C. Infrastructure-as-a-Service (IaaS)
IaaS refers to on-demand provisioning of computer infrastructure as a service, usually in terms of VMs (Virtual machines). IaaS provides access to elementary resources such as physical machines, virtual machines & virtual storages. Examples of IaaS include Amazon Web Services (AWS).

1.3 Service Broker Policies

Service broker algorithms choose the most effective data center to serve the approaching user requests from the User Bases. It works as inter-mediator between cloud users and also the cloud service suppliers.
Presently, there are 3 main service broker algorithms:-

A. Closest Data Center based routing

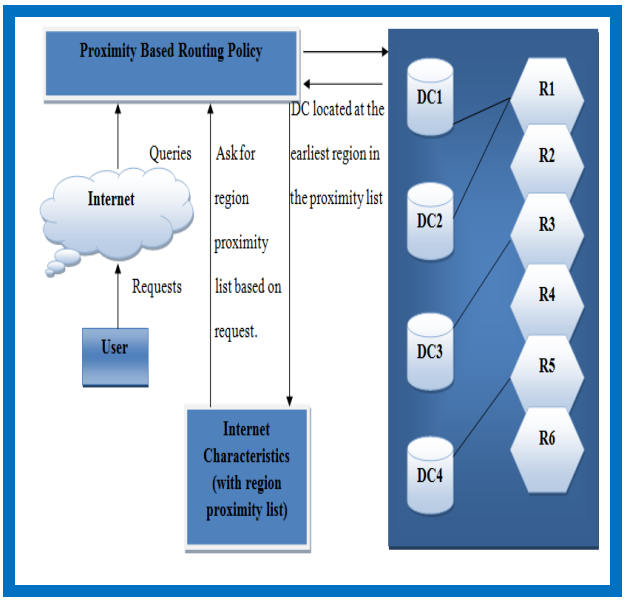

Figure 2: Closest Data Center based routing in Cloud Analyst

In this broker policy, the data center with shortest path from the user base is selected based on the network latency and the service broker routes the data traffic to that data center. In case of many data centers within the same region, the service broker selects the data center arbitrarily.

B. Performance optimized routing
In this broker policy, the data center with best response i.e. data center with lowest total delay is chosen and the service broker passes the traffic to that data center.

C. Dynamically reconfiguring router
In this broker policy, a list containing all data centers and an additional list containing latent period for every data center is maintained. The most feature of this broker policy is quantifiability i.e. the quantity of virtual machines will increase or decrease depending on the threshold value. A number of virtual machines are created if the response time of a data center exceeds the certain threshold value and on the other hand, the numbers of virtual machines are reduced if the response time falls below the threshold value.

2. Literature Survey

Hetal V. Patel *et al.* [12] surveyed two cloud simulators: Cloud Sim and Cloud Analyst, with their overview are presented so it can be easily decided which one is suitable for particular research topic. They also surveyed the service broker policy, its issues and available issues. **Rekha P M** *et al.* [15] stated that the response time and data transfer time is a challenge in cloud environment that can increase the business performance in the IT industry. They discussed the proposed schemes of different service broker policies, highlighting the cost effective data centre, selection of data centre. **Santhosh B** *et al.* [16] surveyed different type of scheduling algorithms and service broker policies in cloud computing environment. Cloud computing service providers aims at using the resources efficiently focusing scheduling to a cloud environment that enables the use of various cloud services to help framework implementation. **Minu Bala** *et al.* [6] represents the performance analysis of three load balancing policies in combination with different broker policies for large-scaled applications using different infrastructural environments. **Gamal I. Selim** *et al.* [13] proposed two algorithms to consider region, response time and cost parameters in order to choose best data center to lower the cost and response time. **Dhaval Limbani** *et al.* [10] proposed extended service proximity based routing policy that can have cost-effective data centre selection. **Bhathiya Wickremasinghe** *et al.* [7] proposed Cloud Analyst, developed to simulate large-scale Cloud applications with the purpose of studying the behavior of applications under various deployment configurations.

3. Problem Definition

In the field of cloud computing, the main concern is to select appropriate data center for executing user requests coming from user bases within same or different regions. Data Centers act as central repository for storage, management & propagation of user requests so as to provide desired response to users. In case of more than one data centers, Service broker policies are used to select appropriate data center in a cost-effective manner. It has been concluded that, in cloud environment, there is always been requirement to select data center in an efficient and cost-effective manner. Thus, Service broker policy plays an important role in selecting data centers in cost –effective way which may be beneficial to both cloud providers and cloud users.

4. Methodology/Approach

In Cloud environment, Cloud Analyst a GUI based simulator, developed on the top of Cloud Sim, is used to simulate the required cloud environment. It gives the simulation results in terms of chart and table that includes cost, response time, datacenter processing time, and load over datacenter, etc [2]. By using Cloud Analyst, application developers are able to determine the best plan for allocation of resources among available data centers, strategy for selecting data centers to serve user requests, and costs related to applications [1]. Cloud Analyst is a graphical cloud simulation tool that provides the necessary simulation environment for executing

and analyzing various cloud scenarios. It also provides facilities to implement new policies and algorithms [9].

These are the steps used in this research work:

1) Creation of Virtual Cloud using Java

On a computer system with Java installed and using a Java IDE (Integrated Development Environment) such as Eclipse or Netbeans project, Cloud Analyst based on Cloud Sim toolkit imported in workspace to run a simulator for analyzing cloud traffic based on user defined parameters.

2) Configuring the Cloud environment using Java.

3) Creation of Data Centers and User Bases.

4) Implementation of Service Broker Policies –

- Closest Datacenter Policy.
- Optimize Response Time Policy.
- Reconfigure Dynamically with Load Policy.

