Performance evaluation of Load Balancing with Service Broker policies for various workloads in cloud computing

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***Abstract*: Cloud computing is one of the emerging models of computing in which users data and stored and processed at remote data centers provided to the user on subscription basis. The primary advantage of Cloud computing model comes from the sharing of computing resources that leads to cost effectiveness. Much of the cost efficiency of the cloud model depends upon scheduling of tasks into computing resources that makes the optimized use of resources. In this work we have performed simulation studies for the performance of various combinations of load balancing and service broker policies. The simulations have been performed in the open source tool Cloud Analyst. We have also designed a new dynamic load balancing algorithm to incorporate the best features of other policies. We have measured the performance of various combinations of service broker policy with load balancing policies on parameters like VM cost, data transfer cost and data center load for various workloads and user bases. Our experiments show better performance for dynamic load balancing algorithm implemented in this work**

I. INTRODUCTION

Cloud computing has emerged as one of the most trending technologies in the IT industry and has transformed the traditional on premise computing model to remote server based web based computing. In this model the user's data is stored and processed at third party data centers, made available to the user on subscription basis. Organizations in almost every sector have realized the advantages of this computing model and started migrating towards this. The primary advantage of cloud computing model comes from the resource sharing at cloud data centers.
Scheduling is the mapping of incoming jobs to VMs running on different physical hosts. As the number of cloud users is increasing as compared to the existing resources and the nature of jobs vary in terms of their resource needs the issue of load balancing comes into existence. Load balancing is incorporated as desirable feature in the scheduling algorithms that distributes the workload among all the available computing resources. There are various issues and tradeoffs that need to balance while considering load balancing in cloud. Some algorithms aim to achieve higher throughput while others aim to achieve maximum resource utilization and so on. When we go through the traffic analyzer over different geographical locations then load balancing algorithm plays a very important role to analyze the traffic flow in real time scenario over different geographical regions and then balance the overall workload. Different regions over the globe have different peak hours during which the network load is supposed to be at its peak.

For the study of different scenarios related to load balancing and management of resources we worked with Java based simulator tools like CloudAnalyst and CloudSim. CloudAnalyst is a GUI based tool that separates the simulation experiment set up exercise from a programming exercise and enables a modeler to concentrate on the simulation parameters rather than the technicalities of programming. It also enables the modeler to execute simulations repeatedly with modifications to the parameters quickly and easily. A graphical output of the simulation results enables the results to be analyzed more easily and more efficiently and it may also help in quickly highlighting any problems with the performance and accuracy of the simulation logic.

There are several highly desirable features of a tool similar to the one described in the above section.

1. Ease of use
Ease of setting up and executing a simulation experiment is the main point of having a simulation tool. The simulator needs to provide an easy to use graphical user interface which is intuitive yet comprehensive.

2. Ability to define a simulation with a high degree of configurability and flexibility
Perhaps the most important feature is the level of configurability the tool can provide. A simulation, especially of the nature of modeling something as complex as an Internet Application depends on many parameters and most of the time the values for those parameters need to be assumed. Therefore it is important to be able to enter and change those parameters quickly and easily and repeat simulations.

3. Graphical output

A picture is said to be worth a thousand words. Graphical output in the form of tables and charts is highly desirable to summarize the potentially large amount of statistics that is collected during the simulation. Such effective presentation helps in identifying the important patterns of the output parameters and helps in comparisons between related parameters.

4. Repeatability

Repeatability of experiments is a very important requirement of a simulator. The same experiment with the same parameters should produce similar results each time the simulation is executed. Otherwise the simulation becomes just a random sequence of events rather than controlled experiment. It is also helpful to be able to save an experiment (the set of input parameters) as a file and also be able to save the results of an experiment as a file.

