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# An Enhancement of Throttled Load Balancing Algorithm in Cloud using Throughput

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**ABSTRACT**

Cloud computing is one of the rising technology in internet, where we can share and access data as a virtual resource. Efficient management and distribution of these data is a big challenge faced by cloud computing. In order to meet this challenge we require a proper load balancing technique. Throttled Algorithm is one of the most efficient algorithm available for cloud load balancing. In this paper we put forward a new approach for enhancing throttled algorithm by using throughput of the host machine, where the cloud virtual machines are actually placed.

***Keywords:*** Cloud computing, Virtualization, Load Balancing, Throughput, Cloud Analyst

## I. INTRODUCTION

Today, cloud computing is a most stunning technology in Internet. Cloud computing[1], which is relevant in terms of resources sharing. Resources include software, hardware, infrastructure etc, to be accessed and shared as virtual resources. Cloud computing is accessible in different ways, namely public cloud, hybrid cloud (which combine both public and private clouds), and private cloud they are collectively known as deployment models.

A. Public cloud:Most popular and standard computing model is public cloud. In public cloud, service providers provide resources like applications, storage and are able to be obtained over the internet as free or pay-per-use [2].

B. Private cloud: This cloud possibly managed by the service provider or by organization. Private cloud model, the pool of resources is accessible within an organization and the model is more secure, reliable than public cloud model. So, this model commonly used for enterprise applications [2].

C. Hybrid clouds: Hybrid cloud is an environment that is a composition of public and private cloud models. Combination of both models enhances hybrid cloud by providing more security, reliability and performance[2].

Cloud computing offers different delivery of services, namely Infrastructure as a service, Software as a service and Platform as a service.

A. Infrastructure as a service: Here the services provided by cloud are networking technologies, Storage servers and Data center space etc. It also provides virtualization technology for the efficient management of resources [3].

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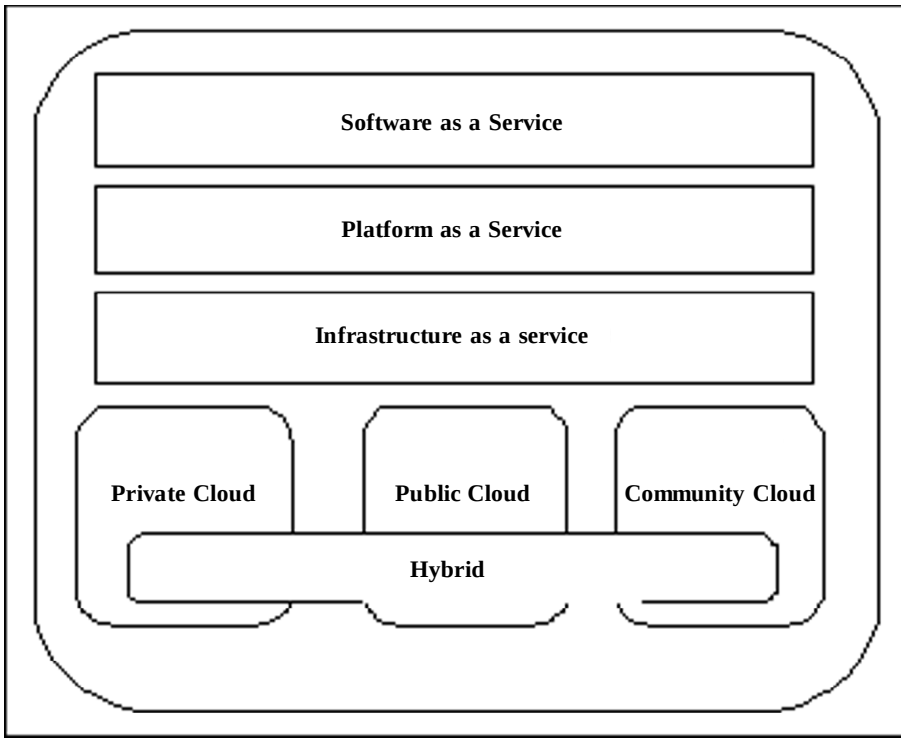



**Figure 1: Cloud computing service models and Deployment models.**

B. Platform as a service: This cloud provides development environment as a service. PaaS provides services to deploy, test and maintain applications and also helps in the rapid development of applications[3].

