

# Software Testing Framework For Cloud Applications

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**Abstract-** In Today's world, Everyday customers and user use the cloud services to fulfill their needs. With the increased use of clouds, security and reliability become the big challenge in Clouds. Testing of Cloud provides the ability to test cloud by testing cloud infrastructures like hardware, workload and bandwidth of the network that are strongly related to real-world situations and parameters. Cloud computing ensures maximize use of available resources but at the same time, privacy and security are the big hurdles in using the clouds, here testing plays a big role. By testing the applications on cloud user can ensure the security of his data. This paper discusses the various challenges in Cloud Testing and also the various software testing techniques like clustering, prioritization, Load balancing etc. so that cloud environment can be enhanced.

**Keywords-** Cloud Testing, Privacy, Security, Clustering, Prioritization, Load Balancing

## I. INTRODUCTION

Cloud testing is a type of evaluation methodology in which the applications that are using the cloud as a computing environment and its infrastructure are to be tested to replicate real-world traffic by using existing cloud computing technologies. Testing clouds involve performance, security, availability, disaster recovery, interoperability testing or in simple words, validations and verifications of environments, infrastructure and applications.[5] Testing the clouds is focused on core components of clouds as shown in Fig 1.

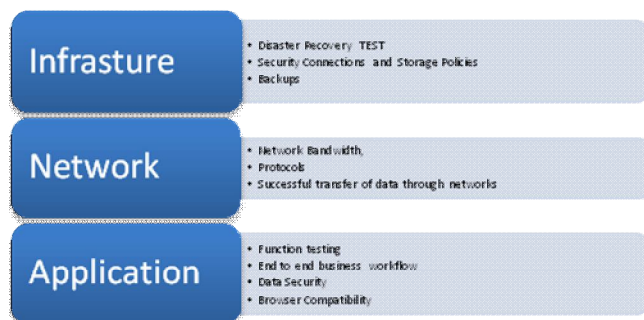


Fig. 1 Components of Cloud

In the above figure, three core areas and what type of testing is required in these areas are shown. Testing in clouds can be divided into four categories.

1. Testing the whole cloud as a single entity
2. Testing the internal features of cloud
3. Testing the different types of cloud-like public, private and hybrid
4. Functional and nonfunctional testing of clouds

## II. CHALLENGES OF TESTING IN CLOUD ENVIRONMENT

Cloud testing is challenged by various difficulties such as limited budget, deadlines, High price per users. In this section, some big challenges that can be faced while testing the clouds are discussed:-

### A. Security Aspects

Security is a crucial concern for the businesses as currently there is still a lot of conversation and research going on in the industry to set up security standards. Some primary issues in security are User privacy protection, security of applications running in the cloud, security standards on the clouds, security testing techniques that must be addressed in the cloud infrastructure.[5]

### B. Performance Related Concerns

One of the main challenges is the performance of cloud's application, specifically in private clouds. It will be shared with various users and hence can be the reason of delays as well. There is also a concern about the network bandwidth that is offered by Cloud services. [5]This may negatively impact on the execution and delivery of the complicated application, as Cloud applications still continue to be bandwidth intensive. Another main concern in performance is to make sure that live upgrades should not affect the existing users of SaaS.[8]

### C. Quality of Service

Cloud's services are mainly used by third parties businesses are moving business's critical application to the Cloud. There are concerns affecting to factors like availability, accessibility, performance, and scalability.[5]

### D. Integration Related Concerns

Some applications demand to integrate with other Cloud applications, When both cloud application integrate their data then it will be a great challenge as both applications can have a different type of database schemas and require a great effort to understand the various data fields, relationships and how they are mapped through SaaS application.[2] Another challenge in integration testing is where the testers need to test the network, servers, etc. In such situations, the tester is not the controller of the environment.[3] Moreover, the challenge is doubled when there has to be communication between these components as the tester will have to anticipate hazards like network breakdown, crashes or servers going kaput.

### III. SOFTWARE TESTING APPROACHES IN CLOUDS

The software Testing is used to detect the error in its working so that the quality of software can be enhanced. For this, there are four important techniques in the cloud environment.

#### A. *Prioritization techniques*

In the software testing phase, prioritization and scheduling of test cases are one of the major tasks, test cases will be prioritized based on the software's major modules and to check the basic functionality of the software. This technique is used to increase the objective of functions.[9] It provides a way for scheduling and running the test cases such that the faults can be predicted in advance. There are many factors on which priority stratify depends like customer requirement, history-based, cost effectiveness etc. The test cases can be prioritized by using some prioritization techniques like Requirement based prioritization, Dependency Structure Prioritization, Coverage based prioritization, and Chronographic based prioritization and Cost-effective based prioritization. [6]

##### 1) *Dependency Structure Prioritization (DSP)*

Dependency structure is related to the communication between the various system parts. Graph Coverage values are used to assign the priority for the test case, which can be defined as the measurement of complexities of test cases, which are dependent on each other. [2] Graph coverage value can be measured either by calculating total no. Of dependent of test cases or by calculating the longest path of test cases which are directly or indirectly dependent.

##### 2) *Requirement-Based Prioritization Techniques*

In this technique, the test cases are prioritized on the basis of requirement of the customer. In this weight factor is calculated which is based on requirement complexity, requirement volatility and customer priority. The test case having highest priority will execute first. [6]

##### 3) *Coverage-Based Prioritization Techniques*

In this technique, white box testing is used. This technique deals with the program's source code that will be processed during the testing. In this, we first discover the areas that are not covered in test cases then create new test cases and identify the redundant one.

##### 4) *Cost Effective-Based Prioritization Techniques*

The main criteria for using this technique are cost. The priority of test case is dependent on the cost of source code, the cost of running a prioritization tool and type of algorithm used.

