Datacenter Selection Policy in Cloud Computing

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***Abstract*— Cloud computing provides computing resources as services to cloud users via the Internet. Nowadays, organizations' IT infrastructures are shifting to the cloud. Users will want to process their requests at the lowest possible cost and with the least possible response time, and that directly depends on getting a suitable datacenter. The service broker is responsible for datacenter selection by using service broker routing policies. The existing Service Proximity-Based Routing policy (SPBR) selects the closest datacenter to the user request. However, if there is more than one datacenter in the same region, a random selection is made without considering any factors like response time, datacenter processing time, cost, etc. An improperly selected datacenter will often give unsatisfactory results. Therefore, a new service broker routing policy was proposed to select the suitable datacenter with better processing time and response time. CloudAnalyst simulation framework was used to evaluate the performance of a proposed service broker routing policy. According to the experimental results, the proposed policy actually improves datacenter selection based on overall response time, processing time and total cost.**

Keywords*— *Cloud Computing; CloudAnalyst; Service Broker Routing Policy

I. INTRODUCTION

According to NIST (National Institute of Standards and Technology), cloud computing is an internet-based model and is a technology in which computing resources delivered to users by service providers over the internet. Cloud computing provides computing resources (e.g. storage, processing power, databases, networking, etc.) as a service to handle various users' demands. Datacenters are composed of physical machines that have processors, storage devices, and memory. And these datacenters are built in various locations around the world in places closest to users. But different cloud users have different needs, constraints, and demands. If several users have the same demands, the allocated datacenter may encounter overloading and performance degradation. Therefore, a suitable datacenter selection has become necessary in order to improve overall performance and meet a variety of user demands.

In this paper, a new service broker routing policy is proposed for suitable datacenter selection. The proposed service broker policy tries to select the datacenter with the lowest response time, datacenter processing time, and total cost to satisfy users' needs. It extended the existing SPBR policy and was implemented on the CloudAnalyst simulation framework. The rest of the documents will be described as follows. Section 2 discusses the related works for the proposed policy. And the next section 3, describes the proposed system, and the simulation and performance results of the proposed policy are discussed in section 4. Finally, the presentation of the system is concluded in section 5.

II. RELATED WORKS

Many studies have been conducted using simulation techniques to evaluate the behavior of cloud-based systems. Some useful simulation frameworks are CloudSim, CloudAnalyst, SPECI, GreenCloud, OCT, Open Cirrus, GroudSim, NetworkCloudSim, EMUSIM, DCSim, and iCanSim. These simulation frameworks are presented in a review by W. Zhao et al. in 2012 [8]. CloudSim [1] can simulate the scenarios of cloud infrastructure level because it offers basic components such as hosts and virtual machines to model the services. But CloudSim does not support a graphical user interface (GUI). Therefore, B.Wickremasinghe proposed CloudAnalyst based on CloudSim in 2009 [7]. Meftah et al. [4] presented the effect of cloud-based application performance using service broker policies and load balancing algorithms. And, C.C. Agbo presented the simulation of a cloud-based application using CloudAnalyst. CloudAnalyst is mainly used for load balancing algorithms and service broker policies in most research papers. Service broker policies help to select the datacenter with the lowest response time, processing time, and cost.

H. V. Patel conducted a survey on CloudAnalyst's existing service broker policies in 2015 [6]. They presented a practical comparison of existing policies. In addition, various service broker policies were proposed to select the suitable datacenter. Nandwani et al. [5] proposed a weight-based service broker policy to choose the appropriate datacenter based on the proportion of virtual machine weights for each datacenter. As a result, this policy reduced the response time, processing time, and overall cost. However, performance-aware policies lead to increased costs, while cost-aware policies increase processing time. Jyoti et al. [2] proposed a service broker policy for datacenter selection by focusing on the workload. They provided an extension of the weight-based service broker policy that was proposed by Nandwani. The result was only a trivial decrease in response time, processing time, and cost. Additionally, Kofahi et al. [3] proposed a user priority-based service broker policy using vector space model and multi-objective optimization techniques. In a real cloud platform, most users do not want to know the specifications of datacenters.

