A Comparative study on Load Balancing Algorithms in cloud computing

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ABSTRACT

An information technology paradigm is Cloud computing, which helps to access shared pools of configurable system resources and higher level of resources. The cloud stores all the data and disseminated resources in an open environmental way, which in turn leads to increases the amount of data storages quickly .so load balancing is major occurring problem in cloud storage, also there is need of low cost to maintain the load information on different nodes. The work load should be scattered and balanced properly among all processing nodes. Now a day's lot of load balancing algorithms has been proposed for efficient job and resource allotment. If we use resources efficiently we will get optimal profits and we can balance the time, with optimized balancing algorithms. In this study we discuss the analysis of load balancing techniques with aiming to share data, calculations and service transparently over a scalable network of nodes and shows the which is the best algorithm for various considerations including the cost.

***Keywords*— Cloud Computing, Broker Policy, Performance Evaluation, Virtual Machines, Load Balancing**

I. INTRODUCTION

Definition concern with the cloud is allotment of resources for the computation to the end user over the internet on the ground of pay-as-use manner. In the era of internet cloud computing is one of the speedy growing technology. In the cloud concept we can use the servers which are hosted on remotely for the processing the data (to store, to manage) rather than to store data as like on traditional storage manner like local server or as in the laptops or personal computers. Current world of Cloud computing has lot of challenges like scattering cloud system and balancing of all incoming requests among all processing nodes in cloud environments. For scattering the load in Cloud computing many algorithms and approaches have been proposed like load balancing algorithm and many more. For improving the system performance we consider many factors among broker policy for scattering the workload among different datacenters in cloud environment is one of important factor. Analytical comparison for the combinations of VM load balancing algorithms and various broker policies are presented in this paper. These approaches are tested by simulating on cloud analyst simulator and the final results are presented based on different aspects in this study and we shows the best algorithm among these combinations is resulted by considering various scenarios.

II. Related work

In this section we will consider the earlier works in load balancing performance evaluation and comparing various load balancing algorithms used in cloud computing environment. Load balancing is the process of improving the performance of the system by shifting of workload among the processors.Here we see two comparative load balancing algorithms that exist previously and those are Round Robin and Throttled virtual machine along with optimized time, response time, service broker policy and simulation is performed by adjusting the various parameters to inspect overall response time, Some parameters time is effected directly on the performance those are datacenter

hourly average processing times, datacenter request servicing time, response time according to region, user base hourly response times and total cost. According to the results in heterogeneous cloud computing environment, the throttled and optimized response time service broker policy has the better performance than round robin load balancing algorithm.

III Proposed Policies and algorithms for the Load balancing in the cloud

In this study we are proposing three load balancing algorithm for simulation, those are Round robin, Throttled and Equally spread current execution (ESCE) with various combination of million instructions per second vs.VM an MIPS vs. Host, but optimum response time is achieved with same value of MIPS vs. VM and MIPS vs. Host. In the last study, we saw some related load balancing performance evaluation algorithms in cloud computing which have described simulation of VM load balancers. But all of the last works just concerned on load balancing that with respect to cloud datacenters while distributing the workload among datacenters in the cloud which usually will be carried by brokers in the data center is so effective for balancing the simulation and load. In this process we are taking the load balancing process in cloud computing by the two separate levels. By the first level that is shown by Cloud Application Service Brokers in the Cloud Analyst simulator, Here service brokers have been proposed and that service brokers handles the traffic Routing between the datacenter and the user bases .Here we are presenting the three default and casual routing policies that are present in Cloud Analyst simulator are: “Closest Datacenter”, “Optimize Response Time” and “Reconfigure Dynamic with Load”. The next level that is second level which is introduced in Cloud Analyst by Virtual Machine Load Balancer(VM) component which is responsible for the load balance exemplary policy that are used by datacenters while serving allocation requests. Here there are three usual “Round Robin”, “Throttled” and “Equally Speared Current Execution Load” load balancing algorithms are using in each of the datacenter that are provided by simulator. By the different combination of three VM load balancing algorithms and by the different datacenter broker Policies we obtain nine different results which we will be analyzed in the rest of our study based on various taken parameters such as response time of overall, processing time and cost of datacenter. The remaining parts of the section will elaborate the VM load balancing algorithms, simulated scenario, and datacenter broker policies