##### 5) *Chronographic history-based Prioritization Techniques*

In this technique, the priority of test case is based on the execution history of test cases. Test cases are covered on the basis of historical information of the fault severities of the defects.

#### B. *Load distribution scenarios*

Load balancing is the activity about the distribution of load within the different nodes of a distributed system to enhance the utilization of resources, extend throughput, avoid the overload on the single resource and eliminate job's response time. While performing Load balancing there are many parameters, which are mainly considered like fault tolerance, migration time, response time, scalability, performance etc. Testing is must to check these parameters. There are no. of cloud testing tools available which can be used in load distribution scenarios some which are mainly used are SOASTA, LoadStorm, BlazeMeter. SOASTA simulates a lot of geographically dispersed users that are visiting a site to test the application under massive loads. LoadStorm is ideal to test performance under massive traffic. BlazeMeter is used to test the end-to-end performance of APIs, mobile apps and sites. Some techniques, which can be used in Load balancing, are hierarchal load balancing techniques, Centralized Load Balancing (CLB) technique[6]

##### 1) *Hierarchical Load Balancing*

This load balancing involves various levels of clouds while taking a decision about the balancing of the load. Each node is balanced under the direction of the parent node. The lightweight agent processes are used by parent node to find the statistics of the child nodes. Network performance can be checked by the node at a higher level by communicating with the nodes at lower levels.

#### 2) *Static Load Balancing*

In this technique, the jobs are assigned to node depending on the ability of a node to handle the new request. For this prior knowledge of node's processing power, storage capacity, memory performance etc. required to take the decision. Round Robin algorithm is used to perform static load balancing.

#### 3) *Dynamic Load Balancing*

In this load balancing techniques resources are flexible and heterogeneous. The algorithm used in this technique assigns and reassigns jobs to node dynamically depending on the computation of current load of a node.

#### 4) *Centralized Load Balancing*

In this load balancing technique, one node is responsible for managing the load of the entire network. For this, that single node maintains the statics of complete network.

### C. *Clustering techniques*

In this technique, the data having the same type of attributes bring together. The main focus in this technique is on finding the structure of unlabeled data. There are many types of clustering in clouds. Some are

#### 1) *Agglomerative Clustering*

This is a greedy method which considers the geometric and non geometric properties. This technique has the ability to use arbitrary clustering dissimilarity or distance function.[9]

#### 2) *Partitioning Clustering*

In this clustering data is organized in various groups or clusters. It includes two types of Clustering: K-means and K-matroids.

#### 3) *Density Based Clustering*

This clustering is based on local cluster criterion. In this, a cluster continuously grows until the density in the neighborhood exceeds some threshold.

#### 4) *Grid-based Clustering*

It quantizes the object space into a finite number of cells that form a grid structure on which the operations are performed.

### D. *Security mechanism*

As Cloud Testing is fully based on the internet, there are many risks of viruses, no privacy of personal data, service disruption, internet suspending etc. Various procedures as virtual private clouds and client partitions are being developed for handling all such security. There are various techniques that can be adapted to secure the data on the cloud

#### 1. *Diffie-Hellman Algorithm*

This is a cryptographic protocol. This algorithm generates a shared key for each party to encrypt and decrypt the information. In this method, all group members are arranged in binary tree form or logical ring to share the DH public key.[7]

#### 2. *Wang's approach*

In this approach, firstly user sends the request for data to the owner, the owner sends the encryption key and access certificate to the user. After getting the certificate from the owner the user sends it to the storage provider and provider then send the encryption details to the user.[6]

#### 3. *DES Algorithm*

DES has a block size of 64-bit block size and uses 56-bit key during execution and 8 bit are used for parity.

#### 4. *AES Algorithm*

This is a very popular method for encryption. It acts like a substitution-permutation network. The number of repetitive transformation obtains the final result. [6]Required number of cycle repetition is

- 10 cycles for 128-bit key
- 12 cycles for 192-bit key
- 14 cycles for 256-bit key

#### 5. *Triple DES Algorithm*

This algorithm uses 112 or 168 bits. This is the strongest encryption method as it contains  $2^{168}$  possible arrangements.

#### IV. COMPARISON OF CLOUD TESTING PLATFORMS

There are a number of platforms available in the market. Some are:-

Table 1. Testing Platforms [1]

Sr. No.	Year Of Launch	Platform	Services Offering
1.	2002	Acutest	Load testing, SAP performance testing, Stress Testing
2.	2006	LoadRunner	Load Testing, Examining System Performance
3.	2006	Soasta	Touch Test, Cloud Testing
4.	2006	Amazon Web Services	Infrastructure as Service
5.	2008	Google app engine	Web application platform as service
6.	2008	Blue Cloud	Virtualized Blue Cloud Data Center
7.	2008	Force.com	Proprietary 4GL Web Application framework
8.	2008	LoadStorm	SaaS performance testing, Load Testing, Stress Testing
9.	2008	GoGrid	Hosting E-Commerce, Web Apps
10.	2009	Azure	Computing Power
11.	2010	Heroku	Build modern apps, Paas

#### V. CONCLUSION

In Cloud, User can use applications that reside on different servers and can be accessed all over the world. As the uses of clouds are increasing, testing is becoming more and more essential.[2] In this paper, we have discussed the various software testing techniques like Prioritization, Load Balancing, Clustering and Security. A testing framework can be improved by Agglomerative Clustering, hierarchal Load balancing, Dependency structured priority etc. as they are helpful in more fault prediction and also consumes less time. In case of Security issues DES, AES, Diffie-Hellman algorithm can be used as they can improve the security.

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