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# PROPOSED LOAD BALANCING ALGORITHM TO REDUCE RESPONSE TIME BY IMPROVING THROTTLED LOAD BALANCING ALGORITHM

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***Abstract***

Due to easy to use approach and quick availability of resources such as virtual machines etc Cloud computing has become a popular technology among the whole world. There are a number of technologies that have been introduced for load balancing in cloud environment so far but if we deeply study all of them we will find that there is a need of improvement in all the existing algorithms in terms of resource allocation ,response time and datacenter processing . Therefore, while Implementing our algorithm for load balancing in cloud environment these were the main parameters which we wanted to improve so that there should be minimum response time and maximum resource utilization and we had succeed in achieving it. The response time and resource utilization of our algorithm is better than the existing Throttled load balancing algorithm.

***Key Words***: Cloud Computing, Load Balancing, Round Robin Algorithm, ESCE Algorithm, Throttled Algorithm

## 1.INTRODUCTION

A) Cloud computing

In simple words we can define cloud computing as a virtual and diffused model[1]. There are many pros of cloud computing such as it allows a number of resources to be accessed by a number of clients, its elasticity, clients need not to buy expensive machines, pay per use, client can unsubscribe the subscription at any time etc[17]. 'Telepsychatist' is the first area that had gained benefit from cloud computing[2].There are following five types of services that cloud computing provides to its users[3][4] :-

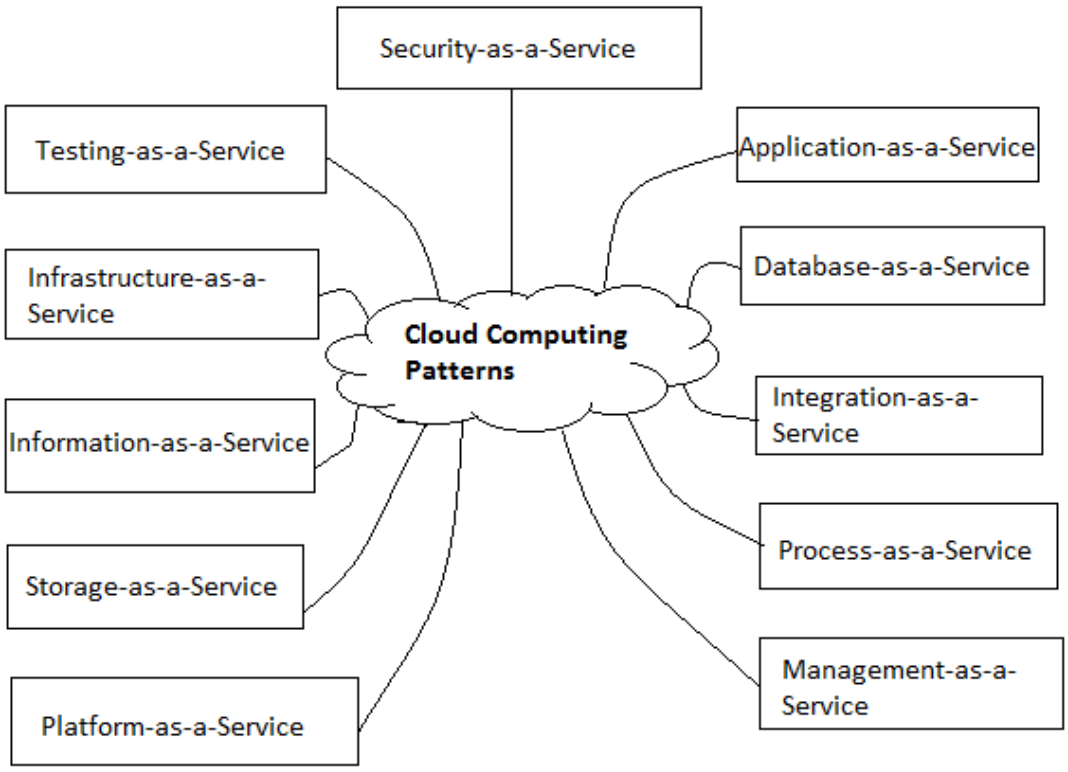
1)IAAS
2)PAAS
3)SAAS
4)RAAS
5)FAAS

B) Components of Cloud computing

It has three main components[5]:

1)Client:- This component helps the end users to interact with the clients so that they can maintain their data.[6]
2)Datacenters:-Datacenters are the group of huge number of servers. It stores the end users subscription.
3)Distributed Servers:- All the requests from the clients are satisfied by the Distributed Servers and are placed all around the world.

C) Cloud Computing Patterns:




