

Cloud Testing- Types, Service Platforms and Advantages

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ABSTRACT

The software testing is a oppugn for the IT industry to provide the quality product both for the system based or web-based applications. 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. This paper 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.

General Terms

TaaS, QA, StaaS, SaaS, PaaS, IaaS, SLA

Keywords

Software testing, Cloud Testing, Cloud based software testing, Cloud on services, Stress testing, Functional testing, Performance Testing, SOASTA.

1. INTRODUCTION

Cloud computing is an uprising web-based public utility computing. Today, top most companies, such as Amazon, Google, IBM, Microsoft, and Salesforce.com put forward their cloud infrastructure for benevolences.

As a service the progressive development of cloud-based computing is overtopping even the most hopeful prognosis. It is lucrative as it requires use of communal possession and software provided on-requisition with minimized executive effort. The cynosure of cloud computing is the elasticity it proffers to confect, mutually distribute, accumulate and collaborate resources from anywhere, at any point and at any site

Cloud computing up brings new big business breaks and has also grounded some chief impacts on software testing which is well-known as testing as a service (TaaS) in cloud .Cloud testing is a substantial concern for the cloud computing users. Cloud testing will show the way to more quicker and efficient performance testing which will further endow with more efficient test results. The model used for software testing is **StaaS** which provides testing of an application across the web.Cloud-based testing is provided on-demand and charged on pay-per-consume basis, so that the consumer remunerates only for the resources they have accessed

Even though there exist numerous published papers that focus on cloud architectures, technologies, and service models, design, and cloud network, cloud testing and TaaS are silent innovative subjects in software testing area. However, cloud computing present's new challenges for testers and data center operators. Because applications and networks are no longer independent entities, these groups need to devise an efficient process for testing applications in the cloud. Hence, test engineers may possibly be encountered with unusual issues and challenges in testing contemporary clouds and cloud-based applications. So organizations need to acquire a special approach to accomplish testing in the cloud.

This paper is written to provide a compendious tutorial and argy-bargy concerning cloud architecture, cloud testing models, cloud testing tools , software testing on cloud as a service and Benefits of Software Testing On Cloud . This paper explores essential concepts in relation to stress testing and cloud, functional testing and cloud. In addition, it presents a relative analysis between cloud testing and conventional software testing covering How Testing Cloud Based Applications can be dissimilar From Testing on Premise Applications in QA Clouds. It also lays emphasis on software testing issues and its consequences for clouds and cloud-based applications in diverse scenarios' from end-users and application providers. Moreover, the paper also covers several sprouting technologies and tools in cloud testing as a service.

2. CLOUD COMPUTING AND CLOUD ARCHITECTURE

Cloud computing can be in point of fact defined as site-independent computing, whereby shared out servers endow with resources, software, and facts to computers and other devices on-order by the external user. Human reliance on cloud is obvious from the actuality that today's most well-liked social networking, email, document sharing and online gaming sites are hosted on cloud. It can be defined as on demand pay-as-per-use model in which mutual resources, information, software and other devices are provided according to the clients' prerequisite when needed [1]. According to National Institute of Standards and Technology, Cloud computing is defined as a sculpt for enabling ubiquitous, expedient, on-demand network access to a collective pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can

be hastily provisioned and unconfined with minimal management effort or service provider interaction. This cloud model is self-possessed with five indispensable attributes, three service models, and four deployment models.

2.1 Indispensable Attributes of Cloud

Five focal essential attributes of cloud model are listed below:

2.1.1 On-Importunity Self-Service. A customer can undertake prerequisite computing credentials, probably server time and mesh storage, as desired without human intervention with each service agent.

2.1.2 Wide-Ranging Network Access. Variety of stuffs are accessible over the internet and can be pierced throughout customary mechanisms that endorse use by varied petite or colossal client rostrum (e.g., mobile phones, tablets, laptops, and workstations).

2.1.3 Resource Pooling. All the computing possessions of the service provider are mutually pooled to supply services to numerous clients by means of a multi-tenant sculpt, with diverse physical and implicit resources vigorously assigned and reassigned depending upon the end user demand. There is no location-transparency provided to the customer which means that the customer in general has no control or awareness about the precise location of the provided possessions but may perhaps be capable to stipulate location at a top echelon of abstraction (e.g., nation, state, or datacenter). Examples of possessions incorporate storage space, processing, memory, and system bandwidth.

