Improved Round Robin Algorithm for Data Center Selection in Cloud Computing

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Abstract **- In cloud computing, the main factor to achieve a high user satisfaction and increased resource utilization ratio by ensuring an efficient and fair allocation of every computing resource is effective load balancing. It helps to achieve. Proper load balancing aids in minimizing resource consumption, implementing failover, enabling scalability, avoiding bottlenecks etc. In Cloud Computing Scenario Load Balancing is composed of selecting Data Center for upcoming request and Virtual machine management of the individual Data Center. In this paper, we propose and implement an Improved Round Robin service broker (DC selection) algorithm in cloud computing. In addition, we compare the results of the proposed algorithm with existing algorithms. This study concludes that the proposed DC selection algorithm mainly focuses on reducing service response time observed at client side. The result shows a drastic reduction in Response time on the client side by using Improved Round Robin DC selection algorithm. Various parameters are also identified, and these are used to compare the existing techniques.**

Keywords **- Cloud Computing, Response time, Data Center Selection Algorithm, Service Broker Policy.**

I.   INTRODUCTION

In recent years, the problem of management of spikes (abundant increase in service requests at particular instant) in online long connectivity application has been addressed by researchers though cloud computing. Cloud computing can be defined as the aggregation of computing as a utility and software as a service [1], where the applications are delivered as services over the Internet and the hardware and systems software in data centers provide those services [2]. The concept behind cloud computing is to offload computation to remote resource providers. The key strengths of cloud computing can be described in terms of the services offered by cloud service providers: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS) [3].

Cloud computing has widely been adopted by the industry, though there are many existing issues like Load Balancing, Virtual Machine Migration, Server Consolidation, Energy Management, security, etc. that are not fully addressed [4]. Central to these issues is the issue of load balancing (service broker policy) that is a mechanism to distribute the workload evenly to all the nodes in the whole cloud to achieve a high user satisfaction and resource utilization ratio. The present problem with cloud computing is that bottlenecks of the system which may occur due to load imbalance, computing resource distribution inefficiently, Minimum resource consumption. So, Proper load balancing techniques not only helps in reducing costs but also making enterprises as per user satisfaction [5] [6]. Hence, improving resource utility and the performance of a distributed system in such a way will reduce the energy consumption require efficient load balancing.

In cloud computing, load balancing aspect is divided into two broad categories as Data Center

Selection so called **DataAppServiceBroker** and Virtual Machine Management (VMM) at each Data Center so called **DataCenterController**. The paper mainly focuses on implementation of Improved Round Robin Service Broker algorithm in which the effective selection of data center for upcoming request is done based on selection region with minimum network delay and maximum available bandwidth and Existing Round Robin service broker algorithm. This research shows that how the effective service broker algorithm leads to minimization of reduction in response time felt by users and load on data centers.

The rest of the paper is organized as follows: Section II discusses about the existing load balancing (Service Broker) algorithms. Section IV, explains proposed algorithm and flow chart of proposed algorithm. Section 5 shows the implementation details of algorithm and says about working environment. Section 6 shows the results and comparison analysis. Finally, Section 7 concludes the paper with future scope.

II.   Literature Survey

Load Balancing Algorithms in cloud computing environment generally divide in two categories [13] as Static Load Balancing Algorithms and Dynamic Load Balancing Algorithm [14].

A. Static Load Balancing Algorithm

Static Load balancing algorithms assign the tasks to the nodes based only on the ability of the node to process new requests but they do not consider dynamic changes of these attributes at run-time, in addition, these algorithms cannot adapt to load changes during run-time. The process is based solely on prior knowledge of node's processing power, memory and storage capacity, and most recent known communication performance.

Round Robin (RR) and Weighted Round Robin (WRR) are most commonly Static Load Balancing Algorithm used in Cloud Computing. Round Robin Algorithm does not consider server availability, server load, the distance between clients and servers and other factors. In this algorithm server selection for upcoming request is done in sequential fashion. The main problem with this approach is inconsistent server performance which is overcome by WRR. In WRR the weights are added to servers and according to weight amount of traffic directed to servers however for long time connections it causes load tilt.

