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PERFORMANCE TESTING OF SERVICE BROKER POLICIES WITH LOAD BALANCING ALGORITHMS FOR DATA CENTER SELECTION USING CLOUD ANALYST IN CLOUD COMPUTING.

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ABSTRACT

As Cloud Computing is an emerging technology in IT industry and offers enormous services with high performance and low cost, many organizations are moving their businesses to the cloud and processing their applications with the help of cloud services such as Infrastructure, Software, Platform etc. But, still it has some issues while balancing the workload among Datacenter and Virtual Servers for executing the company's task due to the immense increase of business applications. Service Brokering and Load Balancing are the techniques used to choose the Datacenter and Virtual Servers respectively for smooth processing of applications. This paper presents the evaluation and analysis of the existing Service Broker Polices such as Closest Datacenter, Optimise Response time and Reconfigure Dynamically LoadBroker Policy along with the existing three Load Balancing techniques such as Round Robin, Equally Spread Current Execution and Throttled Load balancing based on the key parameters such as response time and Datacenter processing timeusing CloudAnalyst simulation tool for efficient allocation of user's workload and to maintain the Quality of Services (QOS).

KEYWORDS: *Cloud Computing, Service Brokering, Load Balancing, Cloud Analyst, Datacenter, Response Time*

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INTRODUCTION

Cloud Computing is a rapidly developed technology which offers various services such as infrastructures, software's, development platforms, databases etc. in a rental basis via internet to almost all the sectors for processing their applications. Since cloud computing has been served as a backbone of all the emerging technologies like Internet of Things, Big Data Analytics etc., large number of organizations and industries are moving towards cloud computing technology which leads to increase the workload of cloud tremendously. Efficient management of workload allotments are required to optimally utilize the cloud resources to improve the overall performance of the system **(Molo, M.J, et al, 2021).**

Cloud is modeled with several Datacenters to keep their resources such as physical servers, networks, storage and databases. Datacenter is the location where it keeps several servers for processing the user's tasks and cloud maintains mulitple Datacenters in different locations to server huge workloads.Service Brokering regulates the traffic flow between the users and the Datacenters. The main aim of Service Brokering is to find the best suitable Datacenter for processing the user's workload and handles the heavy traffic in the web services in order to minimize the latency of each workloads. The proper selection of datacenter influences the response time of the tasks and the efficient utilization of data centers.Figure.1 shows the model of cloud computing. Each Datacenter has actual physical hardware and several virtual machines built upon on each physical hardware. Virtual machines are logical servers for processing various applications and hypervisors are software's that creates the virtual machines and schedules the resources for them. The requests received from the organization can be forwarded by the internet for processing **(Patel, H. et al, 2015)(Xu, M., et al, 2017).**

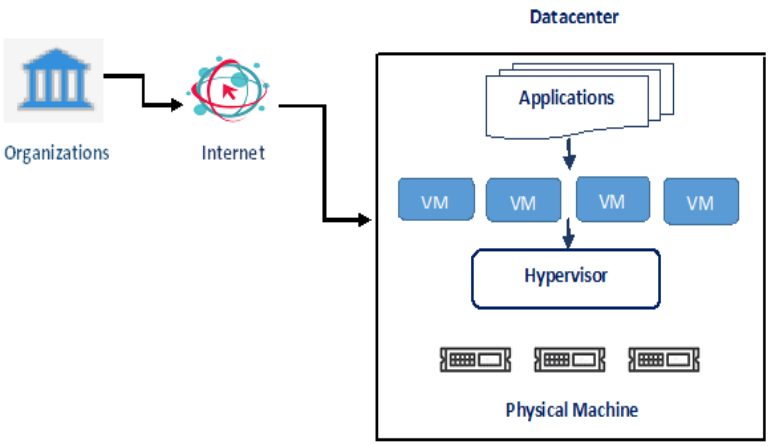

FIGURE 1 -CLOUD COMPUTING MODEL FOR WORKLOAD ALLOTMENT

Load Balancing is the scheduling technique which evenly distributes the users workload among multiple virtual servers i.e. Load Balancer uses Load Balancing Algorithms to choose the suitable virtual servers to perform the users operations in order to reduce the overloading of servers, minimizes the response time of the users task especially when the larger number of applications arrived simultaneously. Load Balancing can be broadly classified as Static and Dynamic Load Balancing based on the scheduling of workloads. Static Load Balancing Schedules the task equally among virtual servers in advance and Dynamic Load Balancing assigns the workload during execution and rearranges the tasks among servers at any time due to overloading or failure. **(Shafiq, D.A., et al, 2021).**

LITERATURE REVIEW

2.1 SERVICE BROKER POLICIES(SBP)

The Service Broker Policy decides which datacenter has to process the user's workload by considering several factors such as capacity of the datacenter, response time and processing time of the datacenter and cost.

