

# Applications of Cloud Computing in Software Testing: Challenges and Issues

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**Abstract**— Cloud computing has become very popular approach which attracts other research areas like software testing process which is general of infinite resources such as accessibility and portability of extended atmosphere of software testing life cycle. Large software is tested in less time in cloud computing that overcome the total cost of software testing process; additionally, cloud computing is helping to build several efficient software testing techniques. Software testing performs the vital role in the process of software development and also required a huge number of resources to improve the quality of software process. With the use of cloud computing, firms can investigate the tools, resources, environment, software authorization and the structure in fewer resources. Since cloud computing is increasing with the passage of time, cloud testing becomes a hot area of research. Several latest approaches are preparing intended for cloud computing in addition to testing is performed to investigate these cloud approaches which establish latest testing problems and issues which needed to be search by researchers. In this research major issues and problems in cloud testing are presented.

**Index Terms**— Software engineering; Software testing; Cloud testing; Quality assurance; Measurement, Cloud computing, Cloud computing challenges.

## 1 INTRODUCTION

Conventional software testing approaches are costly in terms of expenditure, budget and time. Therefore, testing practices have changed with methods which help institutions in getting business and profits. Well renowned organizations like Google, IBM, and Amazon have shown interest in using cloud testing [1]. The process of software testing has moved to the cloud because of customer interaction, storage and computations with in cloud environment. For the purpose of testing new software application, expensive resources having limited access is needed and these resources cannot be used again which leads to extra costs. Organizations will test their services on all platforms in order to increase the reliability of their services [2].

Cloud testing uses a cloud and Software as a service (SaaS). Cloud testing is decision based, in which cloud is utilized as its computing environment for application testing and cloud computing technologies as its resources simulating as traffic in real world [3]. In cloud testing hardware is used to test a cloud, the workload and a network bandwidth which simulate parameters and conditions closely to a real world. So, the process of validating and verifying the applications as well as the infrastructure and the environment is known as cloud testing.

Cloud testing performs different activities such as performance, security, availability, multitenancy, interoperability and disaster recovery [4]. Cloud testing also comes with several issues like large number of test cases, time, less support of test reuse, user geographical distributions and budget.

## 2 BACKGROUND

Cloud testing can be categorized into four models [5], [6]:

1. Software as a Service (SaaS): infrastructure specification of cloud to users is provided by this model. By using the internet users can access applications of infrastructure from various ends using interfaces; users don't need to install such application in order to access them.

2. Platform as a Service (PaaS): Platform-based solutions can be built by the user using this model.
3. Infrastructure as a Service (IaaS): provides users with services of computing plus, so they can develop a system according to their desired configurations. It deals with network devices and storage, for that reason infrastructure can be utilized according to the need for cloud building blocks. These resources can be accessed on request.
4. Hardware as a service: for hardware virtualization or buying IT hardware only.

Cloud can utilize three key models [7]:

1. Public clouds: in this type of cloud, the organization who owns the cloud gives services, and services related to cloud can be accessed by all.
2. Private clouds: this type of cloud services is used by government agencies or other companies which needs data integrity use and high security, so for protection purposes they build cloud for their use.
3. Hybrid clouds: a combination of private and public clouds is used in this type of cloud. Some cloud-based services are public which can access by all, but others are for authorized users only.

The cloud testing is testing software or hardware as per requirement [8].

Cloud computing is considered as SaaS; therefore, testing becomes as a service [9]. Various techniques of testing can be utilized in cloud application are as follow:

1. Functional testing: in this type of testing the requirement and its specifications are checked to ensure that it fulfills the cloud application. Functional testing in clouds system verification testing and acceptance testing.
2. Non-functional testing: focused on testing the web application to ensure that it meets the requirements. Non-functional testing includes performance testing, securi-

ty testing and Availability testing.

### 3 LITERATURE REVIEW

A significant amount of work has been done in the field of cloud testing and the major aims of cloud testing as a service and its environment.

In [9], the authors presented their work on cloud computing, its taxonomy, the architecture and its categorization. Furthermore, they compared various types of cloud systems. In that case, they reviewed some other cloud computing-services based on Amazon and Google in this classification, to show similarity and differences between various architecture approaches of cloud computing. Moreover, they also provided some guidelines to help to develop and improve the existing and new cloud systems.

In [10], the authors conducted a survey on techniques of software testing using cloud computing. Their focus was on the importance of the cloud computing and its features.

In [11], the authors presented a detailed background on software testing and cloud computing. Furthermore, they also categorized various activities that performed in the fields of cloud testing, discovered some gaps, and defined terminology that were used.