B. Dynamic Load Balancing Algorithm

Dynamic Load Balancing Algorithms considers a combination of knowledge based on prior gathered information about the nodes in the Cloud and run-time properties collected as the selected nodes process the task's components. These algorithms assign the tasks and may dynamically reassign them to the nodes based on the attributes gathered and calculated. However, they are more accurate and could result in more efficient load balancing than Static Load Balancing Algorithm.

Least Connection (LC) and Weighted Least Connection (WLC) is commonly used dynamic load balancing algorithm. In LC the total no of connections on server are identified at run time and the incoming request is sent to server with least number of connections. However, LC does not consider service capability, the distance between clients and servers and other factors. WLC considers both weight assigned to service node $W(S_i)$ and current number of connection of service node $C(S_i)$ [15][16]. The problem with WLC is as time progresses static weight can not be corrected and the node is bound to deviate from the actual load condition, resulting in load imbalance.

Xiaona Ren et. al. [17] proposed prediction based algorithm called as Exponential Smoothing forecast- Based on Weighted Least-Connection (ESBWLC), which can handle long-connectivity applications well. In this algorithm, the load on server is calculated from parameters like CPU utilization, memory usage, no of connections, size of disk occupation. Then load per processor

(Load/p) is calculated and this algorithm uses (Load/p) as historical training set, establishes prediction model and predicts the value of next moment. The limitation with this algorithm is this algorithm does not consider the distance between client and servers, network delay and other factors. Deepak Kapgate et. Al. [25] proposed Extended-**ESBWLC,** which overcomes above limitation. The algorithm directly calculates the response time at client side. This got response time is store for further reference. The response time at time instance 't+1' is predicted by using current response time at time instance 't' and previously predicted response time for time instance 't'.

In this paper the author is proposing an Improved Round Robin static service broker algorithm which gives improved result in terms of reduction in response time, reduction of data centre request timing and reduction of costing of VM and data transfer. Here the author improves the service broker algorithm called service proximity broker.

III.   Proposed Service Broker Algorithm

The proposed service broker algorithm is created by combining the Round Robin Service Broker Algorithm and Service Proximity Service Broker algorithm. Service Proximity Service Broker is the simplest Service Broker implementation. In Service Proximity Service Broker the **earliest region** is selected based on the minimum communication delay and maximum available bandwidth from user base (client) to data center residing region. The region selection is based on the earliest/ highest region in the proximity list and any data center of the selected region is then selected randomly for the user requests to be processed [4] [6]. In Round Robin Service Broker algorithm, the data centre selection is done sequentially in serial fashion.
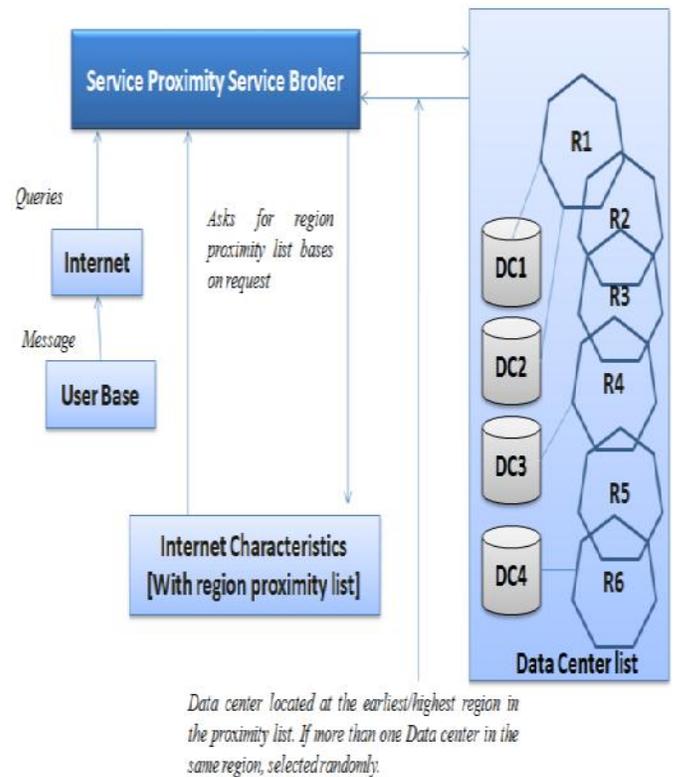