2.1.4 Swift Flexibility. Capabilities can be lithely provided and can be taken away, lacking human interference, to scale swiftly outwardly and internally analogous with demand. The capabilities available to the consumer for provisioning time and again emerge to be unimpeded and can be acquired in any amount at any instant.

2.1.5 Precise Service. Cloud systems involuntarily manage and minimize the resource usage by effectively leveraging a intonation capability at several point of generalization suitable to any sort of service (e.g., storage space, processing, bandwidth, and dynamic user accounts). Utilization of Resources can be monitored by keeping an eye on it, constrained, and recounted, which provides transparency to the service provider and consumer both for the utilized service.

2.2 Cloud Service Models

Cloud is broadly classified into three categories on the basis of delivery, which are:

2.2.1 Software as a Service (SaaS). The facility provided to the end user is to use the service provider's applications running on a cloud infrastructure. Most widespread examples of such web-based applications are Facebook, Salesforce.com, Google Apps, SAP, Taleo, and WebEx etc. All these web applications are full-service applications and are easily obtainable from everywhere on the Internet.

End user does not deal with or organize the fundamental cloud infrastructure which includes system network, web servers,

operating systems, mass-storage, or even an individual application capabilities, with the promising exemption of restricted user-defined application design settings.

2.2.2 Platform as a Service (PaaS). The potential provided to the end user is to deploy onto the cloud infrastructure consumer-produced or acquired applications created by using encoding languages, class libraries, system services, and tools prolonged by the service provider. The consumer does not administer or command the underlying cloud infrastructure including network, servers, operating systems, or storage, but has domination over the deployed applications and perhaps configuration settings for the application-hosting background.

2.2.3 Infrastructure as a Service (IaaS). The facility provided to the end user is to stipulate dispensation, storage, networks, and other elemental computing resources where the end user is able to deploy and run random software, which can comprise operating systems and applications. The end user does not supervise or deal with the fundamental cloud infrastructure although have control upon operating systems, mass-storage, and deployed applications; and probably inadequate control of selected networking components for example host firewalls.

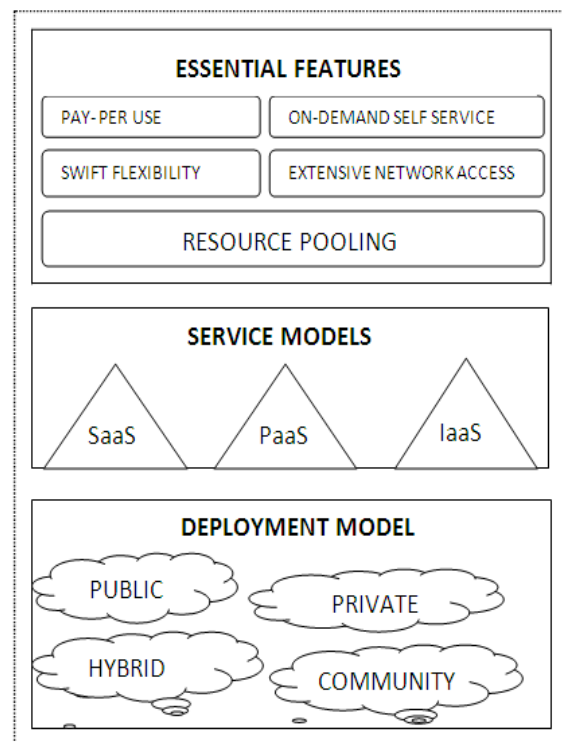


Fig 1: Functioning of Cloud Computing

2.3 Cloud Deployment Models

A cloud is broadly categorized on the basis of deployment model as:

2.3.1 Private cloud. A private cloud is one in which all the services and infrastructure are maintained on a private network so as to provide high level of security and control. The cloud may be possessed, supervised, and functioned by the association, a third party, or some grouping of them, and it may exist on or off location.

2.3.2 Community cloud. These cloud infrastructures are provided for limited use by a precise group of people from organizations that have communal concerns (e.g., operation, security, strategy, and agreement considerations). It may be possessed, administered, and restricted by single or more of the organizations in the assembly of people, a third party, or some blend of them, and it possibly will subsist on-site or off-site.