Fig[1]: Cloud Computing Patterns

## 2.LITERATURE SURVEY

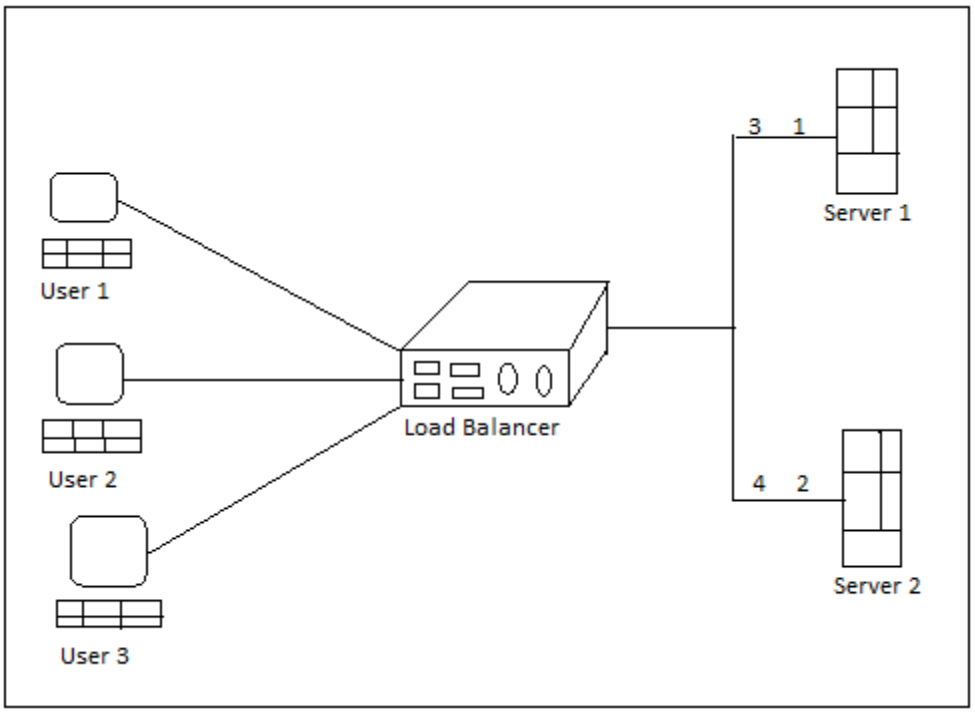
### A) Load Balancing

The concept of load balancing is required in order to improve the performance with respect to a particular task[7]. In this technique workloads are given to resources( like virtual machines) in such a way that the overall performance get improved. The main parameters which are kept in mind during allocation are response time and resource utilization. The response time needs to be as minimum as possible and resource utilization should be as maximum as possible. During the virtual machines allocation it should also be considered that all the virtual machines are loaded equally that is there shouldnot be any overloading or underloading of virtual machines should exist.Two main actors of cloud computing are cloud client and cloud providers[18]. Balancing the workload indicates that all the virtual machines are loaded equally[8].
Two types of Load balancing:-
1) **Static Load Balancing:** As the name suggests, in this load balancing technique the workloads are given to the resources/processors before the execution of the algorithm[9]. Communication delay in this algorithm is less than the dynamic load balancing algorithm and its behavior is also predictable[10]. As far as resource utilization is concerned it is not as effective in utilizing the resource as the dynamic load balancing algorithm is.

2) **Dynamic Load Balancing:** In this load balancing technique the workloads are given to the resources/processors during the execution of the algorithm[9]. This technique is hard to implement but it is more effective and reliable than static load balancing algorithm[13].

Many researchers have given their contribution in Load Balancing in Cloud environment and some of them have also succeeded in achieving their goal of improving load balancing in Cloud environment. Some of the algorithms for improving load balancing in cloud environment have been explained below:

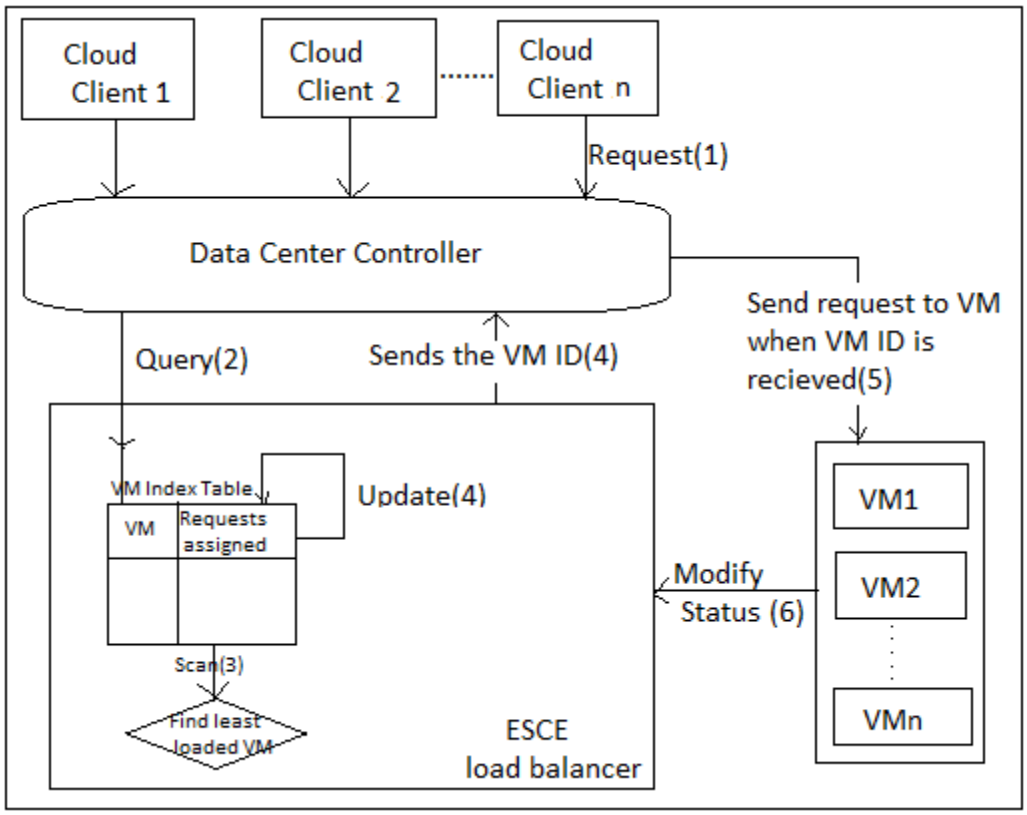
**1) Round Robin Algorithm:**




Fig[2]:Round Robin

If we talk about the simplest algorithm for load balancing then none of the algorithms is better than round robin algorithm. Authers like D. Chitra Devi et al.[11] and Nguyen Xuan Phi[12] had explained round robin algorithm as an algorithm that gives workload to virtual machines or resources based on time quantum in circular motion . The pro of providing the workload in such a way is that no virtual machine will be neither overutilized nor under utilized. But in every work pros and cons run in parallel and the disadvantage of round robin algorithm is that in this algorithm large processes and high priority processes suffers. Also the time quantum should be choosen in such a way that it shouldnot be very small or very large otherwise it will suffer from frequent context switch or long wait situation respectively.

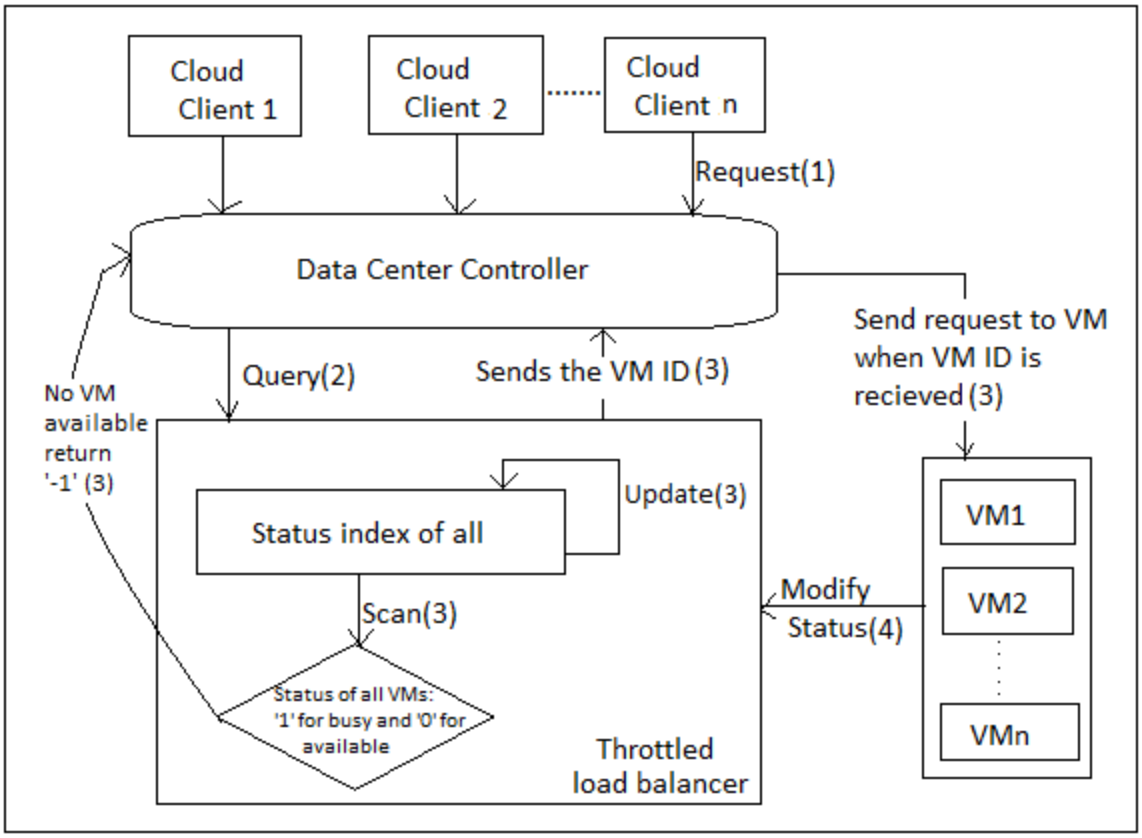
2)Equally Spread Current Execution Algorithm(ESCE):




