

A Proposed Service Broker Strategy in CloudAnalyst for Cost-Effective Data Center Selection

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ABSTRACT

With the advancement of cloud technologies, it is necessary to simulate large scale applications on cloud before their real time implementation. Using simulation, we can study the behavior of cloud environment. CLOUDS Laboratory introduced Cloud-Analyst, the Cloud-Sim based tool. It is useful to model and analyze large scale cloud computing development. The simulator uses different algorithms (Service Broker Algorithms, Load balancing algorithms etc) with taking some parameters under consideration as per requirement. Based on all given inputs, it gives the report for that cloud environment. With the help of simulation report, we can modify the cloud environment as per requirement. The service proximity based routing policy selects closest data center to route the user request. When there is the situation to select one data center from those with same region, the policy selects data-center randomly without considering cost-effectiveness. We have proposed the extended service proximity based routing policy. Using proposed policy, we can have the routing of user requests such that we can have cost effective data-center selection. Same as this modification in Cloud-Analyst, we can have improved simulation tool/process gradually.

Keywords – Cloud-sim, Internet-Cloudlet, Region, Service Broker, User Base.

I. INTRODUCTION

Cloud Computing is getting advanced day by day. Cloud service providers are willing to provide services using large scale cloud environment with cost effectiveness. Also, there are some popular large scaled applications like social-networking and e-commerce. These applications can benefit to minimize the costs using cloud computing.

With the demand of large scale internet applications on cloud, both developers and researchers need to model and test the cloud environment before the real time implementation. Using the simulation, the developers and researchers can predict the working of various cloud components when implemented in real time. There are several factors that will impact cloud environment such as the geographical distribution of the user bases, availability of the Internet infrastructure within the geographic areas, etc. In real time environment, it is not easy to study the impact of different factors on cloud environments. Here, simulation is the best way to study such a dynamic and massively distributed environment.

For the cloud computing simulation, Cloud-sim framework is used [1]. With the use of Cloud-sim, we can do modeling, simulation, and experimenting on Cloud computing infrastructures. Cloud-sim can be used to model service brokers, data centers and scheduling and allocation policies of large scale Cloud platforms [2].

In section II, we have shown the new extensions in the Cloud-Analyst [3] compared to the Cloud-sim framework and their importance in the Cloud-Analyst.

In section III, some of the Cloud-Analyst components are explained with their importance in the Cloud-Analyst.

In Section IV, we have shown how user requests routing take place. In section V, we have explained one of the service broker strategies used in Cloud-Analyst.

We have extended that one strategy and explained in the next section (VI). Finally, we have concluded our work.

II. CLOUDSIM AND CLOUDANALYST

Cloud-Analyst is developed on the top of Cloud-sim and the Cloud-sim is developed on the top of the Grid-sim. Some new extensions are introduced in Cloud-analyst.

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 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

DataCenterBroker 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 DataCenterController and CloudAppServiceBroker in Cloud-Analyst(Fig .1).

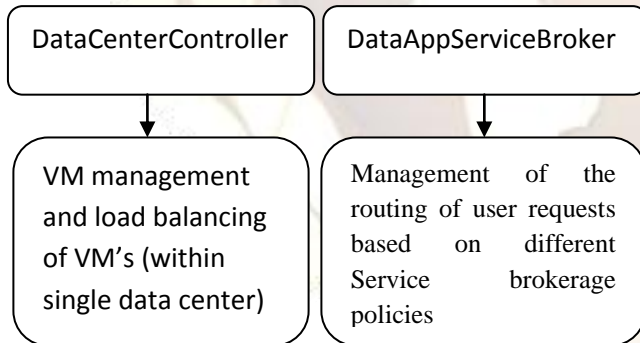


Figure 1. Segregation of responsibilities.

GUI and Ability to save simulations and results: The user can configure the simulation with high level of details using the GUI. It makes easy to do the simulation experiments and to do it in repeatable manner. Using the GUI introduced here, we can also save the simulation configurations as well as the results in the form of PDF files for future use.

Different activities taking place in Data center as given in Fig.2 are included in Cloud-sim:

Simulating:

Data Center hardware definition:
Physical machines composed of processors, storage devices, memory and internal bandwidth

VM specification, VM creation and VM destruction

VM Management, different policies (e.g. time-shared and space shared) based allocation of physical hardware resources for the operation of VMs.

The execution of user or requests (here known as Cloudlet) on the VMs

Figure 2. Different activities in Cloudsim/Cloud-Analyst

Cloud-analyst is implemented including these features.

III. SOME COMPONENTS

REGION

In the CloudAnalyst 6 'Regions' are there based on the 6 main continents in the World. To have the realisting simplicity for the large scaled testing in Cloud-Analyst [3].

