

Investigation of IT Auditing and Checklist Generation Approach to Assure A Secure Cloud Computing Framework

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(Received on 26 July 2012 and accepted on 08 October 2012)

Abstract – Recently, all over the world mechanism of cloud computing is widely acceptable and used by most of the enterprise businesses in order increase their productivity. However there are still some concerns about the security provided by the cloud environment are raises. In this project we are conducting the investigation studies over the IT auditing for assuring the security for cloud computing. During this investigation, we are implementing working of ID auditing mechanism over the cloud computing framework in order to assure the desired level of security. In the IT auditing mechanism, the concept of checklists are prepared for the cloud computing application and their lifecycle. Those checklists are prepared on the basis of models of cloud computing such as deployment models and services models. With this project our main concern is to present the cloud computing implications for large enterprise applications like CRM/ERP and achieving the desired level of security with design and implementation of IT auditing technique. As results from practical investigation of IT auditing over the cloud computing framework, we claim that IT auditing assuring the desired level of security, regulations, compliance for the enterprise applications like CRM, ERP, E-campus, E-learning etc.

Keywords: IT Auditing, Cloud Framework, ERP, CRM, Checklists, Cryptography, E-Campus, E-Learning

I. INTRODUCTION

Search Engines has become one of the most important and interesting area towards the users of World Wide Web (WWW). These commercially available search engines do not completely serve the needs and demands of the users. The problems that typical search engines usually suffer can be cast down in two major areas [13].

Cloud computing is most probability of collection such as service oriented topic, as well as on-centric concept and good practices techniques. Cloud computing gives benefit of provisioning resources and application of services to customer. Customer is needs to subscribe its related services.

This service is to depend upon its development, infrastructure, and storage capacity. These services also provide of two types of computing services software and desktop services. In the cloud computing is the thin client interaction with remote cloud using operating system. It give the virtual desktop in virtual local operating .this operating system is access the virtual data storage. This o.s executes application at anytime & anywhere. When IBM Watson claimed the world is needed only five machine. It is back all the all things.

Now a day's why IT is reaching a critical point of view. In storage total growth is 54% of Explosion of information. Large scientific calculation such as medicine, forecast, and healthcare is most energetic and faster processing capacity. In reality near about 85% computing capacity is idle. Average of IT budget as 70%. It is specifically managed by IT infrastructure added by new things. Many technologies are different than cloud computing such as parallel computing, virtual computing, architecture of services oriented, and autonomic computing. All computing are advancing computing in unusual pace. Connectivity is additional part of the keeps falling. Cloud can be depicted based on web application through internet, this application are standard application.

People can understand without most of period of knowledge's, training section, and they understand to operating system as well as basic thing such as hardware maintenance it can be accomplished of their work done easily and properly. Consumers are purchase on demand for cloud computing capacity but they are not concerned used in underlying technologies. Typically computing data & resources can be accesses by own. They are access by third party provider. It is not copulation to locate nearby. They are potentially beyond state in physical boundary country. Those applications can be moving there its own infrastructure to cloud. It has shifted in house control to a third party. It can be provide many challenges in that we mention its security and privacy, their performances and availability to following graphical view.

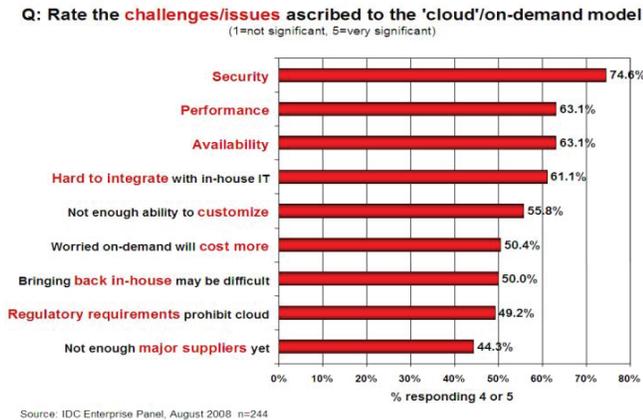


Fig. 1 Rate of Challenges related to Cloud computing

Above figure 1 indicates that, cloud computing has most important challenge is of security which is around 75 %. It is widely quoted survey is mention in that security number is one concern. It the graph included as 3, then all the number in given graph can be increased by at least 10 points. Cloud computing does not make security issue. It can become only challenging topic does not other topic. That means it is not exit a usual utility concept. Thus in this paper our main concern is to carry out the investigation over the security issues over the cloud computing enterprise applications like CRM or E-learning or ERP and design the proposed checklist for security purpose for such application. In addition to this solution to address the security and privacy issue for the requirement assurance and security point of view is presented called IT checklist. That means we take a simple holistic view of example to define a securing cloud computing by using IT auditing vehicle. IT auditing ids basically under the cloud computing it can add extra role of the making strategic plan for enterprise in also additional to the traditional auditing role. General accounting is also same as IT auditing. We making to master checklist depends upon its framework specifically it towards cloud computing. It based on two model such as deployment model and services model. Now we discuss about to making a checklist for public cloud as well as private cloud.

