

# Cloud Testing: A Survey on Tools and Open Challenges

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**Abstract:** Cloud Computing is growing exponentially across organizations and it has a vast impact on the way traditional computation and software testing is conducted. The web based applications these days have different configuration setting, and different deployment requirements. The main focus of Cloud Computing is to deliver reliable, secured, fault-tolerant and elastic infrastructures for hosting Internet-based web applications. Computing the scheduling policies and allocation policy for resources which affect the cloud infrastructure (i.e. hardware, software services) for various web application under fluctuating load and system size is highly challenging problem to deal with. Testing cloud based web applications demands for novel testing methods and tools. This paper is a survey on the growing need of cloud testing, the tools used and the open challenges in the area of cloud testing.

**Keywords:** Cloud-based Testing, Performance Testing, Testing cloud services, Cloud Testing

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## I. Introduction

Cloud Computing a metaphor used to refer to internet based computing, is growing exponentially across organizations and cooperates which impacts computation and software testing. Traditional approaches to software testing are turning out to be pricey in terms of efforts, cost and overheads. The design of complex web application makes it challenging for the organizations to build and maintain the testing facilities within the workplace. Testing an application requires high end servers, auxiliary storage space and networking devices for a limited time, with the overhead of maintenance cost. Pioneering companies such as Microsoft, IBM, Amazon, and Google have shown interest in using the “Cloud” [1]. As shown in Figure 1 from Fujitsu [3] says that testing and web application development are ranked second (57%) most likely workload to be put into the cloud after Websites (61%). The testing model involves various components such as the performance testing tools and the system under test that are deployed ‘on premise,’ within a local environment. Cloud based testing provides a compelling combination of reduced costs, pay-per-use, on-demand flexibility, efficiency to test an application. All these attributes ensure the efficiency of the cloud is always maintained and throw some open challenges which have been surveyed in the following sub sections.

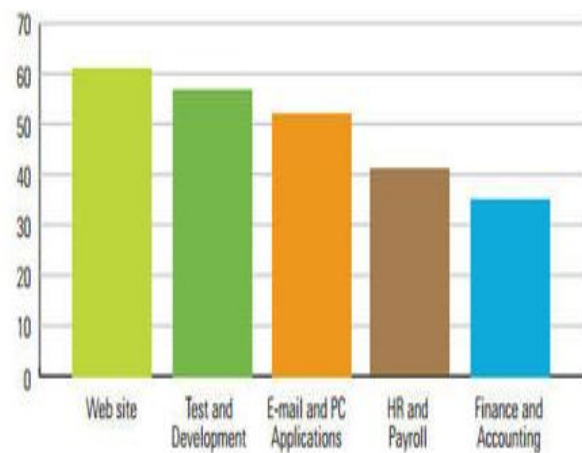


Figure 1

## II. Background

Cloud based testing is a form of software testing where web based applications use cloud computing environments to mimic real-world user traffic. Cloud testing has revolutionized the approach adopted in traditional software testing. Cloud testing has been categorized as shown in Figure 2

- Testing a SaaS in Cloud – assures quality of SaaS based on its functional and non-functional requirements.
- Testing of a Cloud – is used to validate the quality of cloud based on the cloud specification, capabilities and service features.
- Testing inside a cloud – it validates the quality of a cloud on the internal infrastructure of the cloud and specified capabilities.

- Testing over the cloud – it is used to test cloud based applications over the cloud based on system level application requirements and specifications.

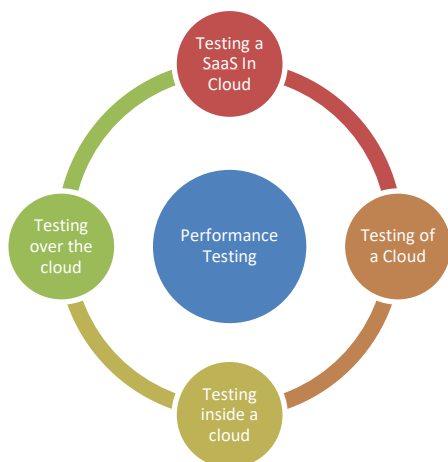


Figure 2: Types of Performance Testing

The various characteristics that need to be tested in applications deployed in cloud are multi-tenancy, security, compliance, high performance, on-demand access, scalability, reliability, elasticity and fast deployment. However, though cloud computing has shown considerable opportunities to the IT industry, it also has many challenges that have to be addressed in all the above mentioned characteristics.

A lot of research scope lies in addressing the issues of performance testing such as capacity planning, workload generator and cost, SLA's, security, fault tolerance and monitoring.

### III. Related Work:

The recent survey papers on Cloud testing focuses on In Reference [4] they discuss the challenges and issues of migrating performance testing to cloud.

In [5] discussion regarding the latest trends, new opportunities, open challenges and issues along with the needs of cloud testing is carried out.

In [6] discusses the performance testing in cloud and how it is different from the traditional benchmarks which are not sufficient to analyze performance testing in cloud computing.

