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Hybrid Cloud Architecture To Minimize Service Level Agreement Violations

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ABSTRACT

Cloud provides services like Infrastructure, Platforms, Softwares in through deployments models like Public, Private, Hybrid Community as per user needs on a pay per use basis. Cloud customer switches among different cloud providers to achieve the needed service. There comes a need of better interoperability to address the vendor lock-in problem. The Cloud Service Provider provides all the services by first establishing Service Level Agreement with the customer which promises reliability, availability and other Quality of Service parameters to be delivered efficiently. Service level agreements is a way of attaining standardization through a contract between the cloud service provider and the customer. Cloud Brokers are responsible to establish and maintain SLA's among the Cloud and the consumers. Hybrid cloud has proven to be a optimised solution in terms of cost, response time and interoperability. This paper proposes to study how SLA management is done in Hybrid Cloud to achieve better Quality of Service. Cloudsim Simulator is used to study latency and uptime as SLA parameters in hybrid cloud.

KEYWORDS: Service Level Agreement(SLA), Hybrid Cloud, Interoperability, Response time, Quality Of Service, Cloud Latency

I.INTRODUCTION

Cloud Computing is a part of parallel and distributed computing where services are deployed to its customers under one umbrella. Cloud technology has various deployment techniques such as Public cloud, Private Cloud, Hybrid Cloud, Community cloud etc. It provides various services in the form of IaaS, PaaS, SaaS, NaaS etc. When a customer requests for a specific resource, the provisioning is done depending upon the type of resource requested and accordingly the deployment model is implemented. The request is first handled by the cloud broker who plays a major role in resource provisioning. [1] Cloud computing does the provisioning of customer service like shared resources, data, and tools on a pay-per-use basis. As the cloud is taking charge of whole industry with umpteen resource provisioning power, the vendor lock-in issue is also mounting. Clouds standardization came to rescue the interoperability issue which was the major cause of vendor lock-in. Vendor lock-in is a situation where a consumer is stuck up with a service provider which may not be able to satisfy its need of needed resource properly thereby creating a monopoly. [3] [4] To avoid this there is an utmost need of proper service level agreement policies which comes to rescue in case the customer faces vendor lock-in.

Hybrid cloud which is a powerful combination of public and private cloud have shown better performance with respect to interoperability or vendor lock-in problem. Here the cloud users may freely move between big public clouds and secured and powerful private clouds as per the need of the user.

STRUCTURE OF PAPER

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss the details of service level agreement . In Section 3 we discus the related work. Section 4 discuss about experimental work for sla parameters. Section 5 is discussing the results and analysis part. Section 6 tells us about the future scope and concludes the paper followed by references.

II. SERVICE LEVEL AGGREMENTS

The customer are provisioned with the resources abiding the Service Level Agreements which is a legal contract signed between customer and cloud provider which formally states the terms of agreement which can have functional or non functional service parameters specified clearly. [5] Non functional parameters are quoted in terms of Quality of Service parameters(QOS), requirements and punishments in case of violation of SLA. [6] If there is a violation of SLA then the cloud provider has to pay heavily to the customer and hence SLA violation is not affordable to the cloud provides. On the other hand the cloud consumers should also use the cloud resources fairly so as to pay a huge resource usage fees to the provider. So there should be perfect balance between cloud provider and the customer. Cloud broker plays a very important role as a middleware between these two. So there should be a fair combination of service broker policy and scheduling algorithm to be implemented. There has to be multiple SLA parameter consideration while implementing cloud computing so as to get better QOS. [7]

There can be different levels where Service level agreements can be implemented which are as follows:

1. Consumer Based SLA
2. Cloud Based SLA
3. Multilevel SLA

Some SLA's abide very stringent regulations while the other which are based on operating level Agreement might be much relaxed with respect to law. Service Level Agreements are based on following :

1. Response time
2. Availability
3. Reliability
4. Peak Load Condition

If a cloud service provider cannot meet the user requirement then the provider has to pay the penalty to the cloud service consumer as per the predecided contract. SLA's are worked out as per the need the consumer requirements.

III. RELATED WORK

There are numerous works that have been done related to cloud computing but service level aggrements has been an understudied issue.