Fig[3]:ESCE

Equally Spread Current Execution algorithm allocates the tasks among accessible VM's with the perspective to find the number of dynamic errands at any time on each virtual machines[13]. It depends on client requests priorities. By finding out the size, this algorithm arbitrarily distributes tasks and will give the stack to the available virtual machine which is assigned with minimum tasks. This algorithm works by searching the virtual machine which has minimum number of allocations in order to provide better resource allocation policy.

3) Throttled Load Balancing Algorithm(TLB):




Fig[4]:TLB

Throttled algorithm for load balancing in cloud environment initiates by appointing the virtual machine which is best for performing the task when customers send requests to the load balancer. This algorithm encloses the quantity of solicitations being produced in virtual machines to a throttling edge. The primary part of this algorithm is to look for a file table of all virtual machines along with their states representing occupied and accessible mode. If the client requests for making this limit be exceeded in all accessible virtual machines then the load balancer returns '- 1' and datacenter lines the request until a virtual machine is available for accessing[13].

**3.Proposed Improved Throttled Load balancing Algorithm (ITLB)**

Input: VM_request _from_client, Policy, Number_of_VM. Number_of_userbases, Number_of_Datacenter.

Output: VM allocated.

Step 1: Client's request for VM from DCC.

Step 2: DCC sends a Query to Improved Throttled load balancer for the allocation of VM.

Step 3: Following operations will take place in Improved Throttled load balancer:-

3.1) check the state of the VMs in "VM State list".

3.2) select the VM which have count=0.

3.3) if there is no such VM which have count=0 then select the one having minimum allocation count.

Step 4: After allocate selected VM perform the following steps:-

4.1) If VM in once allocated list="false", change it to "true".

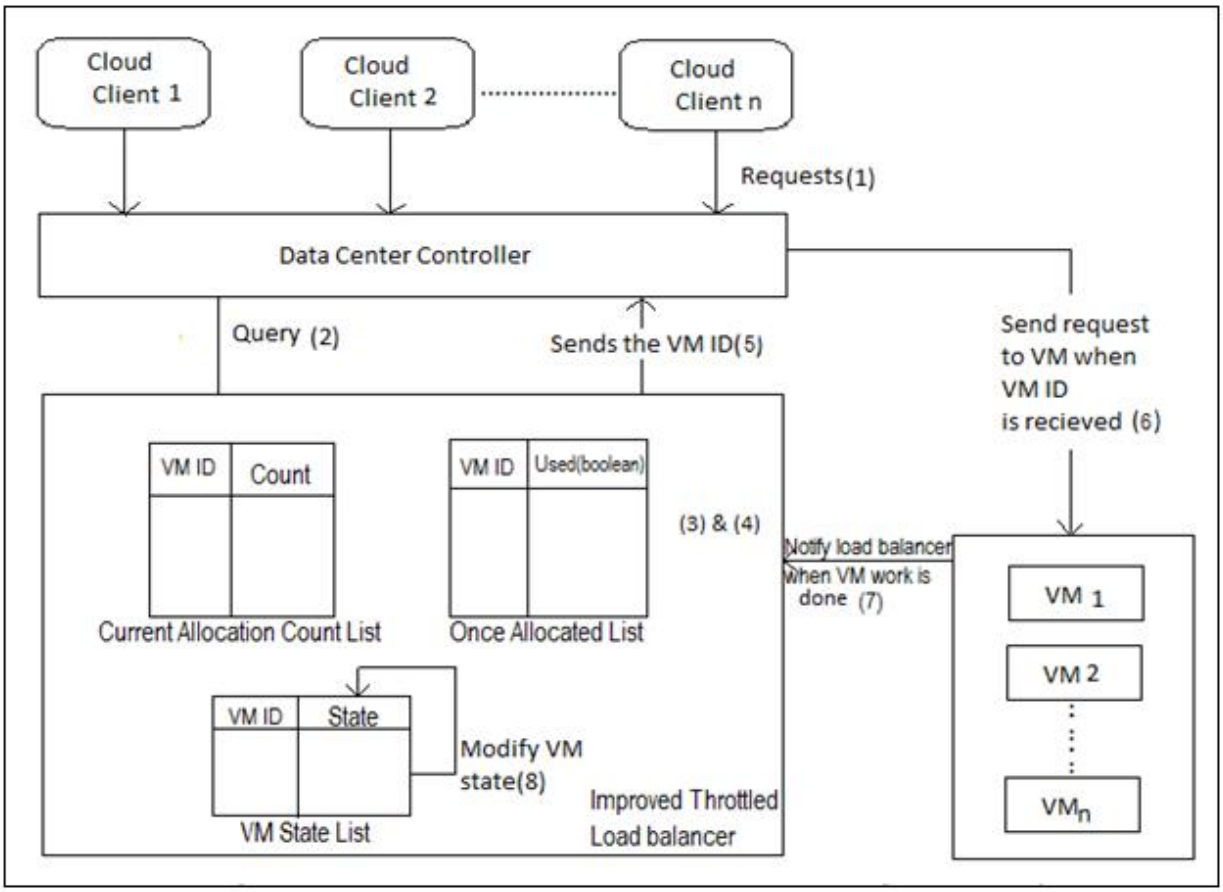
4.2) Increase count in current allocation count list by one corresponding to the selected VM.

Step 5: Improved Throttled load balancer will return the VM ID to the DCC.