2.3.3 Public cloud. These clouds provide an extreme level of effectiveness in shared resources; but on the other hand, they are also weaker than private clouds in terms of security and control. Public cloud exists on the site of the cloud provider. Here the cloud infrastructure is provided for open use by the ordinary public. It may be possessed, controlled, and functioned by a big business, intellectual, or administration organization, or some fusion of them.

2.3.4 Hybrid cloud. A hybrid cloud puts together a variety of public and private options with numerous providers so it is clear that hybrid cloud is a combination of two or more discrete cloud infrastructures (private, community, or public) that linger exclusive entities, but are confined collectively by standardized or exclusive application of knowledge that enables data and application portability (e.g., cloud bursting for load harmonizing among clouds). [2]

Thus according to [3], cloud computing provides a cost-efficient and resilient resource all the way through which scalable computing supremacy and miscellaneous services (computer hardware and software resources, networks and computing infrastructures), assorted application services, business processes to personal intelligence and collaboration are delivered as services to large-scale worldwide users whenever and wherever they need.

3. SOFTWARE TESTING ON CLOUD

As cloud computing came into the depiction, a new perception of testing on cloud has evolved, though not many companies have flung into it. Software testing is an indispensable and significant stage of the software development process because testing software is just more than debugging a software. The vital purpose of testing any software can be quality declaration, verification and validation, or trustworthiness evaluation. Thus, cloud computing is a model or platform on which testing must be conceded out just like any other service.

Testing necessitates exclusive dedicated infrastructure and possessions that were only used intermittently which carefully examine the application's performance, dependability, swiftness, security and functionality. In view of the fact that, business applications are rising day by day in complexity, so it is a tedious job for an organization to put up and maintain in-house testing amenities that imitate real-time environments. This is somewhere cloud testing has come into sight as a spanking new approach to testing where cloud computing environments are leveraged to imitate real-world user congestion by considerably minimizing costs [4]. Software testing is a commutation between three important factors i.e. Time, budget and quality. So concisely, cloud-based software testing pertains to testing and evaluating activities on a cloud-based environment and infrastructure by leveraging cloud technologies and solutions

“Cloud testing is the response to the less-than-pragmatic performance test that commences within the infrastructure of one of our clients. While using cloud testing, an advantage is to be taken of hardware and bandwidth that more strictly impersonate our practical, factual world scenarios. Basically, individual can implement the test in cloud-based infrastructure and bandwidth.”

(R V Ramanan, President – Global Delivery and Chief Software Architect, Hexaware Technologies)

As each and every one is sentient of the actuality that in accustomed circumstances testing of a product is done excellently within the association by the quality/test teams. Firstly, to assure the quality of cloud-based applications deployed in a cloud, including their functional services, Secondly, To validate software as a service (SaaS) in a cloud environment, including software performance, scalability, security, thirdly To test cloud concord and inter-operation competence between SaaS and applications in a cloud infrastructure, for example, checking the APIs of SaaS and their cloud association to others, fourthly, To test out the present automatic cloud-based well-designed services, for example auto-provisioned functions

3.1 Benefits of Cloud Testing

Testing on cloud will escort to number of benefits to an organization in provisions of expenditure and possessions. It is something like “service on demand” or “testing on demand”. The cost of hardware, software, tools, tester etc. is charged on usage basis. Numerous key benefits that can be strained from this are:

1. An individual doesn't need to spend huge amount of money in tool license. They subsist an assortment of wide-ranging alternative for selecting and choosing tool of your preference depending on product to be tested. So rather than paying a immense amount for purchasing a tool, keeping track of updating it with latest patches and fixes, getting hot and bothered about the new release and then depending on it for all your product range; you now need to pay-as-you- utilize basis.
2. Most important benefit of testing on cloud is that one doesn't need to hire experts for the tools.
3. There is no requirement to organize any sort of personal infrastructure to carry out testing process on the cloud; one can go right away for the cloud service provider and this will minimize the cost of required infrastructure.
4. Individual can save ample of time and funds by not spending massive time in procurement and setup process so no setup and procurement time wastage takes place. Straight away select the cloud vendor, and get the setup already up and running to start testing instantly.
5. An individual has the inclusive flexibility of using barely when one really necessitates. And there exist quite a lot of options for choosing the precise tool for right product.