In [7] the authors have put forward a Cloud-based distributed software testing platform which provides continuous integration and automation of testing for large software systems which use resources efficiently on the cloud clients, allocating testing jobs, to resolve the web application software configuration tests, to reduce costs, improve efficiency.

In [8] they have explored various tools used in cloud testing and also surveys various modeling and simulation techniques.

### Survey Outcomes

The proposed paper focuses on the issues related to performance testing addressing the following Research Questions (RQ)

- RQ1: What is the necessity for Cloud Testing?
- RQ2: What are the tools used for Cloud Testing in Cloud?
- RQ3: What are the open challenges and issues of Cloud testing?

RQ1:What is the necessity for Cloud Testing?

A traditional approach to test a software testing incurs huge cost to simulate user actions from various locations. Cloud testing is a part of software testing where cloud web apps are tested by simulating the real world traffic.

Cloud testing has several advantages [14] over the traditional software based testing which includes the following

- 1)Flexibility-Cloud testing is very flexible as the organizations need not have to worry about the test environments, each organization will have a separate test environment.
- 2)Simplicity-Cloud testing is simpler for bug fixing environments which lets the configuration to be launched easily.
- 3)Scalability -here the resources can be scaled and altered according to the requirements. Scalability can be viewed as exchanging the existing resources with the advanced configured resource or adding a new resource to the existing resource list.
- 4)Cost efficient and Maintenance ease- The Service providers provide testers to access scalable and ready-to-use virtual labs with operating systems, test management, execution tools and storage necessary for creating a test environment that emulates the real environment.

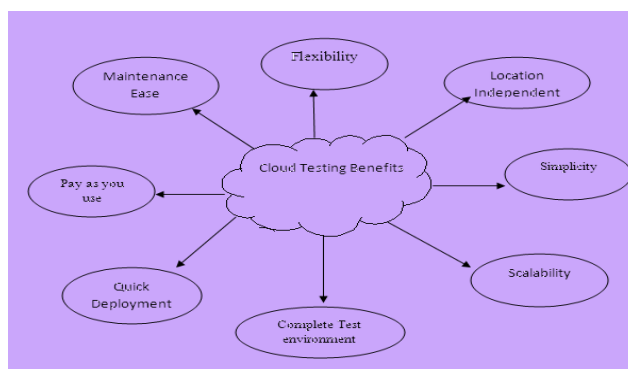


Figure 3

Cloud Testing can be broadly categorized into the following types.

- 1)Elasticity & Scalability- It is one of the major characteristic of the Cloud where in resource demand can be satisfied elastically. Resource provisioning is one of the major concerns of Scalability where we need to provide resource allocation seamlessly whenever required. We need to have a perfect load balancing mechanism to allocate and free resources without disrupting the normal setup of the Cloud infrastructure.
- 2)Stress Testing -stress testing is testing a server with varying load over an extended period of time to determine the stability of a given system or application. The challenge

here is to validate the stability and reliability of the application or system to handle the given stress.

- 3) Performance Testing – Performance testing is an important aspect of testing which directly impacts the user's experience. The aim here is to measure the system parameters such as throughput, resource utilization, latency with varying number of users, and different loads.
- 4) Functional Testing - Functional testing is to ensure that services that the user is paying for is always available to them. The objective here, is to ensure that the corporate requirements are being met.
- 5) Load Testing – the aim here is to test an application against a requested number of users. The main objective is to determine whether the system can sustain this requested number of users with acceptable response times.
- 6) Security Testing – The aim of security testing is essentially to make sure that user's sensitive information has no illegal access and the confidentiality of users is always maintained. It also should verify the user data integrity.
- 7) Disaster Recovery Testing - The cloud has to be up and running all the time and if there is a failure such as network outages, breakdown due to extreme load, any kind of system failures. The challenge here is to have measures on how fast the failure is identified and notified for any kind of data loss.

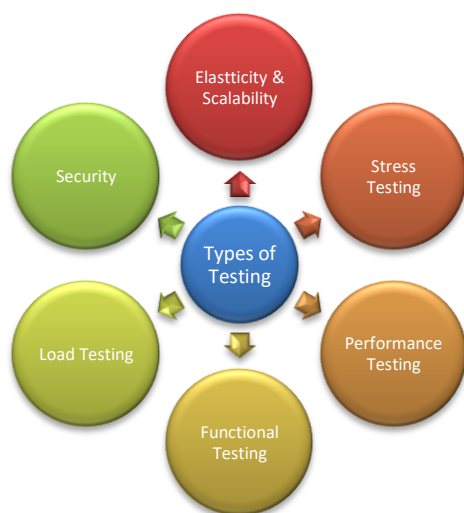


Figure 4

RQ2: What are the tools used for Performance Testing in Cloud?

When we compare conventional testing methods with the cloud testing method, we see that more emphasis is on how system testing varies from online testing. The cloud uses the novel design and development methods. Various tools are available today to test cloud based systems, some of them are briefly discussed below:

**SOASTA CloudTest** - It is used to simulate hundreds of cloud infrastructure services to check the performance of the web application. To handle huge amount of data produced by large scale testing, this tool uses memory based analytic techniques. Analytic dashboards on a synchronized timeline

are used to display the provisioning of data. The tester is provided with a web based UI designed using AJAX, which can operate and monitor the process of launching load generator servers, creating and running test agents and to analyze test results.