Step 6: DCC sends request to VM whose VM ID had returned by the Improved Throttled load balancer.

Step 7: Notify Improved Throttled load balancer to stop VM when the task defined by the client is performed by the VM.

Step 8: Improved Throttled load balancer modifies VM state from unavailable to available.

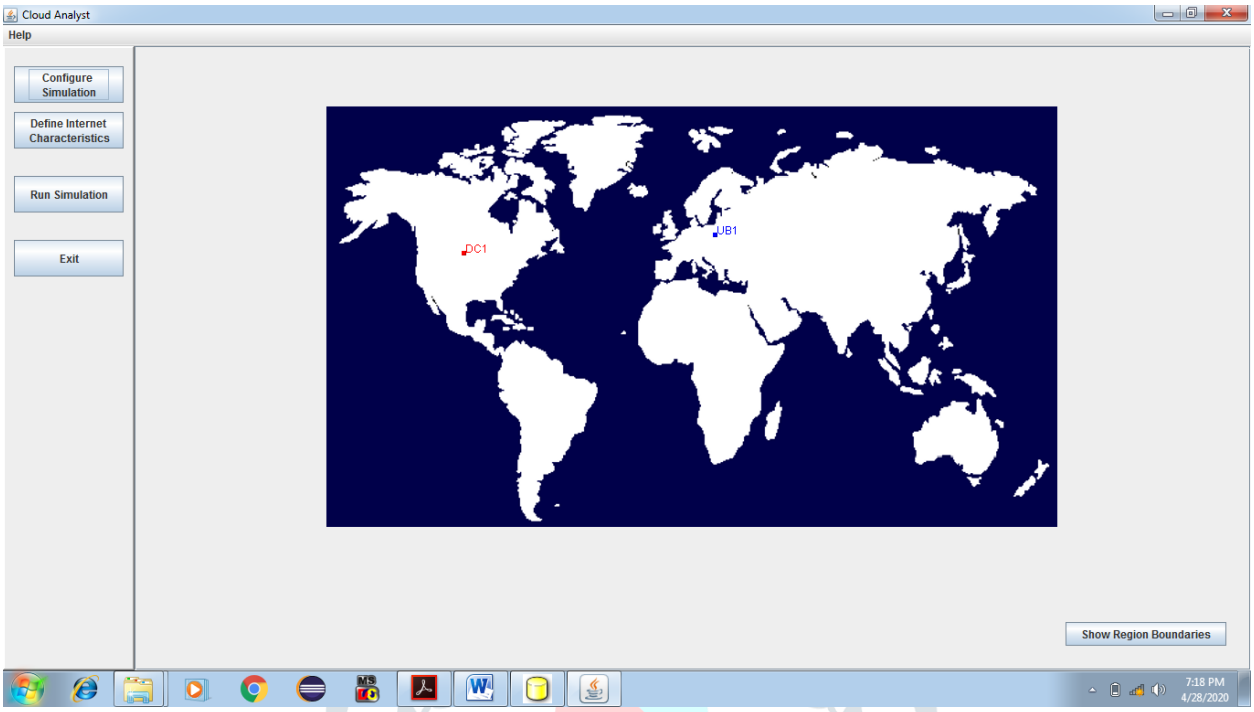



Fig[5]:Improved Throttled Load balancing Algorithm (ITLB)

## 4. Simulation Setup and Performance Analysis

In this paper Cloud Analyst have been used to compare the performance of the existing Throttled Load balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB). The advantage of using Cloud Analyst which is a GUI based simulation tool[14][15][16] is that it is very simple to learn working of this tool. Apart from the simplicity of learning this tool it also provides configuration of many parameters manually by the user such as Datacenter configuration, userbase location, Service broker policy, Duration of Simulation, Userbases in the Scenario, Application deployment configuration,

Executable instructions length per request, Datacenters request grouping factor and User grouping factor in userbase easily and quickly on this tool. The user can maker and save different scenarieos . Figure below shows the GUI of Cloud Analyst.




Fig[6]: Output screen of Cloud Analyst

As we can see in the above figure there are three main features of this tool to set the complete simulation process:-

1)Configure Simulation

2)Define Internet Characteristics

3)Run Simulation

Here in order to compare the algorithms three scenarios have been made in which some parameters are fixed for all scenarios.

The table below shows the fixed parameters corresponding to all the scenarios.

Table: ADVANCED SETTINGS

| | | |
|---|---|---|
| 1. | User grouping factor in Userbases | 10 |
| 2. | Request grouping factor in Datacenters | 10 |
| 3. | Executable instruction length per request(bytes) | 100 |

Table: PARAMETERS CONFIGURATION FOR DATACENTERS

| | PARAMETERS | VALUES |
|---|---|---|
| 1. | VM Memory(Mb) | 204800 |
| 2. | VM Available BW | 1000000 |
| 3. | Processor speed | 10000 |
| 4. | VM Storage(Mb) | 100000000 |
| 5. | Number of processors in VM | 4 |
| 6. | VM policy | Time_Shared |
| 7. | Datacenter OS | Linux |
| 8. | Datacenter Cost per VM $/H | 0.1 |
| 9. | Datacenter Architecture | X86 |
| 10. | Datacenter VMM | Xen |
| 11. | VMS in every datacenter | 5 |
| 12. | Datacenter physical H/W units | 2 |
| 13. | Datacenter data transfer cost $/Gb | 0.1 |
| 14. | Datacenter Storage cost $/S | 0.1 |
| 15. | Datacenter memory cost $/H | 0.05 |

SCENARIOS 1: EXPLANATION AND COMPARISON RESULTS

In scenario 1 there are five userbases UB1 at region 0, UB2 at region 1 and UB3, UB4, UB5 at region 2,3 and 4 respectively. Number of datacenters in this scenario is one at region 5 and it has 5 VMs. The fixed parameters are shown in the tables. Comparison results are carried out by comparing the average of five readings from each algorithm. The table shown below shows the comparison readings between the existing Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) concerning response time as the comparison parameter.

