

# Software Testing as a Service (STaaS) using Cloud Computing

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**Abstract:** Due to wide range of applications of cloud computing it has become very popular in current era of the computing. Many companies and academies has started migrating their data from their expensive servers to clouds. This work deals with providing the testing of software as a service via clouds. As known in prior: the testing is very critical and costly part of software development. So this paper we find the various directions or circumstances to provide software testing as a service. In this paper we also described different tools that used to test the software via cloud. By using TSAAS we minimize the cost of software testing. Different researchers used different methods to test the software, web applications, mobile applications via cloud computing .

**Keywords:** Software Testing, Cloud Based Software Testing, Software Testing Tools, Cloud Based Software Testing VS software testing, STAAS.

## I. Introduction

In these days software testing plays a vital role in software development management. Software testing is the process of executing a program with the intent of finding bugs errors and help to make the software bug free. Software testing process is very expensive and time consuming process. Cloud testing are allocated dynamically to create a highly flexible and scalable computing environment through using virtualization technology. Cloud computing offers an alternating solution to solve this problem. The make use of virtualized resources , effectively indefinite storage, and software services that can help in decreasing the execution time of large test suites in a cost-effective manner. The new area of software testing in the cloud lies at the intersection of some key areas: software testing, cloud computing, and system migration. The main emphasis on the cloud computing model is a more economic method of providing higher quality and faster services at a lower cost to the

consumers. The cloud computing model will help enable Automatic Test Equipment ATE [12] manufacturers to focus their attention on creating and delivering innovative services to the end user. In order to deliver high quality products, the ATE community needs to ensure the reliability in the delivery of products and processes. The ATE community can benefit from this environment by migrating software tools and applications to the cloud, such as, fault isolation databases, instrument drivers, test set software and diagnostic programs. Cloud testing can be classified into three following types accounting to the roles cloud played in the testing process [14].

1. Test for the cloud, it involved the testing problems about inner structure, resource arrangement and function extension and so on in cloud computing.
2. The migration of the testing, the traditional test methods, management process and framework are migrated to the cloud.

- Test other software system using cloud computing.

## II. Cloud-Based Software Testing

Cloud testing at its simplest utilizes the cloud computing infrastructure for software testing. It uses infrastructure based, platform based and software based cloud services to test the application by minimizing the cost and time with improved product quality. Cloud Testing is a method for testing cloud-based provisions that utilization assets found in the cloud [15]. The steps to done cloud based software testing are shown in fig 1. By resources, we mean any component (infrastructure, hardware and software) important to do the tests. Cloud testing provides an back-to-back outcome that changes the way testing is carried out and can help an association support its intensity by reducing the cost of testing without contrarily impacting mission critical production applications. This helps ensure unused servers are not sitting idle. Cloud Testing, is a new business and service [15] model where testing activities are performed using cloud infrastructure by leveraging cloud technologies. Advantages of cloud testing include reduced costs from a shared resources and large-scale test environments.

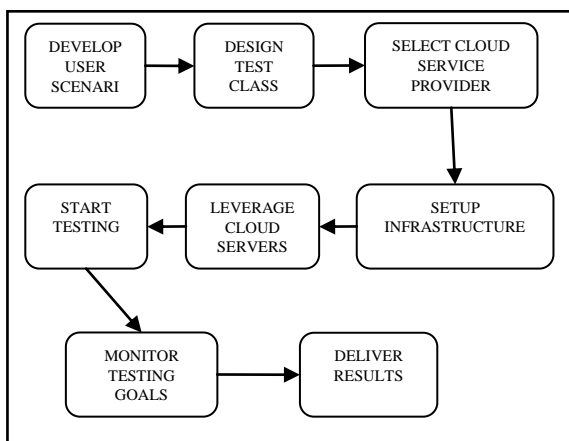


Fig 1. Steps to Perform Cloud- Based Testing

While the focus of this discussion is on “testing as a service in the cloud”, there are other types of cloud-based software testing such as testing of a cloud, testing inside a cloud and testing over clouds. Similarly, there are different types of