II. PROBLEM DEFINITION

Moving traditional applications and their infrastructure to cloud has shifted the in-house control to a third party. It posts many challenges including security and privacy, performance and availability out of the security is the number one concern. Clearly using cloud computing does not make the security

issue go away. It becomes an even challenging topic. In that sense, it is not quite a usual utility concept we are talking about it. Still there is problem with the security as the data leakage due to the poor authentications and information assurance.

III. LITERATURE SURVEY

A. Introduction to Cloud Computing

Cloud computing is a term that is used for anything which involves the delivery of hosted services using internet. These services can be categorized into three types:

1. Infrastructure services
2. Platform services
3. Software services

Cloud computing is also known as “location independent computing”, where servers are shared. These shared servers provide different services on their demand. These services may be including the type of the resources, devices or data to the computer. Cloud computing is development of widely used to adopt of concept of virtualization, architecture which is the service-oriented and cloud computing. The abstraction is used that is the details information is hidden from the users, as users don’t need to get command over the technology infrastructure in the “cloud” which supports them. The “Cloud computing” name is inspired by the symbol of cloud which is generally used in the flowcharts to represent in internet.

This service has provided to the three different characteristics which makes difference between a cloud and traditional hosting. User can have large or small number of services at any instant of time. The provider can fully manage the service. This is very difficult to the managing the services. The requirement for the consumer is that he needs to have only a personal computer and the access to the internet on the computer.

A cloud computing may be public or it may be private.

1. Public Cloud: Anyone person on the internet can buy services through Public cloud. It treats platforms and infrastructure as services. Users share resources and costs and use them over internet. Pay per use model is used. Though there are benefits like faster time to market, cost savings, it also has few challenges listed below:

a. Security

Public clouds have multiple natures. Because of it the potential security. This is very biggest issue here. Same physical sharing is used with unknown parties therefore there are privacy and security concerns.

b. Reliability and Performance

Availability and their performance are an important criterion that defines the success of business.

c. Vendor Lock-in

Different vendors can offer different type of services which are not governed by any standards alone. To adapt the services the applications have to undergo changes, depending on the vendors.

2. Private Cloud: A private cloud is used where there is need to supply to limited number of people. It is a data center which supplies services that are hosted. Several challenges faced in public adoption have overcome in this model. It adds capabilities like automation, self service, charge back.

a. Infrastructure Services

Infrastructure services provide a virtual server. This server is used to start, access, configure and stop their virtual servers as well as storage. A company can pay only for the capacity needed, and bring online as soon as required. This model works on "Pay for what you use", because it resembles the way fuel, water, electricity are consumed. This is also known as utility computing. That why this service is very important.

b. Platform Services

In cloud platform services is a set of the product development and software tools. They are hosted on infrastructure of provider's. Many applications are created by developers on the dependent on platform of provider over the internet. In this model which is providers can use the APIs, gateways, portals installed on the customer's system. Google applications and the Force.com both are the best examples of this model. One point should be important that model developer is that, there is no interoperability there are standards and cloud and also there is no data portability. Some providers will not allow the customer's software to be moved off the platform of provider.

c. Software services

In this model infrastructure, software product and hardware product are provided by the vendor. They can Interaction with the user is made by using front end of the portal. It is very wide to use in the market. Services maybe include anything from the inventory control, database can processing to dependent on the Web based email. Both the application and the related data are hosted by the service provider. End user can use the services from anywhere. Cloud computing conceptual diagram can given as follows.