Fig1. On map cloud Analyst scenario on various regions

A Scenario on simulation

Figure 1 illustrates the simulated scenarios in the Cloud Analyst simulator. Here we use the same scenario for all various combinations of load balancing methods to simulate under the same scenario. As n Fig. 1 we present the simulated scenario that consists of four users (User Basis) and two datacenters that are placed in various geographical regions in the map. In the region 0, there is datacenter 1 and there is one user base. And region R1 has just one user and there is no datacenter. While in region 3 there is one user and no datacenter and lastly R4 which has one datacenter and one user base. By this kind of scenario configuration we tried to cover all available situations for the simulation process

B. Policies on Datacenter Brokers

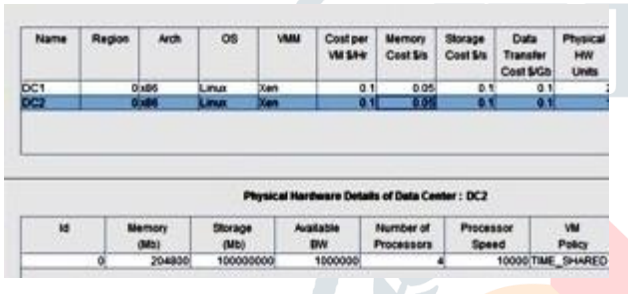
Service broker policies balance traffic routing between datacenters and user bases. There are three different datacenter broker policies are applied on Cloud Analyst simulator. By default routing policy which is called “Closest Data Center” policy (ClosestDP) it routes traffic to the nearest datacenter which in terms of network latency from the user base(source).Second policy which is called “Optimize Response Time” policy (OptRP), that routes the Initial traffic to the closest to the requests originating in terms of network latency, if the response time meet by the closest datacenter starts worst, OptP service broker looks for the service broker with the best response time at the time and distributes the load between the fastest and the nearest data centers. The third load sharing mechanism which is called “Reconfigure Dynamically with Load” policy (ReconfigDP) on Cloud Analyst attempts to share the load of a one datacenter with another datacenters when the first datacenter’s performance abasement above a predefined threshold.

C. VM Load Balancing Algorithms

Datacenters uses the VM load balancing algorithms whenever they serving the allocation requests for balancing workload in a datacenters. Several VM load balancing algorithms have been proposed in related work those are

Round Robin: Round robin works on time slicing mechanism. As name suggests that it works in the round manner where each of the nodes is allotted with a time slices and has to wait for their turn. The time is divided and gap is allotted to each node. In allotted time slice node have to perform their task. The complicity of this algorithm is less compared to the other two algorithms..This algorithm simply allots the job in round robin fashion which doesn't consider the load on various machines. Long response time is a drawback in round robin architecture as it tends to degradation of system performance. The experimental work is performed using the cloud analyst simulation

Equally spread current execution load: This algorithm requires a load balancer which observe the jobs which are asked for the execution. The task of load balancer is to queue up the jobs and hand over them to different virtual machines. The balancer looks over the queue rapitedly for new jobs and then assigns them to the list of free virtual server. The balancer also maintains the list of task allotted to virtual servers, which helps them to identify that which virtual machines are free and need to be allotted with new jobs according with priorities. As name indicate about this algorithm is that it work on equally spreading the execution load on various virtual machine. The experimental work is performed using the cloud analyst simulation



Name	Region	Arch	OS	VMM	Cost per VM $/Hr	Memory Cost $/s	Storage Cost $/s	Data Transfer Cost $/Gb	Physical HW Units
DC1	0	x86	Linux	Xen	0.1	0.05	0.1	0.1	
DC2	0	x86	Linux	Xen	0.1	0.05	0.1	0.1	

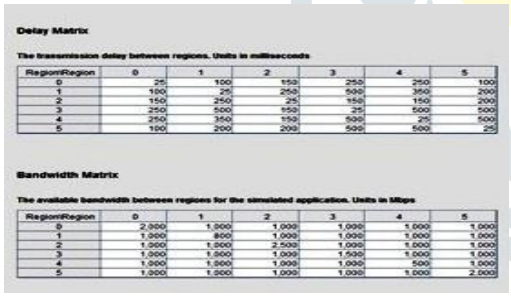
Physical Hardware Details of Data Center : DC2

Id	Memory (Mb)	Storage (Mb)	Available BW	Number of Processors	Processor Speed	VM Policy
0	204800	100000000	1000000	4	10000	TIME_SHARED

Fig 2 configuration summery of simulation and

Throttled Load Balancing: The throttled algorithm work by finding the convenient virtual machine for allocating a individual job. The job manager is having a list of all virtual machines, by using the indexed list, it allot the desire job to the particular machine. If the job is well suited for a desired machine than that job will assign to that machine. If no virtual machines are available to accept the jobs then the job manager halt for the client request and takes the job in queue for fast processing. It restricts the number of processing request in each Virtual machine to a throttling threshold

