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Cloud cost management: An empirical view

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ABSTRACT

Cloud computing provides a mechanism to access, store and retrieve the applications and data online. The word cloud refers to a network or the internet. Nowadays, many IT Companies are adopting Cloud Computing. In Cloud, computing resources are made available to the users easily, quickly and on a pay-per-usage basis. In this paper, an attempt has been made to analyze the cost involved in accessing the paid services of cloud and show how the service broker policy of retrieving data from the closest datacenter and retrieving data after optimized response time of the datacenters. After a close analysis, we find that retrieving data from the nearest datacenter is more cost-effective than optimized response time data retrieval of data from datacenters.

Keywords— *Cloud computing, Datacentre, Broker, Service broker policy, Optimized response time, CloudSim, CloudAnalyst, User bases, Virtual machines*

1. INTRODUCTION

Cloud computing technology dates back to 1960 when John McCarthy wrote that “Computation may someday be organized as a public utility” [1]. Now a day’s cloud computing technology is emerging very rapidly. Cloud Computing provides a mechanism to access, store and retrieve the applications and data online. The word cloud refers to a Network or an Internet. Cloud provides various services over the internet. A user can store and retrieve their valuable data over cloud anytime from anywhere, as the cloud provides security to its end users. So, Cloud computing provides a way to deliver computing resources over the internet. Cloud computing provides a shared pool of resources which includes network, data storage, bandwidth and other applications. Examples of cloud services include online Business Applications, Online File Storage, and WebMail etc. [2]. Three services are provided by cloud viz. Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS).

There are lots of cloud computing definitions, but the most accepted definition is from USA NIST (National Institute of Standards and Technology), which lays out five essential characteristics [3]:

(a) On-Demand Self Service: In on-demand self-service, the user accesses cloud services through an online control panel.
(b) Rapid Elasticity: Rapid elasticity allows the user to automatically request additional space in the setup of cloud computing services. Because of a set of cloud computing services, provisioning can be seamless for the client or user.
(c) Resource Pooling: A pool of computing resources is available remotely for users.
(d) Broad Network Access: Broad network access refers to resources hosted in a private cloud network (operated within a company’s firewall) that are available for access from a wide range of devices, such as tablets, PCs, Macs and smartphones. These resources are also accessible from a wide range of location that offers online access.
(e) Measured services: services can be offered over the internet or private networks. Cloud system automatically control and optimise resource use by leveraging a metering capability.

Some of the benefits attributed to the use of Cloud Computing are [4]:

(a) Reduced Cost: Pay As per Usage is used as a billing model, therefore, user need not purchase the infrastructure. The initial expense and recurring expenses are much lower than the traditional approach.
(b) Increased Storage: Due to the massive infrastructure provided by cloud storage and maintenance of large volumes of data become quite easy.
(c) Increased Manageability: A simplified and enhanced management of resources, infrastructures and SLA backed agreements are provided by cloud computing.

The rest of the organized as follows: Section II describes the description of the cloud simulator environment. Section III presents the analysis of cloud cost management which consists of input, output and the interpretation from the results. Section IV presents the conclusion and future scope respectively.

2. DESCRIPTION OF CLOUD SIMULATOR ENVIRONMENT

This section presents the description of a cloud simulator environment which are as follows:

2.1 CloudSim: A Simulation tool for cloud environment

CloudSim provides various functionality to help a user to develop and deploy a cloud environment. The CloudSim toolkit enables users to model and simulate extensible Clouds as well as execute applications on top of Clouds. As a completely customizable tool, it allows extension and definition of policies in all the components of the software stack. This makes it suitable as a research tool as it can relieve users from handling the complexities arising from provisioning, deploying, configuring real resources in physical environments. Its support for modelling and simulation of large scale Cloud computing infrastructure, including data centers on a single physical computing node. It is a self-contained platform for modelling datacenters, service brokers, scheduling, and allocations policies. It provides virtualization engine for enabling the simulation of data centers. The virtualization engine aids in the creation and management of multiple, independent, and co-hosted virtualized services on a datacenter node. CloudSim has the flexibility to switch between space-shared and time-shared allocation of processing cores to virtualized services. Some models such as workload models and models for database services such as blob, SQL, etc are not included in CloudSim toolkit. Also, it does not support QoS monitoring capability at VM and cloud level.

2.2 CloudAnalyst: An extension for analysing cloud data transfer in CloudSim

This extension of CloudSim helps to study the behaviour of large-scaled Internet application in a cloud environment and makes use of a new simulation tool that can be used for simulating this type of large scaled applications along
With a novel approach for such studies [5].