Table: Comparison between Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB Response Time | ITLB Response Time |
|---|---|---|
| 1. | 601.05 | 601.09 |
| 2. | 601.21 | 601.09 |
| 3. | 601.10 | 601.03 |
| 4. | 601.13 | 601.06 |
| 5. | 601.12 | 601.25 |
| Average | 601.122 | 601.104 |

By seeing the results of the table it is clear that the proposed Improved Throttled Load balancing Algorithm (ITLB) is better than Throttled Load Balancing Algorithm (TLB) while concerning response time as the comparing parameter.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning Cost as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB | ITLB |
|---|---|---|
| Cost($) | 0.82 | 0.82 |

The cost charges by Throttled Load Balancing Algorithm and Improving Throttled Load balancing Algorithm (ITLB) are same.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning Datacenter Processing Time as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB | ITLB |
|---|---|---|
| Datacenter Processing Time | 0.10 | 0.10 |

The Datacenter Processing Time by Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) is same but ITLB has less response time than TLB.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning resourse utilization as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB resourse utilization | ITLB resourse utilization |
|---|---|---|
| VM0 | 5923 | 1261 |
| VM1 | 398 | 1264 |
| VM2 | 48 | 1274 |
| VM3 | 1 | 1272 |
| VM4 | | 1299 |

The above table shows the comparison Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) concerning resource utilization. The table clearly indicates that every virtual machine is utilized evenly by using the proposed ITLB algorithm on the other hands in TLB most of the work is given to the VMs which are located near to the userbase which results in underutilization of other resources.

SCENARIOS 2: EXPLANATION AND COMPARISON RESULTS

In scenario 2 there are two userbases UB1 at region 2 and UB2 at region 2. Number of datacenters in this scenario are four where DC1 is at region 0, DC2 is at region 3 , DC3 is at region 4 and DC4 is at region 5 and it has 5 VMs. The fixed parameters are shown in the tables. Comparison results are carried out by comparing the average of five readings from each algorithm. The table shown below shows the comparison readings between the existing Throttled Load Balancing Algorithm and Improving Throttled Load balancing Algorithm (ITLB) concerning
response time as the comparison parameter.

Table: Comparison between Throttled Load Balancing Algorithm (TLB) and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB Response Time | ITLB Response Time |
|---|---|---|
| 1. | 205.19 | 205.14 |
| 2. | 205.32 | 205.15 |
| 3. | 205.24 | 205.31 |
| 4. | 205.32 | 205.12 |
| 5. | 205.21 | 205.14 |
| Average | 205.256 | 205.172 |

By seeing the results of the table it is clear that the proposed Improved Throttled Load balancing Algorithm (ITLB) is better than Throttled Load Balancing Algorithm (TLB) while concerning response time as the comparing parameter.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning Cost as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB | ITLB |
|---|---|---|
| Cost($) | 2.16 | 2.16 |

The cost charges by Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) are same.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning Datacenter Processing Time as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

| | TLB | ITLB |
|---|---|---|
| Datacenter Processing Time | 0.22 | 0.22 |

The Datacenter Processing Time by Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) is same but ITLB has less response time than TLB.

The following table shown below shows comparison between the existing Throttled Load Balancing Algorithm(TLB) and Improved Throttled Load balancing Algorithm (ITLB) concerning resourse utilization as the comparison parameter.

Table: Comparison Between Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB):

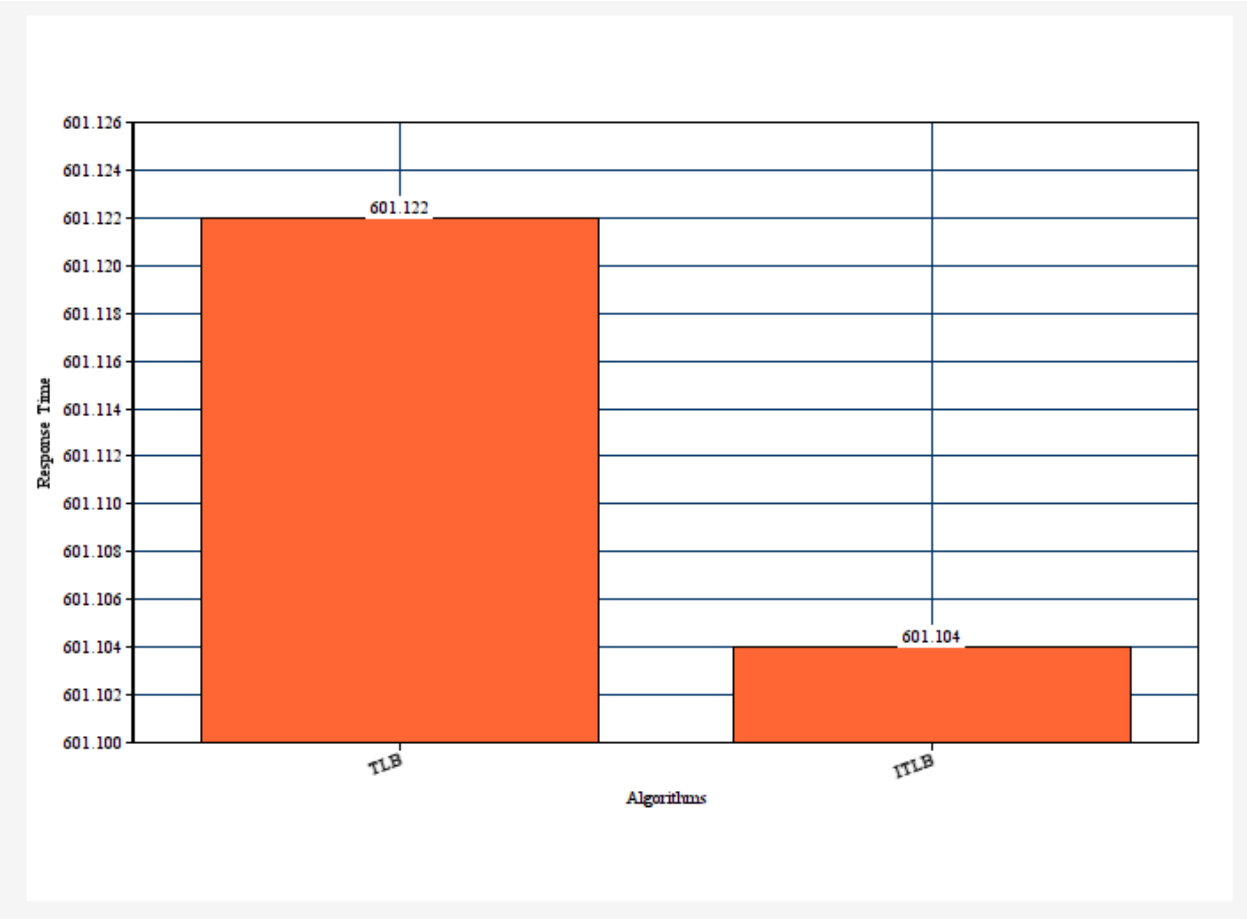
| | TLB resourse utilization | | | | ITLB resourse utilization | | | |
|---|---|---|---|---|---|---|---|---|
| | DC1 | DC2 | DC3 | DC4 | DC1 | DC2 | DC3 | DC4 |
| VM0 | 1942 | 271 | 213 | 10 | 426 | 60 | 41 | 6 |
| VM1 | 127 | 3 | 5 | | 426 | 52 | 36 | 2 |
| VM2 | 12 | | | | 421 | 55 | 36 | 2 |
| VM3 | 1 | | | | 420 | 55 | 36 | |
| VM4 | | | | | 427 | 50 | 33 | |

The above table shows the comparison Throttled Load Balancing Algorithm and Improved Throttled Load balancing Algorithm (ITLB) concerning resource utilization. The table clearly indicates that every virtual machine is utilized evenly by using the proposed ITLB algorithm on the other hands in TLB most of the work is given to the VMs which are located near to the userbase which results in underutilization of other resources.