Foued Jrad, Jie Tao and Achim Streit, in their paper "SLA based service brokering in Intercloud Environment", have presented a generic architecture for a cloud service broker operating in intercloud environment. The paper focuses on the work of cloud broker working as a SLA manager more oriented towards cloud consumer than cloud service provider. They discuss the life cycle of SLA management and then introduce the SLA oriented cloud broker in the architecture right form SLA service and definition to SLA provisioning and monitoring in intercloud architecture. [8]

Eman Aljoumah et.al.in their paper "SLA in Cloud computing architectures: A comprehensive study", have focused on the SLA agreement between the cloud provider and the consumer. They have first discussed the general overview of SLA and then stressing the advantages it delivers such as improved customer acceptance, improving QOS etc. They further discussed the importance of SLA management and monitoring process as well as different SLA parameters and metrics. They have conducted a comparison between major cloud provider SLA and also SLA pricing, violations, and penalties are discussed thoroughly. [9]

Vincent Emeakaroha, Ivona Brandic, Michael Maurer, Ivan Breskovic in their paper "SLA-Aware Application Deployment and Resource Allocation in Clouds", present a novel scheduling heuristic where they consider multiple SLA parameter like number of CPU's required, bandwidth, and mainly storage application deployment. The heuristic implements a load-balancing mechanism for efficient distribution of the applications' execution on the Cloud resources. There is a significant discussion on dynamic resource allocation strategy which has automatic initialization of virtual machines (VM) when an allotted virtual machine is not suitable for application deployment. [10]

Justice Opara Martins, Reza Sahandi, Feng Tian in their paper "Critical Analysis of Vendor Lock-in and its impact on cloud computing migration: A Business Perspective", have conducted a critical analysis of vendor lock-in with view of business. The paper has given a detailed survey of various situations that give rise of vendor lock-in. The importance of interoperability and portability while migrating to and out from clouds has been discussed and more focused in the paper. The analysis done in the paper points out that the problem of vendor lock-in increases when the computer resources migrate from on-premise to the clouds. The paper also suggests how to avoid and lessen lock-in risks when migrating to cloud computing. [11]

IV. EXPERIMENTAL WORK

Service level agreements are based on utility of the resources provided by the provider. Cloud providers charge on pay per use basis to the customers who then get the access to only limited number of resources. Depending upon the SLA's the customers are provided with requested resources through suitable deployment model. The cloud broker plays a major role while deciding the service level agreements. Broker according to the need of the customer offer different policies so that the resource provisioning is done in an optimised way. If the customer is in need of any specific resource out of pre-decided ones then he has to pay extra which sometimes is not much feasible monetarily. Above all dynamic resource provisioning is not possible in peak load conditions. The work is more focused on peak load conditions where most of the SLA's fail to commit. The cloud analyst tool kit of Cloudsim simulator is a very useful kit for studying the geographical distribution of clouds which is not possible in other toolkits.

The earlier work done has already proved that out of the three broker policies provided optimised response time works the best for the customers for hybrid cloud. Hybrid cloud provides better interoperability and hence gives optimised results with respect to response time, turn-around time, and data centre processing time. In case of peak load conditions there can be change in the type of access to the clients i.e. the client might not get a smooth access to some resources or he has to pay more for getting those. [12] [13] [13]. The experimental work done here considers the two important factors of QOS i.e. response time and data centre processing time. The simulations were done on hybrid cloud and the best combination of broker policy i.e. optimum response time(ORT) and best scheduling algorithm i.e. throttled load balancing algorithm. The simulations were done in cloud analyst toolkit of Cloudsim.

Parameters set in cloud analyst:

Region wise distribution of data centre:

Table 1 :

Regions	Location
R0	USA
R1	Countries of North America
R2	Countries of European Union
R3	Countries of Asia like India, China
R4	Africa
R5	Australia

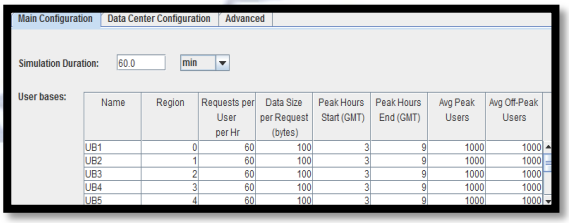

Fig 1: Screenshot of Data centre configuration

Service Broker Policy: Optimise Response Time

Data Center	# VMs	Image Size	Memory	BW
DC3	200	10000	512	1000
DC4	250	10000	512	1000
DC5	300	10000	512	1000
DC6	200	10000	512	1000
DC7	500	10000	512	1000

Fig 2: Screenshot for Service Broker Policy

Overall Response Time Summary

	Average (ms)	Minimum (ms)	Maximum (ms)
Overall Response Time:	229.92	48.94	639.47
Data Center Processing Time:	102.82	0.23	313.40