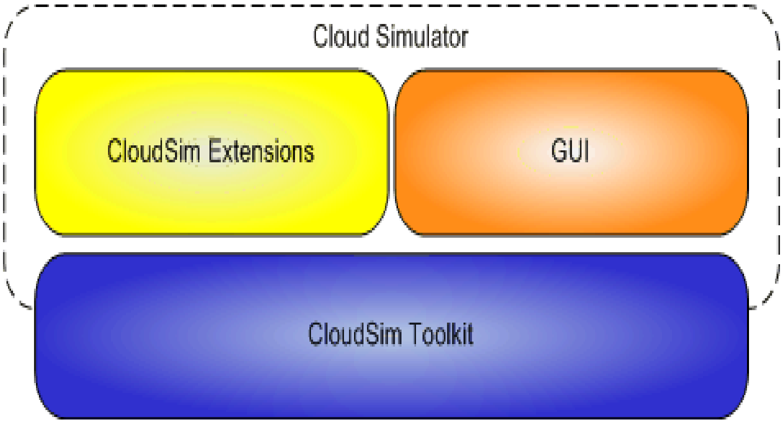

Fig. 1: CloudAnalyst built on top of CloudSim

3. ANALYSIS OF CLOUD COST MANAGEMENT

We often encounter user based of cloud retrieving data from the datacenter which has a greater response time to that particular base than the others which leads to another datacenter being idle even if it is nearer to the userbases than other. In this paper, an attempt has been made to set up a similar kind of environment and analyse the cost involved in retrieving the data from the respective data centers. We keep track of the Cost per VM(Virtual Machine)($/Hr), Memory Cost($/sec), Storage Cost($/sec) and the Data transfer Cost($/Gb) after setting the service broker policy to “Nearest datacenter” at one simulation and “Optimized Response time” at the other. The result would depict the cost difference in using both the techniques.

3.1 Methodology

Firstly, we set the specifications of the cloud in the CloudAnalyst framework. For a proper analysis, we take 10 user bases located all around the world divided across 6 regions and 3 datacenters. We also handle the load balancing of each Virtual machine in the data center by setting it all to Round Robin Scheduling technique.

3.2 Inputs

The specifications and characteristics of the user bases are:

Table 1: Specifications and characteristics of the user bases

Name	Region	Request per user per hr.	Data Size per request (bytes)	Avg. peak users	Avg. off-peak users
UB1	2	60	100	1000	100
UB2	2	60	100	1000	100
UB3	2	60	100	1000	100
UB4	2	60	100	1000	100
UB5	2	60	100	1000	100
UB6	2	60	100	1000	100
UB7	2	60	100	1000	100
UB8	2	60	100	1000	100
UB9	2	60	100	1000	100
UB10	2	60	100	1000	100

The specifications and characteristics of the Datacenters are:

Table 2: Specifications and characteristics of the datacenters

Name	Region	Arch	OS	VMM	Cost per VM $/hr	Memory cost $/sec	Storage cost $/sec	Data Transfer cost $/Gb	Physical HW units
DC1	0	X86	linux	Xen	0.1	0.05	0.1	0.1	1
DC2	4	X86	linux	Xen	0.1	0.05	0.1	0.1	1
DC3	5	X86	linux	Xen	0.1	0.05	0.1	0.1	1

Physical hardware unit's configuration of each datacenter:

Table 3: Physical hardware unit's configuration of each datacenter

Datacenter name	Id	Memory (Mb)	Storage (Mb)	Available BW	Number of Processors	Processor Speed	VM policy
DC1	0	204800	100000000	1000000	4	10000	Time Shared
DC2	0	204800	100000000	1000000	4	10000	Time Shared
DC3	0	204800	100000000	1000000	4	10000	Time Shared

Application Deployment Configuration:

Table 3: Physical hardware unit's configuration of each datacenter

Datacenter	#VM	Image size	Memory	BW
DC1	5	10000	512	1000
DC2	5	10000	512	1000
DC3	5	10000	512	1000

3.3 Internet Characteristics

Delay matrix (units in milliseconds):

Table 4: Delay matrix

Region\Region	0	1	2	3	4	5
0	25	100	150	250	250	100
1	100	25	250	500	350	258
2	520	1250	25	150	150	200
3	250	500	1250	25	500	500
4	220	350	150	500	120	500
5	100	200	600	500	500	25

Bandwidth Matrix (Units in milliseconds):

Table 5: Bandwidth matrix

Region\Region	0	1	2	3	4	5
0	2000	1000	1000	1000	4000	1000
1	1000	800	2000	1000	1000	1000
2	1000	1000	2500	1000	1000	1000
3	5000	1000	1000	500	1000	1000
4	5000	1000	1320	1000	500	1000
5	500	1000	1000	1000	1000	2000

Cloud Environment Characteristics main points:

(a) Request per user per hr. is kept same for all user bases that is 60.