3.2 Models of Cloud Testing

Software Testing in Cloud has three models

3.1.1 Testing as a Service (TaaS)

Concept of TaaS was originally introduced by Tieto in Denmark in 2009. Software testing as a Service (TaaS) is a sculpt of software testing that is used to test an application as a service provided to clients across the Internet. By excluding the requirements of the clients to test the application on the client's own computer with testers on site, TaaS has vanished the client's load of installing and maintaining test environments, sourcing and (test) support. Using TaaS can also diminish the expenses of testing, all the way through less costly, on-demand pricing.

3.1.2 Testing Support as a Service (TSaaS)

To upgrade testability of autonomic services, TSaaS was anticipated so that each service will depict both production and test environment to external users. Test functions (such as requirement specification, implementation, configuration and reporting) are revealed as API services. King, et al., [6], [7] pertained autonomic computing which is called as autonomic self-testing (ATC). This technique was then shifted to the cloud platform [8], called TSaaS, so that services that are hosted on far-flung cloud platform can expose their test support APIs for associate providers and due to this an self-

test strap up is developed to handle the testing workflow and actions. These conveniences are provided for cloud associates during the development, testing and maintenance of bespoke cloud applications and services. It also keeps a check on changes or updates that takes place on hosted services, uses essential infrastructure services, and invokes TSaaS supporting services to substantiate the changes made so far.

3.1.3 Testing inside Cloud

Testing cloud applications that are hosted and deliberated in a cloud environment, or assessing the cloud infrastructure itself.