2.1.1 CLOSEST DATACENTER OR SERVICE PROXIMITY BASED SERVICE BROKER POLICY

This policy routes the user's workload to the datacenter which gives lowest network latency or takes minimum delay while transmitting the request from user base to datacenter. The datacenter's are located in different locations called regions and multiple datacenters may be present in the same region. If multiple data centers resides in the same proximity then this policy randomly chooses one among them to process the incoming workload. But this policy does not consider the other parameters such as datacenter efficiency, cost, current load, response time etc. **(Sheikhani, L., et al, 2017).**

2.1.2 OPTIMISERESPONSE TIME

This broker policy first finds the closest datacenter's using network latency and calculates the response time of each datacenter. This policy keeps track the response time of each datacenter that was previously serviced by the datacenter. If the nearest datacenter has lowest response time than other datacenters then it chooses it for allocation, otherwise it chooses the datacenter with lowest response time for workload allocation. However, this policy does not allocate any workload to the datacenter that have not received any task previously **(Meftah, A., et al, 2018).**

2.1.3 RECONFIGURE DYNAMICALLY WITH LOAD

This policy is still under research and not implemented in real situations. This policy follows the closest data center and scale up and down the number of virtual machines based on the workload given by the userbase. It also expands the number of virtual machines in the nearby datacenter to raise the workload of this datacenter which leads additional cost and affects the performance.**(Al-Tarawneh, M. et al, 2019)**

2.2 LOAD BALANCING TECHNIQUES

MAJOR TECHNIQUES USED IN LOAD BALANCING

2.2.1 ROUND ROBIN TECHNIQUE(RR)

Round Robin Load balancing algorithm is a simplest and basic load balancing technique which equally assigns the loads to all the virtual machines in the circular fashion. Here, all virtual machine has equal number of workloads regardless of its capacity and load size. This technique is appropriateonly in the heterogeneous environment i.e. all the virtual machines having identical capacity. If virtual machine of different capacity is available in the datacenter then this technique leads overutilization of some servers and some may be underutilized.**(Jyoti, A.,et al, 2020)**

2.2.2. EQUALLY SPREAD CURRENT EXECUTION(ESCE)

Equally Spread Current Execution Algorithm maintains the list of available virtual machines and its present number of workloads. This technique allocates the given load to the virtual machine having less number of loads compared to other virtual machines i.e. it always chooses the lightly loaded virtual machine to reduce the response time.**(Ze, Y.K. et al, 2020).**

2.2.3 THROTTLED LOAD BALANCING(TLB)

Throttled Load Balancing Algorithm maintains the list of available virtual machine and its status i.e. either available or busy. Available virtual machine has no load to process and busy virtual machines contains loads for processing. It assigns the load to the suitable virtual machines i.e. the size of the task should be lesser than the capacity of the virtual machine to avoid overloading of servers. If no machine is available then the task has to wait until any one of the virtual server becomes available. Each Virtual machine supports only one task simultaneously and gives better response time compared to RR and ESCE algorithm**(El Karadawy, et al, 2020).**

2.3 RECENT ARTICLES REVIEW ON SERVICE BROKER POLICIES

In this paper, the author proposed a new service broker policy by extending the existing closest datacenter service broker policy. Closest datacenter chooses the datacenter with low latency, if multiple datacenters are available within the same boundary then it randomly chooses one among them. Here, the proposed algorithm directs the users load on to the datacenter by considering the metrics such as cost, response time and availability of the datacenter if multiple datacenter is available in the same proximity. The performance of the proposed algorithm has been carried out by the CloudAnalyst simulation tool.**(Benlalia, Z., et al, 2019).**

In this paper, the main goal of the new service broker policy algorithm is to overcome the random selection of datacenter by the service proximity based policy by considering the datacenter with overall response time and datacenter processing time. Here, the proposed policy uses the Ant Colony Optimization (ACO) technique to finding the best datacenter with optimal performance. ACO technique follows the behavior of the real ant which finds the best optimal path from the nest to the foodstuff, the same strategy has been followed to find the datacenter with minimal makespan. The evaluation of the proposed policy has been carried out with the CloudAnalyst simulation tool which shows that the proposed algorithm finds the datacenter with lower response time.**(Raghuwanshi, S., et al 2018).**