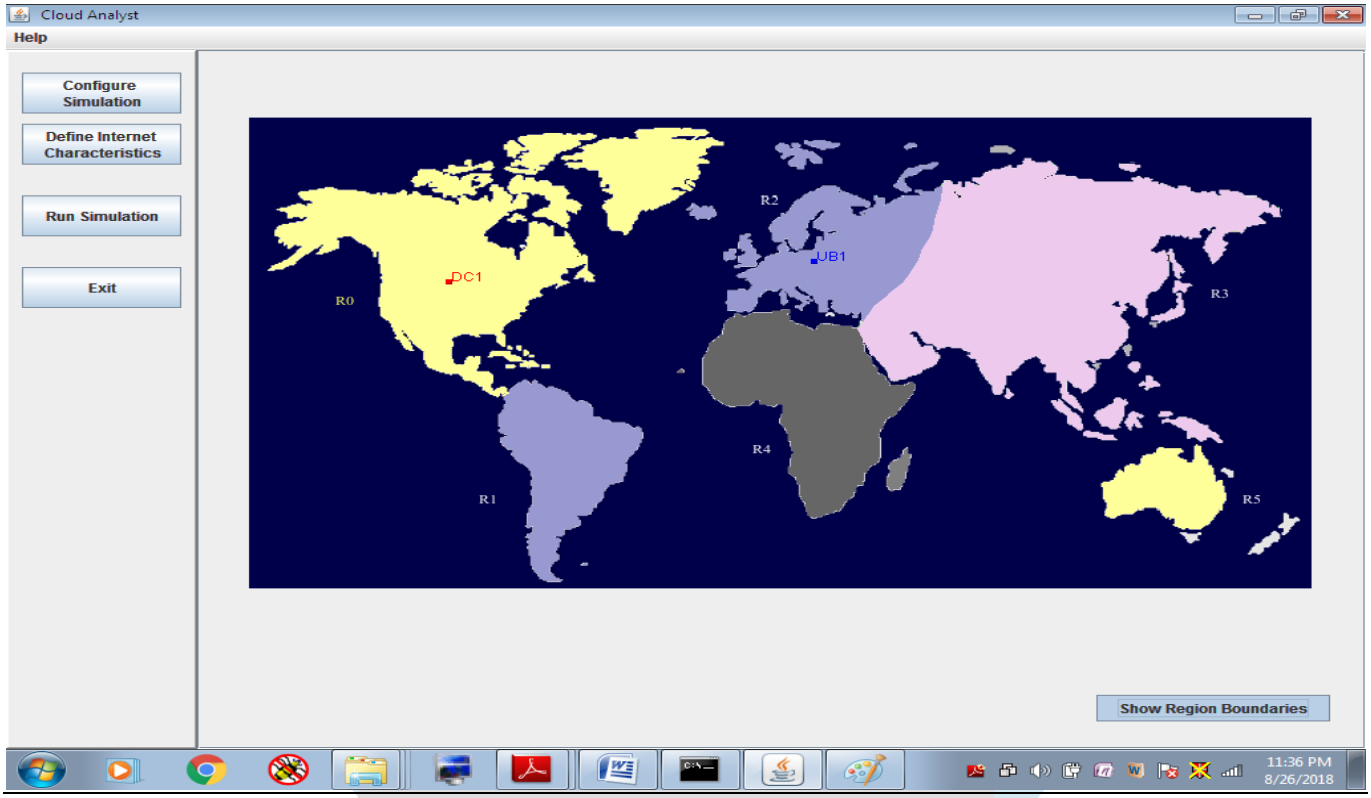

Fig1 : A screenshot of simulator showing world map.

LITERATURE SURVEY

- Mayank Mishra et al. Dynamic Resource Management Using Virtual Machine Migrations. 2012.

In this paper author discusses the advantages of pay-as-use model, wherein users pay only when they want to use resources. The paper also points out the variations between peak and non peak period.[1].

- Venkatesa Kumar, S Palanis. "A Dynamic Resource Allocation Method for Parallel Data Processing in Cloud Computing" 2012

In their paper they have proposed the overall utilization of resource and processing cost and presents scheduling approaches which focuses on both high and low priority scheduling [2].

- Liang Luo et al. A Resource Scheduling Algorithm of Cloud Computing based on Energy Efficient Optimization Methods. 2012.