C. Software as a service: With the help of this model, software and applications are delivered as a service through internet. This service model allows customers to use software and hardware without installing and updating. Use of this model reduces the time spend on installing and configuration of software, also it helps to reduce cost and complexities from maintenance and support[3].

Virtualization [4][5] is the most striking feature of computing environment which refers to the abstraction of computer resources. It is a successful method to minimize Information Technology expenses whereas increases the performance and agility. Virtualization is one of the solutions to remove the trouble by introducing multiple applications and operating systems to work on a single physical server or "host". Each virtual machine (VM) is isolated from the others, and it is able to use host's computing resources as it requires. Hence, it becomes a fundamental technology that powers cloud computing.

## 2. LOAD BALANCING

Load balancing [6] as the name implies distributing the load among multiple nodes so as to balance the load within a distributed system. This mechanism reduces the resource utilization and also improves the job response time. Load Balancing focus on two foremost tasks, one is resource allocation and other is task arrangement in distributed environment. Load balancing methods should achieve maximum throughput, high performance and reduce response time. Mainly two load balancing technique are exists, that are static and dynamic load balancing.

A. Static Load balancing Algorithm: Algorithms in this category never depend upon the present state of the system. This algorithm divides the traffic equivalently between servers. It has former knowledge regarding the system assets and details of every task in an application. One of the drawbacks of this algorithm is in the case of unexpected failure of system assets and tasks [7].

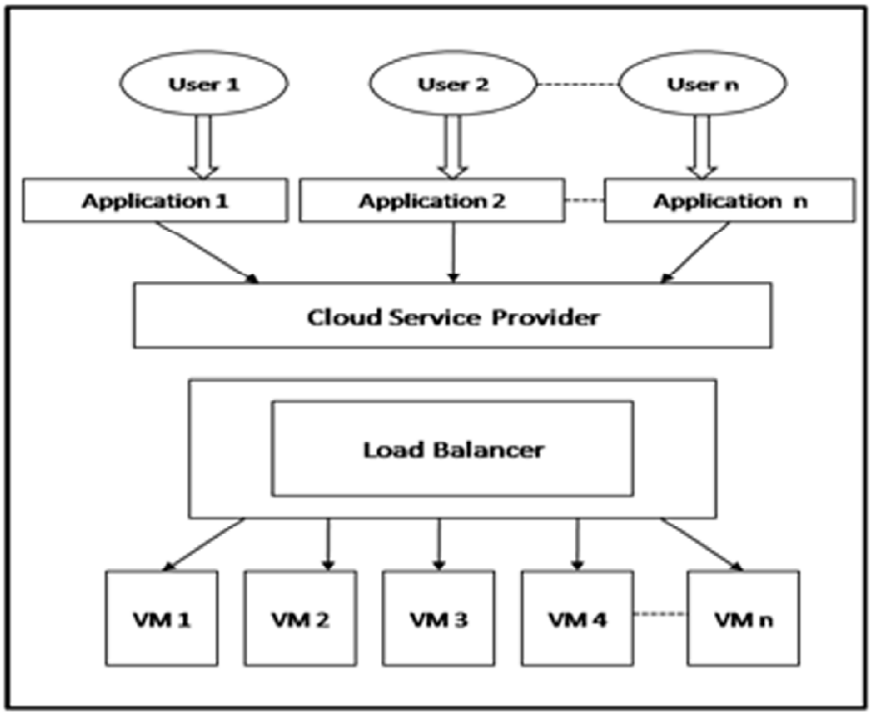



**Figure 2: Execution of load balancing algorithm in cloud computing.**

B. Dynamic Load balancing algorithms: This algorithms work on the basis of present state of the system and do not needed any former knowledge regarding the system [7].