IV RESULTS AND ANALYTICAL COMPARISON BASED ON THE EXPERIMENT



Delay Matrix

The transmission delay between regions. Units in milliseconds

RegionRegion	0	1	2	3	4	5
0	25	100	150	250	250	100
1	100	25	250	500	350	200
2	150	250	25	150	150	200
3	250	500	150	25	500	500
4	250	350	150	500	25	500
5	100	200	200	500	500	25

Bandwidth Matrix

The available bandwidth between regions for the simulated application. Units in Mbps

RegionRegion	0	1	2	3	4	5
0	2,000	1,000	1,000	1,000	1,000	1,000
1	1,000	800	1,000	1,000	1,000	1,000
2	1,000	1,000	2,500	1,000	1,000	1,000
3	1,000	1,000	1,000	1,500	1,000	1,000
4	1,000	1,000	1,000	1,000	500	1,000
5	1,000	1,000	1,000	1,000	1,000	2,000

Fig 3 describe the matrix for the latency and delay

As we stated earlier we simulated the different combination of datacenter broker polices and VM load balancers by the same scenario that consist of four user bases and two datacenters in four various geographical areas and Each datacenter consist of four physical servers and allocates the resources to its virtual machine by timeshared policy. Here we execute the simulation for the duration of 60 minutes for each iteration. We simulate 9 various load balancing approaches by the same consideration of scenario. We check the cloudlet lengths from 300 to 12000 bytes in 5 different steps and therefore simulated 80 various simulations iterate.

A. Case1: Closet Data Center Policy (ClosestDP)

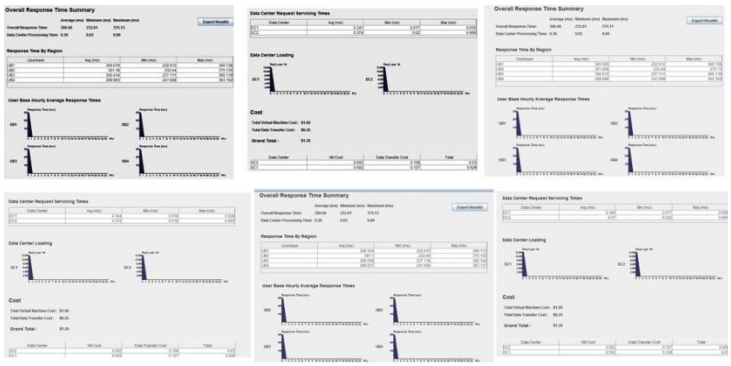


Fig 4Comparison of RR, Throttled and ESCE VM load Balancing under the ClosetDP

For case 1, the datacenter broker policy is ClosestDP as we consider and simulated the same workload with four user bases in RR, ESCE and Throttled VM load balancing algorithms. Fig 3 shows the average response time of total user bases and data center. we observed in Fig. 3, Here the Throttled load balancing algorithm is the best response time than the others in combination with closets datacenter policy as the volume per request of datacenter workload increases. As the Workload increases the it going to increase under loaded and overload virtual machines by allocating the workload randomly. So In this scenario RR algorithm doesn't work so better as the result shows, because it allocate the load in between the system nodes without having any consideration of their current loads. But the throttled algorithm takes all virtual machines load in a equilibrium state by using the throttled threshold by sending the job requests to the VM which having some jobs to process. so by using the Throttled algorithm the system performance won't decrease and in the situation of large amount of incoming requests from various region will have a better and average response time. The ESCE algorithm consider the number of Assigned tasks to each virtual machine and based on that allocate the future work load in between the VMs but it doesn't consider the length of the workload. Then ESCE has a better performance than RR, because it doesn't care about VMs' workload so it doesn't work as good as Throttled load balancer algorithm