USER BASE

A User Base models a group of users that is considered as a single unit in the simulation and its main responsibility is to generate traffic for the simulation. A single User Base may represent thousands of users but is configured as a single unit and the traffic generated in simultaneous bursts representative of the size of the user base. The modeler may choose to use a User Base to represent a single user, but ideally a User Base should be used to represent a larger number of users for the efficiency of simulation. [3]

VM LOAD BALANCER

VM Load balancer is useful to determine which VM should be assigned the requests (Cloudlet) for processing. Three policies are included currently in the Cloud-analyst. [3]

Round-robin Load Balancer

This uses a simple round-robin algorithm to allocate VMs

Active Monitoring Load Balancer

This version load balances the tasks among available VM's

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.

INTERNETCLOUDLET

It is a grouping of user requests. The number of requests grouped into a single Internet Cloudlet. This Internet Cloudlet is configurable in Cloud Analyst. The Internet Cloudlet is having information such as the size of a request execution command, size of input and output files, the originator and target application id used for routing by the Internet and the number of requests.

CLOUDAPPLICATIONSERVICEBROKER

A service broker decides which data center should provide the service to the requests coming from each user base. And thus, service broker controls the traffic routing between User Bases and Data Centers.

Currently, Cloud-Analyst is with three types of service brokers each implementing a different routing policy.

Service Proximity based routing

Here, the shortest path to the data center from the user base, depended on the network latency is selected and according to that, the service broker routes the traffic to the closest data center with the consideration of transmission latency.

Performance Optimized routing

In this routing policy, service broker actively monitors the performance of all data centers, and based on that, directs traffic to the data center with best response time

Dynamically reconfiguring router

This router has one more responsibility of scaling the application deployment depended on the current load it faces. This policy increases and decreases the no.

of virtual machines allocated in the data centers. This will be done taking under consideration the current processing times and best processing time ever achieved.

IV. ROUTING OF USER REQUESTS

In Cloud-Analyst, how the routing of user request takes place is shown in the figure below including the use of service broker policy and the virtual machine load balancer. [3]

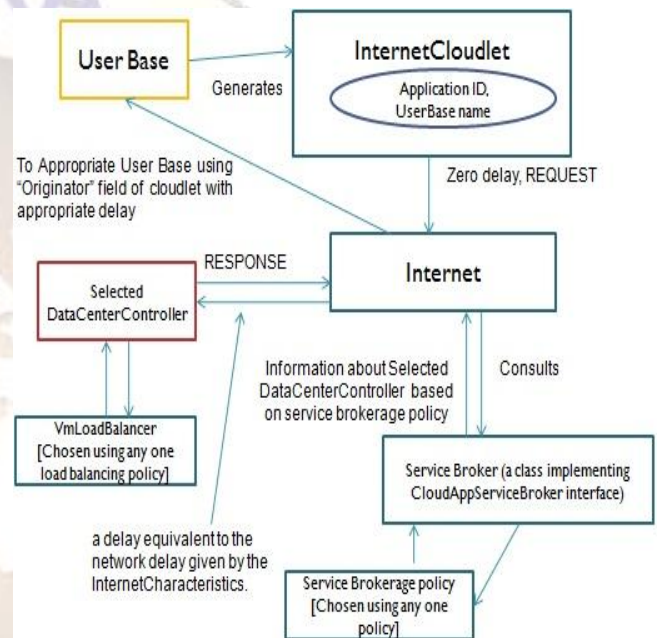


Figure 3. User Requests Routing

User Base generates an Internet Cloudlet, with the application id for the application it is intended and also includes the name of the User Base itself as the originator for routing back the responses. With the Zero delay, REQUEST is sent to the Internet. On receiving the REQUEST, Internet consults the Service broker for the data center selection. The service broker uses any one of the service broker policy based on the REQUEST information and sends information about selected data center controller to the Internet. Using this information, Internet sends the REQUEST to the Data Center Controller. Now Selected Data Center Controller uses virtual machines load balancer and after processing the requests, sends the RESPONSE to the Internet. Now Internet will use the "originator" field of the cloudlet information it received earlier and will add

appropriate network delay with RESPONSE and sends to the User Base.

Some results about cost using this strategy of routing.

V. SERVICE PROXIMITY BASED ROUTING

This routing simply follows the “closest data center” strategy. The strategy is presented below in the figure.

Case: Two Data Centers in Same Region

Simulation Duration: 24 Hours
Application Deployment environment
Service Broker Policy: Closest Data Center

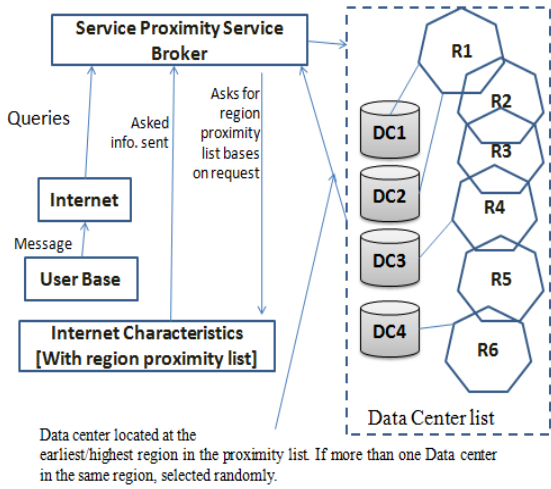


Figure 4. Proximity Based routing

How it works?