Here, the author proposed the variable service broker policy is a heuristic technique which considers the factors such as network latency, bandwidth and overloading of the task and performing the comparison analysis with the existing service broker policies such as closest datacenter and optimize response time using CloudAnalyst tool. The simulation experiment shows that the overall responses time of the task and datacenter processing time is improved in the proposed variable service broker policy along with throttled load balancing algorithms for datacenter and virtual machine allocations. **(Manasrah, A.M., et al, 2017)**

EXPERIMENTAL SETUP

CloudAnalyst tool equipped with java programming has been used for displaying simulation results. CloudAnalyst is a modeling and simulation tool used for evaluating the performance of service broker policies and it has been built upon the CloudSim tool. CloudAnalyst has a feature called Graphical User Interface (GUI) and displays the simulated results with charts and graphs. It already supports three service broker policies such as closest datacenter, optimized response time and dynamically reconfigurable service broker policy and also allows the users to add new policies.Fig.3.shows the architecture of CloudAnalyst.

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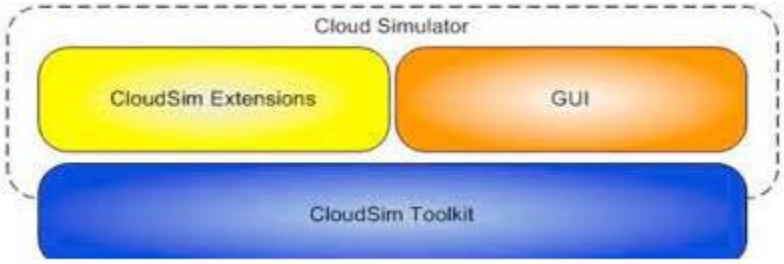

FIGURE 3 -CLOUDANALYST ARCHITECTURE

The model of Cloud Analyst divides the whole world into Regions, which contains User bases and, Datacenters and each Datacenters contains Virtual servers. Each Userbases consisting of several users who generates requests for processing. **(Khodar, A., et al, 2020).**

PERFORMANCE METRICS

The metrics used for evaluating the performance of Service brokering and Load balancing are response time and data center processing time.

Response time: the amount of time taken to by the task being in the queue and processing the task by the datacenter and the total transmission delay.

Datacenter processing time: The amount time taken to processing the task by the virtual machine.

PROCEDURE OF WORKLOAD ALLOCATION

1. Each Userbases receives request from each user's
2. The requests are forwarded to the particular Datacenter based on the Service Broker Policies used
3. The Datacenter Controller transmits the request to the Load Balancer
4. The Load Balancer Forwards the appropriate Virtual Machine based on the Load Balancing Policies
5. Virtual Machine process the request and sends the results back to Datacenter Controller.

For the experiments, we have used the following parameters

The number of Userbases = 5

The number of Datacenter = 3

Number of Physical Machine in each Datacenter = 1

Number of Virtual Servers in each Datacenter = 5

Virtual Machine Allocation Policy = Time-Shared Policy

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The performance metrics used for comparing these three algorithms are response time and Datacenter processing time.

