

Empirical Study and Evaluation of Cloud Testing

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Abstract- One of the most challenging activities for many software engineering projects is Software Testing. Lot of resources and budget is required to successfully complete software testing. One of the major challenges faced by organizations is to provide enough resources for software testing in distributed environment, with varying loading level. When web applications use cloud computing and infrastructure to simulate real world user traffic by using cloud technologies and solution it is known as CLOUD testing. This form of testing provides ability to test cloud by using hardware and bandwidth of cloud infrastructure. As in life every positive comes with some negatives too, same is the case with cloud testing. Some of the potential risks associated with this technology are –security, lack of standards, usage, infrastructure and planning.

Security in the public cloud is still a major concern. Since cloud testing is based on Internet, it is directly prone to any issue that may impact Internet. At present, there are no universal or standard procedures and solutions to integrate public cloud resource with a company's internal data center resources and At times it is difficult to create real time test environment as some cloud providers offer very less flexibility. Cloud Authentication for Virtual servers uses clear text sometimes as user name password which becomes a major threat. In this paper we have proposed an idea to overcome this issue.

1. INTRODUCTION

Cloud computing is a means of remotely accessing software applications, storage resources and data using internet. A direct advantage is that business applications and customers can access the cloud service resources without need to install them locally on their machines. This results in reduced complexity by doing away with complex configuration and customization of applications, hence saving time in setting up computation environment and better resource utilization.

Let us take a live example to understand and clarify the theory of Cloud Computing- Paneer dish at a restaurant. Consider having chili paneer dish at home versus having it in restaurant. While the objective

remains same i.e. to consume the dish, the approach and model varies to great extent in both above scenarios

While at home we need to ensure that we have all ingredients required for the dish and required preparation is done to cook the dish as per a set procedure. The ownership of outcome (dish) is solely on individual preparing the dish. In contrast to this, having chili paneer dish at restaurant is a type of service – catering. As a customer we only have to go to restaurant, order the dish and pay for the services. All other steps such as ingredients, preparation, recipe, cooking, presentation and serving followed by cleaning, packing, delivery etc. and their outcome and ownership belong to restaurant and its administration.

This example can be viewed in sync to ideologies, characterize and the principles of cloud computing – “On-demand availability”, “As a service” and “Pay for the usage”.

In cloud – customer only pay for what they have taken services of particular application.

"CLOUD TESTING is a form of software testing in which Web applications use Cloud computing environments ("cloud") to simulate real-world user traffic"(Radhika,2014).

Cloud Testing offers a combination of lower costs, reduction in capital cost, on demand access, reduced maintenance, enhanced collaboration, greater levels of efficiency and above all, reduced time to market for key business applications. These characteristics make cloud testing as an alternate to traditional approach and methods of testing Also, one of the studies has indicated that organizations might save from 40% - 70% of cost if they adopt this technology as a testing(Fujitsu, 2010).

Khamer (2012) defines cloud testing as "a subset of software testing where simulated real world web traffic is used to test cloud based web applications". Cloud testing also utilizes specific cloud characteristics, including redundancy and performance scalability. According to Shajee (2012),

the main purpose of cloud testing is to leverage what is out there on the network for the cost effective testing. It can test numerous other types of applications including mobile applications, which is used by a number of customers from different geographic locations (Jadhav, 2012).

Cloud testing has gained considerable attention in recent years as a new paradigm for developing and delivering computing application and services. Riungu-Kalliosaari et al. (2012) points out that, as the growth of cloud based service has increased, it is certain that the need for testing them also increase. According to them, this approach helps to test faster than the traditional approach, which consists of a large room of servers running different variations of operating systems. Using the cloud testing approach, different servers can be hired and decommissioned when not in use. The testing based on cloud offers a combination of lower costs, reduction in capital expenditure, on demand access, reduced maintenance, enhanced collaboration, greater levels of efficiency and most importantly, shorter time to market for key business applications. These characters make cloud testing an attractive alternative to the traditional approach of testing.

In this paper, we will focus on basic introduction of cloud testing, types of cloud services (SaaS/PaaS/IaaS), common challenges in software testing and various forms of cloud based testing

2. TYPES OF CLOUD SERVICES

Cloud services can be classified into three main categories

2.1 Software as a Service (SaaS)-Software as a Service (SaaS) In this users are given access to application and products online instantly. For example online services from Google Docs can be accessed instantly using web browser, without any need for additional installation or configuration in local machine.