As soon as the Internet gets the message from the User Base, it queries to the service proximity service broker. The service broker asks for the region proximity list to the Internet Characteristics based on the region of the User Base.

The region proximity is ordered based on the latency (region with lowest latency first). Based on the information from the Internet Characteristics a data center is picked by the routing policy.

If there are more than one data centers within the same region, it will be selected randomly.

What is lacking here in the routing policy?

In this policy, when we look at the last step of the data center selection, there is the random selection of data centers within the same region. Now questions arises are:

Why to select the data center randomly?

What if the non-selected data center is better than selected data center if some parameters are taken under consideration? Etc.

Table 1: Application Deployment Environment

Data Center	No. of VM	Memory	Bandwidth
DC1	5	512	1000
DC2	5	512	1000

Table 2: Data Center Configuration

Name	Region	Cost per VM \$/hr	Memory Cost \$/s	Data Transfer Cost \$/Gb
DC1	2	0.01	0.05	0.1
DC2	2	0.02	0.05	0.1

Table 3: User Bases

Name	Region	Req. per user per hour	Avg. Peak User	Avg off pick users
UB1	2	60	400000	40000

User Grouping Factor in User Base: 100
Request Grouping Factor: 100
Executable instruction length per request (bytes): 250
Load Balancing Policy across VMs in a Single DC: Throttled
Results:

Table 4: Cost

Data Center	VM Cost \$	Data Transfer Cost \$	Total \$
DC2	24.01	477.57	501.57
DC1	12.00	477.69	489.70

Cost
Total Virtual Machine Cost (\$): 36.01
Total Data Transfer Cost (\$): 955.26
Grand Total: (\$) 991.27

From the results above, we can conclude that if the data center selection goes randomly, there is no surety about cost effectiveness. We can observe (TABLE 2) that even if the cost per VM in DC2 is more than that in DC1, DC2 is selected and overall cost increases. We can also take other parameters under consideration that are not taken in this so called random selection of data center within same region.

VI. PROPOSED SERVICE BROKER POLICY

Our proposed Service Broker Policy is a modified proximity based routing policy. In that policy as explained, in the last section, one of the data centers from the same region is selected randomly. In the proposed service broker policy, as shown below in the Fig. 5, selection of data center from the data centers within same region is done in a cost effective manner i.e. selected most cost effective data center.

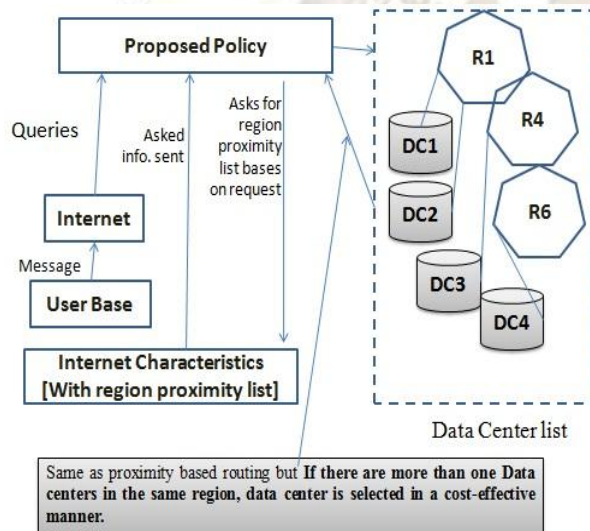


Figure 5. Proposed Service Broker Policy

Case: Same as in Section V but only one Data center (DC2) is chosen as per proposed policy. We have assumed that the DC1 is selected as it has less VM cost than VM cost in DC2. Based on this, if DC1 is selected, following is the result for that.

Results: Cost
 Total Virtual Machine Cost (\$): 12.00
 Total Data Transfer Cost (\$): 955.26
 Grand Total: (\$) 967.27

Table 5: Cost

Data Center	VM Cost \$	Data Transfer Cost \$	Total \$
DC1	12.00	955.26	967.27

From the results above, we can observe that VM cost is \$12.00 for the same requests we used in the case of section V and is more cost-effective than just Service Proximity Routing results.

VII. CONCLUSION

We have proposed a new strategy that can be included in the Cloud-Analyst to have cost effective results and development and we can conclude from the results that this strategy is able to do so. From the work done, we can conclude that the simulation process can be improved by modifying or adding new strategies for traffic routing, load balancing etc. to make researchers and developers able to do prediction of real implementation of cloud, easily.

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