REVIEW ARTICLE

Cloud Testing: A Review Article

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Abstract: Today Cloud computing is emerging as a new technology in corporate world and organization. Cloud testing is a form of software testing in which web applications use cloud computing environments (i.e. a "cloud") to handle with real-world user traffic by using various cloud technologies and solutions. Cloud computing leads an opportunity in offering testing as a service (TaaS) for SaaS and clouds. But at the same time, it causes new issues, challenges and needs in software testing, particular in the field of 1) testing clouds and 2) cloud-based applications. In this paper we discus some basic concepts of cloud testing, its type and major issues and challenges comes in this field. The paper also gives light on the benefits of cloud testing over conventional software testing.

Keywords: Cloud computing, Cloud Testing, Testing Techniques, Verification, Validation

I.   INTRODUCTION

If a cloud is expressed in simple words then it's just a data centre hardware and software. The cloud computing can be defined as set of hardware, networks, storage, services, and interfaces that combine to deliver aspects of computing as a service. The name cloud computing comes from the use of a cloud-shaped symbol as an abstraction for the complex infrastructure it contains in system diagrams.

Cloud computing has four characteristics: Elasticity and Scalability, Multi-tenancy, Self-managed function capabilities, Billing and Service usage metering. Cloud testing is an important part of cloud computing, it gives a new direction to information technology.

In this paper we discus some basic concepts like

- What is cloud testing?
- Why cloud testing is important?
- How many type of cloud testing is there?
- What are the major issues and challenges of Cloud testing?
- What is difference between Conventional Software testing and Cloud Based Testing?

II.   CLOUD TESTING

According to Wikipedia, "Cloud testing is a form of software testing in which Web applications that leverage Cloud computing environments ("cloud") seek to simulate real-world user traffic as a means of load testing and stress testing web sites. The ability and costs to simulate Web traffic for software testing purposes has been an inhibitor to overall Web reliability."
Based on our recent literature survey, there is a few of published papers addressing cloud-testing concepts, issues, and challenges. The authors in collected some other views about cloud software testing from practitioners in the real world. They are listed below.

- "Testing in the cloud leverages cloud computing environments and seeks to simulate real-world user traffic as a means of load or stress testing Web sites. (By Nivedan Prakash)

- "Cloud testing is the answer to the less-than realistic performance test that originates within the infrastructure of one of our clients. When we use cloud testing, we take advantage of hardware and bandwidth that more closely mimics our observed, real world conditions. Essentially, we execute the test in cloud-based infrastructure and bandwidth." (R V Ramanan, President – Global Delivery and Chief Software Architect, Hexaware Technologies)

- "Cloud testing basically aligns with the concept of cloud and SaaS. It provides the ability to test by leveraging the cloud, thereby bringing the same benefits that the cloud brings to customers…." (by Vinita Ananth, Director - APJ Region, HP Software as-a-Service).
In short, cloud-based software testing can be define as the verification and validation of environments, applications, and infrastructure that are available on demand by conforming these to the expectations of the cloud computing business model.

III.   Why CLOUD TESTING Important?

- ➢ It reduce costs by leveraging with computing resources in clouds – This means to use virtualized resources and shared cloud infrastructure effectively so that the required computer resources and licensed software costs in a test laboratory can be eliminated.
- ➢ It take the advantage of on-demand test services conduct by a third-party to deliver large-scale and effective real-time online validation for internet based software in clouds.
- ➢ It can reduce small business division's capital and licensing expenses as much as 50% to 75% using virtualized resources.
- ➢ It can reduce operating and labour costs up to 30% to 50% by automating development and testing resource provisioning and configuration.
- ➢ Testing improve the product quality and because of that there is large reduction in detection of defects by as much as 15% to 30%.
- ➢ It also directly influence the development and testing setup time of a product as it decreases from weeks to minutes.