2.2 Platform as a Service (PaaS)-Platform as a Service (PaaS) In this developers are assigned requested run time environments to design & implement their applications/code. For e.g. Windows Azure is cloud service operating system to serve development, service hosting & service management

for Windows Azure platform. This platform facilitates developer with hosting and managing web applications through Microsoft Datacenters with on-demand compute and storage options

2.3 Infrastructure as a Service (IaaS)- Infrastructure as a Service (IaaS) This provides computing resources to users for their computations. Resources such as power, storage, and networking are available on user demand. For e.g. Amazon Elastic Computer Cloud (Amazon EC2) offers computing resources on demand in Amazon Web Services (AWS) cloud.

3. ISSUE AND CHALLENGES IN CLOUD TESTING

- Security- Security in the public cloud is still a major concern. Since cloud testing is based on Internet, it is directly prone to any issue that may impact Internet. There could be instances of leaks in private information, internet suspension, disruption in service by service provider, disruption due to maintenance, slow speed and connectivity issues, Virus & malware attacks etc. Procedures are being developed to counter these challenges and make cloud computing more robust

While Data storage on cloud is “Physically” safe and there is no need for backups, still security threats remain. Data & applications are stored and managed by third party vendors, and hence it is a great challenge for Businesses to have the confidence and trust on these vendors to handle client code and secure it. An organization may face issues such as data loss, phishing and data integrity due to lapse by these third party vendors (Dillion, 2010)

- Lack of standards- At present, there are no universal / standard procedures and solutions to integrate public cloud resource with a company’s internal data center resources. Public cloud providers offer very less interoperability as they have their own architecture, operating model and pricing mechanisms.
- Infrastructure- At times it is difficult to create real time test environment as some cloud providers offer very less flexibility, they have limited types of technology, configurations, servers and storage, network & bandwidth

- Usage-There is direct appreciation in costs due to improper use of cloud based test environments
- Planning-Test environments should be rigorously planned by Testing teams, from utilization periods through disassembly. Another areas to be aware of before putting testing in cloud environment should be the associated expenses, such as encryption cost etc . Since these will consume additional resources (CPU& Memory) , hence it is important to monitor cloud resource utilization to avoid over usage and over payment.

Cloud Security has posed a big threat and provide as a big challenge to engineer and Architects alike. Security has become a major point of discussion in various IT forums.Cloud Authentication for Virtual servers uses clear text sometimes as user name password which becomes a major threat.

We can propose an idea to use VeraCrypt to encrypt the user name and password. The integration can be used at both sides to encrypt and decrypt the same. As a part of cloud testing we initiate multiple test cases like hits from Public IP, Private IP and Local LAN.

VeraCrypt encrypts your data and prevents anyone who does not have your passphrase from accessing them. It works like an electronic safe in which you can securely store your file.

With the help of encryption we can prevent the data from unauthenticated users who can misuse any confidential information. These unauthenticated users can attack the jump servers to get the user login information which is there in clear text format and with this login information anyone can have access to the confidential data.VeraCrypt encryption software makes digital files unreadable except to people who have the passwords to open them.

However my suggestion to get rid of this problem is to use VeraCrypt encryption tool with the help of VeraCrypt the login information can be encrypted and decrypted which will prevent the unauthenticated users to access the confidential information.

4.VARIOUS FORMS OF CLOUD BASED SOFTWARE TESTING

4.1 Testing of the whole cloud: The cloud is viewed as a whole entity based on its features and testing is carried out based on that.It deals with validating a cloud from an external view based on service

capability and features. Cloud and SaaS vendors are mainly interested in performing this testing.

4.2 Testing within a cloud:

It is where testing is carried out inside cloud by testing the quality of a Cloud from internal view based on infrastructure and specified Cloud capabilities. It is mainly performed by Cloud vendors as they have complete access to the internal cloud features and infrastructure

4.3 Testing across the clouds:Based on the specifications, here the testing is carried out on the different type of clouds-like public, private and hybrid clouds.

In this cloud based application system providers perform testing of applications over Clouds to check their conformance with the system level service requirements and specifications.