Data center located at the earliest/highest region in the proximity list. If more than one Data center in the same region, selected randomly.

Figure 1. Service Proximity Based Routing

Problems using Service Proximity

1) Selection of data center is done randomly when more than one data center in the same region.
2) There is a possibility of selection of data center with higher cost.
3) For the same configuration, results may be different (random selection) and developers/researchers may get difficulties to use the results.
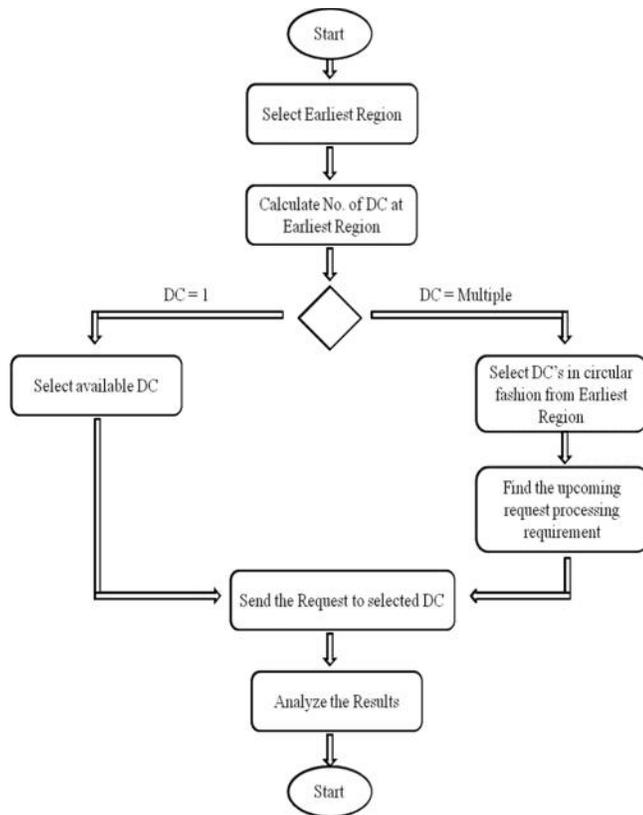
The flowchart for Proposed Prediction Algorithm:

Figure 2. Flowchart of Proposed Algorithm

Proposed Algorithm:

1) Calculate the DC region with minimum communication delay and maximum usable bandwidth between user base (client) and data center as **Earliest Region**.

2) Find total number of data centers available at Earliest Region to satisfy upcoming request.

3) If there is single available data centre at Earliest Region then select it to satisfy the upcoming request.

4) If there is multiple data centers at Earliest Region then Selection of DC is done in sequential fashion from DC's available at Earliest Region.

5) Send the request to selected Data Center.

6) Analyze the results.