In their paper have discussed about Cloud Sim toolkit and VM load balancing algorithm, where CloudSim toolkit is a tool for simulation purpose. Various VMs are used and have different processing power. Task, request and application service are assigned to VM. The paper discusses the optimization of the performance parameters such as response time and data processing time, giving an efficient VM Load Balancing algorithm i.e. Weighted Active Load Balancing Algorithm in the Cloud Computing environment[3].

- Lu huang, Hai-shan et-al. "Survey on Resource Allocation Policy and Job Scheduling Algorithms of Cloud Computing. 2014.

In their paper authors discuss a scheduling schema that provides good performance and fairness simultaneously in heterogeneous cluster and make resource request in a cost effective manner [4].

- Kaur. Kinger. "Analysis of Job Scheduling Algorithms in Cloud Computing. 2014.

In this paper the authors have raised issues in cloud computing resource management like heavy load balancing and traffic while computation and also give solution which job scheduling algorithm. The authors proposed various scheduling algorithm like FCFS, round robin, priority algorithm and concluded that none of the algorithms are best scheduling in each algorithm has some drawbacks like when we talk about priority algorithm only higher priority algorithm comes first to execute and so on. so there should be a new algorithm which achieves all objective and provide better performance [5].

- Arya, Verma. "Work flow scheduling algorithm in cloud environment". 2014

In this paper the concept of workflow scheduling algorithm has been discussed. A workflow algorithm defines the parent child relationship. The parent task should be executed before its child task. In WSA the parameters like reliability, load balancing, fault tolerance can be enhanced [6].

- In the paper "Comparative Study on Load Balancing Techniques in Cloud Computing," (2014) N. S. Raghava and Deepti Singh has been presented. The work presents a head to head comparison between various scheduling techniques based on different algorithm respect to different performance parameter [7].

- Efficient Resource Management for Cloud Computing Environments.

In this paper the authors tell about power aware scheduling techniques and discusses about DVFS techniques and some current technology power aware and thermal aware scheduling to maximize energy saving . (using Vms)[8].

- Amit Agarwal, Saloni Jain. "Efficient optimal algorithm of task scheduling in Cloud Computing Environment". 2014 .

In this paper authors discuss various scheduling algorithm and every algorithm has been observed to have its own characteristics, applicability. A lot of pros & cons have been discussed but none of the algorithms take care of reliability and performance[9].

- Genetic-based task scheduling algorithm in cloud computing environment. 2016.

In this paper a genetic algorithm has been used for minimizing the cost and completion time and maximizing the resource utilization. The CloudSim toolkit has been used for the simulations [10]

After going through the literature available regarding comparative study of various scheduling algorithms for cloud computing we draw an outline of the major advantages and shortcomings of the popular algorithms. These findings have been aggregated from various papers.

II. PROBLEM STATEMENT

The primary advantage of using the cloud model is efficient usage of shared computing resources that leads to the cost effectiveness. The computing resources in cloud environment include server, network, application, software and services. The efficiency achieved depends a lot on the scheduling and load balancing algorithms of incoming tasks to the resources available at cloud data centers.

The research problem addressed in this work includes the study of efficiency of different cloud scheduling algorithms in combination with different load balancing and broker polices. The efficiency is measured on the parameters of VM cost, data transfer cost, data center load etc.

III. METHODOLOGY

This paper mainly focuses on how broker use broker policy with load balancing policy,.

a. Cloud Application Service Broker

The traffic routing between User Bases and Data Centers is controlled by a Service Broker that decides which Data Center should service the requests from each user base. CloudAnalyst implements three types of service brokers each implementing a different routing policy.

i. Service Proximity based routing.

