Analysis of Load Balancing Algorithms using Cloud Analyst

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***Abstract:** Cloud computing is emerging as a new system for dealing with large scale distributed applications over a network. Load balancing is one of the major challenges in cloud computing as it is required to evenly distribute the workload evenly across all nodes in a network.Many existing algorithms exist which provide efficient load balancing which results improper resource utilization.In this project we have performed a comparative analysis of three load balancing algorithms namely round robin algorithm, ESCE Algorithm and Throttled Load Balancing Algorithm. This learning will help in gaining understanding to design infrastructure services of the Cloud. Proper load balancing aids inmaking cloud network which consumes resources efficiently and avoids failure. Load Balancing is important for making operations efficient in distributed cloud network systems. As Cloud Computing is growing rapidly and demand for services is increasing, load balancing for the Cloud has become a prominent research area.*

***Keywords:** Cloud Computing, Response Time, Round Robin, Throttled, ESCE.*

I. INTRODUCTION

Cloud Computing is a service in which infrastructure, software applications and platform are provided over the internet based on a user's request, according to their requirement at a particular time. Cloud computing is a pay as you go model and provides the service as and when required, with just a few clicks. The basic need of cloud computing is the sharing and provision of computational resources i.e. virtual machines based on demand. The cloud provides several resources infrastructures, platforms and services that not only save valuable time and expenses but are also safe, flexible, and scalable. Cloud utilities are easy to implement, do not need procurement of long-term contracts and are easy to scale up and down as per user requirement. In cloud computing, allocation of an appropriate virtual machine occurs based on user's request. This allocation is performed using the load balancing techniques. Load balancing in cloud computing is a computer network method for distribution of workloads and requests amongst various computing nodes.

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Load balancing involves distributing work between all servers, so data can be sent and received without any delay. Load balancing plans to optimize use of resources, maximize throughput, minimize response time, improve scalability and fault tolerance[10][11]. Load Balancing Algorithms can be classified into static and dynamic algorithms. Static approach mainly considers the traffic at each node in the network and divides the traffic equivalently amongst all the nodes. Dynamic approach however considers only the present state of the system while making decisions of distributing the load. In cloud computing, it is the dynamic algorithm, which is mainly used for large networks. Another classification segments load balancing into centralized and distributed algorithms. In a centralized approach only a single node is responsible for managing the traffic and load distribution while in distributed system each node makes decisions based on collected information about traffic.

Theload-balancing algorithm plays an important role in deciding which VM is to be allotted on demand to the client. Load balancing algorithms distribute the load amongst all the nodes in a network uniformly. It also makes sure if each resource is distributed efficiently and fairly or not. The overall performance of the system is also affected by the complexity of load balancing algorithms. In real time scenarios the workload is distributed accordingly by the load balancing algorithm by observing the incoming traffic.

Load distribution is a major issue in cloud computing. As the number of users associated with the network increases, the demand requests to be scheduled correspondingly increase. However, in many cases the existing methods of load scheduling cannot meet therequirements. It is thus necessary to determine and use an effective load scheduling system soas to reduce traffic and processing time. There are many existing load balancing algorithms, which aim to increase efficiency in cloud environment. Load balancing algorithms have been explored in various environments, yet, some challenges are present and must be dealt with. In Cloud Computing the main problem is to efficiently assign tasks to the nodes in the network so that the requests are processed as efficiently.

In this paper we present a survey of the current load balancing algorithms developed and compared so as to determine the better algorithm. We provide an overview of these discussions and see some methods used to perform comparisons. In addition, we compare three of these various algorithms based on response time and cost of utilization.

II. LITERATURE REVIEW

Rajeev Kumar[1] discussed the existing load balancing

algorithms such as Round Robin, Equally Spread Current Execution Load, Bee Colony Optimization and Ant Colony optimization. The paper also discusses a new hybrid algorithm which provides efficient load balancing of nodes and performs efficient scheduling. The hybrid algorithm works on two basic swarm intelligent algorithms, including ant colony optimization and priority based bee colony. The above two algorithms for scheduling are executed and load balanced within a scenario of cloud where performance of load balancing determines which virtual resource is loaded heavily or under loaded. The hybrid algorithm proves to outperform the existing approaches like RR, ESEC and ACO.

SimarPreet Singh [2] discuss the cloud analyst tool and highlight its main features stating that it is simple to use, produces GUI based outputs, possesses the ability to repeat computations and also provides the feature to save any calculated results. It discusses the four main components of the cloud analyst tool including regions, Internet settings, service broker, user bases, data center controller and Load Balancer which is used to implement the round robin, active monitoring load balancing and throttled load balancing algorithm where throttled proves to be superior algorithm.