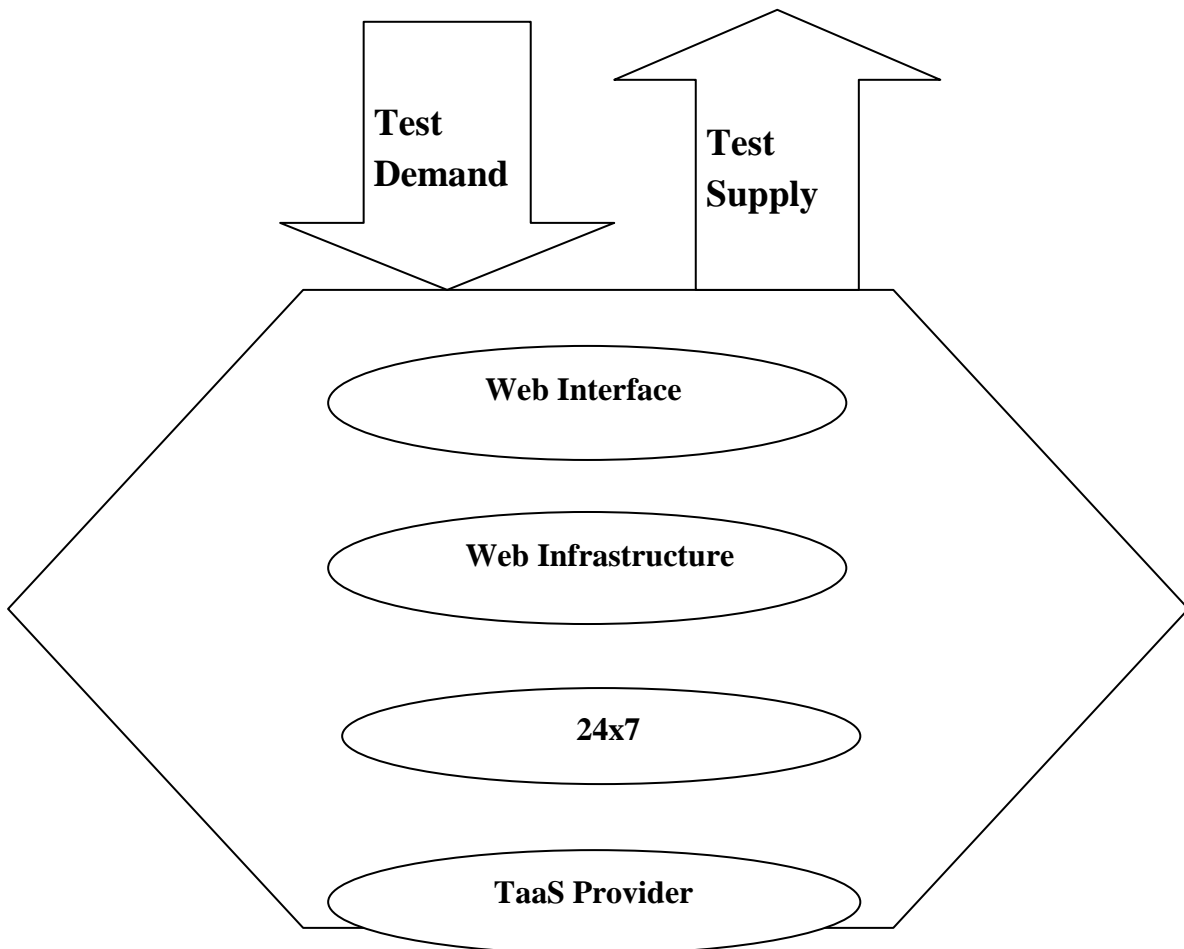


Fig 2: TaaS Process

4. SOFTWARE TESTING ON CLOUD AS A SERVICE

Cloud computing provides a good chance of advancement by offering testing as a service (TaaS) for SaaS and clouds. The paper [9] explains a comprehensive tutorial on cloud testing and cloud-based application testing. It provides a apparent relative analysis among internet-based software testing and cloud-based application testing. In actuality, it examines the most important issues, challenges, and requirements in testing cloud-based software applications.

4.1 Cloud Testing versus Conservative Software Testing

Here, one can do comparison between web-based software testing and cloud-based software testing.

Points explained below shows the details in different aspects

1. Primary Testing Objectives of web-Based Software Testing is to Assure the quality of system functions and Performance based on the given specifications and also to

ensure the usability, compatibility, interoperability. Whereas Cloud-Based Software Testing cloud based software testing Assure the quality of cloud flexibility & scalability and also assures the functions and performance of SaaS, Clouds, and applications by leveraging a cloud environment.

2. In case of web based software Testing a pre-fixed and configured test environment exist with purchased hardware and/or software resources but in case of Cloud-Based Software Testing their exist an open public test environment with miscellaneous computing resources

3. An In-house internal software testing as engineering tasks is done in case of web-based software testing where as instantaneous on-demand testing service offered by a third-party in cloud based software testing.

4. Web based software testing Costs includes hardware costs, software (license) costs and Engineering costs in a test process. And cloud based software testing includes cost Based on a pre-defined service-level-agreement (SLA),TaaS and Cloud testing service costs (pay-as-you-test) and Engineering costs in SaaS.

5. Security Testing in case of web based software testing Aim to the subsequent targets such as Function-based security features, User confidentiality, Client/server access security, procedure access security, Data integrity .Various Aims of security testing in case of cloud based software testing are SaaS/Cloud security features, User privacy in different web clients, End-to-end application security over clouds, SaaS/Cloud API and connectivity security and many more.

6. In Web based software testing Integration Testing includes various types of testing such as Function-based integration, Component-based integration, Architecture-based integration, connection integration, but in cloud based software testing their exist SaaS-based integration in a cloud , SaaS integration between clouds, Application-oriented end-to-end integration over clouds , Enterprise-oriented application integration between SaaS/Cloud

7. In case of web based software testing Offline test execution takes place in a test lab and testing a product is done before it is delivered. On other hand On-demand test execution by third-parties is done in case of cloud based software testing and Online test execution is done in case of a public cloud; Offline test execution in case of a private cloud.

So as compared with conventional testing, cloud testing emphasizes supplementary on system testing and online testing. This is due to the new-fangled design and development techniques imposed by cloud computing

4.2 Cloud Testing Types

Any application that is developed or is currently in the progression of migrating to a cloud ought to be undertaken by cloud testing because cloud testing is a fortunate thing and an inevitable activity within the industry. Cloud testing is a undeniable innovative way for companies to congregate promising business needs for quickness, elasticity, price diminution and time-to-value. But it also insinuate new technology peril which, if not thoroughly understood, can trim down or even eradicate the impending business profits

Cloud Testing [10] is pioneered by a huddle of architects and recital delicates from UK's leading Website Performance Monitoring & Load Testing Corporation. It targets to uphold cross browser and serviceable testing of internet applications. cloud testing covers many other types of testing as shown in the table below, but Cloud testing is often seen as merely performance or load testing and in this paper we will discuss regarding Performance testing and functional testing. Various kinds of testing that can be performed on the cloud model is described in the table shown as under.