Different algorithms commonly used for load balancing are[8] :

A. Round-robin Algorithm: R-R algorithm is work on the basis of random sampling. If some server is over loaded or some are under loaded, round robin will select load randomly.With this method incoming requests are distributed one after another across the cluster. Round robin is chooses, if all servers have same or similar performance and are running the same load [9].

B. Equally Spread Current Execution Algorithm: It allocate the load arbitrarily by inspecting load to those virtual machines which is under loaded or switch that task easier and take minimum time, and give maximum throughput[10].

C. Throttled Algorithm: This algorithm make sure that a fixed count of cloudlets is assigned to a single virtual machine. There is a job manager, the main role of job manager is to maintain a list of all virtual machines and it chooses appropriate machine for the desire job. If more request are present than the count of available virtual machine, assign incoming requests in queue basis until the next virtual machine become available [11].

Different qualitative metrics of load balancing are:

- *Throughput:* Which is a measure of how many tasks a node can be processed in a given amount of time. For systems improved performance, it is essential to have high throughput.
- *Fault tolerant*: Fault tolerance is a crucial issue in cloud computing. Fault tolerance is the masking of failures, i.e. continues to operate despite failures. With the help of Fault tolerance techniques the failures can be predicted early. Also it helps to take appropriate action before failures actually occur. Loadbalancing algorithm must have improved fault tolerance.
- *Response time:* It is defined as the entire amount of time a load balancing algorithm required to respond to a request for service.

## 3. EXISTING THROTTLED ALGORITHM

Throttled load balancing algorithm [11] depends on state of virtual machine . Here two virtual machine states are there based on which the algorithm is performed that are AVAILABLE/BUSY .This state is based on the allocation of virtual machine to the request, is allocated or not. A hash table maintained at loadbalancer will contain this state information. ID and status(AVAILABLE/BUSY) of the virtual machine are the two parameters of a hash table. At the beginning every virtual machine is on available state.

When the data center receives client request it simply forward them to load balancer to find suitable virtual machine for request.Among all virtual machine with AVAILABLE state the virtual machine (VM) which is to be assigned to a request is determined by load balancer. For this, load balancer will start look through the hash table from top-to-bottom. After identifying an available virtual machine from the hash table ,datacenter controller will be notified with the id of that virtual machine for request allocation.

If data center successfully allocate the virtual machine id to the specified request, it will notify the success of its operation to load balancer and accordingly, then hash table will be updated by load balancer.During allocation if datacenter controller detecting any problem then a negative feedback will send to load balancer which result no updation on hash table. If all virtual machine's are in BUSY state datacenter will receives a notification, based on which datacenter will start queuing user requests at its own pool. The virtual machine itself notify job done to the data center controller after the completion of allocated job to that virtual machine and it will inform the same to the load balancer,and load balancer will make appropriate changes in the hash table.

## 4. RELATED WORKS

A research paper presented by Manan.D.Shah, Dipak.L.Agrawal and Amit.A.Kariyani which titled Allocation of Virtual Machines in Cloud Computing Using Load Balancing Algorithm suggested a modification to the existing throttled algorithm.The improvement is done by calculating response time of VM, and using this algorithm decides the efficient virtual machine for the allocation. Furthermore after performing above steps we can reveal the availability of VM's to the user so that they get to know whether they have to wait or receive service from other cloud provider. [12]

The paper named Analytical Study for Throttled and Proposed Throttled Algorithm of Load Balancing in Cloud Computing using Cloud Analyst which is done by Pragnesh Patel and Slesha Nayak together introduced an enhancement in throttled algorithm using response time of all available virtual machine. Here for load transmission they consider minimum response time along with the state of the VM. This algorithm reduces response time and improve performance [11].