5) Performance Analysis of Service broker Policies based upon the following parameters –

- Average response time of data center (in ms).
- Average processing time of data center (in ms).
- Total cost (in $).

6) Find the best service broker policy amongst the three policies.

5. Results & Discussion

In order to analyze various cloud service broker policies we have to set the configuration of the various components of the cloud analyst i.e. user base configuration, data center configuration and advanced configuration. The comparison is done between three policies: Closest Datacenter, Optimal Response Time and Reconfigure Dynamically with Load. The comparison is given below in terms of graphs for data center response time, datacenter processing time and cost.

Table 1: Comparison of policies on basis of overall response time

	Avg (ms)	Min (ms)	Max (ms)
Closest Data Center	300.22	210.23	400.69
Optimize Response Time	300.19	201.27	402.12
Reconfigure with Load	359	211.41	5076.01

Table 2: Comparison of policies on basis of overall DC processing time

	Avg (ms)	Min (ms)	Max (ms)
Closest Data Center	0.4	0.01	1.05
Optimize Response Time	0.4	0.01	1.1
Reconfigure with Load	59.21	0.02	4761.5

Table 3: Comparison of policies on basis of Cost

	VM Cost $	Data Transfer Cost $	Total $
Closest Data Center	12	49.04	61.04
Optimize Response	12	49.04	61.04
Reconfigure with Load	233.84	49.04	282.88

Table 4: Comparison of Policies on basis of all three parameters

	Average Response Time	Average Processing Time	Total Cost
Closest Data Center	300.22	300.19	359
Optimize Response	0.4	0.4	59.21
Reconfigure with Load	61.04	61.04	282.8

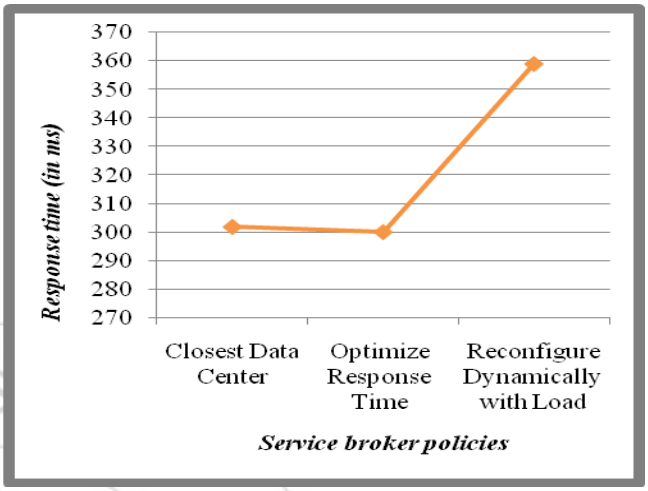

Figure 3: Graph showing Average response time (in ms).

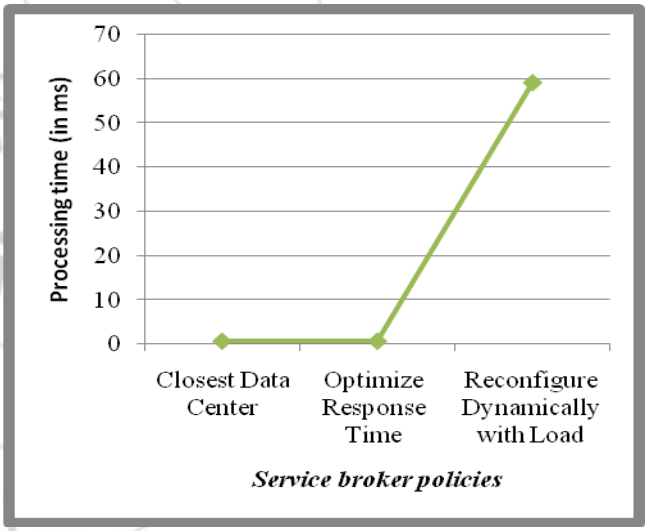

Figure 4: Graph showing Average processing time (in ms).

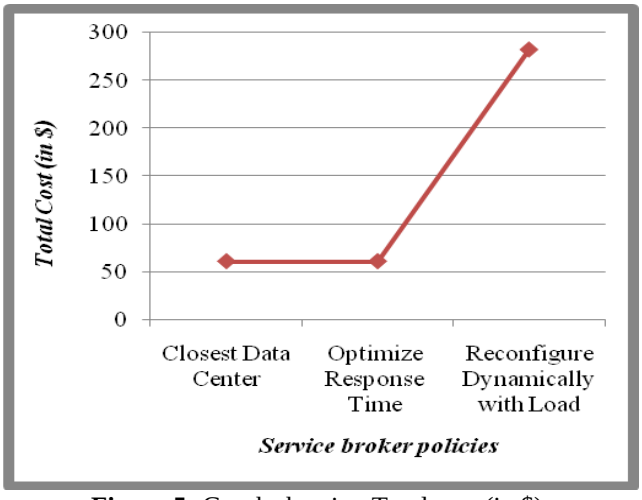

Figure 5: Graph showing Total cost (in $).

The plotted graphs and tables shows that the average response time is less in case of optimize response time service broker policy whereas the average response time, average processing time and cost is much higher in case of Reconfigure dynamically with load service broker policy.

6. Conclusion

In this paper, three service broker policies are compared on the basis of three parameters – Average Response Time (in ms), Average Data Center Processing Time (in ms), Total Cost (in $). From the above discussion, we can conclude that Reconfigure dynamically with load service broker policy produces worst results in terms of all three parameters- Average response time, Average processing time and Cost. Optimize response time service broker policy produces better results in terms of Average response time. So, according to our research work, **Optimize Response Time** service broker policy is the best service broker policy amongst the all three policies.

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