Abstract

This white paper introduces Cloud computing business model which has been the natural evolution of the adoption of the ‘On Demand’ paradigm. The On Demand paradigm has been explained with examples. Cloud computing as a business model has been discussed for its various benefits and limitations. The view point described in this document differentiates between the terms ‘Cloud Testing’ and ‘Testing a Cloud’ as applicable in day-to-day business offerings. Cloud Testing exemplify Testing on demand and why is it termed as the future of testing services. Testing a Cloud demonstrates how contemporary verification strategies can help to overcome the associated limitations.
Introduction

So, you have decided to jump on the Cloud bandwagon and reap its benefit. Before leaping onto term definitions, I would like to ask a question. What does Cloud mean to you?

Cloud computing is not a new:
• Technology that one should learn to be abreast for future business
• Architecture that would help in easier software deployment
• Standard or protocol

In fact, one of the main issues that technical leaders are trying to address is interoperability between Cloud platforms.

The introduction in any white paper or article or blog discussing Cloud computing often states, ‘Cloud computing is not new. It has been there since the inception of formal business contracts’. The following is definition of Cloud computing coming from a beginner that should clear the air for all novices starting with the usage ‘As a Service’:

‘Cloud computing is a business and economic model. This model has been successfully deployed and executed for various material commodities since its inception, but in the recent years it has been formalized for IT products and services’.

Let us take the analogy of automobiles to understand the use case of Cloud computing. Take the case of a car versus a taxi cab. Both are automobiles with the basic functionality of transferring people / goods from one place to other. The difference is in the business model for the service provided by them.

As the owner of a car, you pay for the petrol or diesel, maintenance and possibly a garage. The car provides the service solely to the owner - you. On the other hand, the service provided by the taxi cab can be described as ‘Travel as a service’. The taxi cab driver owns the cab. As a customer, you pay to travel whenever you use the cab service. There is no need to pay for the maintenance or the gas and you need not worry about the parking. This responsibility lies with the cab driver. This is why Cloud is synonymous with ‘On Demand’. You pay only on demand (when you require) it.

![Figure 1: Think of Cab Service as a ‘Travel as a service’](image)

Specifically in the IT industry, there is a wide range of products and services available on demand. Almost every day, we notice various ‘as a service’ offerings like ‘Games as a service’, ‘Java as a service’, ‘Storage as a service’ and the list is endless.
The Cloud is broadly classified in three categories on the basis of delivery, which are:

- **Software as a Service (SaaS):** Applications and products are available on demand for any Internet user. For example, an online music company charges a certain amount of money for every track downloaded.
- **Platform as a Service (PaaS):** The runtime environment is available on demand which is used by developers to deliver their applications. The framework for deployment of application code along with various on demand services is available as PaaS offerings.
- **Infrastructure as a Service (IaaS):** Computing resources such as power, storage, networking components or middleware are available on demand. IaaS is for architects where the actual hardware infrastructure is deployed on a 'pay per use' basis.

The Cloud is broadly categorized on the basis of deployment models as well: public, private, community and hybrid Clouds. Let us look at the pros and cons of this business model.

**Benefits**

The Cloud business model is economically advantageous both for the vendor and end user. As mentioned earlier, one of the main advantages of using this business model lies in monetary reductions in subscription of any product or service. The additional advantages of using this business model are:

- **Scalability:** The business model is described as being elastic - a Cloud based application or product can be customized based on the requirement
- **Auto-Provisioning:** The Cloud vendor provides and withholds the offering in an automatic and self-serving format as required by the end user
- **Seamless Resource Availability:** This refers to the service / product being available as and when it is demanded and in the required quantity

The Cloud computing model should be coined as ‘Green Model’ as it maximizes usage of resources and minimizes wastage making it environment friendly. As always with any business model, there are disadvantages. The next section describes the limitations of this model.

**Limitations**

When a vendor migrates from the existing business to the Cloud or is planning to launch a new business on the Cloud, there are various challenges in adopting this business model. Some of the major challenges are:

- Data integrity
- Security
- Privacy
- Availability

Take the analogy of the taxi cab service from the perspective of a customer. As a customer you must reach the airport in an hour. Think about the problems anticipated with the taxi cab service:

- Will the taxi cab arrive on time?
- Is the booked taxi cab in good condition and upto expectations?
- Is there room for privacy in the taxi cab?
- Is the taxi cab driver trustworthy?

These questions of uncertainty usually force people to buy their own cars. However the taxi cab service is a boon for many and this business flourishes. This is because the taxi cab service provider adopts strategies to overcome the limitations.

Similarly, with its entire limitations, the Cloud computing model is a boon especially for small and medium
business enterprises. Most of the risks associated with this model are mitigated (if not removed) by verification and validation. This brings us to the question what is Cloud Testing and Testing a Cloud.

Testing a Cloud

Testing a Cloud refers to the verification and validation of applications, environments and infrastructure that are available on demand. This ensures that applications, environments and infrastructure conform to the expectations of the Cloud computing business model.

Every Cloud offering requires traditional and contemporary verification strategies. Conventional testing methodologies are ideal for on-premise applications and environments. Any product or service offered on-premise or on Cloud should meet its functional requirements. Specifically for Cloud offerings, equal (or may be more) emphasis is required on non-functional requirements.