V. Implementation Details

The working environment for cloud computing where the proposed algorithm is implemented is done using cloud analyst simulator which is built above "CloudSim", "GridSim" and "SimJava". Cloud-Analyst is built on the top of Cloud-sim. Cloud-sim is developed on the top of the Grid-sim.
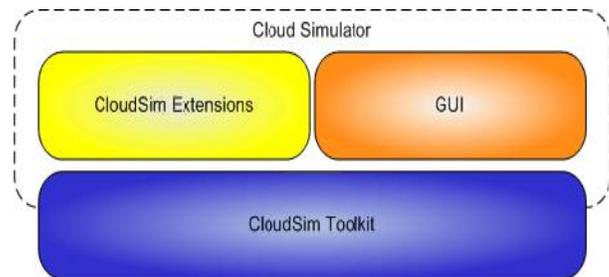

Figure 3. Cloud-Analyst built on top of Cloud-Sim toolkit

- Application users - There is the requirement of autonomous entities to act as traffic generators and behavior needs to be configurable.
- Internet - It is introduced to model the realistically data transmission across Internet with network delays and bandwidth restrictions.
- Simulation defined by a time period - In Cloud-sim, the process takes place based on the pre-defined events. Here, in Cloud-Analyst, there is a need to generate events until the set time-period expires.
- Service Brokers - DataCeneterBroker in CloudSim performs VM management in multiple data centers and routing traffic to appropriate data centers. These two main responsibilities were segregated and assigned to the DataCenterController and CloudAppServiceBroker in Cloud-Analyst.
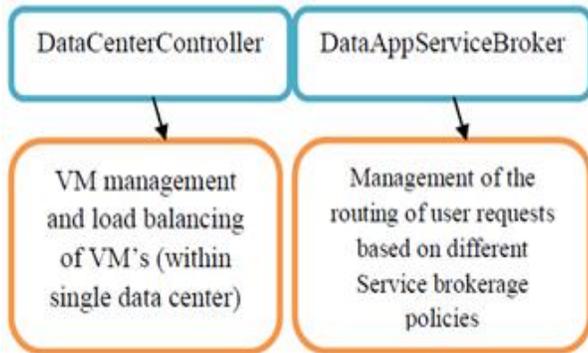
Figure 4. Responsibilities- Segregation

VI.   Results Calculated

The Proposed algorithm is implemented using simulation Cloud-Analyst. The scenario is taken where the data centers are located at single regions with user bases requesting services from different regions or from same region. The simulation runs approximately 60 min amount of time and the final result screen shown below as -
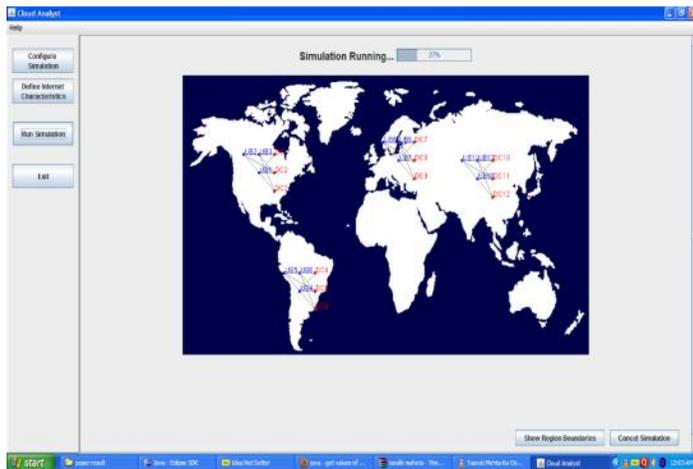
(a)
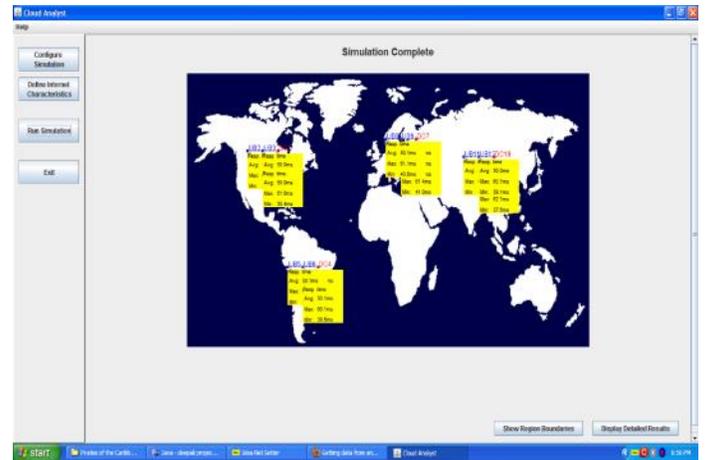
(b)