4.4 SaaS testing in cloud: It deals with testing the quality of services offered in a Cloud (or a SaaS program) both Functional and non-functional. The testing involves integration, unit testing, system function validation and regression testing, as well as performance and scalability evaluation. Testing service APIs and connectivity in a Cloud environment, SaaS-based security and functional features, and scalability and elasticity features are also included in it

5.TYPES OF CLOUD TESTING

5.1 Functional Testing:

Functional testing has to be done to ensure that offering provides with the services user is paying for and that all agreed business requirements are met

Some of the functional tests are described below:

5.1.1. System Testing: This technique is used to prove the system behavior within its own boundaries. The criticality is in proving that system functions as designed and when its components work together, results (input & output) are as expected. Hence resulting in robust cloud system

5.1.2. User Acceptance Testing: It is done to prove that the delivered cloud solution meets the agreed

business requirements and the developed cloud solution is acceptable by user. It is carried on both on-premise and off-premise

5.1.3 Integration Testing: It allows verification of cloud solution by business to ensure it will work within the current infrastructure and environment to eventually prove that cloud solution implementation does not impact existing systems. The end result of cloud solution must meet the agreed and documented needs of business.

5.2 Non-Functional Testing:

Non-functional tests mainly focus on the web application based tests to ensure that they meet the desired requirements.

Here are few forms of nonfunctional tests discussed below:

5.2.1 Business Requirement Testing- One of the prerequisite for organizations before migration to cloud solution is that they must carefully analyze and document business requirements. This documentation should be clear, precise and unambiguous. These will form the foundation of migration outcome and can be achieved through reviews, periodic customer feedback and workshops. Once this is done, we can expect that a perfect system is in place which is capable of delivering results as per business requirements.

5.2.2 Cloud Security Testing: Increase in security breach in business makes security testing an indispensable part of application testing. When done correctly and successfully, it provides assurance that critical data is stored and handled safely & securely. Studying common methods, tools and techniques used by hackers can help us and guarantee security of cloud solutions.

5.2.3 Cloud Scalability and Performance Testing: An ample amount of testing is needed for testing cloud scalability to stand to their claim of on-demand scalability. Load/Stress testing techniques are used to prove that the proposed cloud solution can scale with help of software tools as expected. Cloud testing allows us to accurately measure cloud system performance and its capacity can be verified. Load

testing when combined with performance testing allow in getting an accurate measurement of solution's ability on the cloud

5.2.4 Cloud Load and Stress Testing: Application stability is a major factor as the user count is expected to be increases. An application's load testing involves creation of heavy traffic and then measuring solution's response. Based on results, the solution/applications need to be fine-tuned to certain standards. It further involves measurement of response time and isolation of issues in response to specific actions while the system is subjected to increased load from different locations and multi user operations. It is necessary to identify and isolate issues as system is tested to breaking points maximum expected capacity or beyond that benchmark. Stress test is used to determine an application's ability to maintain certain level of effectiveness at breaking point or beyond that.

5.2.5 Latency Testing: Cloud testing is utilized to measure the latency between the action and the corresponding response for any application after it has been deployed on cloud.

5.3 ABILITY TESTING TECHNIQUES

5.3.1 Compatibility and Interoperability Testing- Since in cloud environment, different software and operating systems are used and created on demand, it is must to have compatibility testing. A cloud application must be capable to work and executed across multiple environments and various cloud platforms, making it very easy for cloud applications and platforms to migrate from one infrastructure to another infrastructure

5.3.2 Disaster Recovery Testing- The cloud service provider will always prefers that his cloud services must be available all the time to end-users but is not practically achievable in real world. Although there may be instances of failure, but the disaster recovery time must be minimal. Cloud verification must be done to ensure the service is back online with minimum impact on business and cloud solutions

5.3.3 Multi-Tenancy Testing- Multi-tenancy testing ensures that the multiple clients and organizations using on-demand services gets these services

activated at a given time. Cloud solution and service should be customizable for each client while catering to data security and safety at the same time

6.CONCLUSION

Cloud Computing technology has recently emerged as a new paradigm for offering services to users over the Internet. We are still in the initial stage and there is need to do lot of real world testing on mobile and web based applications. Testing of the Cloud services, termed as Cloud Testing, plays an important role in Cloud Computing as it helps to verify and validate the conformance of applications with their requirements and business models. In this paper, we provide basic introduction of cloud testing, types of cloud services (SaaS/PaaS/IaaS), issues and challenges in software testing and various forms of cloud based testing.

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