	Response (average)	Errors	Requests	RPS (average)	RPS (peak)	Throughput (average)	Throughput (peak)	Total Transfer
HTML	0.107	0	3,306	4	4	52 kB/s	66 kB/s	45 MB
Other *	0.051	0	15,646	17	23	320 kB/s	401 kB/s	281 MB
<b>Total</b>	<b>0.061</b>	<b>0</b>	<b>18,952</b>	<b>21</b>	<b>27</b>	<b>372 kB/s</b>	<b>463 kB/s</b>	<b>327 MB</b>

Fig 2. Result of load testing done at cloud by loadstorm tool [16]

cloud test environments. Among the many differences from conventional “dedicated” testing, in cloud testing there are requirements around SLA’s and service capabilities, pricing models, and data & traffic simulations. Essentially, TaaS is an outsourced model of conventional testing.

## III. Cloud-based Software Testing Tool

In this we discuss the different types of testing that can be performed in cloud [16]. There are different service providers available in the market depending upon the type of testing. The different type of testing like mobile testing, website testing, software testing, module testing, service testing etc. In table 1 different types of testing tools are discussed and what type of test is performed by these testing tools.

Table. 1 Different tools of software testing

Tools	Service Provider	Testing types supported	Application
Loadpro	Keynote <a href="http://www.keynote.com/">http://www.keynote.com/</a>	Load testing	Website and mobile
Apache Jmeter	BlazeMeter <a href="http://BlazeMeter.com/">http://BlazeMeter.com/</a>	Performance testing	Website and mobile
Load storm	CustomerCentrix <a href="http://loadstorm.com/">http://loadstorm.com/</a>	Load testing	Website
Cloud Test Lite	Soasta <a href="http://www.soasta.com/">http://www.soasta.com/</a>	Functional and Performance testing	Website and mobile
Load Impact	Load Impact <a href="http://loadimpact.com/">http://loadimpact.com/</a>	Load testing	Website
Cloud Test	Soasta <a href="http://www.soasta.com/">http://www.soasta.com/</a>	Performance testing	Website and mobile

## IV. Cloud-Based Software Testing Architecture

Cloud testing refers to the concept using the cloud as SAAS application. The other services like IAAS and PAAS is also a part of cloud testing. The cloud testing depends upon the association and their working methods. Different associations have their own tools to test the application. Generally, there are three person involved in a cloud testing shown in fig 3.

**Service Developer:** Service developer develops the application or services and then deploys in the cloud.

**Consumer:** The services provided by the provider is consumed by the consumer.

**Provider:** The cloud providers are responsible for managing and provisioning the cloud infrastructure.

The cloud is made up of three service models (IAAS, SAAS, PAAS) and all the three models may or may not be dependent on each other. Cloud application console Firewall Web application. The test architecture running in the cloud might differ according to the providers and the organizations[16]. A general form of test architecture is shown in Figure 3. The organizations first select the testing tool suitable for them from the service provider. For some tools, no installation is required in the local machine whereas some tools need to be configured. The testers can start the test through the test console that is available in the cloud. They can create, execute and record the tests through the test console. The tests then pass through the firewall and thus creating the virtual instances to handle the load in the cloud. The results can then be monitored and controlled by the user from the test console if necessary.

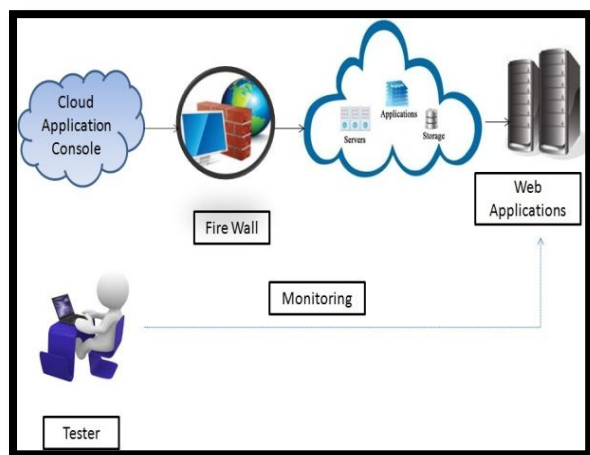


Fig 3. Cloud testing architecture

## V. Benefits of Cloud-Based Software Testing

In a normal scenario testing of a product is done within the organization by the test team members. Now a days cloud computing came into the picture, a new concept of testing on cloud has developed and many companies start using it. Testing on cloud carried a several number of benefits in terms of cost and resources. It is like a “on demand service” or “on demand testing”. The cost of tools, tester hardware, software, etc. is charged on usage basis.