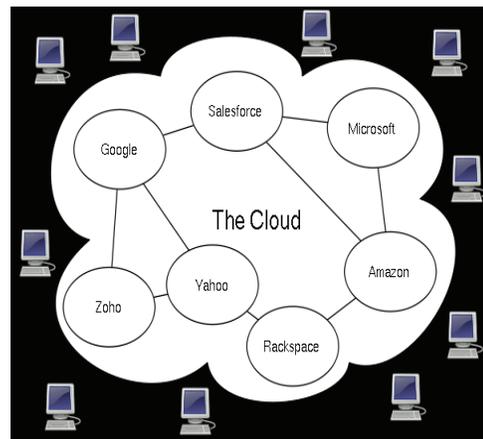


Fig. 2 Cloud computing conceptual diagram

B. Benefits of Cloud Computing

Every customer is enterprises would need to the align their own applications, so as to explain the architecture of the models that Cloud Computing offers. Cloud computing is provide by three types of benefits such as:

1. Reduced Cost: There are such numbers of the reasons to attribute Cloud computing technology with lower costs. The billing model is pay as per usage; the provide infrastructure is not purchased thus lowering to the maintenance. T allows the two types of the expenses such as Initial expense and recurring expense. Initial expense and recurring expenses are much lower than traditional computing.

2. Increased Storage: Now with the massive Infrastructure that is offered by Cloud providers, storage & maintenance of large volumes of data is a reality in cloud computing. Sudden workload spikes are also managed effectively & efficiently, since the cloud can scale dynamically.

3. Flexibility: This is almost important characteristic other than two characteristic. With enterprises having to adapt, even more rapidly, to changing the business application

and their conditions, there speed to deliver is very difficult. Cloud computing stresses on getting applications to market very quickly, by using the most appropriate building blocks necessary for deployment. This characteristics is widely used in cloud computing.

Cloud Computing make by the computer framework and services available “on-need” basis. The computing framework could include that the hard disk, development of the platform, related database, computing power or complete software applications and software condition. To access these resources from the cloud vendors, organizations do not need to make any large scale capital expenditures. Organization need to “pay per use” i.e. organization need to pay only as much for the computing framework as they use. The billing model of cloud computing is similar to the electricity payment that we do on the basis of usage. In the description below vendor is used for cloud computing service provide and organization is used for user of cloud computing services.

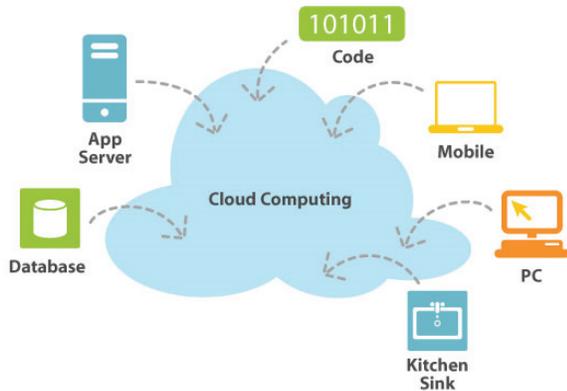


Fig. 3 Cloud Computing

C. Characteristics of Cloud Computing

“Clod Computing in the cloud”, which is the key characteristic of the cloud computing. The cloud processing is not static or in a specified place. All other concepts are complementary to this. In that concept no any physical infrastructure is owned by the customers. Resources are consumed as a service and they have to pay only for the resources used. Servers are not kept idle unnecessarily which helps significantly in reducing cost and development speed of the application is increased. There is dramatically rising in overall computer usage as customers do not engineer peak load. This approach has provided this type of side effect.

A. Availability of the large computing infrastructure on need basis: Cloud computing vendors provide by the details about of the infinite computing framework availability. This is available to organizations which is need to the basis. This is phenomenon that organizations do not need to the set up of the servers for their peak of requirements. The site will get extremely high traffic in the two weeks when the championship to be happens. For this two weeks period this site will have high server usage. For rest of the year the site will need to only pay for the reduced usage. In general case organizations are do not need to bear of the cost of cloud computing framework about for their peak loads. The usage of computing resources can be increased or reduced on their need of basis, which type is called as elastic computing.

B. Cloud computing used to the a “pay-per-use” billing model. Cloud billing model are very different but when it compared to the traditional IT billing techniques. Typical billing models include the per user billing, per GB billing or per-use billing (i.e. an organization is billed on each usage of the computing service).

C. Cloud computing typically does not allows or a involve long-term scheduled or their commitment which is used to the computing framework. The vendor does not enforce long-term usage of services.

D. Cloud computing does not involve any type significant capital expenditure for the organization. Unlike the traditional IT infrastructure, in cloud computing organizations just use the computing services without procuring it. In some sense cloud computing involves renting the computing resources instead of buying them. Cloud computing is required to no capital expenditure to acquire to their initial computing resources.