III. THE PROPOSED SYSTEM

To be handling the issues of the existing SPBR policy, we proposed a new service broker routing policy based on the weight and the total cost of each datacenter to overcome the datacenter random selection issues. The proposed service broker routing policy selects the most suitable datacenter based mainly on the number of virtual machines in each datacenter and the total cost of each datacenter for achieving system performance improvement and cost-effective system. As a result, the proposed policy focuses on the selection of the suitable datacenter with better response time, processing time and cost.

In the system flow diagram, userbases are responsible for the group of users that can access the cloud datacenters through the Internet from different regions. This system is mainly focused on the datacenter selection by extending the existing service proximity-based routing policy. The existing service proximity-based routing policy randomly selects the datacenter when there is more than one datacenter in the same region. So, this system extends the section of random datacenter selection based on the weight and total cost of each datacenter. When the user generates the request, such as downloading the file from the datacenter, deploying the application infrastructure to the datacenter, this system selects the suitable datacenter with less response time, processing time and overall cost. The number of virtual machines and cost of each datacenter are mainly used for the suitable datacenter selection.

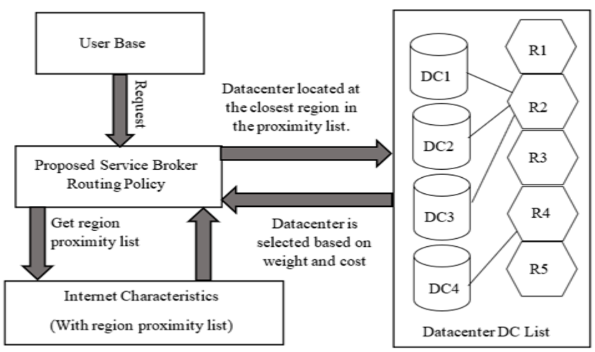

Fig. 1 System Flow Diagram

The system works by using weighted values from the number of virtual machines within the datacenter to determine the best response time of datacenter. Therefore, the weight value is considered based on equation 1.

$$W_i = \frac{no\ of\ VM\ on\ each\ DC_i\ from\ closest\ region}{no\ of\ VM\ in\ all\ DC\ from\ closest\ region} \quad (1)$$

In the equation, W_i refers to the weight of each datacenter, DC refers to the datacenter, DC_i refers to each datacenter, and VM refers to the virtual machine.

Then, the system works to determine the lowest-cost datacenter using the virtual machine processing cost and the data transfer cost of each datacenter. Then the total cost can be calculated based on equation 2.

$$C_i = \left(\frac{MIPS_{total}}{VM_{MIPS}}\right) \times VM_{cost} + U_{DS} \times DT_{cost} \quad (2)$$

In the equation, C_i refers to the total cost of each datacenter that considers both data transfer and virtual machine processing cost, $\left(\frac{MIPS_{total}}{VM_{MIPS}}\right)$ refers to the total number of instructions per average processing power assigned to the datacenter. VMcost denotes the cost of each datacenter's virtual machine; U_{DS} denotes the size of requests; and DTcost denotes the data transfer cost. Then, we calculate the optimal values by using weight and total cost based on equation 3.

$$Opt_i = w1 \times W_i + w2 \times C_i \quad (3)$$

In the equation, Opt_i refers to the optimal value of each datacenter, W_i refers to the weight value of each datacenter, and C_i refers to the total cost value of each datacenter. According to the general formula of multi-objective scalarization, the coefficient values will determine the solution of the fitness function and show the priority. The larger the coefficient value, the higher the priority, and the sum of coefficient values must be 1. Therefore, w1 and w2 are the coefficient values. Then we calculate the total optimal value and average values of each datacenter by using equation 4 and 5, respectively.

$$totalOpt_i = \sum_{i=1}^{N} Opt_i \quad (4)$$

$$Avg_i = \frac{totalOpt_i}{N} \quad (5)$$

In the equation, $totalOpt_i$ refers to the sum of optimal values of each datacenter, Opt_i refers to the optimal value for each datacenter, and N is the number of intervals. Avg_i refers to the average value of each datacenter. When the average values of all datacenters have been calculated, the system selects the datacenter with the smallest average value.