**v. Experimental Results:**

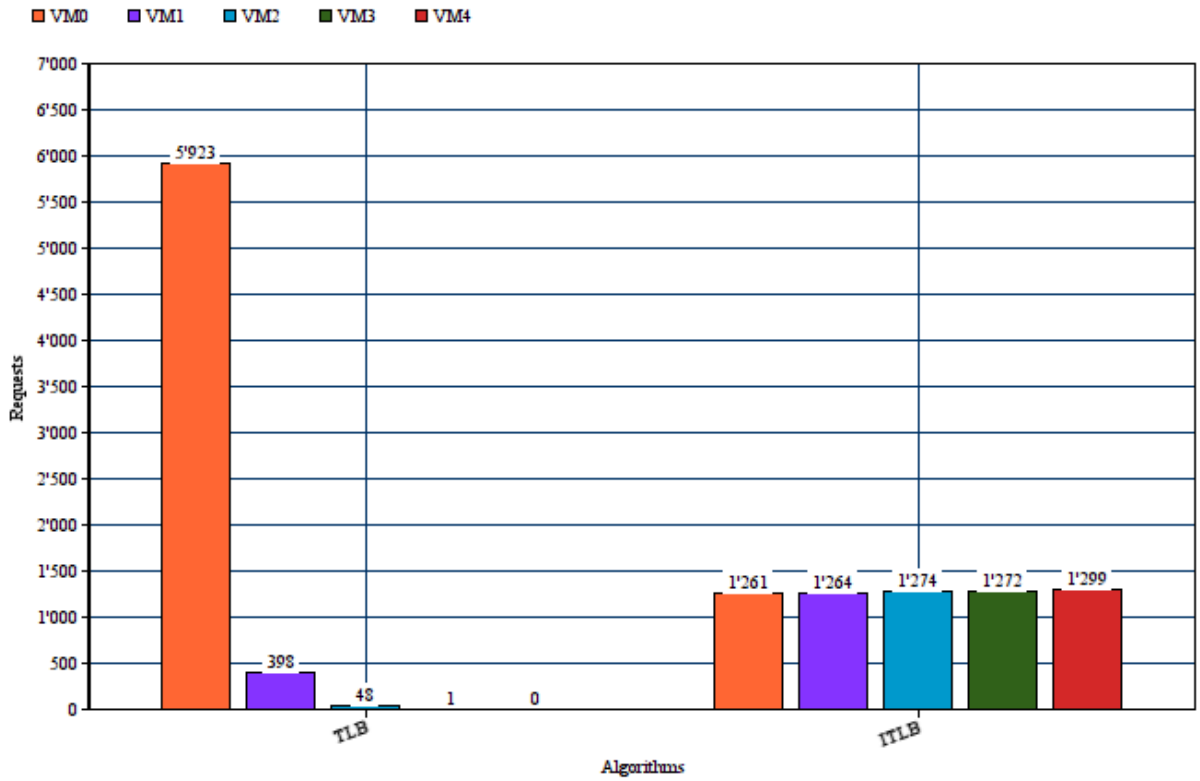
Scenario 1:

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of response time.




Fig[1]: Analytical comparison of average response time for scenario 1

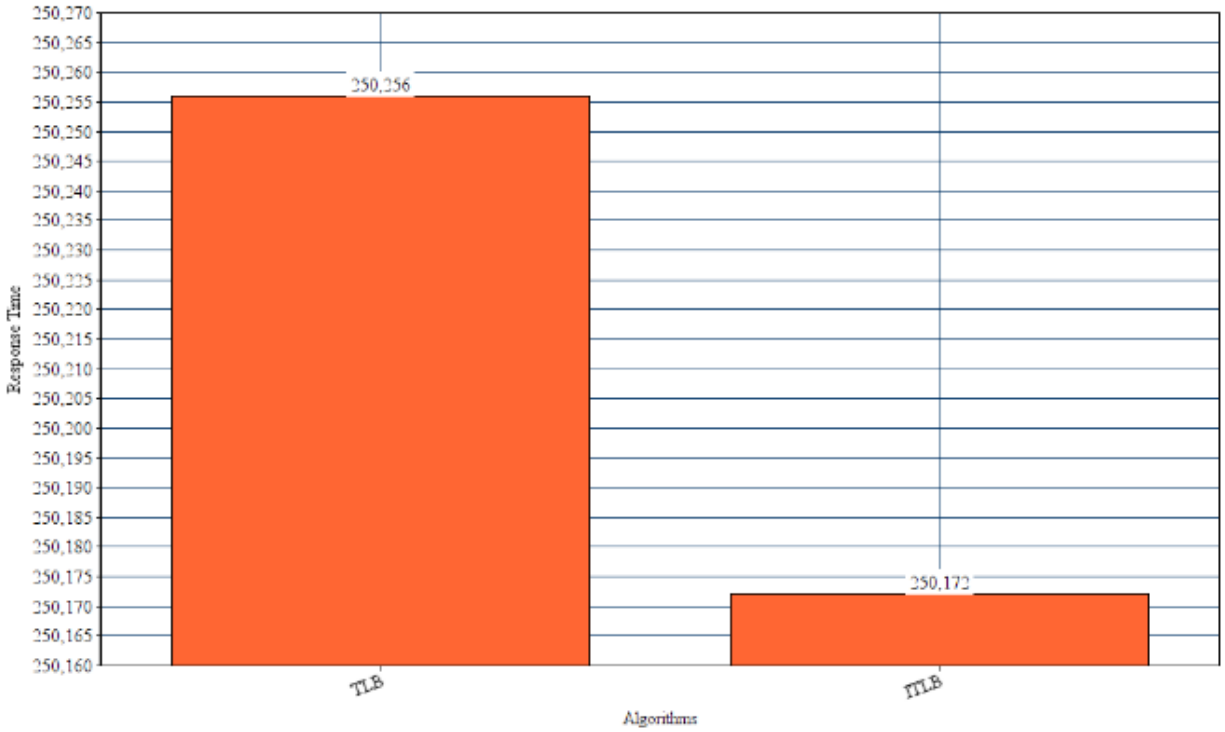
From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of resource utilization.