A research paper titled Adaptive Load Balancing Algorithm Using Modified Resource Allocation Strategies on Infrastructure As a Service Cloud Systems done by Lavanya M., Sahana V., SwathiRekha K. and Vaithiyanathan V proposed an effective scheduling algorithm to overcome the drawbacks in Throttled Load Balancing Algorithm. This support the load balancing and gives better way through efficient job scheduling, modified resource allocation and minimize the power usage and context switch between the servers. This provides a better enhancement to the existing Throttled Load Balancing Algorithm [13].

Meenakshi Sharma, Pankaj Sharma, Dr. Sandeep Sharma in their work titled Efficient Load Balancing Algorithm in VM Cloud Environment , first of all a study of various VM load balancing algorithms has done. After the analysis, they proposed a new virtual machine load balancing algorithm and implement in cloud computing Virtual Machine environment so as to achieve improved response time and cost. The Proposed algorithm is divided into three part. The estimated response time of each VM is find in the initial phase. Find the efficient VM in second Phase. The last phase gives back the ID of efficient VM [14].

## 5. PROPOSED MODEL

Throttled algorithm is one of the efficient algorithms available for load balancing where virtual machine selection decision is based on the state (AVAILABLE/BUSY) of virtual machines, which is stored in a hash table along with its Id. This paper proposes a model which is an enhancement to the existing throttled algorithm by introducing a new parameter called throughput, which is the measure of how many tasks a node can be processed in a given amount of time. For improved performance of the system it is essential to have high throughput

Here we are calculating the throughput of every host machine (in which a virtual machine works) with respect to its virtual machine and store the result in the hash table along with the existing details maintained in the load balancer. Then performs a descending sort on the hash table on the basis of this throughput .The task will be allocated to the available virtual machine on the basis of this sorted hash table. This improved throttled algorithm works efficiently even though underlying capacity of each virtual machine is different as the hardware configuration of its host is different.

**Proposed Algorithm:**

1. In ProposedThrottledLoadbalancer we are calculating the throughput of every host.
2. Store that throughput in to the hashtable along with the state (BUSY/AVAILABLE) and id of virtual machine which runs within the particular host machine, At the beginning all VM's are available.
3. Perform descending sort on hash table on the basis of throughput.
4. Datacenter Controller gets a new request.
5. Datacenter Controller queries the ProposedThrottled Loadbalancer for the next allocation.
6. ProposedThrottledLoadbalancer scan the hashtable from top until the first virtual machine available or the table is scanned from top to bottom.

   **If found:**

   a) The ProposedThrottledLoadbalancer returns VM id.

   b) With the help of this id DataCenterController identifies the VM and sends request.

   c) DataCenterController notify the proposedloadbalancer regarding the new allocation

   d) ProposedThrottledLoadbalancer updates hash table accordingly

   **If not found:**

   e) The ProposedThrottledLoadbalancer returns -1.

   f) The DataCenterController makes the request to wait in queue.
7. When VM completes the processing of request, and the DataCenterController gets the response cloudlet, it notifies the ProposedThrottledLoadbalancer of the VM de-allocation.
8. The Data Cener Controller checks waiting queue for requests. If any, it continues from step 5, otherwise continue from step 4.

## 6. SIMULATION ENVIRONMENT

The experiment is done with help of Cloud Analyst simulator. Cloud Analyst is built over the CloudSim tool kit [15].