### 4 CHALLENGES AND ISSUES IN CLOUD TESTING

Challenges of cloud testing has become a focused area of several researchers.

In [12], [13], [14] presented various problems related to perseverance of application whether it suits online testing or not, furthermore some problems with the efficiency of quality checks for software were also pointed.

In [15] they have elaborated various problems and issues related with quality assurance and security validation in SaaS and cloud testing.

In [16], [17], [18] described several challenges and problems related with privacy and data security, services that are needed to ensure service assurance, efficiency and access in the cloud testing. Furthermore, lack of procedures, infrastructure, functionalities, proper guidance and business, strategies tools and automatic, standards, new features and knowledge of tools in cloud testing were also highlighted.

In [19], [20], [21], [22] presented challenges of evaluation, security and scalability in cloud testing.

In [23], [24], [25], [26] elaborated on the issues of cost and time in cloud testing, challenges of integration testing in cloud, problems to analyze eventual testing reports and test tools, problems of security and integration of data and issues of lack of standards in cloud testing.

In [27] they recognized challenges related to cloud testing with the prospect of testing as services.

In [28] they argued demands, issues and challenges in cloud testing.

In [29] some technical issues were focused like testing is an intermittent action, for that a new framework is needed for setting project that needs to test.

In [30] Presented issues related to security and privacy problems when utilizing cloud computing.

In [32] presented issues in utilizing cloud computing approaches.

In [32] they focused the problems related to security standards that were based on quality assurance activities for application relying on cloud testing.

In [33] Presented some challenges and issues during testing of methods, models, capability and tools to support security in the cloud testing.

### 5 CONCLUSION

In the fields of cloud computing and software engineering, cloud testing has become a major research area. As cloud technology and testing becomes better and better, more research work is needed to address the problems and challenges in cloud testing. Furthermore, in order to control testing services in a scalable cloud infrastructure, some advanced testing methods and solutions are required. This paper presents a broad review on the problems and challenges of cloud testing. The main contribution of this paper includes its perceptive discussion on cloud testing in terms of its advantages, features and major requirements as well as the comparison with traditional testing. Moreover, opportunities of cloud testing, existing big players, and current research work are presented.

A detail explanation on problems and challenges in cloud testing has been presented, in addition some advanced techniques of cloud testing are required in order to solve the identified challenges and issues of cloud testing.

### REFERENCES

- [1] Nachiyappana, S. Justus, "Cloud Testing Tools and Its Challenges: A Comparative Study", 2nd International Symposium on Big Data and Cloud Computing (ISBCC'15).
- [2] Ganesh Neelakantalyer, Member, IEEE, IEEE-CS,PCTF: "An Integrated, Extensible Cloud Test Framework for Testing Cloud Platforms and Applications";13th International Conference on Quality Software 2013.
- [3] Namrathagantayat, "Testing in the cloud and its challenges", asian journal of research in social Science & Humanities Vol.2 Issue 4,ISSN 2249 7315, April 2012.
- [4] Xiaoying Bai, "Cloud Testing Tools", Proceedings of The 6th IEEE International Symposium on Service Oriented System Engineering, SOSE 2011.
- [5] Hind Husni, Ahmad A. Saifan, "Cloud Testing: Steps, Tools, Challenges", Proceedings of the New Trends in Information Technology (NTIT-2017). The University of Jordan, Amman, Jordan. 25-27 April 2017.
- [6] B. Rimal, E. Choi, and I. Lumb, "A taxonomy and survey of cloud computing systems," NCM 2009 - 5th Int. Jt. Conf. INC, IMS, IDC, pp. 44-51, 2009.
- [7] V. Katherine and K. Alagarsamy, "Conventional software testing vs. cloud testing," Int. J. Sci, vol. 3, no. 9, pp. 1-5, 2012.
- [8] P. Harikrishna and A. Amuthan, "A survey of testing as a service in cloud computing," 2016 Int. Conf. Comput. Commun. Informatics, pp. 1-5, 2016.
- [9] J. Gao, X. Bai, T. Tsai, and T. Uehara, "Testing as a service (TaaS) on clouds," Proc. - 2013 IEEE 7th Int. Symp. Serv. Syst. Eng. SOSE 2013, pp. 212-223, 2013.