The Service Proximity Service Broker picks the first data center located at the earliest/highest region in the proximity list. If more than one data center is located in a region, one is selected randomly.

ii. Performance Optimized routing

Here the Service Broker actively monitors the performance of all data centers and directs traffic to the datacenter it estimates to give the best response time to the end user at the time it is queried.

iii. Dynamically reconfiguring router

This is an extension to Proximity based routing, where the routing logic is very similar, but the service broker is entrusted with the additional responsibility of scaling the application deployment based on the load it is facing. This is done by increasing or decreasing the number of VMs allocated in the data center, according to the current processing times as compared against best processing time ever achieved.

b. VM Load Balancer

The Data Center Controller uses a VM Load Balancer to determine which VM should be assigned the next Cloudlet for processing. Currently there are three VM Load Balancer implementing three load balancing policies which can be selected as required by the modeler.

i. **Round-robin Load Balancer**

It uses a simple round-robin algorithm to allocate VMs like in first come first served basis but given with a fixed amount of time which is called as time quantum. The resources are provided to the process on the basis of time quantum. In the event that a procedure does not finish in its time quantum, the CPU is seized and given to the following procedure which is holding up in a line. The appropriated procedure is then placed into the back of the ready queue. The upside of this calculation is that it uses every one of the assets in a balanced order. So it is good for load balancing but the power consumption is high because each process will be kept on for a long period of time**.**

ii. **Active Monitoring Load Balancer**

This version load balances the tasks among available VM's in a way to even out the number of active tasks on each VM at any given time.

iii. **Throttled Load Balancer**

This ensures only a pre-defined number of Internet Cloudlets are allocated to a single VM at any given time. If more request groups are present than the number of available VM's at a data center, some of the requests will have to be queued until the next VM becomes available.

iv. **Dynamic load balancer**

We are using dynamic load balancer policy in this it dynamically reallocate incoming external load at each nodes it is same as dynamic load balancing algorithm rebalance the load of each processor with speed and scalability. It is same as a dynamic load balancing. These algorithms take decisions concerning load balancing based upon the current state of the system and don't need any prior knowledge about the system. The algorithms in this category are considered complex, but have better fault tolerance and overall performance