Figure 5. Cloud Analyst Main Result Screen

In above screen fig. 5(a) the lines show that the user base is requesting service from corresponding data center or server. In fig. 5(b) the values shown at boxes at each user bases represents the response time observed by respected user base. The values are the minimum response time calculated at client side wile requesting service from data center in the duration of simulation was running ,similarly it shows the maximum response time and the average response time from above two calculated values.

VII.   Comparative Analysis

A. Experiment 1 – Comparison of Response time observed by user.

The graph shows drastic reduction in average response timing observed by user for proposed algorithm as compared to traditional Round Robin service broker algorithm.

Figure 10. Response Time observed by user

B. Experiment 2 – Comparison of DC Request Service Times.

The graph shows increase in average DC Request Service Times for proposed algorithm as compared to traditional round robin service broker algorithm.

Figure 10. Data Center Request Servicing Times

VIII.   Conclusion

Here, we have discussed, a service broker algorithm that is called Improved Round Robin drastically minimizes the response time observed by user. It leads to an improvement of the service request timing. The proposed DC selection algorithm is achieved by combining the advantages of existing Round Robin and Service Proximity service broker algorithm. Finally, experiments show that the proposed algorithm improves the performance of existing Round Robin algorithm. The future work may include design and development of effective service broker algorithm for multimedia and live streaming web applications.

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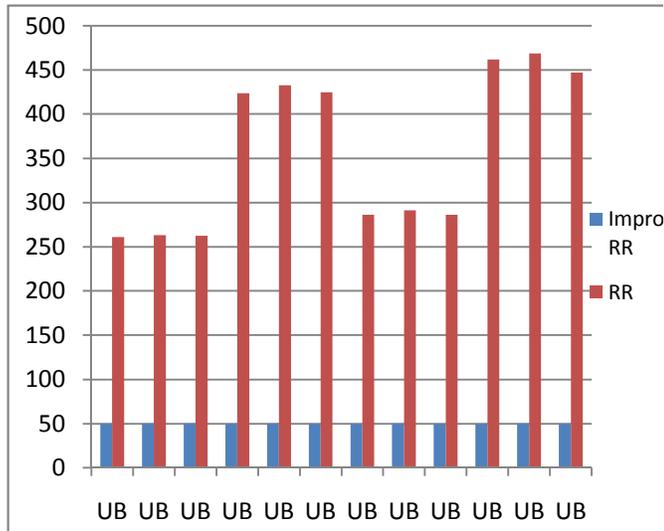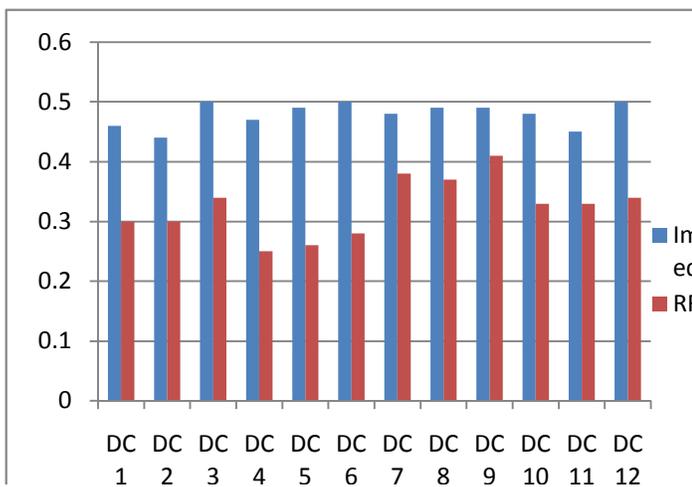
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