The benefits of cloud testing are discussed as follows:

1. **Tool License Costs:** User doesn't need to buy a tool license. User have various options to select the tool depending upon the type of testing performed on the product. The service provider provide latest tool to perform testing.
2. **Infrastructure Costs:** User doesn't need to buy new hardware and software for testing the product. User can directly for the cloud service provider for testing the product.

3. **Flexibility:** User has the flexibility of using the service when user really require and user have an option of choosing the right tool for right product.
4. **Time Saving:** User don't need to waste his time for procurement and setup process. User has to just select the cloud provider, and get the arrangement already up and running to start testing immediately.
5. **Expertise:** User doesn't need to hire tool experts.

## VI. Issues in Cloud-Based Software Testing

Cloud computing has become one of the exciting and fastest growing segments of IT industry [16]. However, there are different issues and challenges to be faced by the cloud, as it totally depends upon the network connection.

Different issues faced in cloud testing are discussed as follows:

1. **Security:** Security is a main concern for every organization. Since the applications and data will be stored by third party vendors, it is a great challenge for the organizations to have the assurance and trust them for the client's code to be safe. It is just like running an applications on others hard disk which is a risky. With this, the organizations might encounter the security issues such as data loss, phishing and data integrity.
2. **Quality of Cloud Vendor:** when the organization shift its product over the cloud organization don't need worry about computing resources rather than they can focus on the quality, availability, reliability and performance of the resources. So, it is very important for the companies to have the guarantee on service delivery.
3. **Lacks of Standards:** Cloud providers have a challenge of providing a standard pricing models that meet the customers' expectations. Without having a standard process, it is difficult for the customers if they have to compare product with another. Each service providers operate in their own way having their own structural design, price chart and other models which might create an interoperability issue.

## VII. Difference between Software Testing and Cloud-Based Software Testing

In this section the difference between software testing and cloud based software testing according to some parameters.

Table 2. Difference between Software Testing and Cloud-Based Software Testing

Parameters	Software Testing	Cloud-Based Software Testing
Cost	High cost effective	Less cost effective
Security	More secure	Less secure
Testing environment	Private environment (labs)	Open public environment (Cloud)
Time	Take more time for testing	Take less time for testing
Tools	Limited tools available	Variety of tools available
Knowledge	Limited	Wide
Resources	Required	Not Required
Accuracy	Less	More
License	Need to buy license for tool	Do not required to buy a license

### VIII. Types of Cloud Testing

Any application that is created or is presently in the movement of relocating to a cloud should be attempted by cloud testing on the grounds that cloud testing is a blessed thing and a certain action inside the business [13].

Cloud testing is a confident creative way for organizations to assemble guaranteeing business requirements for speed, flexibility, value reduction and time-to-esteem. At the same time it likewise suggest new innovation hazard which, if not altogether comprehend, can orderly down or even destroy the approaching business benefits Cloud.

It focuses to maintain cross program and serviceable testing of web applications. cloud testing spreads umerous different sorts of testing as indicated in the table underneath, yet Cloud testing is frequently seen as simply execution or burden testing and in this section we will talk about in regards to Performance testing and utilitarian testing.

Table 3. Different Types of Testing [13]

Sr. No.	Testing Type	Description
1	Interoperability and Compatibility testing	To make sure that gather the business requirements precise to cloud computing
2	System Integration and User Acceptance Testing	To make sure the developed cloud result meets the functional requirement
3	Performance and Load Testing	To make sure submit the big business requirements accurate to cloud computing
4	Security Testing	To make sure that summit the Application/ Data security constraints.