- [10] V. Priyadharshini and A. Malathi, "Survey on software testing techniques in cloud computing," arXiv.org, vol. cs.SE, no. 8, pp. 2572-2575, 2014.
- [11] K. Incki, I. Ari, and H. Sözer, "A survey of software testing in the cloud," IEEE Sixth Int. Conf. Softw. Secur.Reliab.Companion, vol. 46, no. 6, pp. 18-23, 2012.
- [12] Vilkomir, S. (2012). Cloud Testing: A State-of-the-Art Review. Information & Security: An International Journal, 28(2), 213-222.", Information and Security- AInternational Journal, Vol. 28, No.2.
- [13] Gao, J., Bai, X., & Tsai, W. T. (2011). Cloud testing issues, challenges, needs and practice. Software Engineering: An International Journal, 1(1), 9-23.
- [14] Riungu-Kalliosaari, L., Taipale, O., & Smolander, K. (2012). Testing in the cloud: exploring the practice. Software, IEEE, 29(2), 46-51.
- [15] Er. Tamanna Narula1, "Framework for Analyzing and Testing Cloud based Applications", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 6, ISSN: 2277 128X, June 2014.
- [16] Naganathan, V., & Sankararaya, S. "Overcoming Challenges Associated with SaaS Testing" Infosys Viewpoint.
- [17] Gao, J., Bai, X., & Tsai, W. T. (2011). Cloud testing issues, challenges, needs and practice. Software Engineering: An International Journal, 1(1), 9-23.
- [18] Swapnil, H., Chandane & Bartere, M. M. (2013), "New Computing Paradigm: Software Testing in Cloud, Issues, Challenges and Need of Cloud Testing in Today's World", International Journal of Emerging Research in Management & Technology.
- [19] P. Jogalekar, M. Woodside. "Evaluating the scalability of distributed systems," IEEE Trans. Parallel and Distributed Systems, vol. 11, no. 6, 589-603, 2000.
- [20] A.Y. Grama, A. Gupta, V. Kumar, Isoefficiency: "Measuring the Scalability of Parallel Algorithms and Architectures," IEEE Parallel and Distributed Technology, 12-21, Aug. 1993.
- [21] L. Duboc, D. S. Rosenblum, and T. Wicks, "A Framework for Modeling and Analysis of Software Systems Scalability," In 28<sup>th</sup> International Conference on Software Engineering (ICSE'06), May 20-28, Shanghai, China, 2006.
- [22] Y. Chen and X. Sun, "STAS: A Scalability Testing and Analysis System," in IEEE International Conference on Cluster Computing. Available at: <http://ieeexplore.ieee.org/>, 1-10, 2006.
- [23] V. Katherine and K. Alagarsamy, "Conventional software testing vs. cloud testing," Int. J. Sci, vol. 3, no. 9, pp. 1-5, 2012.
- [24] J. Gao, X. Bai, T. Tsai, and T. Uehara, "Testing as a service (TaaS) on clouds," Proc. - 2013 IEEE 7th Int. Symp. Serv. Syst. Eng. SOSE 2013, pp. 212-223, 2013.
- [25] V. Priyadharshini and A. Malathi, "Survey on software testing techniques in cloud computing," arXiv.org, vol. cs.SE, no. 8, pp. 2572-2575, 2014.
- [26] N. Dangwal, N. Mehra, and S. Sachdeva, "Testing the cloud and testing as a service," Encyclopedia of Cloud Computing, p 338, 2016.
- [27] P. Jogalekar, M. Woodside. "Evaluating the scalability of distributed systems," IEEE Trans. Parallel and Distributed Systems, vol. 11, no. 6, 589-603, 2000. [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=862209](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=862209).
- [28] A.Y. Grama, A. Gupta, V. Kumar, Isoefficiency: "Measuring the Scalability of Parallel Algorithms and Architectures," IEEE Parallel and Distributed Technology, 12-21, Aug. 1993. [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=242438](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=242438).
- [29] L. Duboc, D. S. Rosenblum, and T. Wicks, "A Framework for Modeling and Analysis of Software Systems Scalability," In 28<sup>th</sup> International Conference on Software Engineering (ICSE'06), May 20-28, Shanghai, China, 2006. <http://eprints.ucl.ac.uk/4990/1/4990.pdf>.
- [30] Y. Chen and X. Sun, "STAS: A Scalability Testing and Analysis System," in IEEE International Conference on Cluster Computing. Available at: <http://ieeexplore.ieee.org/>, 1-10, 2006. [http://ieeexplore.ieee.org/xpls/abs\\_all.jsp?arnumber=4100388](http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=4100388)
- [31] Scott Tilley, Tauhida Parveen, "Migrating Software Testing".
- [32] B. Wrenn, CISSP, ISSEP, "Unisys Secure Cloud Addressing the Top Threats of Cloud Computing," (white paper).
- [33] AppLabs, "Testing the Cloud," white paper, Internet: [http://www.applabs.com/html/TestingtheCloud\\_786.html](http://www.applabs.com/html/TestingtheCloud_786.html).