(b) Virtual Machine Manager used for all Datacentres is XEN.

(c) All userbases are kept in the same region intentionally and Datacenters are kept at different regions so as to test for "Nearest Datacenter" and "Optimised response time" service broker policy.

3.4 Outputs

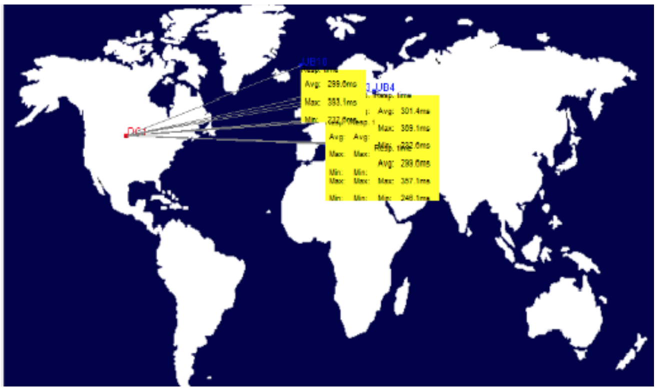

Fig. 1: The output of CloudAnalyst Datacenters

Simulation Results

Overall Response Time Summary

	Average (ms)	Minimum (ms)	Maximum (ms)
Overall Response Time:	300.04	229.62	393.11
Data Center Processing Time:	0.35	0.02	0.80

Export Results

Response Time By Region

Userbase	Avg (ms)	Min (ms)	Max (ms)
UB10	299.554	232.616	393.113
UB1	300.004	231.112	358.616
UB2	299.463	229.618	363.119
UB3	299.285	240.09	360.114
UB4	301.395	232.612	369.115
UB5	301.028	229.615	364.612
UB6	299.581	246.116	357.118
UB7	299.457	244.636	382.622
UB8	300.615	235.616	358.613
UB9	300.042	232.617	375.112

Fig. 2: Response Time for Round Robin with 10 userbases

Cost

Total Virtual Machine Cost ($): 1.30

Total Data Transfer Cost ($): 0.64

Grand Total: ($) 1.94

Data Center	VM Cost $	Data Transfer Cost $	Total $
DC2	0.50	0.64	1.14
DC1	0.40	0.00	0.40
DC3	0.40	0.00	0.40

Fig. 3: Processing Cost for Round Robin

3.5 Interpretation from the results

A certain interesting observation made from figure 2. And figure 3. As Request per user per hr. is kept the same for all user bases i.e 60. Virtual Machine Manager used for all Datacentres is XEN and all userbases are kept in the same region intentionally and Datacenters are kept at different regions so as to test for “Nearest Datacenter” and “Optimised response time”.

From figure 2. It is observed that minimum value for userbase is UB2 (min: 229. 618) it will be processed first and accordingly datacentre selection will be done in Round robin manner based on the minimum and maximum values of the userbases. Accordingly, we get the overall response time and processing time for DC2: 300.04, 0.35; for DC1: 229.62, 0.02 and for DC3:393.11, 0.80.

From Fig 3. It is found that based on the result obtained in Fig. 2, the Datacenter DC2 got less cloud cost around 0.50 as compared to DC1 and DC3. Even the total virtual machine cost is 1.30 for the 10 userbases. It leads to more resource utilization, but the cost is somehow increased (compared DC1 and DC3 with DC2) and response time is less.

4. CONCLUSION AND FUTURE SCOPE

Cloud computing is a new era of computing utilities which provide utilities as a service like pay as you go, model. Cloud technologies focus on many policies and novel methods. We found that cloud computing is very emerging techniques and it has various benefits. In this paper, an attempt has been made to analyze the cost involved in accessing the paid services of cloud and show how the service broker policy of retrieving data from the closest data center and retrieving data after optimized response time of the datacenters. We analysed the cloud cost and response time in a cloud computing environment using CloudAnalyst toolkit, in Java language. After a close analysis, we found that retrieving data from the nearest data center is more cost-effective than optimized response time data retrieval of data from datacenters. From Fig2. And Fig. 3, it leads to more resource utilization, but the cost is somehow increased (compared DC1 and DC3 with DC2) and response time is less. The future work includes a new service broken policy in the simulator.

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