### IX. Literature Survey

**Pasareanu et. al (2009)** has presented that Symbolic execution is a remarkable project investigation strategy which speaks to program inputs with typical values rather than cement, instated, information and executes the system by controlling system statements including the typical qualities. Typical execution has been proposed in excess of three decades prior however as of late it has discovered reestablished enthusiasm for the exploration group, due to a limited extent to the advancement in choice strategies, accessibility of compelling machines and new algorithmic advancements [1]. They give a study of a percentage of the new research slants in typical execution, with specific attention on applications to test era and system investigation. They initially portrayed an approach that handles complex programming builds, for example, info recursive information structures, clusters, and in addition multithreading. Besides, they portrayed late half and half methods that join cement and typical execution to beat a percentage of the natural restrictions of typical execution, for example, taking care of local code or accessibility of choice techniques for the application area. **Oriol et. al (2010)** has presented The York Extensible Testing Infrastructure [2] (YETI) is a computerized irregular testing instrument that permits to test programs written in different programming dialects. While YETI is one of the quickest arbitrary testing apparatuses with over a million technique calls every moment on quick code, testing vast projects or moderate code –, for example, libraries utilizing seriously the memory – may advantage from parallel executions of testing sessions. In this they exhibited the cloud-empowered form of YETI. It depends on the Hadoop bundle and its guide/diminish execution to convey assignments over possibly numerous machines. This would permit circulating the cloud rendition of YETI over Amazon's Elastic Compute Cloud (Ec2). **Vengattaraman et. al (2010)** has informed that 7Cloud figuring is a developing stage of administration registering intended for quick and element conveyance of guaranteed processing assets. Distributed computing give Service-Level Agreements [3] (Slas) for ensured uptime accessibility for

empowering helpful and on-interest system access to the circulated and imparted registering assets. In spite of the fact that the distributed computing ideal model holds its potential status in the field of circulated registering, cloud stages are not yet to the consideration of lion's share of the scientists and professionals. All the more particularly, still the specialists and professionals group has divided and blemished information on distributed computing standards and methods. In this connection,[3] one of the essential inspirations of the work exhibited in this substance uncover the flexible benefits of distributed computing standard and henceforth the destination of

this work is characterized to bring out the amazing significances of distributed computing ideal model through an application environment. In this work, a distributed computing model for programming testing

is produced. **Ciortea et al. (2010)** has presented happy to the point bursting. Cloud9 plans to decrease the asset escalated and work serious nature of top notch programming testing [4]. To begin with, Cloud9 parallelizes typical execution to huge imparted nothing groups. As far as anyone is concerned, Cloud9 is the first typical execution motor that scales to substantial groups of machines, in this way empowering careful computerized testing of genuine programming in advantageously short measures of time[4]. Preparatory results show one to two requests of size speedup over a condition-of-the crafts man ship typical execution motor. Second, Cloud9 is an on-interest programming testing administration: it runs on process mists, in the same way as Amazon Ec2, and scales its utilization of assets over a wide dynamic extent, relatively with the testing current workload. **Candea et. al (2010)** has talked about that Software testing basically comprises of practicing however many ways through a system as would be prudent and watching that certain properties hold along those ways (no crashes, no cushion floods, and so forth.) Taas joins two thoughts: (1) offering programming testing as a focused, effortlessly open Web administration, and [5] (2) doing completely mechanized testing in the cloud, to saddle tremendous, versatile assets to making robotized testing functional for genuine programming. A product testing Web administration permits clients to transfer the product of investment, educate the administration what sort of testing to perform, click a catch, and afterward acquire a report with the results inside minutes or hours [5]. This report is a rundown of bugs found, or the level of scope got by tests with effective results. Such an administration can have a fundamental interface, where an end client transfers, e.g., the most recent Windows administration pack and after that looks over a menu of conceivable test sorts (e.g., far reaching testing, security testing). An administration can likewise have a master interface, to be utilized by programming engineers to give refined meanings of what "a bug" may be, accordingly showing the testing administration what sorts of rightness infringement to search for. For expert uses, Taas can coordinate specifically with the advancement process and test the code as it is composed. **Yu, Lian et. al (2010)** has talked about Testing-as-an administration (Taas) is another model to give testing abilities to end clients[6]. Clients spare the expense of confounded support and update exertion, and administration suppliers can redesign their administrations without effect on the end-clients. Because of an even volumes of simultaneous solicitations, it is imperative to address the versatility of Taas stage in a cloud environment [6]. Booking and dispatching calculations are

