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Cloud Computing Integrated With Testing to Ensure Quality

[I]S. Rahamath Nazneen, [II]R.Kavitha
[I]PG student, Dept. of CSE, Velammal College of Engineering and Technology, Madurai, India
[II]Assistant Professor, Dept. of CSE, Velammal College of Engineering and Technology, Madurai, India

Abstract
Cloud data is budding day by day. Cloud Data already exists and creators and analytics are working on it using upcoming frameworks and technologies. Storage and retrieval systems, access layers and processes are being proposed for cloud Data. Test Designers and Testing squads are also involved in this development. Specialized testing techniques are considered on cloud Test Data Management system. Cloud Data is the continuous explosions of large volumes of data that are generated, processed, stored and accessed by applications that handle several concurrent transactions of data instantaneously. A transition from structured relational data to voluminous, unstructured, non-semantic, highly complex data remains a great challenge for data managers, data workers, data analyzers to hold and organize such Cloud Data. Whether static or dynamic, cloud Data possesses four characteristics - volume, variety, velocity and veracity of data processing. Volume is the enormity of data, variety is the heterogeneity of data, velocity is the rate of transfer (speed) of data that comes in, flows within and goes out, and veracity is the truthfulness of the data or information.

Keywords
Big Data, Cloud Computing, Performance analysis, Cloud Testing Issues, Cloud Testing Benchmarks, Load Pattern

I. Introduction

Cloud computing is the latest trend all over the world nowadays, through which users access information and computer power via a web browser. It eradicates the need for upholding exclusive computing facilities. The characteristics of a cloud are: on-demand access, scalability, elasticity, cost reduction, minimum management effort, and device/location independence. As the acceptance and arrangement of cloud Computing increases, it is critical to evaluate the performance of cloud environments. Modeling and simulation technologies are suitable for calculating performance and security issues. Cloud-based testing software systems need techniques and tools to deal with infrastructure-based quality concerns of clouds. These tools can be built on the cloud platform to take advantage ofvirtualized platforms and services as well as substantial resources and parallelized execution. This paper describes the idea and main categories of cloud computing along with different issues regarding performance analysis in cloud computing, and then explores recent solutions in modeling and simulation for cloud environments. Then it introduces cloud testing, and finally investigates common benchmarks to support cloud testing.

There are three general categories of cloud computing which are briefly discussed below.

1. SaaS (Software as a Service):

This is the most popular way of using cloud computing. It uses a multitenant architecture, in which the system is built in a way that allows several clients to share infrastructure in an isolated way, without compromising the privacy and security of each customer's data. Google Doc, Gmail and Zoho are some examples in this category.

2. IaaS (Infrastructure as a Service):

This type of cloud computing previously used to be called as HaaS (Hardware as a Service). IT infrastructure was rented out with pre-determined hardware configuration for a specific period of time, and the client had to pay for the configuration and time regardless of the actual use. IaaS is offered in three different models namely Private, Public and Hybrid.

Private cloud implies that the infrastructure resides at thecustomer premises and the internal cloud is based on a private network behind a firewall.

Public cloud is located on the cloud computing platformvendor's data center and provides public accessible services.

Hybrid cloud is a combination of the aforementioned modelswith customer choosing the best of each model. It allows an organization to provide and manage few of itsresources in-house and has others externally. Amazon S3, Simple Storage Service, is an example in this category.

3. PaaS (Platform as a Service):

This type of cloud computing not only deals with operation systems, but also provides a platform where we can run existing applications or develop and test new ones without hurting our internal system by allowing the customer to rent virtualized servers and associated services. AppEngine and Bungee Connect are two examples in this category.

II. Literature Review

The performance testing and the scalability of the testing is relatively small comparing the number of users and their transactions [1]. Cloud testing and testing on cloud is more applicable in current cloud market [2]. Providing a good virtual storage for multi-tenant and necessary resources is modeled in cloud computing [3]. The system throughput and the latency getting changed due to the number of users concurrently working in the entire time, periodical manner can be maintained successfully by performance testing [4]. The pay-n-use, fault-tolerance are the added advantages of cloud [5]. One of the major factors for successfully growing IAAS of clouds is because of Elasticity [6]. The cloud services are available in online at the maximum time [7]. The testing of transaction can be done by TPC-W [8]. The elasticity of TAAS should be addresses due to the more number of user request concurrently [9]. In [10], the author provides a framework for performance testing for web services.