Kaur[3] highlights the challenges and characteristics of cloud computing. It discusses the various services that cloud computing offers, the layers of service, virtualization and load balancing. It introduces the approaches of load balancing – static and dynamic, stating that static load balancing algorithms divide the traffic equivalently between all servers while dynamic load balancing is a non-centralized approach. The paper also discusses the existing load balancing algorithms such as Round Robin, Opportunistic Load Balancing, Randomized algorithm, Min-Min Algorithm, Max-Min Algorithm, Active Clustering, Lock-free multiprocessing solution for LB, Ant Colony Optimization, Shortest Response Time First, Based Random Sampling, Active Clustering and honey bee foraging behavior.

Nuaimi[5] investigates the different techniques of load balancing algorithms to find the solution for the issues related to load balancing and task scheduling in Cloud Computing. The paper contrasts the static and dynamic load balancing algorithms stating that the static algorithms in terms of over head are very efficient because during runtime they do not need to monitor the resources. Therefore, in a stable environment they would work well as their operational properties will not change over time and loads are generally constant and unique. On the other hand the Dynamic algorithms give better solutions so that the properties of the resources at run time can be adjusted dynamically at run-time.

Neethu[6] discusses the existing load balancing algorithms such as Fuzzy based Fire-Fly, Honey Bee Inspired, Ant Colony Optimization, Stochastic Hill Climbing and Genetic Algorithm based algorithm. It compares these algorithms using cloud simulation toolkit and compares them in terms of parameters such as static environment, dynamic environment, centralized balancing, distributed balancing and hierarchical balancing.

Randles[7] compares the Active Clustering algorithm, Biased Random Sampling and the Honeybee Foraging algorithm. Their experiment shows that as system diversity increases the honeybee algorithm performs consistently well. However, despite of performing better with low diversity and high resources, the random sampling walk and active clustering *degrades* with increase in system diversity. The result shows usthat when a diverse population of service types is required the honeybee-based load- balancing approach gives better performance. In case of similar populations the random sampling walk is used, and it quickly degrades with the increase in population diversity. Active clustering suggests that it is better than random walk with population diversity.

A. Proposed work

In this project, we analyze the load balancing algorithms. We perform analysis on the Round Robin, Throttled load balancing and Equally Spread Current Execution Algorithms described below:

B. Round Robin Algorithm

The cloud round robin algorithm[8][9] is similar to the round robin algorithm used in process scheduling. This algorithm works on the basis of random choice of the Virtual Machines (VMs) and continues in a cyclic manner.

The algorithm proceeds as follows:

i. Start

ii. Make all virtual machines available in the virtual machine state list

iii. Set current VM as -1

iv. If data center controller receives a new request, incrementvm and if the virtual machine corresponds to the user base that is being currently requested and the virtual machine in available, allocate the virtual machine.

v. Update the virtual machine state list

vi. If machine id is greater than list size, set machine id to zero to continue in cyclic manner.

vii. If request queued in data center controller, go to step iii.

viii. Stop

C. Throttled Load Balancing Algorithm

Throttled load balancing algorithm performs allocation triggered by client request to choose an appropriate virtual machine. The load balancer performs allocation by scanning the list of virtual machines to find the appropriate available virtual machine.

The algorithm proceeds as follows:

i. Start

ii. Make all virtual machines available in the virtual machine state list

iii. If Datacenter Controller gets a fresh task, perform throttled allocation i.e. iterate through the list of virtual machines from the top and allocate the first available virtual machine. Return the id of the chosen machine to the data center controller.

The Datacenter Controller then transfers the call to the virtual machine identified by that particular virtual machine id and informs the VM Load Balancer about the allocation.

iv. On receiving the allocation event from the Data Center Controller, update the virtual machine state list.

v. On receiving the de-allocation event from the Data Center Controller, update the virtual machine state list.

vi. If request queued in data center controller, go to step iii.

vii. Stop

D. Equally Spread Current Execution

ESCE Algorithm aims for fair

distribution of load amongst the virtual machines. It allocates the virtual machine with least load when triggered by a client request. This is done to have a more or less equal load on the set of virtual machines.