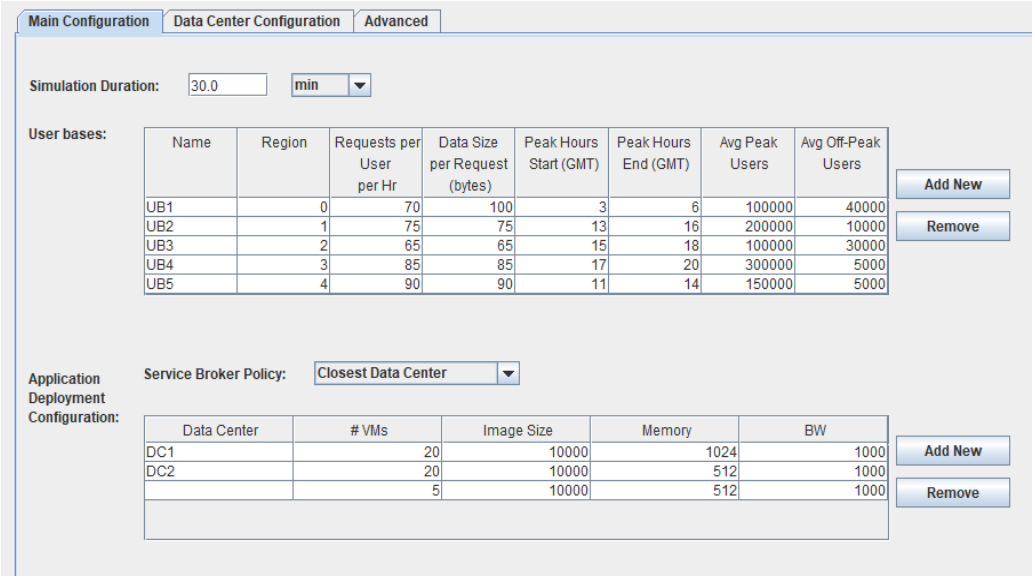

FIGURE 4 -CONFIGURATION PARAMETERS IN CLOUD ANALYST

SIMULATION RESULTS

This section presents the performance evaluation of the three service brokering policies such asClosest Datacenter, Optimise Response time and Reconfigure Dynamically Load Broker Policy with the existing three Load Balancing techniques such as Round Robin (RR), Equally Spread Current Execution(ESCE)and Throttled Load Balancing(TLB). Three scenarios has been carried out with different service brokering policies are shown in the below tables 1, 2 and 3.

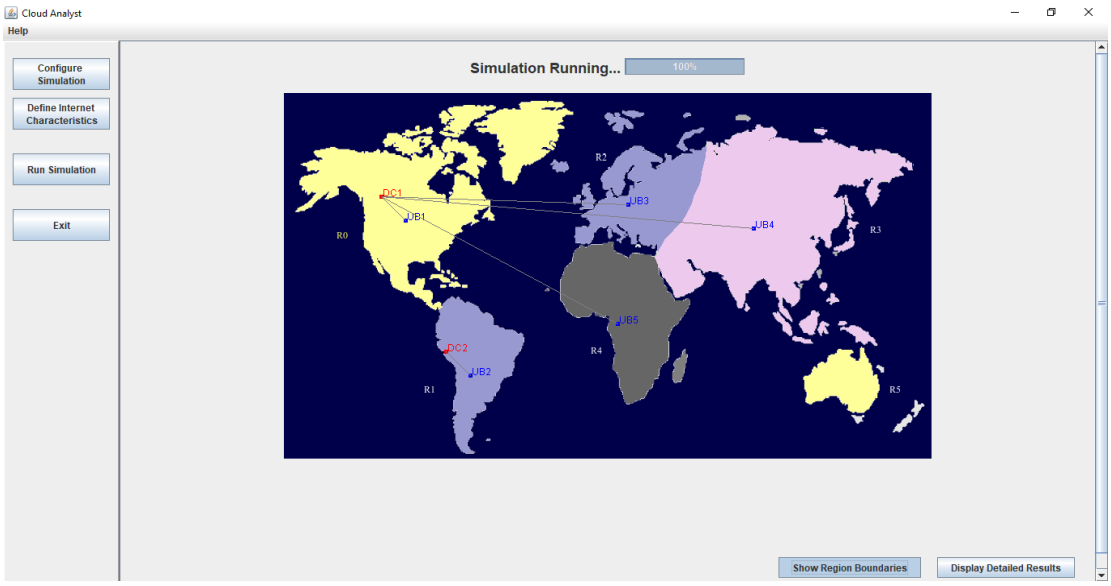

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TABLE - 1 SCENARIO – 1: SERVICE BROKERING POLICY – CLOSEST DATACENTER

Load Balancing Policy	Avg. Response Time(ms)	Avg. DC Processing Time (ms)
RR	203.48	130.56
ESCE	200.57	126.54
TLB	196.45	118.43

TABLE - 2 SCENARIO – 2: SERVICE BROKERING POLICY – OPTIMISE RESPONSE TIME

Load Balancing Policy	Avg. Response Time(ms)	Avg. DC Processing Time(ms)
RR	210.21	135.65
ESCE	206.57	132.89
TLB	190.89	122.43

TABLE – 3 SCENARIO – 3: SERVICE BROKERING POLICY – RECONFIGURE DYNAMICALLY WITH LOAD

Load Balancing Policy	Avg. Response Time(ms)	Avg. DC Processing Time(ms)
RR	213.48	140.56
ESCE	204.57	140.54
TLB	198.45	130.33

Figure 5 and Figure 6 represents the graphical illustrations of the comparison of above three scenarios with the metrics response time and datacenter processing time respectively.

