorithm

- **Step 1**. Set all of the Virtual machines allocation status to AVAILABLE in the VM state list.
- **Step 2**. Initially the hash map contain no entries.
- **Step 3**. Data Center Controller then receives a new request from the client.
- **Step 4**. Data Center Controller ask Load Balancer for next allocation.
- **Step 5**. If hash map list size <VM state list size, Then Allocate the VM. Else wait for the VM to get free.
- **Step 6**. When the VM finish processing the request and the Data Center Controller receives the cloudlet response, it notices the load balancer of the VM de-allocation.
- **Step 7**.The load balancer update the status of VM in VMs state list and hash map list.
- **Step 8**. When all the virtual machine get busy if new request received then load balancer using ESCE check for virtual machine with minimum load and assign request to that machine

5. Simulation and Result Analysis

The Simulation and Result Analysis will be done by using the cloud Sim.

A) Cloud Sim

Cloud Sim goal is to provide a generalized and extensible simulation framework that enables modeling, simulation, and experimentation of emerging Cloud computing infrastructures and application services, allowing its users to focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

In order to analyze various load balancing policies, configuration of the various components need to be set [13]. We can set the parameters for the application deployment configuration, data center configuration and user base configuration.

By using CloudSim, researchers and industry-based developers can focus on specific system design issues that they want to investigate, without getting concerned about the low level details related to Cloud-based infrastructures and services.

Features and Advantages of Cloud Sim

Features

- Discrete Time Event-Driven
- Support modeling and simulation of large scale Cloud computing environments, including data centers
- Support simulation of network connections among simulated elements

Advantages

- Time effectiveness
- Flexibility and applicability

B) Netbeans (software)

NetBeans is an integrated development environment (IDE) for developing primarily with Java, but also with other languages, in particular PHP, C/C++, and HTML5 [2]. It is also an application platform framework for Java desktop applications and others. The Net Beans IDE is written in Java and can run on Windows, OS X, Linux, Solaris and other platforms supporting a compatible JVM. The NetBeans Platform allows applications to be developed from a set of modular software components called modules. Applications based on the NetBeans Platform (including the NetBeans IDE itself) can be extended by third party developers [3].

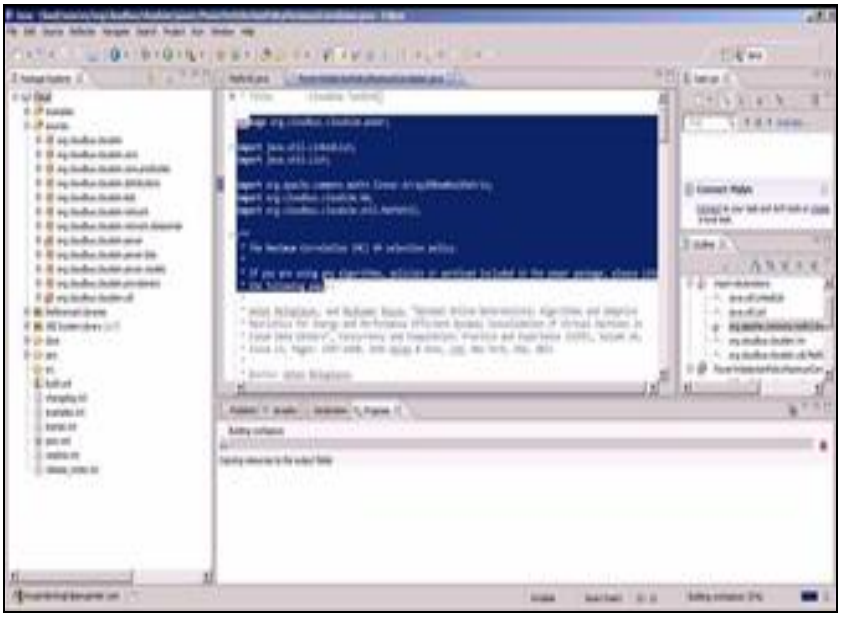

Fig 3: CloudSim

Table 1: Comparative Study of Response Time and Data center Processing Time

S.No.	No of Cloudlets	Turn Around Time	Total Response Time	Average Response Time
1	10	1042	1762.88	160.25
2	50	4932.09	7617	149.35
3	100	10839.74	14780.44	146.34
4	500	54802.58	77384.63	154.46
5	1000	105889.03	147556.91	147.4
6	1500	168243.3	233632.08	155.65
7	2000	222551.5	299476.82	149.66
8	3000	328910.12	447199.24	149.16
9	5000	553675.5	7441291.7	148.22
10	10000	1112556.5	1513733.19	151.36

Average response time of Throttled, ESCE and Composite (Throttled + ESCE)

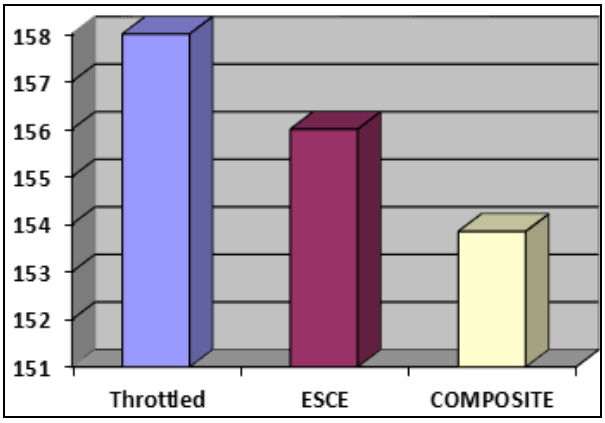

Fig 4

6. Conclusion and Future Work

In this paper, a composite scheduling algorithm is proposed and then implemented in cloud computing environment using CloudSim toolkit, in java language. The hybrid algorithm based on Throttled and Equally Spread concurrent Execution take the advantages of both throttled and algorithms and consider the average response time and earliest finish time as evaluation parameters to achieve the objectives. The experiments were implemented in the Cloud Simulation environment. From the simulation results, we have found that hybrid algorithm takes less processing time and response time. But the algorithm works good when no fault occurs in VM. In future an algorithm will be developed which automatically create the migration of VM in case of failure of a virtual machine. The algorithm assumed the homogeneous VM memory. In future, an algorithm will be developed with heterogeneous VM memory

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