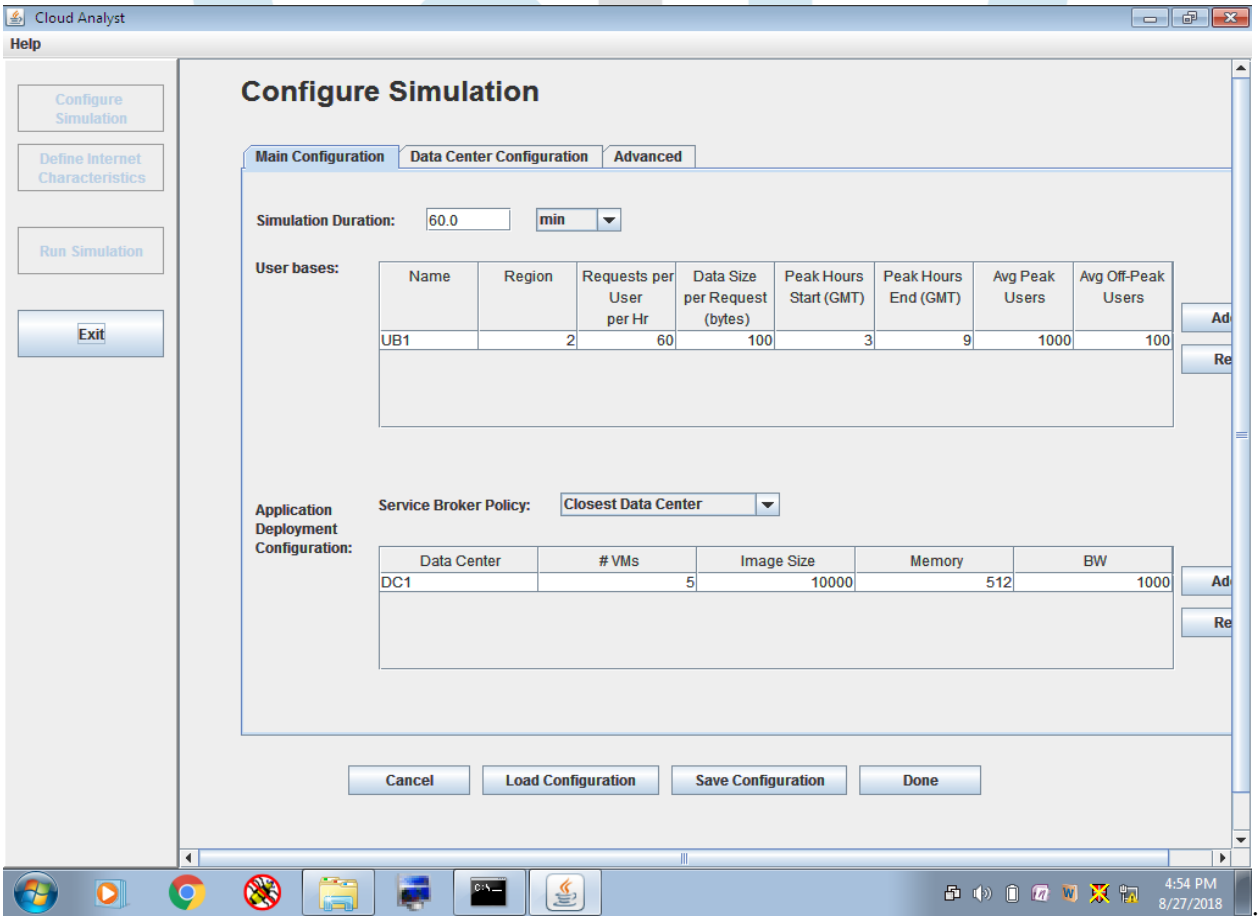

Fig-2 Screenshot of simulator showing service broker policy

For our study we performed simulated execution for various combinations of broker policies and load balancing algorithms. We also implemented the Dynamic load balancing algorithm and incorporated with the Cloud Analyst tool

IV. RESULTS AND DISCUSSIONS

We performed experiments with the 4 load balancing policies with each of the 3 service broker policies and repeated the experiment for various workloads.

The 12 different combinations of (service broker policy + load balancing policy) used for the simulation.		
C+R	O+R	R+R
C+E	O+E	R+E
C+T	O+T	R+T
C+D	O+D	R+D

Where
C ,O & R are broker policies

- C= closest data center
- O= optimized response time
- R= Reconfiguring router

R,E,T,D are load balancing policies

- R= Round Robin
- E= Equally spread current execution load
- T=Throttled Load Balancer

Results of the Simulation Completed at: 10/07/2018 23:11:41

a. Overall Response Time Summary

	Avg (ms)	Min (ms)	Max (ms)
Overall response time:	228.09	44.68	530.26
Data Center processing time:	0.41	0.02	1.30

b. Response Time by Region

User base	Avg (ms)	Min (ms)	Max (ms)
UB1	200.07	179.25	215.32
UB2	49.42	44.72	58.44
UB3	49.23	44.68	56.00
UB4	405.59	358.10	530.26
UB5	303.77	283.61	336.03

c. Data Center Request Servicing Times

d.

Data Center	Avg (ms)	Min (ms)	Max (ms)
DC1	0.32	0.04	0.97
DC2	0.81	0.28	1.30
DC3	0.35	0.02	0.71

Total Virtual Machine Cost ($): 1.02

Total Data Transfer Cost ($): 0.06

Grand Total: ($) 1.07

Data Center	**VM Cost $**	**Data Transfer Cost $**	**Total $**
DC2	0.45	0.01	0.46
DC1	0.45	0.04	0.49
DC3	0.11	0.01	0.12