Export Results

Response Time By Region

Userbase	Avg (ms)	Min (ms)	Max (ms)
UB10	370.883	64.439	606.951
UB11	214.508	167.646	253.798
UB1	71.845	48.937	98.068
UB2	254.935	74.559	309.842
UB3	205.345	52.092	371.43
UB4	229.427	60.289	478.786
UB5	382.681	67.415	639.469
UB6	221.384	178	268.011
UB7	71.716	49.681	95.597
UB8	256.485	71.309	314.581
UB9	231.74	63.329	456.289

Fig 3 : Screenshot of Response Time And DCPT

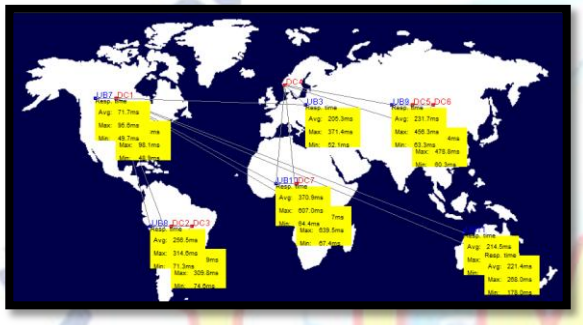

Fig 4: Screenshot For Resource Allocation among user bases

Name	Region	Requests per User per Hr	Data Size per Request (bytes)	Peak Hours Start (GMT)	Peak Hours End (GMT)	Avg Peak Users	Avg Off-Peak Users
UB1	0	60	100	6	9	1000	1000
UB2	1	60	100	0	3	1000	1000
UB3	2	60	100	3	6	1000	1000
UB4	3	60	100	0	3	1000	1000
UB5	4	60	100	3	6	1000	1000

Fig 5: Screenshot for User Base Configuration in Case2

Overall Response Time Summary

	Average (ms)	Minimum (ms)	Maximum (ms)
Overall Response Time:	228.53	48.99	629.42
Data Center Processing Time:	97.74	2.21	313.42

Export Results

Response Time By Region

Userbase	Avg (ms)	Min (ms)	Max (ms)
UB10	368.651	62.984	606.975
UB11	221.568	177.319	266.989
UB1	71.628	51.196	95.336
UB2	256.48	69.824	309.363
UB3	206.733	52.327	366.97
UB4	231.575	63.811	310.067
UB5	372.567	63.208	629.418
UB6	221.734	174.424	277.049
UB7	71.514	48.991	97.523
UB8	255.531	71.068	309.379

Fig 6: Screen shot ORT &DCPT in Case 2

V. RESULTS AND DISCUSSION

The base of the experimental was construction of hybrid cloud consisting of one private and two public clouds where the resource allocation is done by the broker using optimum response time policy. The load balancing algorithm used was throttled load balancing algorithm. The earlier studies have shown that hybrid cloud gives very good results when the combination of ORT and Throttled is used.

In peak load conditions there is a probability that the service level agreements get violated. The above experiment was done by considering the peak load conditions in terms of more number of virtual machines. There are two cases designed as follows:

Case 1: Hybrid cloud with peak load condition with no consideration given to geographical allocation of user bases.

Case 2: Hybrid cloud with peak load condition and consideration given to geographical allocation of user bases.

The screen shots of case 1 shows that in case of peak load condition the average response time comes out as 229.92 ms and the average data centre processing time as 102.82 ms. This means that in the case of peak load condition where the service level agreements tend to get violated by the provider hybrid cloud works well here.

The screen shots of case 2 shows that in the case of peak load condition the average peak load condition comes out as 228.53 ms and the average data centre processing times as 97.74 ms. It can be very well observed here that when he geographical conditions are considered in terms of time wise slot allocation the hybrid cloud is very much successful in avoiding the peak load condition.

VI. FUTURE SCOPE AND CONCLUSION

Hybrid cloud being a combination of fast secured private clouds and big public clouds prove to be ideal for various issues in cloud computing. Hybrid cloud gives best results when the combination of optimum response time policy and throttled load balanced algorithm is implemented. Thus hybrid cloud gives optimized results in terms of all the Quality of service parameters. Violation of Service level agreements remained a big problem in cloud computing technology due to the problems such as vendor lock in. It has been observed from the above work that hybrid cloud gives optimized results with respect to QOS parameters like Average Response Time & Average Data Centre Processing Time. Thus it can be very well concluded that Hybrid cloud is successful in avoiding vendor lock

in issue and also it is able to address the problem of SLA violation which may happen in case of peak load condition.

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