IV.   TYPE OF CLOUD TESTING

Cloud testing is mainly categorised in three categories: Functional, Non- functional, Ability Testing Technique.
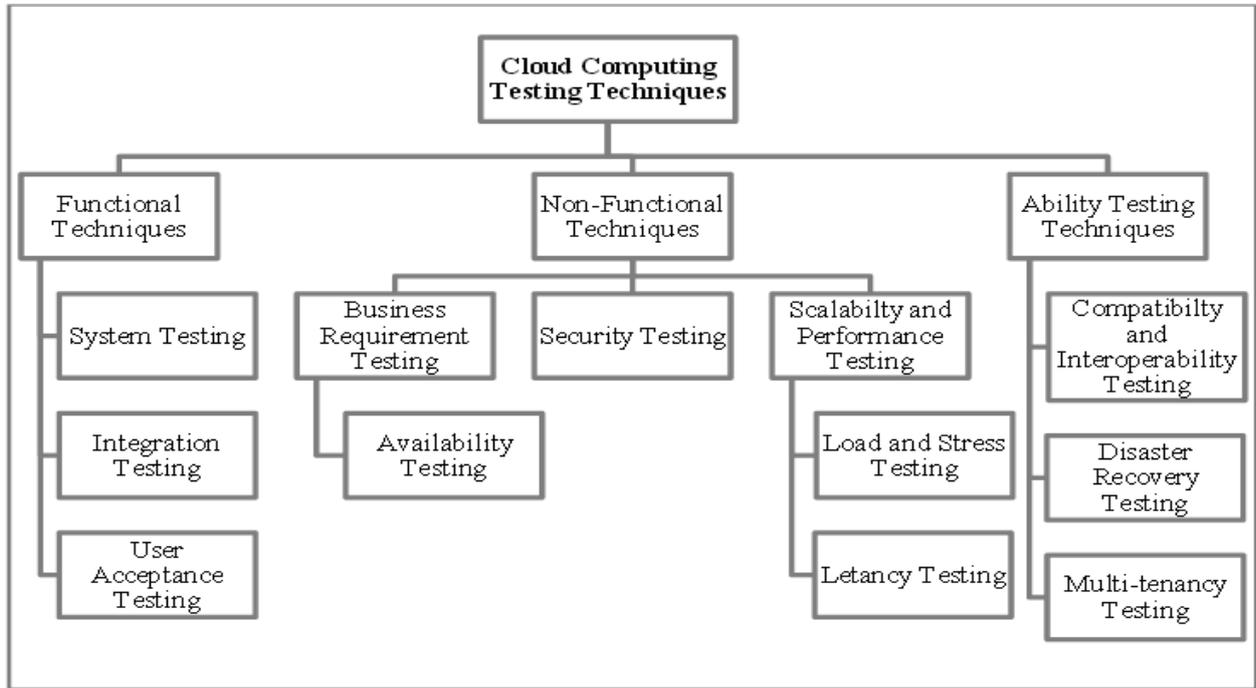
Figure 2: Cloud Computing Testing Techniques

A. Functional Testing

Functional cloud computing testing technique is performed for both remote and local applications. In this testing technique all the functions and features of a system are to be test including all software and hardware. The process of verification is done against system specifications and all the requirements are carried out in cloud instead of on-premise software testing. The main feature is that it is always conduct on complete, integrated software to check its compliance with requirement. The functional testing is divided into three sub categories i.e. System Testing, Integration Testing, and User Acceptance Testing.

a) *System Testing:* System testing techniques is used to prove the systems behavior within its own boundaries. It is critical to prove that the system functions as it has been designed when the system components work together, inputs and outputs are as expected and the overall resulting system is a high quality cloud system [Jerry Gao et al., 2011].

b) *Integration Testing:* Integration cloud testing allows the business to verify the cloud solution will work within the current infrastructure and environments which ultimately proving that the implementation of a cloud solution does not detrimentally impact any existing systems. Finally, the business requirements must be verified and validated to prove that the end result of the Cloud solution will meet the documented needs of the business [Vanitha Katherine & Alagarsamy, 2012].

c) *User Acceptance Testing*: This testing is done to prove the user that delivered cloud solution meets its all specified business requirement so that the user will accept the developed cloud solution. The user acceptance testing is not only applicable to on-premise software testing but also to off-premise software testing.