III. Performance Analysis In Cloud Computing

Dynamic configuration is a major challenge that performs analysis in large-scale cloud computing systems to determine the system performance characteristics, since one of the key requirements in performance maintenance is to make sure that system performance is SLA-driven. The System is managed dynamically by SLA,

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Service Level Agreement, which is a negotiated contract between a customer and a service provider that clarifies all service features that are to be provided, and consequently the policies that are to be taken in this way. An SLA generally uses response time, how quickly responses to requests need to be delivered, as a performance metric. For instance, if the system encountered peaks in load, in order to abide by the committed service levels, it would create additional instances of the application on more servers.

In most cloud computing categories, service components are located on different hosts. Passing user requests through these components generates many differenttypes of execution paths that make it challenging for performance analysts to determine

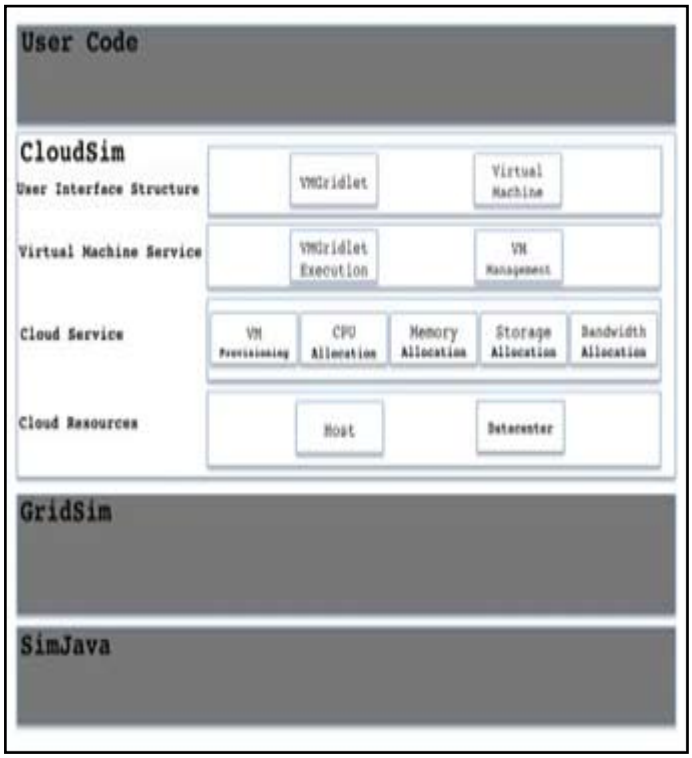

Fig. 1: Cloud Computing Modeling and Simulations

system behavior. For instance, to find out which service component might be the main issue when the system performance does not satisfy the expectation or when specifying the critical paths among execution paths is challenging. Cloud Simulators are required for cloud system testing to decrease the complexity and separate quality concerns. They enable performance analysts to analyze system behavior by focusing on quality issues of any specific component under different scenarios. Some of the published cloud computing simulators for evaluating cloud computing systems performance is described briefly in this section.

1. Cloud Sim

Cloud Sim is a simulation application which enables seamless modeling, simulation experiments and the application services that are proposed due to the problems existing in distributed system simulators were not applicable to the cloud computing environment.

The users could analyze specific system problems through Cloud Sim, without considering the low level details related to Cloud-based infrastructures and services. The layered Cloud Sim architecture is depicted in the Figure. Several works have been done to improve Cloud Sim which is described briefly below.

2. Cloud Analyst

Cloud Analyst was derived from Cloud Sim and extends some of its capabilities. This simulator can be applied to examine the behavior of large scaled Internet application in a cloud environment and to separate the simulation experiments exercise from a programming exercise. It also enables a modeler to repeatedly perform simulations and to conduct a series of simulation experiments with slight parameters variations in a quick and easy manner. The Cloud Analyst architecture is shown in Figure.2

IV. Cloud Testing

Cloud testing is defined as TaaS, Testing as a Service. This testing includes both functional testing, including redundancy and performance scalability, as well as non-functional testing, including security, stress, load, performance and interoperability of numerous applications and products. Cloud testing is not testing the cloud. It is a subset of software testing in which cloud-based web applications are tested by simulated real-world web traffic. Migration of IT organizations to cloud solutions makes cloud testing essential to validate functional system and business requirements.