Fig[2]: Analytical comparison of resource utilization for scenario 1

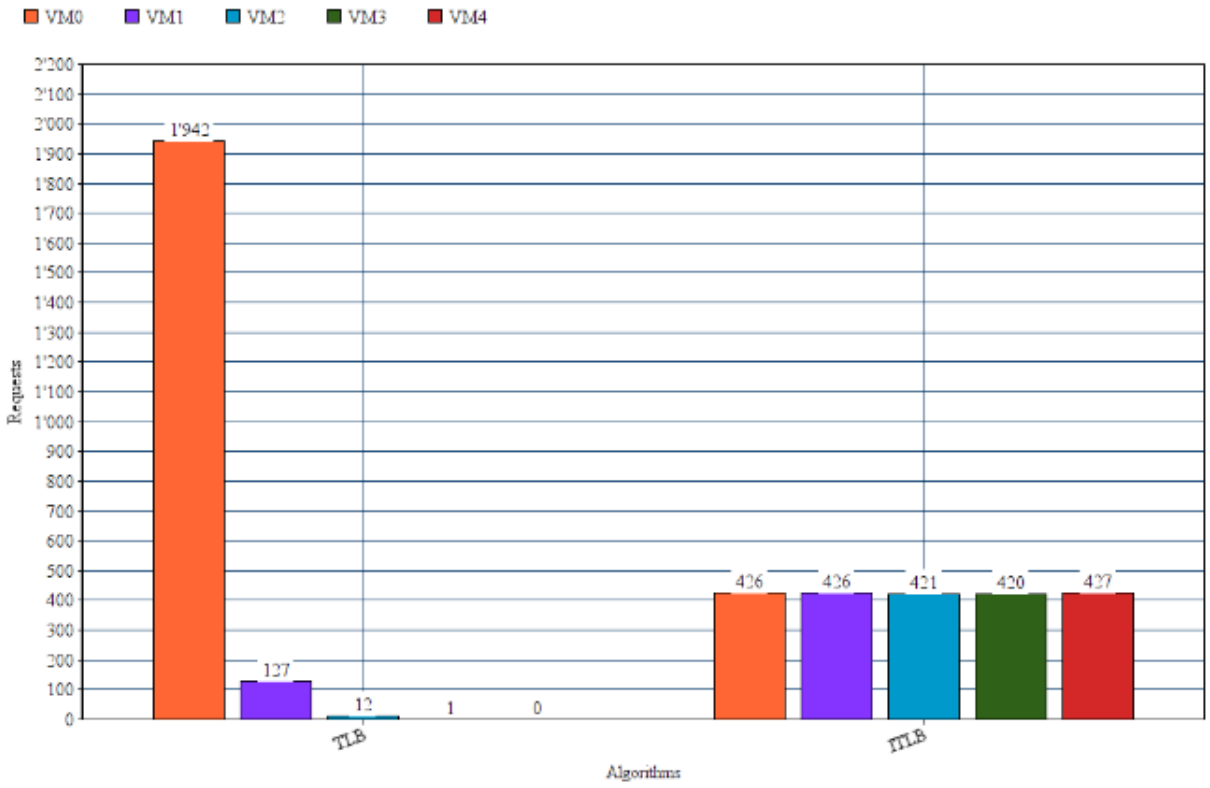
Scenario 2:

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of response time.



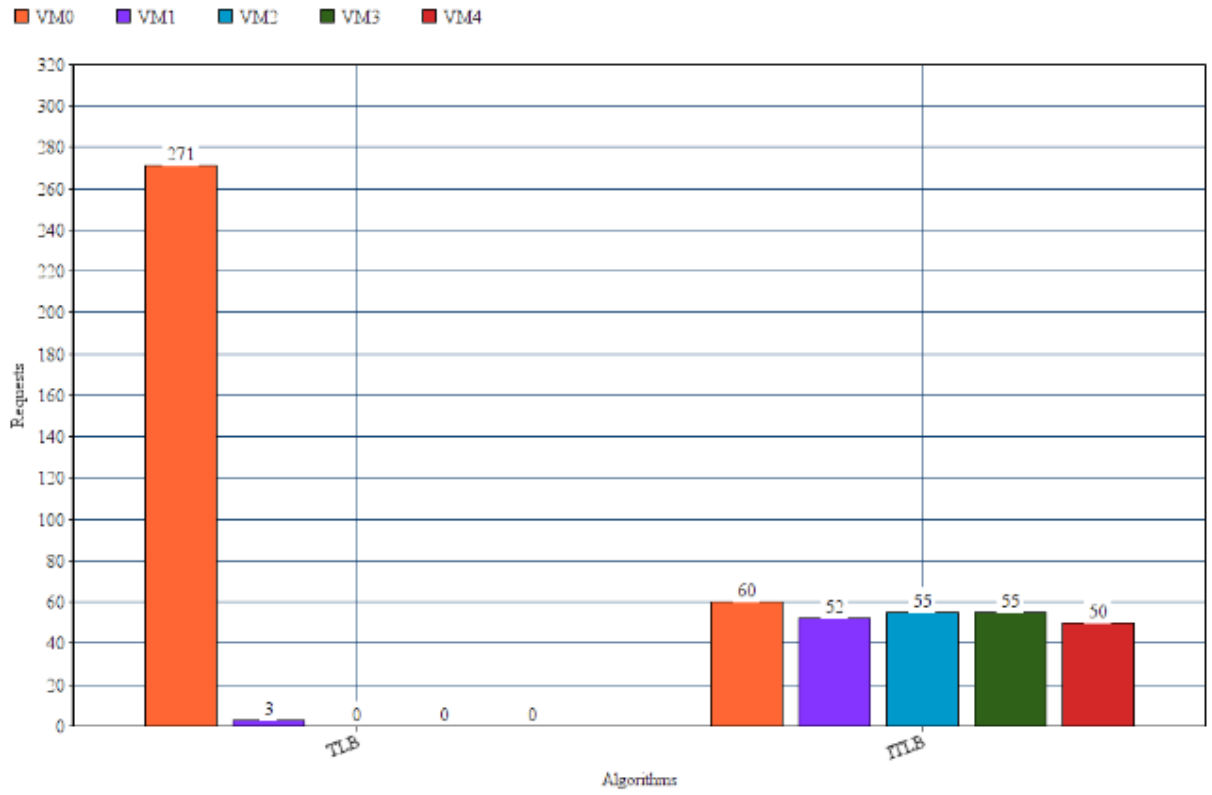

Fig[3]: Analytical comparison of average response time in scenario 2

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of resource utilization.