**Figure 3: Cloud Analyst Home Screen**

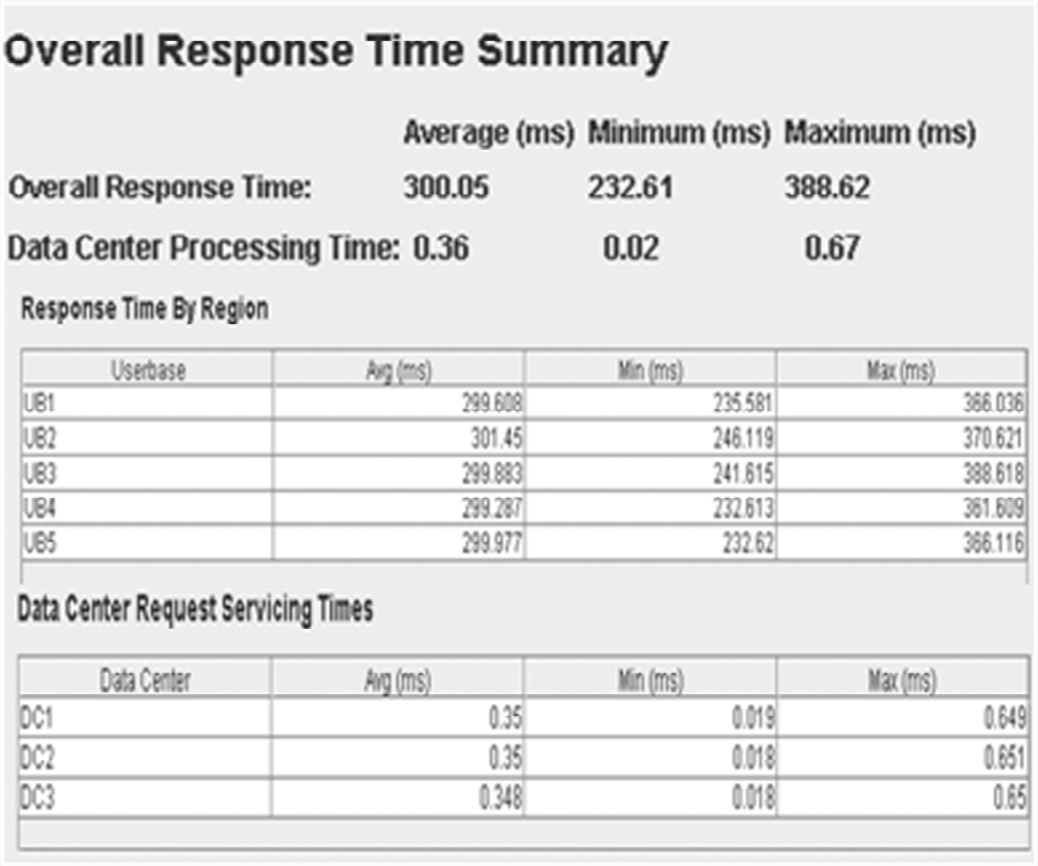
**Components of Cloud Analyst:**

- Region: In Cloud analyst tool includes 6 'Regions'. Data centers and user bases are fit in one of these regions.
- Cloud Application Service Broker: It helps traffic routing among data centers and user bases. It decides which Datacenter must service the request from each and every user base.
- User Base: A User Base is a set of users that is treated as a single unit in simulation and its major task is to create traffic for simulation.
- Internet Cloudlet: An Internet Cloudlet is a set of user requests. These requests are clustered into a single Internet Cloudlet.
- Datacenter Controller: Datacenter Controller controls activities of data center.
- VmLoadBalancer: The VmLoadBalancer to settle on which VM to be assigned the next cloudlet for processing. The load balancing policy exist in Cloud Analyst tool are Round-robin Load Balancing Algorithm. Equally Spread Current Execution Algorithm, Throttled Load Balancing Algorithm.

In our experiment, simulation duration is set to 60 minutes. And simulation is done for five user bases and three datacenters. Configuration Simulation is divided in three parts, In Main Configuration we are able to setup parameter such as simulation duration, service broker policy, user base, application configuration. The brokering policy we have selected to compare existing and modified throttled algorithm is Optimize Response Time. In datacenter configuration we are able to set datacenter and physical hardware (host) configuration. From the drop-down we can select different load balancing policy for our experiment. As we have created our own new policy modified Throttle Algorithm we can select it from proposed system simulation. We have set UGF to 10, EIL to 100 bytes and RGF to 10.