Algorithm: Proposed Service Broker Routing Policy

Input: Datacenter List DCi = {DC1, DC2, …, DCn}, User Request List UBi = {UB1, UB2, …, UBn}, Region List Ri = {R1, R2, …, R6}

Output: Optimal Data Center List DCi

Get a region proximity list

if there is new User Request UBi then load Datacenter List DCi of closest region

if there is more than one Datacenter DCi at that region Ri then

for each Datacenter DCi at that region Ri do

Calculate the weight value Wi of each Datacenter DCi using (1)

Calculate the cost value Ci of each Datacenter DCi using (2)

Calculate the optimal value Opti of each Datacenter DCi using (3)

Find the total optimal value totalOpti of each Datacenter DCi using (4)

Calculate the average value Avgi of each Datacenter DCi using (5)

end for

Sort the average value Avgi of each Datacenter DCi in ascending order

Select the smallest average value Avgi and its Datacenter DCi

Return Datacenter DCi

else

Return Datacenter DCi according to

SPBR Policy

end if

end if

IV. EXPERIMENTAL RESULTS

The CloudAnalyst simulation framework is used to evaluate the proposed service broker routing policy and compare its response time, datacenter processing time, and total cost with the existing SPBR policy. The network connectivity values, such as delay and bandwidth, are fixed for the experiments according to the CloudAnalyst. This system implementation is only done with same virtual machine cost and data transfer cost.

TABLE I. USERBASE CONFIGURATION

Name	Region	Peak Hour (GTM)	Avg Peak Users
UB1	0	3-9	100-1000
UB2	1	3-9	100-1000
UB3	2	3-9	100-1000

TABLE II. DATACENTER CONFIGURATION WITH THE SAME VIRTUAL MACHINE COST AND DATA TRANSFER COST

Datacenter	No. of virtual machines	Cost per virtual machines/hr	Data transfer cost/Gb
DC1	80	0.1	0.1
DC2	50		
DC3	10		
DC4	100		
DC5	70		
DC6	60		
DC7	90		

Three scenarios are used for measuring the performance. If a user request is to be handled by one or more datacenters, we can observe that the proposed service broker routing policy gives us an improvement in the overall response time (RT), datacenter processing time (PT) compared to the existing SPBR policy in Tables III. Thus, the proposed service broker routing policy leads to more accurate datacenter selection.

TABLE III. EXPERIMENTAL RESULTS

Scenario	Policy	RT	PT
	proposed	496.33	34.72
UB1 must be handled by three DCs	SPBR	501.34	34.87
UB1 must be handled by five DCs	proposed	495.71	43.98
	SPBR	501.72	44.24
UB1 must be handled by seven DCs	proposed	496.81	46.37
	SPBR	501.81	46.48

According to the experimental results Table III, the proposed service broker routing policy is better than the existing SPBR policy.

V. CONCLUSION

In the existing SPBR, there were some issues due to selecting a random datacenter. The proposed Service Broker Routing Policy is proposed to minimize the datacenter processing and response time of user's requests. The proposed policy extends two behavior of the SPBR policy to select the datacenter in an efficient way. The proposed policy adds the VM weight and DC cost equations of the old policy. The proposed policy is evaluated and compared with the existing SPBR policy using the CloudAnalyst simulator. It is concluded that the proposed policy is better than the existing SPBR policy because the datacenter selection depends on the overall response time, and datacenter processing time, via the simulation results. The proposed policy can be improved in the future by the introduction of a new equation for response time, datacenter processing time, and the cost of each datacenter. Moreover, system implementation will be done with different virtual machine cost and data transfer cost to simulate real cloud environment.

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