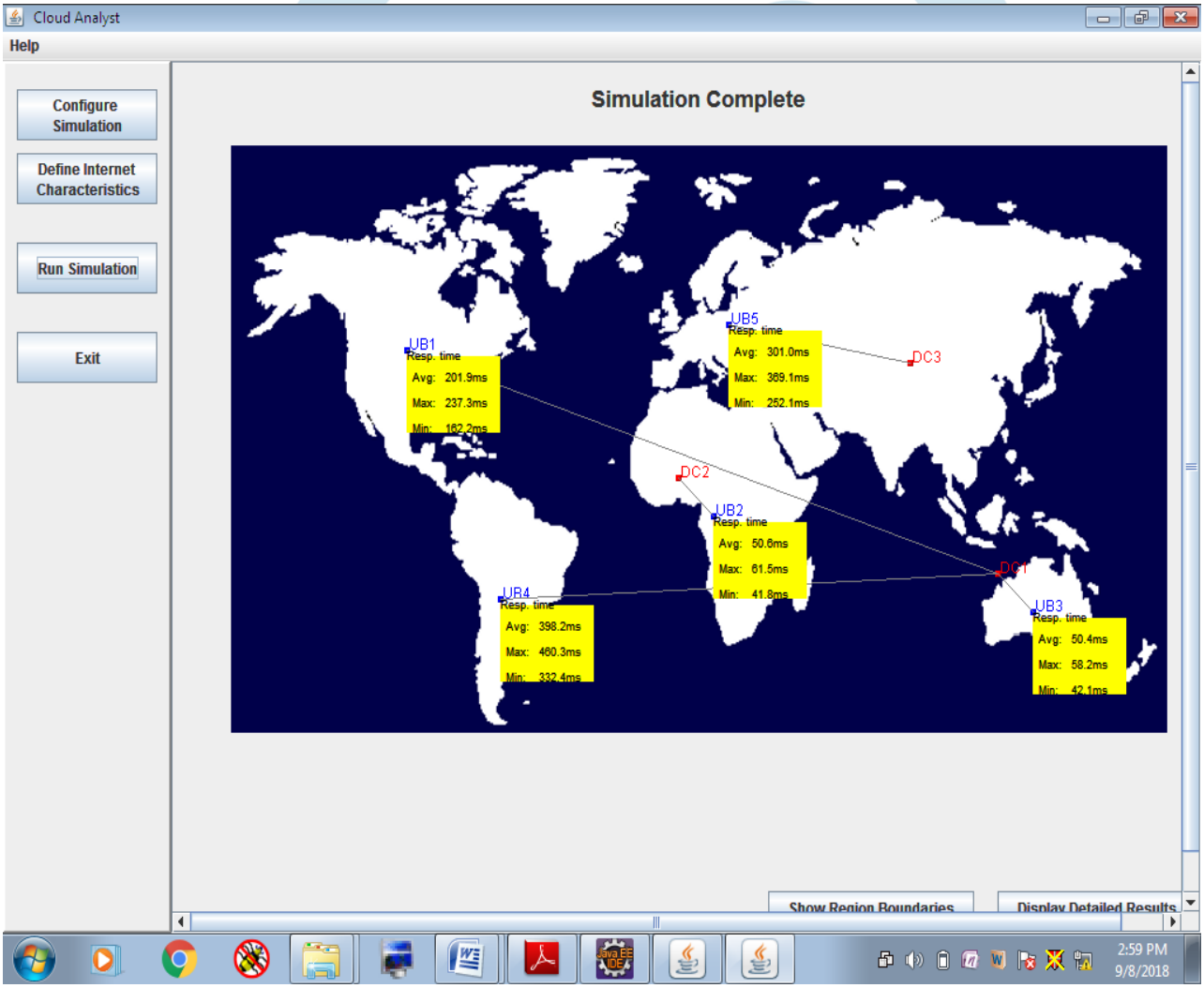

Fig-3 Map showing result of reconfigure routing with Dynamic load balancing

V. CONCLUSION

After performing the simulations with the various combination between service broker policy and load balancing we observed that throttled has very less response time and round robin has the largest response time combination of RR,RE,RD,RT. we compared the simulation on the parameters of overall response time, data center processing time, data center request service timing, data center hourly load, vm cost and data transfer. We found that our own dynamic load balancer performance is best under all parameter

and round robin has not more efficient result So finally we concluded that our own load balancing policy which we have implemented in this project has the best performance.

VI. FUTURE SCOPE

Our work can be extended to design new improvised dynamic load balancing algorithms that can incorporate features like machine learning and artificial intelligence to dynamically adopt itself to the conditions. Another scope of work lies in the extension of the features of the Cloud Analyst tool itself to accommodate new algorithms and improving the GUI. There is also a scope in the improvement in the simulation panel animation during simulation.

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