## 7. EXPERIMENTAL RESULT

Here figures showing the experimental result and comparison between the existing throttled algorithm and proposed algorithm.



**Overall Response Time Summary**

| | Average (ms) | Minimum (ms) | Maximum (ms) |
|---|---|---|---|
| Overall Response Time: | 300.05 | 232.61 | 388.62 |
| Data Center Processing Time: | 0.36 | 0.02 | 0.67 |

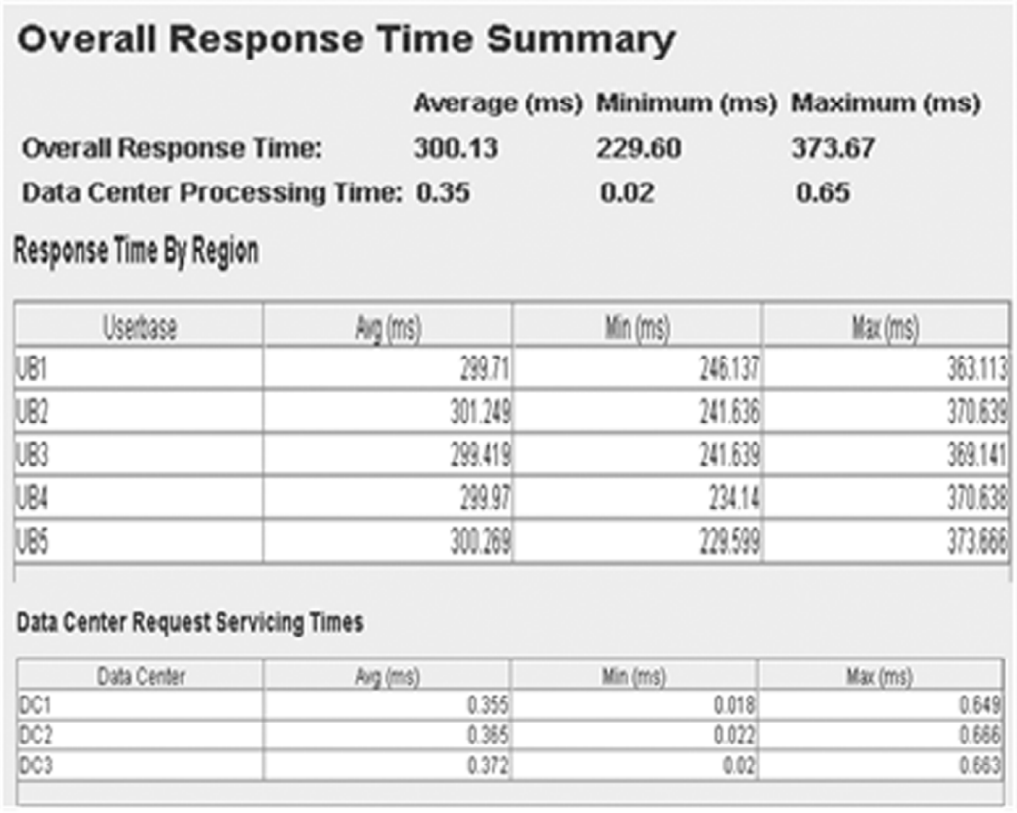
**Response Time By Region**

| Userbase | Avg (ms) | Min (ms) | Max (ms) |
|---|---|---|---|
| UB1 | 299.608 | 235.581 | 366.036 |
| UB2 | 301.45 | 246.119 | 370.621 |
| UB3 | 299.883 | 241.615 | 388.618 |
| UB4 | 299.287 | 232.613 | 361.609 |
| UB5 | 299.977 | 232.62 | 366.116 |

**Data Center Request Servicing Times**

| Data Center | Avg (ms) | Min (ms) | Max (ms) |
|---|---|---|---|
| DC1 | 0.35 | 0.019 | 0.649 |
| DC2 | 0.35 | 0.018 | 0.651 |
| DC3 | 0.348 | 0.018 | 0.65 |