- **LoadStrom**-LoadStrom is easy and inexpensive load testing tool with the features to support performance testing, load testing and stress testing of a web application. The testers can use this tool to find problems of a site in a server by page and script or by the type of request made for the performance metric. The testers can simulate hundreds of concurrent users for a given application under test. It generates reports in the form of graphs for capturing response time, throughput, error rates, user requests made per second, completion time etc.
- **ITKO LISA** was designed with a focus to improve the effectiveness of the web application. It includes features to compose a web application, verification and validation. Using this tool the testers can simulate the dynamic behavior of the real time system and it can also be used for simulate some of the inaccessible resources during the test phase. Doing so it attempts to break the dependency constraints of system integration and it also supports constant testing of the web application under test.
- **Blaze Meter** is well equipped with advanced scripting abilities for professional use. It also has capabilities leveraging JMeter and Selenium. It helps the customers to locate errors and fix the performance issues. It can simulate load up to 1,00,000 concurrent users. It also gives the privilege of creating scripts and load case scenarios based on geographical locations. It also offers web based test management, monitoring, reporting, archiving and support for protocols such as HTTP, TCP, XML along with web services and SQL. The Selenium script can be used as a load tool to automate the launch of browsers to measure the real-time user experience.
- **WebLOAD** - is load testing tool used to test performance and stress of the web application. It includes scalability, integrity and performance as a single process verifying the web applications. It has the capabilities to identify an report the issues during the testing. It includes the report for various components such as servers, database, network, firewall. It also has a feature to monitor the end user experience by comparing the SLA between the user and the service provider.
- **Neoload** - is used for load and stress testing for Windows, Linux, and Solaris, which is designed to analyze and improve the performance of the web based application. It provides rational solutions to optimize performance before the application goes into production. It enables in monitoring the web, database and application servers such

as Job application server, HP UX 11, Web logic, Web Sphere, Tomcat, and MySQL database.

- **LoadRunner**-is a load testing tool for Windows and Linux to test the web based application. It is used in determining

the performance of the web application under varying loads. It also measures system behavior. It simulates the user activity by generating messages between application components or by simulating interactions with the user interface such as key presses or mouse movements.

<u>Tool</u>	<u>Pros</u>	<u>Cons</u>
SOASTA CloudTest	1) It gives users locations. 2) Supports comprehensive real-time interface to Metrics.	1) Requires some setup: you have to spin up a VM to load the test Environment.
LoadStrom	1) It can scale up to 300,000 users 2) No scripting language is involved	1) No built-in feature to collect server performance metrics
ITKO LISA	1) It reduces software delivery timeline to support continuous integration for development and testing	
Blaze Meter	1) Easy to use test creation interface 3) You can export test results 4) Integrated with Google Analytics.	1) Available only in limited geographical areas, cover's (Brazil, Tokyo, Oregon and Virginia USA, Singapore, California, Australia and Ireland)
WebLOAD	1) Allows to simulate various system and connection configuration. 2) Generates and stimulate traffic in both .net & J2EE environments	1) "Smart copy" function is not available 2) Performance measurements manager is not a part of open source edition. 3) scheduling multiple loads at the same time is not possible.
NeoLoad	1) Strong performance team that can analyze and co-relate the test results with raw data.	1) SLA configuration is not available analyzing results
Load Runner	1) Programming/Scripting language is used to represent the captured protocol data and manipulate the data for play-back. 2) Correlation is a way to substitute values in dynamic data to enable successful playback.	1) Support only web protocol. 2) User cannot be added or deleted during the test 3) Method level monitoring tools cannot be integrated

### RQ3? What are the challenges of testing in Cloud?

Even though cloud computing has many major advantages over the traditional software testing methods there few challenges that have to be addressed

- There is a need for estimation policies to evaluate if the service level agreement requirements for availability, performance and scalability are satisfied or not.
- There is growing requirement for automated monitoring, automatic provisions and usage based costing techniques with the major focus on capacity management.
- Security testing is one of the most challenging issue where we need to address how to assess and assure users privacy.
- Irrespective of sophisticated tooling for automated monitoring, cloud computing users need to analyze their demand for capacity and their requirements for performance. In their contract with cloud computing providers, users should always take a bottom-line approach to accurately formulate their service-level requirements.
- There is a necessity for making automated load testing which has to be included as an integral part of workflow.

Another challenge with load testing is the increase in the scale of systems.

- There is a stipulation for automatic re-testing techniques to address the multi tenancy feature of clouds as and when the software gets updated.

**Conclusion:** The evolution of cloud has created the need for standards that can extend the features of performance of a cloud application. The testing teams should be equipped with efficient strategies to ease risks and issues associated with the cloud. In this paper few cloud testing tools have been discussed and some of the few testing challenges have been identified. There is a lot of work scope in the field of testing a cloud application to make it more efficient.

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