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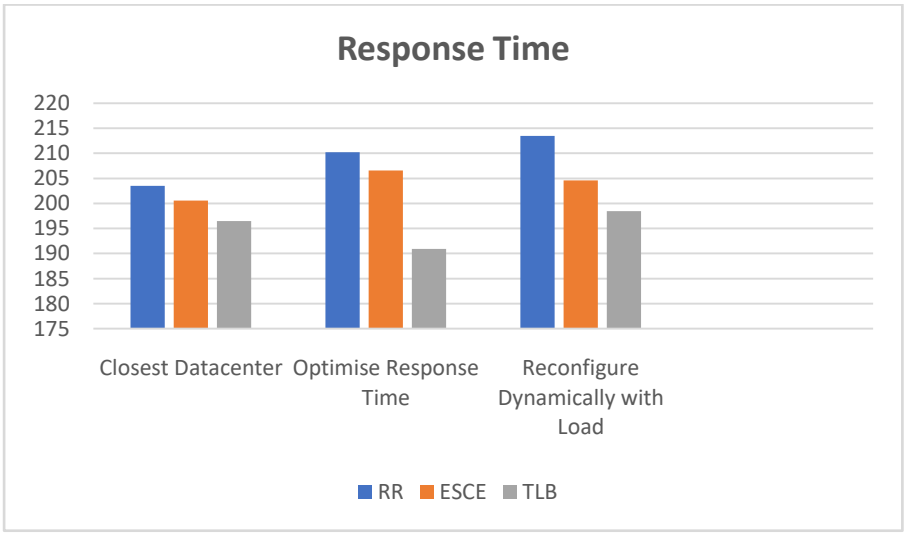

FIGURE 5 - RESPONSE TIME FOR THREE SERVICE BROKER POLICIES WITH THREE LOAD BALANCING ALGORITHMS

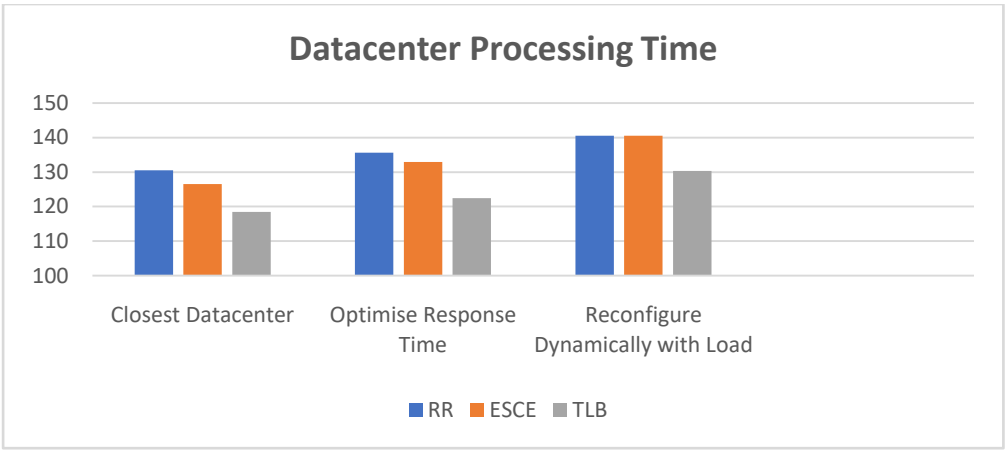

FIGURE 6 - DATACENTER PROCESSING TIME FOR THREE SERVICE BROKER POLICIES WITH THREE LOAD BALANCING ALGORITHMS

While comparing the results of each Service Brokering Policies along with Load Balancing Policies. Closest Datacenter with Throttled Load Balancing technique gives best response time and data center processing time.

CONCLUSION

As more and more number of workloads received by the cloud computing simultaneously raises the necessity of service brokering and load balancing for scheduling the user's workload among datacenter

and virtual machines to improve the overall performance of the system, minimizes the response time, cost and processing time of the task and also to achieve efficient utilization of the datacenter and avoid overloading or underutilization of virtual machines. We have examine the performance of various existing service broker policies along with the load balancing policies using CloudAnalyst simulator under various user grouping factors with the performance metrics such as response time and datacenter processing time.

In future work, a technique of new service broker policy can be developed by expanding any one of the service broker policies to improve the workload balance of the data center, minimize both response and execution time of DC in a virtualized cloud environment with different type of parameter.

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