B. Case2: Optimize Response Time Policy (OptBP)

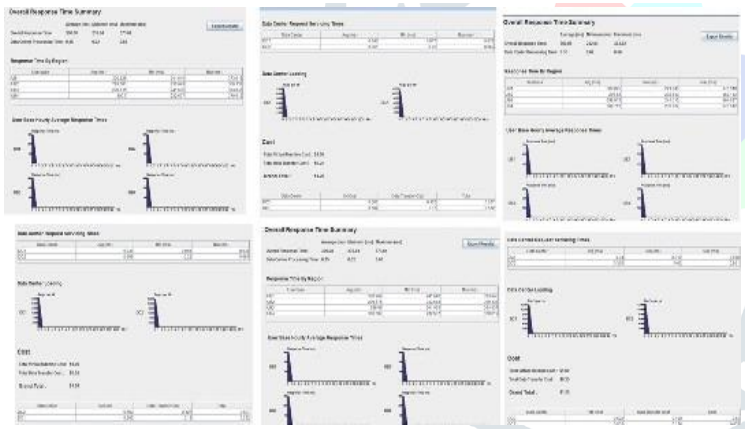


fig 5 comparison under OptRP

For case 2, the datacenter broker policy is *OptBP* as we consider and simulated the same workload with four user bases in RR, ESCE and Throttled VM load balancing algorithms. Fig 4 shows the average response time of total user bases and data center. Like ClosestDP policy this broker policy takes the destination datacenter based on the matrix for the delay that is delay matrix at the first. Here it shown in Fig. 5, the simulation results are similar to previous case. That proves Throttle algorithm has the best performance by taking considering total average response time Than remaining VM load balancing algorithms because under increasing requests from various incoming node from various region, the system performance won't be delay and available VMs will allocate the request that allocated to this datacenter. The simulation results shows that RR algorithm have the better performance in this case than last one because in this datacenter broker policy that routes initial traffic to the closet datacenter, but if response time starts delaying, this broker policy shares the load among fastest and closest datacenter. Hence in this scenario the RR algorithm will have the better performance by protecting the occurrence of more overloaded VMs.

C. Case3: Reconfigure Dynamically with Load Policy(ReconfigDP)

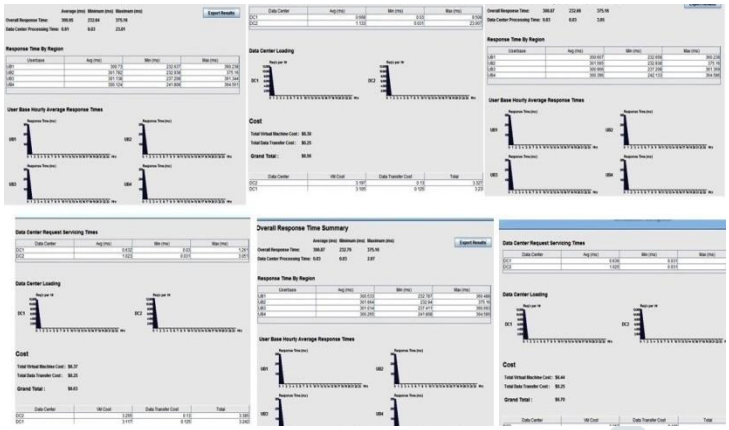


fig 6 Comparison of RR, Throttled and ESCE VM load Balancing under the *ReconfigDP*

For case 3, the datacenter broker policy is *OptRP* as we consider and simulated the same workload with four user bases RR, ESCE and Throttled algorithms for 20 iterations like last situations. Figure 5 makes the simulation results which consist some unexpected variations. The results for this case are completely very different in comparison with the previous two cases. But here also Throttled algorithm offers still a better performance, but there is an unexpected change between the workload length 300bytes and 1200 bytes. The dynamic reconfiguration policy couldn't offer a appropriate configuration and distribute the load among various datacenter. So called in this scenario of Throttled algorithm, when the workload length is closing to 300 byes a big amount of workload was forced to the datacenter that caused a delay in their performance along with this in this scenario the contrast of RR and remaining two others VM load balancers are so much and have the optimum response time clearly that we can say the combination of ReconfigDP and RR has the worst result for this VM load balancing Algorithms because the enlarging amount of system workload and equilibrium it by RR without taking into the current VMs' load caused to massive overloaded situation. Other VM load balancing algorithms because under the greater coming request, the system performance won't delay and presently available VMs will serve the request which Distribute to this datacenter. The simulation results show that RR algorithm has the Good performance in this case than last one because in this datacenter broker policy the starting traffic will be routed to the closet datacenter, but if response time starts Delaying, this broker policy distributes the load between the fastest and closest datacenter. Hence for this case the round robin algorithm will have the better performance by protecting the occurrence of more overloaded VMs.