Let us now consider the various types of testing that should be carried out.

- **Availability Testing:**
  Cloud offerings must be available at all the times. It is the responsibility of the Cloud vendor to ensure that there are no abrupt downtimes. In addition the business of the client must not be adversely affected in case of any planned downtime.

- **Security Testing:**
  There must be no unauthorized access to data. Shared data integrity should be maintained and secured at all times. At present several organizations and communities are formalizing industry standards to define the acceptability criteria for Cloud offering in terms of security.

  Any on-premise application is as much prone to unauthorized access as any Cloud offering.

- **Performance Testing:**
  Performance measurement for a Cloud offering is different from on-premise offering. The Cloud should be elastic. Elasticity enables enterprises to use limited resources from the Cloud application and increase
Cloud Computing is an excellent business model if the security and flexibility concerns are addressed.

Offerings must not be made available on demand until they have been successfully verified and conformed for both functional as well as non-functional requirements.

the usage as required. Hence, the Cloud offering should be tested for fluctuating usage. The performance of the application should stay intact with maximum inflow of requests. Testing should also ensure that automatic deprovisioning occurs as the load decreases. To test the offering in case of increasing load and stress, two of the following traditional performance testing methods are used:

- Load testing
- Stress testing

- Interoperability Testing:
  Any developed or migrated Cloud application must work in multiple environments and platforms. The application should also have the capability to be executed across various Cloud platforms. It should be easier to move the Cloud applications and platforms from one Infrastructure (as a service) to another Infrastructure. As with Security Testing, standards are being formalized for interoperability between diverse Cloud offerings too

- Disaster Recovery Testing:
  It is preferred that a Cloud offering be available all the time, though it is not 100% achievable even for on-premise applications. In case of a failure, the disaster recovery time must be low. Verification must be done to ensure the service is back online with minimum adverse effects on the client's business

- Multi-tenancy Testing:
  Multi-tenancy refers to multiple clients and organizations using an on demand offering. Considering the requirements to be verified for multi-tenancy, the offering should be customizable for each client and should provide data and configuration level security to avoid any access related issues. A Cloud offering should be thoroughly validated for each client whenever multiple clients are active at a given time

To decide on verification and validation strategies, Cloud vendors must understand the technical and commercial aspects of their Cloud offering. Migration of an on-premise application to the Cloud requires a comprehensive test plan and execution at every stage of migration.

So far, the discussion has revolved around Cloud and the types of testing required for Cloud based applications. The next section helps in understanding the term Cloud Testing.

**Cloud Testing**

Cloud Testing is defined as ‘Testing as a service’. IT organizations that deal with Testing Products and Services are making use of a Cloud based licensing model for their end clients. The offering includes functional as well as non-functional testing of various applications / products offered.

The two types of Cloud testing services are:

- **On-Premise:**
  Testing as a service can be used for validation and verification of various products owned by organizations or individuals. Load testing is available as both an on demand and metere service. For instance, instead of installing a load testing product to test proprietary application, you can avail this offering on demand
• **On-Demand:**
  Testing on demand is used to test On-Demand software as well. It is becoming increasingly popular to use testing as a service to simulate production such as Cloud environments instead of traditional on-premise testing products.

Products are available in all the three delivery models. Various non-functional testing such as security, performance, load, stress, and interoperability testing are offered as:

- **SaaS:** Testing products and services are recognized as on demand testing applications and are now being extensively deployed for black box models
- **PaaS:** Build and automation environments are available on demand. Developers can make use of the on demand environments to build and test the automation scripts
- **IaaS:** Organizations provide their storage servers or network and other computing infrastructure on demand which are used for verification and validation in production-like environments

Many of my contemporaries dealing in verification projects agree that it is becoming increasingly difficult to acquire necessary licenses to buy and maintain performance and security testing products both from financial as well as administration perspective. Also, it is difficult to align required human resources having the know-how to understand the application and execute the tools as and when required. The IT vendors are now considering various performance and security testing products available on demand. On Demand testing results in converting the flow of budget from purchasing assets (tools / infrastructure / resources) to other promotional and obligatory IT operational costs.

The IaaS model can significantly reduce the cost involved in purchasing authorization and licenses for infrastructure. Several vendors and managers are now aligning to the idea of using the resources on demand when there is a need to certify the interoperability of an application. For interoperability testing, various types and configurations of infrastructure (such as servers / browsers / platforms / OS) are required.
Conclusion

This paper elucidates the difference between Cloud Testing and Testing a Cloud. Cloud Testing is an offering while ‘Testing a Cloud’ is an inexorable activity that must be undertaken for any application developed or is currently in the process of migrating to a Cloud.

The differences explained are applicable to almost every Software Development Life Cycle stage. For example, sustaining a Cloud refers to maintenance activities for Cloud offerings, whereas Cloud Substance may be defined as ‘Maintenance as a service’.

References

No part of this paper has been directly referred from any copyright material. The following blog has been used to get a basic understanding of Cloud offering:

About the Author

Neha Mehrotra is a Technology Lead at Infosys Engineering Services. She has close to 8 years of experience in Java and Java EE technologies. She has been involved in the development and sustenance of identity and access management products. She is currently engaged in research involving Testing framework for Cloud based offerings. She can be contacted at neha_mehrotra@infosys.com