B. Non Functional Testing

This technique is widely known as performance testing technique. The Non-functional testing is used to ensure whether a web application meets the specified performance requirement of the user. This technique is sub categorised in three techniques i.e. Business requirement testing, Security testing, scalability and performance testing.

a) *Business Requirement Testing:* As the name refer, the testing of all the user requirement is done either they are feasible or not. Before migrating their business to a cloud computing solution, the organization must carefully analyse the feasibility and document all its requirements clearly. To achieve these business requirements one should go through reviews, periodic customer meetings, and workshops.

b) *Cloud Availability Testing:* The essential need of a cloud computing environment is its all time availability. There should not be any abrupt downtime so that that business of the client will not be affected.

c) *Cloud Security Testing:* Security testing which is an indispensable part of testing applications due to increase in security breaches in business. This can provide assurance that business critical data is stored and transported safely. To identify methods of gaining access to a system by using common tools and techniques used by hackers can very well guarantee the security of Cloud solutions [Prakash & Gopalakrishanan, 2012; http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools].

d) *Cloud Scalability and Performance Testing:* Cloud Scalability is another major area of concern where adequate amount of testing is needed. Cloud Computing solutions always claim to be scalable on demand. Load or Stress testing can be used to prove that the developed cloud solution can be scale as required with the help of software tools. Hence Cloud solution can be accurately measured and its capacity is verified. Cloud Performance testing techniques allow us to measure the cloud systems performance accurately. Performance testing with the load testing techniques allows getting an accurate image of the solution's ability on the cloud [Prakash & Gopalakrishanan, 2012; http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools]. Performance is generally tied to an application's capabilities within the cloud infrastructure. Finding out thresholds, bottlenecks & limitations is a part of performance testing. For this, testing performance under a particular workload and vary the nature of traffic on-demand is necessary [http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools].

e) *Cloud Load and Stress Testing:* Application stability is a major factor as the user count is expected to be increases. Load testing of an application involves creation of heavy user traffic and measuring its response. There is also a need to tune the performance of any application to meet certain standards. Measure response times and isolate issues related to specific actions while system is subjected to increasing load from different locations and multi user operations. It is imperative to identify issues as system is tested to breaking points maximum expected capacity or often beyond the expected usage. Stress Test is used to determine ability of application to maintain a certain level of effectiveness beyond breaking point or maximum expected capacity or beyond the expected usage [http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools; Eljona Proko & Ilia Ninka, 2012]. It is essential for any application to work even under excessive stress and maintain stability. Stress testing assures this by creating peak loads using simulators. But the cost of creating such scenarios is enormous.

f) *Latency Testing:* Cloud testing is utilized to measure the latency between the action and the corresponding response for any application after deploying it on cloud [Prakash & Gopalakrishanan, 2012; http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools].

C. Ability Testing Techniques

Ability testing is done to ensure that the cloud environment is able to gives its service on-demand to users. In this category, the compatibility, interoperability and multi-tenancy ability of cloud computing environment is tested [Spirent Communications, 2010; Eljona Proko & Ilia Ninka, 2012].

a) *Compatibility and Interoperability Testing:* In cloud environment, different software's and operating systems is used and created on demand which makes the compatibility testing must. A cloud application must capable to work and executed across multiple environments and various cloud platforms. Hence, it is very easy to migration of a cloud applications and platforms from one infrastructure to another infrastructure [Spirent Communications, 2010; http://www.toolsjournal.com/testing-lists/item/404-10-cloud-based-testing-tools].

b) *Disaster Recovery Testing:* The cloud service provider has always prefers that his cloud services must be available all the time to end-users but actually it is not achievable. There may be some chance of failure so the disaster recovery time must be low. Cloud verification must be done to ensure the service is back online with minimum adverse effect on business [Spirent Communications, 2010; IXIA, 2011].

c) *Multi-Tenancy Testing:* Multi-tenancy testing ensures that the multiple clients and organizations using on-demand services activated at a given time. Cloud service should be customizable for each client and provide data and security level to avoid any access related issues [IXIA, 2011].

V. ISSUES AND CHALLENGES OF CLOUD TESTING

a) **Lack of standards:** As till date there is no universal/standard solution. The public Cloud providers have their own architecture, operating models and pricing mechanism. This results a big challenge to change the vendor.

b) **Security in public cloud**: In public cloud the security is major concern area. The existing encryption techniques are insufficient. The main reason for concern is that the data may be stored in a remote location beyond an organization's legal and regulatory

c) **SLAs:** According to a study by The Centre for Commercial Law Studies at Queen Mary, University of London 2010 most of the companies mislead in terms and conditions of cloud services which are hard to understand and follow by users.