D. ANALYTICAL BIRD'S-EYE VIEW

As the simulation results sawn in last sections, the greatest VM load balancing performance in mean of average of total response time for ClosetsDP, OptRP and ReconfigDP datacenter i.e.,DC broker policy, included to Throttled load balancers. so we match the performance of the these 3 combinations of various broker policies and Throttled load balancer for searching the best solution. Figure 6 shows the experimental results. As Fig. 6 shows, the ClosestP-Thr and OptP-Thr have the same and nearly same average response time, because in both methods the VM load balancing algorithm is same and the different is just in datacenter broker policies that ClosestDP and OptRP have the same character for the starting traffic routing. Depends on the simulation output for bigger workload size we can conclude that the best solution is using mixture of Throttled VM load balancing algorithm and closest datacenter broker policy. In ClosestDP as we saw earlier the closest datacenter will be selected based on the network latency and just allowing request to the nearest resource and when dealing these request by throttled algorithm which protect the VMs' performance delay the best result will be achieved. Till now we evaluate the best combination based on the average response time parameter. Figure 7 shows the minimum and maximum response time for all nine possibilities. As it is sawn in Fig. 7, the minimum response time for all possibility is same and it is because of this reason that at the first requests in the system, work will get resources without any considerable waiting time. Hence same workload will be served in the same order and by identical resources. But the best optimal response time belongs to ClosestDP-Throtteled which has the least optimal response time because this approach has the best average response time as we explained in last section

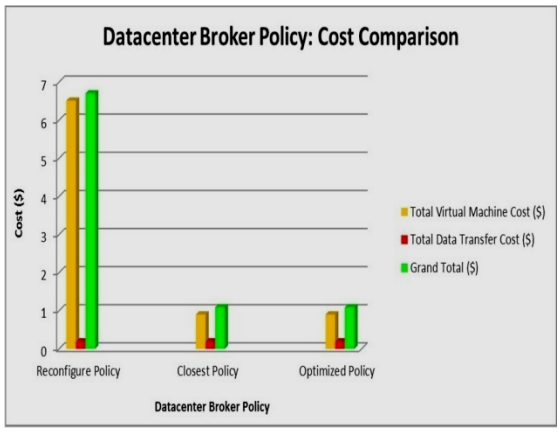


Figure 7 shows the performance evaluation of 3 datacenter DS broker policies in terms of cost. The last total is the total of virtual machine VM cost and data transfer cost. The Closest policy and best policy have the least costs in comparison with Reconfigure policy cost. The cost of data transfer based on experimental results is same but the total virtual machine VM cost is more costly in Reconfigure policy because this policy tries to allocate the load of a datacenter and task with other datacenters DS and a task will be executed by various VMs, resources and Hence assess and more expensive cost. We evaluated the performance of various possible combinations of VM load balancing algorithms and Data center broker policies (DS) based on the simulation results and considered the result through various parameters.

Fig 7 the performance evaluation of 3 datacenter DS broker policies in terms of cost

V. CONCLUSION

We analyzed the possibilities of 3 Throttled, Round Robin and Equally Spread Current Execution VM Load balancing algorithms and 3 different datacenter broker policies in cloud computing environments. We lodge a simulation scenario for assess the performance of these load balancing approaches. By these possibilities, we generate the 9 various possible load balancing approaches which simulated each one about five Iterations with various workloads. Finally we achieve 60 various simulated results that through these results we compare the performance of load balancing in cloud computing in terms of average response time, optimal and minimum response time and virtual machine cost. We saw the performance of these approaches by simulating on Cloud Analyst simulator. The simulation Results describes that throttled algorithm have a better performance than other load balancing algorithms, because that uses a threshold and available VM list for preventing server the workload by overloaded VMs. In addition with this we analyzed and offered the best combinations of each VM load balancer
With datacenter broker policy.

#	VM Load Balancing Algorithm	Performance Evaluation Factors for Selecting Datacenter Broker Policy					
		Average Response Time (ms)		*Maximum Response Time (ms)*		*Total Virtual Machine Cost ($)*	
		Best Policy	*Simulation Result*	*Best Policy*	*Simulation Result*	*Best Policy*	*Simulation Result*
1	Round Robin	Optimize Response Time Policy	155.02	Optimize Response Time Policy	20.01	OptP / ClosestP	0.9
2	Throttled	Closest Data Center Policy	154.70	Closest Data Center Policy	10.02	OptP / ClosestP	0.9
3	Equally Spread Current Execution	Closest Data Center Policy	155.19	Optimize Response Time Policy	13	OptP / ClosestP	0.9

Fig 8 Performance Evaluation of various algorithem

VI. FUTURE WORK

As with the future works we will enhance these experimental results by solving the more VM load balancers in cloud computing and under the various scenarios by considering the different evaluation
Factors and parameters for having a comprehensive survey

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