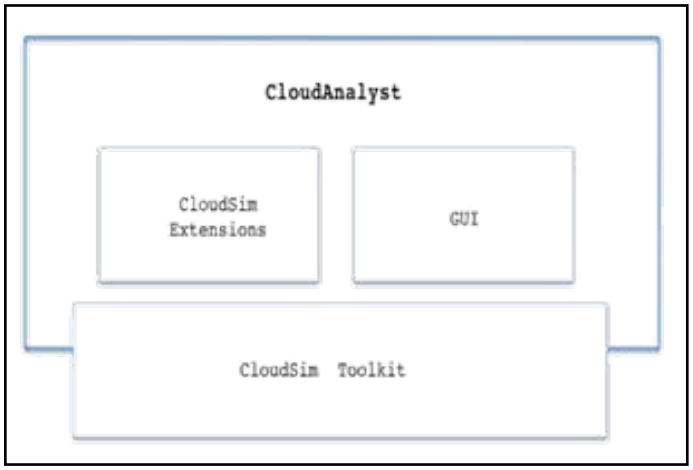

Figure 2: Architecture of Cloud Analyst

V. Types of Cloud Testing

There are two types of cloud testing services: On-Premise and On-Demand.

A. On-Premise

On-Premise testing can be used for validating andverifying different products owned by individuals or organizations.

B. On-Demand

On-demand testing is getting increasinglypopular nowadays and is used to test on-Demand software.

Cloud testing advantages, are based on factors such as.

1. Using scalable cloud system infrastructure to test and Evaluatesystemperformanceand scalability.
2. Leveraging On-demand testing to performextensive and effectivereal-timeonlinevalidation.
3. Reducing costs bytaking advantage of using computing resource in clouds.

The other key benefits are flexibility, simplicity, geographic transparency and traceability.

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VI. Requirements and Features in Cloudtesting:

New requirements and features in cloud testing, according to a survey are:

1. Cloud-based testing environment: Using a selected IaaS, orPaaS as a base to form a prepared test bed in which both virtual and physical computing resources can be included and deployedinside.
2. SLAs: Service Level Agreements such as system reliability,availability, security, and performance agreements could be part of testing and quality assurance requirements.
3. Price models and service billing: Price models and utilitybilling are basic parts and service for TaaS.
4. Large-scale cloud-based data and traffic simulation: Inperformance testing and system-level function validation, simulating large-scale online user accesses and traffic data at interface connections is essential for cloud testing.

VII. Issues and Challenges in Cloud Testing

Some of the issues and challenges in clouds testing are:

1. Constructing on-demand test environments

Providing on-demand testing environments is necessary for customers who want to test their applications on the cloud. There is no supporting solution to serve engineers in a cost-effective way to establish their required test environment in a cloud since most of the existing tools for testing cloud-based applications are not cloud-enabled. To overcome this shortage, TaaS providers provide a systematic solution that enables users to setup their required test environment based on their selection.

2. Scalability and performance testing:

The emphasis is on the scalability metrics and frameworks for parallel and distributed systems that have preconfigured resources and infrastructures. Therefore, metrics, frameworks, and solutions for these static systems can not consider scalable and dynamic testing environments, SLA-based requirements.

3. Testing security and measurement in clouds

Providing secured services inside clouds is a crucial concern in modern SaaS and cloud technology. Assuring user privacy in a cloud infrastructure, guaranteeing the security of cloud-based applications inside a third-party cloud infrastructure, finding techniques, tools and models for testing security of end-to-end applications in clouds and determining the QoS standards for security oriented quality assurance for end-to-end applications in clouds are some of the challenges involved in security validation and in the process of quality assurance.

4. Integration testing in clouds

In a cloud infrastructure, engineers must deal with the integration of different applications in the cloud in a black-box view according to their APIs and protocols. There is a lack of well-defined validation methods and quality assurance standards to address the connectivity protocols, interaction interfaces and service APIs provided by applications and cloud APIs.

5. Regression testing issues and challenges

Software changes and bug fixing would cause regression-testing challenges. We lack dynamic software validation methods and solutions in order to address these regression testing issues, especially for on-demand software, and the dynamic features of SaaS and clouds.

VIII. Cloud Testing Benchmarks

There is no single or ideal approach for cloud testing. This is basically due to the fact that there exist different factors such as cloud architecture design, non-functional and compliance requirements etc., which need to be taken into account to ensure successful and complete testing when an organization starts cloud testing.

Some common benchmarks developed to support cloud testing are briefly introduced below.

A. YCSB

A key design goal of Yahoo! Cloud Serving Benchmark's tool is extensibility; it is designed to be extensible and portable to mixed clouds to provide a comparison between cloud storage systems. Since this benchmark is under an open source license, others are able to use and extend the tool, and contribute new workloads and database interfaces. YCSB can be used to measure the performance of several cloud systems, and it is intended to deal with various quality concerns such as performance, scalability, availability and replication.