Table 1. Types of cloud testing

SNO	TESTING TYPES	DESCRIPTION
1	Performance and Load Testing	To ensure summing the big business necessities precise to cloud computing
2	Interoperability and Compatibility testing	To ensure meeting the business necessities explicit to cloud computing
3	Stress and Recovery testing	To ensure statistics recovery from crashes, hardware failures in a cloud environment.
4	System Integration and User Acceptance Testing	To ensure the developed cloud solution meets the functional prerequisite.
5	Security Testing	To ensure meeting the Application/Data security constraints.

4.3 Functional Testing

Functional Testing is also known as Behavior testing/black-box testing because it captures the user requirements. It is based on the Functionality of the program. Functional testing only involves surveillance of the output for some definite input values applied to the system under test. In functional testing no effort is made to breakdown the code, which generates the output [12]. Functional Testing habitually describes about the functionality of the system and it is an quality assurance (QA) process[13] Functional tests incarcerate all the client side requirements and give both client and developers assurance that the system meet those requirements, and facilitate QA (quality assurance) teams to make sure that the software is geared up for making it public..

Functional testing of both web-based and non-web based applications can take place using cloud testing. Functional testing provides the ability to verify that applications work as they in the way they are expected to do so as to satisfy the user requirements. The technique of verification against

circumstances or system requirements is carried out in the cloud as a replacement of in-house software testing.

4.4 Performance Testing

Performance testing is a way of quality assurance (QA). It entails testing software applications to pledge that they will carry out well under their estimated workload. The target of performance testing is to eradicate performance bottlenecks but not to stumble on bugs.

Attributes and Functionality endorsed by a software system is not the only concern. A software application's performance like its response time, do matter.

The major limelight of Performance testing is inspecting a software program's pace, scalability and firmness. Pace because pace determines whether the application responds quickly or not, Scalability because it determines utmost user load the software application can grip and last but not least Stability or firmness determines if the application is unwavering under changeable heaps.

Load testing and stress testing both are the precise forms of the performance testing

Performance testing, load testing, stress testing are all based on industry necessities. It's a proficient approach to weigh up the performance of an application. It requires the imitation of genuine load scenarios running in opposition to your intended applications or websites

4.5 Stress Testing

Stress testing in IT industry means testing of software/hardware for its efficacy in giving consistent performance under intense and adverse circumstances such as heavy network traffic, heavy processes load etc. Stress testing a Web application at all times is been an awfully exclusive test to be performed in a conventional lab environment but then also website crashes takes place and the cost of having a website crash is also becoming very expensive. So Stress Testing helps to determine the competence of application to sustain a assured point of efficacy away from the contravention point. In other words [11] helps to divulge out the height of robustness and performance of software/hardware even when the system performs beyond its normal operations.

Companies such as Hallmark.com, Genentech, and Proctor & Gamble have discovered Cloud Testing as an inexpensive and scalable alternative. It is indispensable for any application to work even below disproportionate pressure and maintain constancy so stress testing assures this by generating maximum loads by using various simulators, But this is an exclusive process.

Instead of investing huge amount of funds in structuring of on-premise testing environments, cloud testing provides reasonably priced and scalable substitute. For only little amount of money massive stress tests can be achieved in just an hour. A major media site has recently used SOASTA CloudTest and Amazon EC2 to test their music download site by simulating over 500,000 coexisting virtual users that are downloading the songs. Cloud Testing is altering the way how we test our Web sites everlastingly.

5. CONCLUSION and FUTURE SCOPE

As max and more software and databases are coming on the cloud so there is a need for the robust software testing tool to test the cloud based software. The tool is required to test the

cloud based application as well as provide the solution to different companies to use this cloud based software testing tool for testing their applications.

Using a apposite testing environment is always a noteworthy testing concern, but it is critical on the subject of cloud based testing. It is clear that cloud based next generation testing tool is a new tool and will continue to change for years to come.

Cloud based computing and testing is the superior option for the contemporary days. It is for the reason that this will endow with the flexibility of assuage and location autonomy of testers and coders. One can acquire it as a stupendous option for disaster administration as well as additionally highly secure alternative to put down countless stuff on cloud relatively than the system based at one location.

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