d) **Performance:** As the public clouds are shared by many users, so there are cases when one user have to wait for the required bandwidth which is accessed by another one. Sometime it may happen when a service provider may suddenly announce disruption of service due to a maintenance window or network outage.

e) **Infrastructure:** Some cloud providers offer only limited types of configurations, technology, servers and storage, networking and bandwidth, which create difficulties to user to run real-time test environments.

f) **Usage:** Some providers may charge for the misuse/improper usage of cloud-based test environments.

g) **Dependency on the Internet:** For carrying out any testing activity, there should be internet connection, So there is a high reliance on the internet.

h) **Testing all layers:** Due to presence of testing network connections, database, software applications, and server performance adds multiple layers for testing. So, a large and responsible tester team should be needed to test the communication between various layers in terms of the connection between the elements, and risks that may occur. For example, if the internet connection breaks mid-way, the server goes down or the software crashes. All these have to be tested beyond what testers can physically manage in their environment.

VI.   CONVENTIONAL SOFTWARE TESTING VS. CLOUD BASED TESTING

Differences	Conventional Software Testing	Cloud Based Software Testing
Testing time	Minutes or days or weeks or more	Weeks to minutes
Large scale testing	Not for large-scale as in Cloud based software testing.	Supports large-scale and valuable real-time online testing for internet-based software in clouds.
Infrastructure	It is a kind of lab testing	It has scalable cloud computing infrastructure to test and evaluate system (SaaS) performance and scalability.
Cost	Costs are higher in the long run	Costs are cheaper for long run, since it utilises the same computing resources in cloud(s) for its testing purposes.
Flexibility	Less flexible in comparison.	More flexibility enhanced collaboration
Security	No risk of data security.	Risk of data security.
Standard	Well defined standards.	No universal standards are defined.

VII.   CONCLUSION AND FUTURE WORK

This paper gives a brief review of cloud based testing techniques. It includes what is cloud computing ,all its major techniques , being some major challenges in the cloud testing what are those needs which increases the use of cloud computing and at last the comparison of conventional software testing vs. cloud based testing are identified in this paper. As the cloud computing is a growing technology, with its growth the work on cloud testing techniques will also increase. New more matured architecture for cloud computing will developed and more and more testing on the cloud applications. So, there is every possibility of more testing challenges which can be explored by researchers.

REFERENCES

[1] Laurin H. Mills (2009), "Legal Issues Associated with Cloud Computing".
[2] Spirent Communications (2010), "Cloud Computing Testing", *Spirent Communications, California*.
[3] Pat Hyek (2011)," Cloud Computing Issues and Impacts", *Global Technology Industry Discussion Series*.
[4] IXIA (2011), "Testing the Cloud: Definitions, Requirements and Solutions", *August 2011, CA, URL: http://www.ixiacom.com/*.
[5] Neha Mehrotra (2011), "Cloud Testing Vs Testing a Cloud", *Infosys Viewpoint*.
[6] Jerry Gao, Xiaoying Bai & W.T. Tsai (2011), "Cloud Testing- Issues, Challenges, Needs and Practice", *Software Engineering: An International Journal*, Vol. 1, No. 1.
[7] Prince Jain, Dr. Gurdev Singh & Isha Gulati (2011), "Process Model for Cloud Service Engineering", *International Journal of Computer Applications*, Vol. 36, No. 8.
[8] Vinaya Kumar Mylavarapu (2011),"Taking Testing to the Cloud", *Cognizant Reports*.

[9] Sergiy Vilkomir (2012), "Cloud Testing- A State of the Art Review", *Information and Security- A International Journal*, Vol. 28, No.2.

[10] Prince Jain (2012), "Security Issues and their Solution in Cloud Computing", *International Journal of Computing & Business Research, Proceedings of 'I-Society 2012' at GKU*, Talwandi Sabo Bathinda (Punjab), India.

[11] A. Vanitha Katherine & Dr.K. Alagarsamy (2012), "Conventional Software Testing Vs. Cloud Testing", *International Journal of Scientific & Engineering Research*, Vol. 3, No. 9.

[12] V. Prakash & S. Gopalakrishanan (2012), "Cloud Computing Solution- Benefits and Testing Challenges", *Journal of Theoretical and Applied Information Technology*, Vol. 39, No.2.

[13] Cognizant Reports Taking Testing to the Cloud November 2013.