The algorithm proceeds as follows:

i. Start

ii. Make all virtual machines available in the virtual machine state list. Maintain another list with current number of allocations to each virtual machine. Initially, every VM is set to zero allocations

iii.If Datacenter Controller gets a fresh task, perform fair allocation i.e. iterate through the list of virtual machines from the top and allocate the first available virtual machine with minimum number of current allocations. Return the id of the chosen machine to the data center controller.

iv. The Datacenter Controller then transfers the call tothe virtual machine identified by that particular virtual machine id and informs the VM Load Balancer about the allocation.

v. On receiving the allocation event from the Data Center Controller, update the virtual machine state list by incrementing the current allocations for the chosen machine and setting its busy status.

vi. On receiving the de-allocation event from the Data Center Controller, update the virtual machine state list by decrementing the current allocations for the chosen machine and setting its availability status.

vii. If request queued in data center controller, go to step iii.

viii. Stop

III. RESULTS

We used the cloud analyst tool to implement the algorithms. Cloud analyst is a tool built to support and simulate the cloud environment. We performed analysis on the three algorithms and the results obtained after simulation of the various scenarios considering for different algorithms are shown

In each case we alter the number of data centers and user bases.

CASE 1:

Algorithm	Average Response Time (ms)	Average Data Center Processing Time (ms)	Cost ($)
Round Robin	130.83	31.80	9.56
Throttled	99.92	0.88	9.18
ESCE	99.99	0.96	9.55

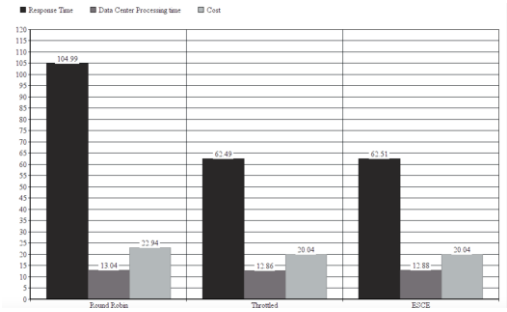
CASE 2:

Algorithm	Average Response Time (ms)	Average Data Center Processing Time (ms)	Cost ($)
Round Robin	104.99	13.04	22.94
Throttled	62.49	12.86	20.04
ESCE	62.51	12.88	20.04

CASE 3:

Algorithm	Average Response Time (ms)	Average Data Center Processing Time (ms)	Cost ($)
Round Robin	72.71	2.18	19.66
Throttled	71.02	0.48	3.77
ESCE	71.69	1.13	19.48

The following figure.1,2,3 represents the cases are as follows:



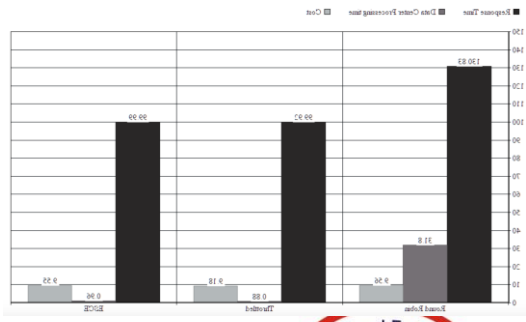


Fig.1. Cost of RR, Throttled and ESCE in First Case.Fig.2. Cost of RR, Throttled and ESCE in Second Case.

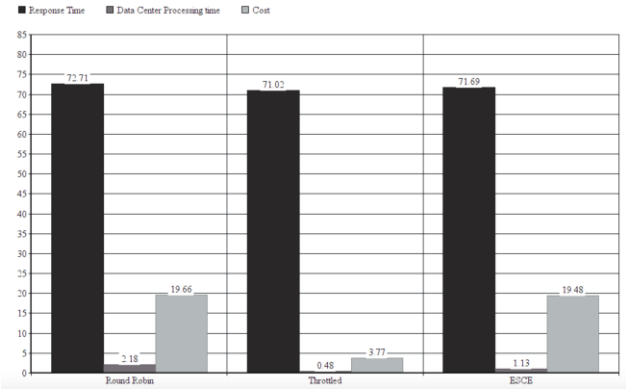


Fig.3. Cost of RR, Throttled and ESCE in Third Case.

Comparing with the table and graph, overall response time, data center processing time and cost it can be seen that the ESCE and throttled algorithm outperform the round robin lgorithm. The results alsoshow that Throttled performs better when compared to the other two algorithms

IV. CONCLUSION

In Cloud Computing load balancing is an issue which is yet to be completely solved. Load Balancing is a key challenge in the cloud system that is required to distribute the workload in an efficient and scalable manner. It is a major challenge to deduce an algorithm which reduces considerably the response time and cost of processing, By comparing the load balancing algorithms we strived to help make this deduction to choose the best load balancing algorithm in any given scenario. The work can be further enhanced by comparing other existing load balancing algorithms such as Ant Colony Optimization, Bee Colony Optimization, Randomized algorithm and the likes. The objective is to balance the workload of the cloud infrastructure while reducing the response time for the given number of tasks and efficiently handle the resources at hand.

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