produced to enhance the use of figuring assets. They create a model of Taas over cloud, and assess the adaptability of the stage by expanding the test assignment burden; break down the appropriation of registering time on test undertaking planning and test errand preparing over the cloud; and look at the execution of proposed calculations by contrasting others. **Zhang et al. (2011)** has exhibited the structural engineering of the cloud-based execution testing framework for web administrations (CPTS) [8], which is a versatile, extensible and simple to utilize structure for creating and submitting test workloads to registering mists. At that point the procedure how to utilize CPTS to run an execution test and present the idea of element movement in CPTS has been demonstrated. At long last, the encounters with CPTS in Amazon Ec2 have been exhibited [8]. They found that the CPTS permits a client to effectively set up and test a web administrations framework on the cloud and enhance test successfully. **Bucur et. al (2011)** has presented Cloud9 [9], a stage for mechanized testing of true programming. Their fundamental commitment is the adaptable parallelization of typical execution on bunches of merchandise fittings, to help adapt to way blast. Cloud9 gives an orderly interface to composing "typical tests" that briefly define whole groups of 6 inputs and practices to be tried, hence enhancing testing gainfulness [9]. Cloud9 can deal with not just single-strung projects additionally multi-strung and conveyed frameworks. It incorporates another typical environment display that is the first to help all significant parts of the POSIX interface, for example, techniques, strings, synchronization, systems administration, IPC, and record I/O. They demonstrate that Cloud9 can naturally test genuine frameworks, in the same way as Apache the Python mediator, and twist etc furthermore they demonstrate that how Cloud9 can utilize existing test suites to produce new experiments that catch untested corner cases (e.g., system stream discontinuity)[9]. Cloud9 can likewise diagnose deficient bug settles by investigating the contrast between carriage ways prior and then afterward a patch. **Zhang et. al (2012)** has presented distributed computing stages, for example, the Windows Azure stage, are accessible to give advantageous frameworks [10] such that cloud applications could lead cloud and information escalated figuring. To guarantee high caliber of cloud applications being worked on, engineer testing (additionally alluded to as unit testing) could be utilized. The conduct of an unit in a cloud application is subject to the executed test inputs and the condition of the cloud environment [10]. For the most part, the time it now ,drawn out and work concentrated to physically give different test inputs and cloud states for directing engineer testing. To decrease the manual exertion, designers could utilize mechanized test era instruments. Then again, applying computerized test era apparatuses confronts the test of producing different cloud states for attaining to viable testing, (for example, accomplishing high structural scope of the cloud application) since these devices can't control the cloud environment [10]. To address this test, they had proposed a methodology to (1) model the cloud environment for reenacting the conduct of the genuine environment and, (2) apply Dynamic Symbolic Execution (DSE) to create both test inputs and cloud states to accomplish high structural scope. They connected their methodology on some open source Azure cloud applications. The results demonstrate that their methodology helps produce test inputs and cloud states to attain to high structural scope of the cloud applications. **Reitze et al.**

(2013) has talked about the fundamental attributes of the distributed computing models and characterize the different kinds of cloud offerings accessible to fashioners today [12]. They will likewise dissect the distributed computing model to touch base at a reasonable approach that can be utilized to improve the current Automatic Testing Equipment (Ate) testing and Maintenance abilities. Down to earth suggestions will be examined on the most proficient method to change the current ATE [12] Testing and Maintenance abilities into the particular distributed computing model offerings to help arrange an internationally connected ATE support framework. Narula et. al (2013) has discussed that The software testing is a oppugn for the IT industry to provide the quality product both for the system based or web-based applications [13]. But the recent news of alleged breakdown of many web-based portals of financial institutions, banks and software companies' shows that something is definitely going wrong with the software testing methodology. The problem exists even after the comprehensive functional and stress testing of the web-based applications [13]. They attempts to provide a solution for certain ills of the software testing, riding on the robust and still developing cloud computing architecture to provide the methodology for stress and functional testing for next generation tools. Bensehng et al. (2014) has presented related innovations including cloud testing, [14] and depicted the configuration of general structural planning of the framework in points of interest, composed and actualized the booking module utilizing a high need first booking focused around dynamic need. The consequences of the Matlab reproduction analysis demonstrate that this booking calculation can diminish test cost and understand the mechanization of programming testing under the state of altogether enhancing test proficiency and asset usage [14].