Performance examines the response time with increasing throughput until database saturation. Scaling tests how increasing the number of machines affects system performance. Scale-up and speed-up are used as scaling metrics. A workload generator, which defines YCSB tool, utilizes user-defined workload descriptions and a standard workload package, whichis a collection of programs representing typical cloud operations.

B. Enhanced TPC-W:

The architecture of TPC-benchmarks and its metrics are designed for transactional database systems therefore they are not suitable for cloud systems. Hence a new benchmark system is suggested specifically for cloud scalability, pay-as-you-go, fault-tolerance testing and evaluation. The benchmark defines web interactions as benchmark drivers with the usage of e-commerce scenarios. Scalability, fault tolerance, cost and peaks are defined as new metrics for cloud storage system evaluation.

1. Scalability:

Cloud services are expected to scale linearly with a constant cost per web interaction. It has been found that the aviation of response time to the perfectlinear scale can be measured by using correlation coefficients.

2. Fault tolerance:

Since hardware failures are common inIaaS, a metric is determined to analyze the potential of cloud self-healing. The recoverability of failures in a period of time is defined as the ratio between WIPS (Web Interactions per Second) in RT (real-time) and Issued WIPS.

3. Cost:

Cloud Performance economy is measured by WIPSUsed by conventional TPC-W benchmark.

4. Peaks:

This metric is to measure how well a cloud can adapt to peak loads, scale-up and scale-down. The adaptability is defined by the ratio between WIPS in RT and Issued WIPS.

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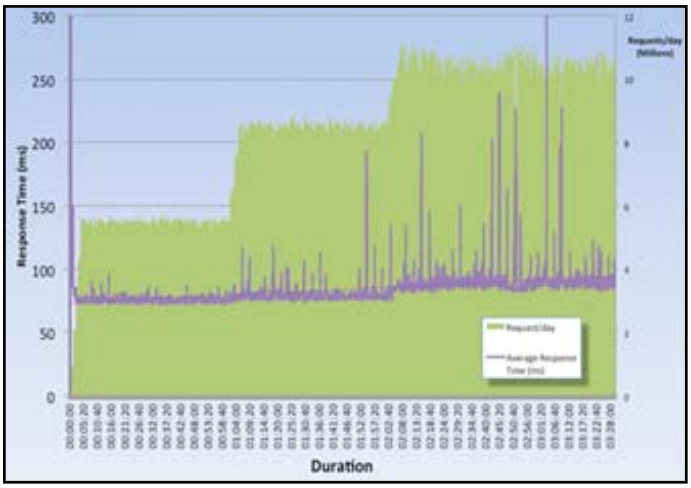

Figure-3: Devising a Load Pattern

IX. Results and Discussion

The simulation of the cloud testing can be obtained by SOASTA testing tool. The QA professional, performance testing engineers are testing the cloud by setting, building, executing and analyzing the cloud data or storage mass.Load Pattern According to the experiment the load test pattern has been verified for 1 user's response time. If number of users increase means the required target load will be analyzed.

For invoking 1 quote engine takes 1 second. 1 quote request by 1 user = 1 second

Quotes generated by 1 user for 24 hours = 1 * (((2 * 60) * 60) * 24) = 172,800

Quotes generated by 30 users in 24 hours = 172,800 * 30 = 5,184,000

It is a very simple example, when the application need more concurrent users to test scenario's such as caching, etc. then you can devise your own load pattern, some examples of load test patterns and the time requirement is shown in the following Figure-3.

X. Conclusion

Conventional testing for performance plays a big role in the ongoing process of evaluating the basic performance and stability of cloud applications. Since cloud data is huge is size and it comes from Multi-Tenant, the data should be verified and tested by deploying a Testing as a Service in the cloud. In this paper is it very clear that the cloud testing is deployed in multi-levels and a simple private cloud testing can be compared with the Bench-Mark Testing clouds like TCP-W, YCSB etc. This paper says that the performance of the cloud is getting increased after deploying the TAAS in the cloud. The load tests, web tests are significant and provide real advantages for cloud based applications. Ultimately the web based business with the IT is successful because of Testing deployed in cloud.

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Author Biography

S.Rahamath Nazneen, born in Madurai, T.N, India, received her B.Tech degree in Information Technology from Sethu Institute of Technology, affiliated to Anna University, Tirunelveli in 2012. She is currently pursuing her M.E degree in Computer Scienceand Engineering in Velammal College of Engineering and Technology, affiliated to Anna University, Chennai. Her research interests include Cloud computing and software testing.

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