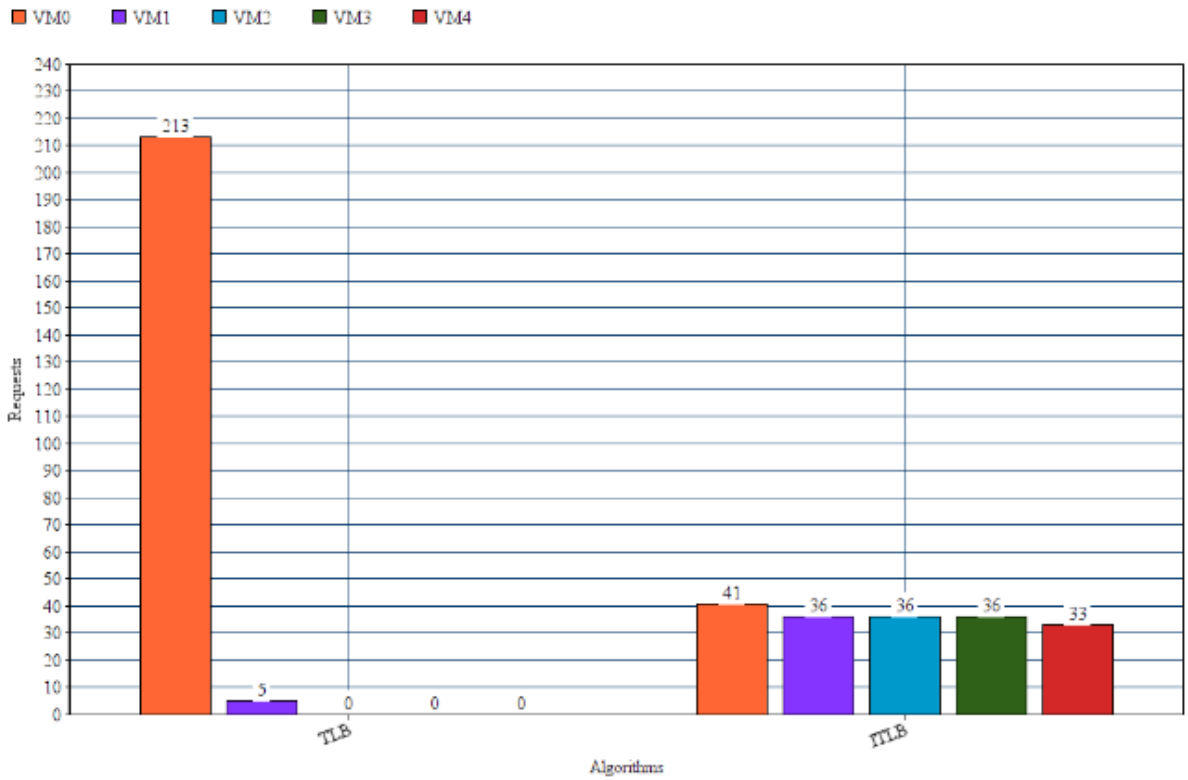

Fig[4]: Analytical comparison of resource utilization for DC1 in scenario 2

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of resource utilization.



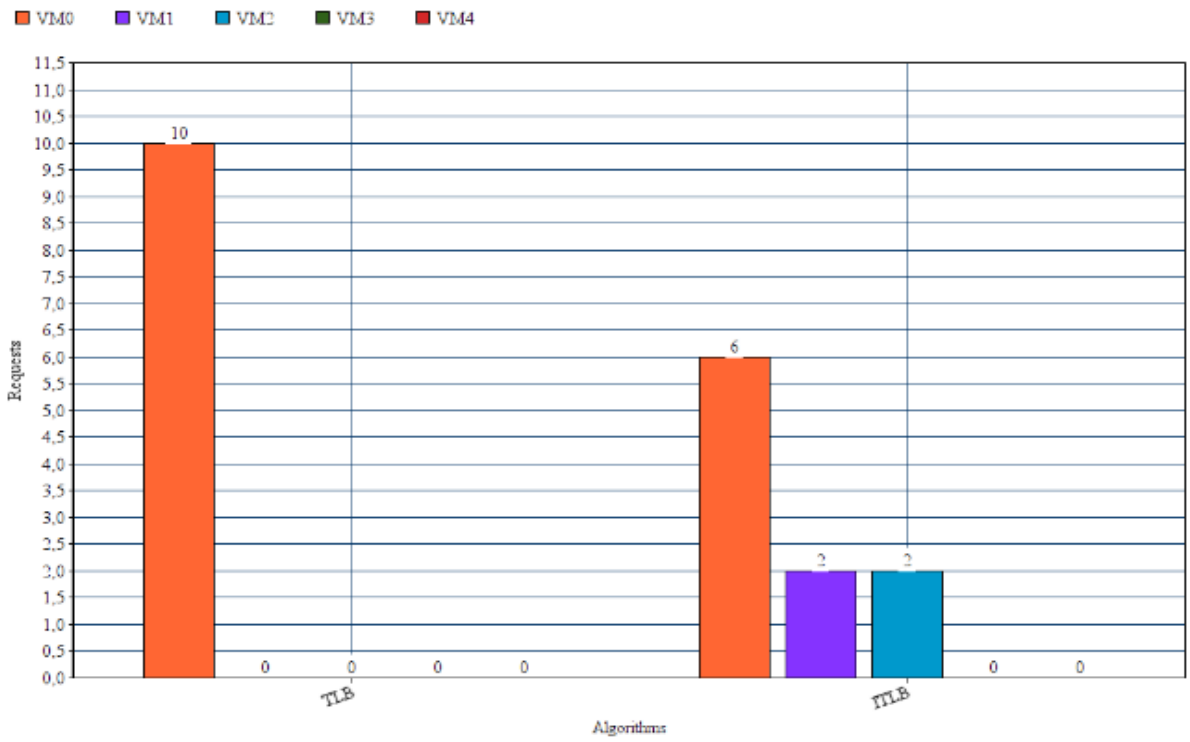

Fig[5]: Analytical comparison of resource utilization for DC2 in scenario 2

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of resource utilization.




Fig[6]: Analytical comparison of resource utilization for DC3 in scenario 2

From the graph shown below in figure it can easily be concluded that the Improved Throttled Load balancing Algorithm (ITLB) works better than Throttled Load Balancing Algorithm in terms of resource utilization.




Fig[7]: Analytical comparison of resource utilization for DC4 in scenario 2

## vi. Conclusion and Future Work:

A Novel technique for load balancing by Improving Throttled Load balancing Algorithm named Improved Throttled Load balancing Algorithm (ITLB) have been proposed in this paper. The tool used for simulation of cloud environment is cloud analyst. The comparison results between Throttled Load balancing Algorithm and Improved Throttled Load balancing Algorithm are depicted using graphs and from that it is clearly visible that the and Improved Throttled Load balancing Algorithm performs better than and existing Throttled Load balancing Algorithm concerning response time and resource utilization as comparison parameters. However two parameters namely datacenter processing time and cost have same values in both algorithms and needs to be decreased in future work.

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