**Figure 4: Overall response time summary, region response time and datacenter request servicing times taken by throttled algorithm for the completion of simulation.**



**Overall Response Time Summary**

| | Average (ms) | Minimum (ms) | Maximum (ms) |
|---|---|---|---|
| Overall Response Time: | 300.13 | 229.60 | 373.67 |
| Data Center Processing Time: | 0.35 | 0.02 | 0.65 |

**Response Time By Region**

| Userbase | Avg (ms) | Min (ms) | Max (ms) |
|---|---|---|---|
| UB1 | 299.71 | 246.137 | 363.113 |
| UB2 | 301.249 | 241.636 | 370.639 |
| UB3 | 299.419 | 241.639 | 369.141 |
| UB4 | 299.97 | 234.14 | 370.638 |
| UB5 | 300.269 | 229.599 | 373.666 |

**Data Center Request Servicing Times**

| Data Center | Avg (ms) | Min (ms) | Max (ms) |
|---|---|---|---|
| DC1 | 0.355 | 0.018 | 0.649 |
| DC2 | 0.365 | 0.022 | 0.666 |
| DC3 | 0.372 | 0.02 | 0.663 |

**Figure 5: Overall response time summary, region response time and data center request servicing times taken by proposed algorithm for the completion of simulation.**

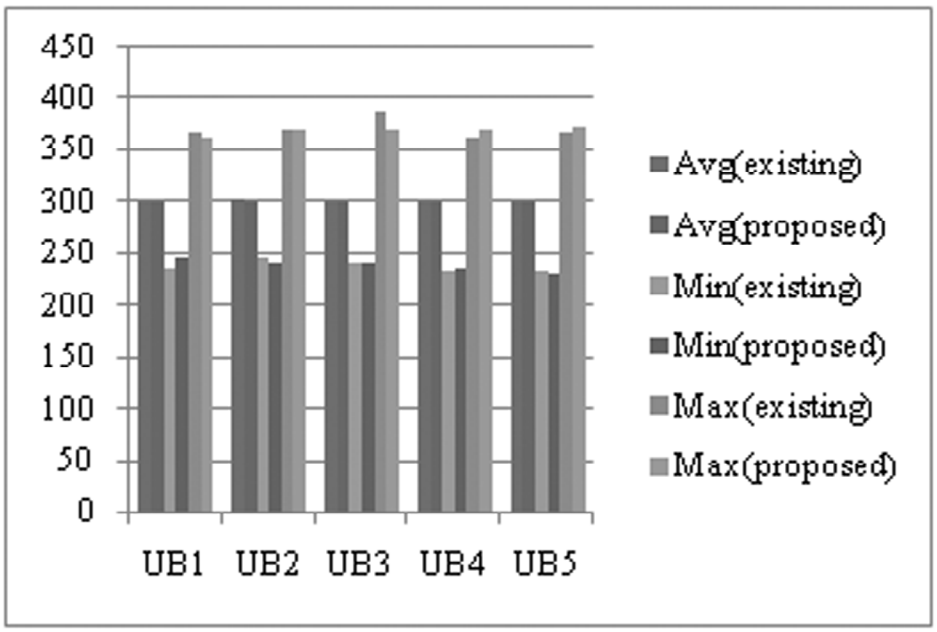



**Figure 6: Max, Min and Avg response time summary of Existing and Proposed Throttle Algorithm.**

## 8. CONCLUSION

Throttled load balancing algorithm maintains a hash table for the current state of virtual machine (Busy/ Available), which helps in making decision for virtual machine selection. In this paper the proposed algorithm works based on throughput. This algorithm provides better performance than existing, even though underlying capacity of each virtual machine is different as the hardware configuration of its host machine is different. Here by, we can minimize the overall response time of the algorithm by transmitting load to most efficient virtual machine.

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