## X. Conclusion and Future work

The review has shown that the migration of the software testing service to clouds has come up with many challenges. When one will use software testing as a service using cloud computing it will reduce the effort and the development cost of the software development. The analysis has shown that the software testing as a service may cause the issue of the alpha testing because it is done by the professionals expertise in that particular field. So developing a universal software testing as a service will be done in near future.

## References

- [1] Păsăreanu, Corina S., and Willem Visser. "A survey of new trends in symbolic execution for software testing and analysis." *International journal on software tools for technology transfer* 11, no. 4 (2009): 339-353.
- [2] Oriol, Manuel, and Faheem Ullah. "Yeti on the cloud." In *Software Testing, Verification, and Validation Workshops (ICSTW), 2010 Third International Conference on*, pp. 434-437. IEEE, 2010.
- [3] Vengattaraman, T., P. Dhavachelvan, and R. Baskaran. "A model of cloud based application environment for software testing." *arXiv preprint arXiv:1004.1773* (2010).
- [4] Ciortea, Liviu, Cristian Zamfir, Stefan Bucur, VitalyChipounov, and George Candea. "Cloud9: A software testing service." *ACM SIGOPS Operating Systems Review* 43, no. 4 (2010): 5-10.
- [5] Candea, George, Stefan Bucur, and Cristian Zamfir. "Automated software testing as a service." In *Proceedings of the 1st ACM symposium on Cloud computing*, pp. 155-160. ACM, 2010.
- [6] Yu, Lian, Wei-Tek Tsai, Xiangji Chen, Linqing Liu, Yan Zhao, Liangjie Tang, and Wei Zhao. "Testing as a Service over Cloud." In *Service Oriented System Engineering (SOSE), 2010 Fifth IEEE International Symposium on*, pp. 181-188. Ieee, 2010.
- [7] King, Tariq M., and Annaji Sharma Ganti. "Migrating autonomic self-testing to the cloud." In *Software Testing, Verification, and Validation Workshops (ICSTW), 2010 Third International Conference on*, pp. 438-443. IEEE, 2010.
- [8] Zhang, Li, Yinghui Chen, Fan Tang, and Xiong Ao. "Design and implementation of cloud based performance testing system for web services." In *Communications and Networking in China (CHINACOM), 2011 6th International ICST Conference on*, pp. 875-880. IEEE, 2011.
- [9] Bucur, Stefan, Vlad Ureche, Cristian Zamfir, and George Candea. "Parallel symbolic execution for automated real-world software testing." In *Proceedings of the sixth conference on Computer systems*, pp. 183-198. ACM, 2011.
- [10] Zhang, Linghao, Tao Xie, Nikolai Tillmann, Peli De Halleux, Xiaoxing Ma, and Jian Lv. "Environment modeling for automated testing of cloud applications." *IEEE Software, Special Issue on Software Engineering for Cloud Computing* 1 (2012).
- [11] Proko, Eljona, and Ilia Ninka. "Analysis and Strategy for the Performance Testing in Cloud Computing." *Global Journal of Computer Science and Technology* 12, no. 10-B (2012).
- [12] Reitze, Dale D. "Using cloud computing to enhance automatic test equipment testing and maintenance capabilities." In *Autotestcon, 2013 IEEE*, pp. 1-6. IEEE, 2013.
- [13] Narula, Bisret, and Vinod Beniwal. "Cloud Testing-Types, Service Platforms and Advantages." *International Journal of Computer Applications* 72, no. 20 (2013).
- [14] Bensehng, Yang, Yuan Xiangmeng, and Huang Xiaoguang. "Framework of Software Testing Based on Cloud Computing." *Telkomnika Indonesian Journal of Electrical Engineering* 12, no. 7 (2014).

[15] Jain, I Shivam, and Devesh Kumar Srivastava. "Testing as a Service (TaaS) on Cloud: Needs and Challenges." (2014).

[16] Shah, Khusboo. "Survey on cloud based testing tools." (2014).

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