D. Challenges of Cloud Computing

1. Challenges that cloud computing currently faces in being deployed on a large enterprise scale.
2. Self-healing - in case of their application or the network as well as data storage can goes to the failure, there will always to be a running backup.
3. Without major issues, making the resource switch to appear same as to the user resources.
4. SLA-driven - cloud is administrated by the service level confirmed that allow several instances of one
5. Application to be replicated on multiple servers machine if need to the arises; dependent on a priority scheme of the application,

6. The cloud may be minimize or shut down to a lower level of the application.
7. Multi-tenancy - the cloud permits multiple clients to use the same hardware at the same time, without hanging.
8. Them knowing it, possibly causing conflicts of interest among their customers.
9. Service-oriented - cloud allows to the one client to use the multiple applications in creating its own.
10. Virtualized–Given applications are not hardware specific; but the various programs may be run on one machine using this data.
11. Virtualization or many machines may run one program at a time.
12. Linearly scalable - cloud should be handling an increase in the data processing linearly; if “n” times more users.

IV. PROPOSED APPROACH

This section presents all the techniques which we are proposed to use with cloud based enterprise applications.

A.Data Life Cycle of Cloud Computing

Cloud computing making the world even flatter. Public cloud provider can provide resources locally or globally. In which that in case limit of the sky. Each Cloud user do not required to in theory where the computing resources is location is because they are all the virtualized.

Now we see the starting of cloud data life cycle. Data and the information are changeable the terms. In general thing cloud computing in which that data life cycle includes collection strove, transferring and the destruction.

The data collection in which that two types of data can included such as raw data and derived data. Derived data is also known as information that is generated from raw data to deliver intelligence, which is not used to easily from the raw data. There are Data storage and inactive storage. Data storage and the data processing are not necessarily under the same location in the cloud environment. Data destruction is to destroy data permanently, no backup should be left somewhere either user side or the provider side.

B.Checklist for Public Cloud

Government is kept to use public cloud to take the advantages of the cost effective by the providing public useful information in cloud. It can mention the cloud concepts to the integrated computing resources. There are different

departments in the manageable pool. It auditing in public cloud can have different type which is based on different type of services model. There are address two popular service models in this topic, Infrastructure as a Service (IaaS) and Software as a Service (SaaS).

IaaS: Infrastructure as a Service (IaaS) is very popular service model that provides computing resources to cloud users who deploy operating systems and run their applications on top of it or use it as a storage or archive. When it comes to IT auditing, location, geopolitics, data owner and regulatory issues are not going to be virtualized.

1. Data Location Aware

Rationale: Infrastructure as a Service (IaaS) is a popular service model that provides computing resources to cloud users who deploy operating systems and run their applications on top of it or use it as a storage or archive. When it comes to IT auditing, location, geopolitics, data owner and regulatory issues are not going to be virtualized.

2. Data Ownership Aware

Rationale: Data owner in public cloud is always to small issue between providers and users. We see that it happened in the argument among too same as face book and its related users, many cloud users are sure that to avoid such complicated situations. So far, no universal legal guidance is established. Cloud users assume they are the owners of their data. This application should be written in an agreement.

When it comes to then move the data out of the data are destroyed completely & how. No backup should be there left alone when the data is supposed to discard. The process should be written in the agreement.

What: It is clearly that stated in the agreement on data ownership on data life cycle. Also included the data destroy and verification process.

How: Discuss with the cloud coordinators about the data ownership and data life cycle management. Now we have written the document about on data ownership the procedure of data removal.

3.Regulatory Compliance

Rationale: We make compliance in public cloud is a daunting task.

What: Regulatory compliance in terms of public should be including that privacy, security rule, information system Controls, etc.

How: understand the specific needs of compliance for the enterprise by talking to the compliance officer's and chief information officers. Collect all the documents and there information.

4. Cloud IT technique

Rationale: IT auditing toward to the public cloud is challenging because the IT is the basically depends on and offered by a third party to which depending on the agreement auditors may not have direct access. Practical IT auditing techniques need to refine to reflect the change.

What: The techniques should be include database, datacenter, wired and wireless connection, cloud operating system like virtual technology like VMware, Hardware dependencies.

How: It auditors should find out the agreement using the third party cloud provider, how far it can go and test, talk with the cloud coordinators what are procedures of reporting any incidents, inspecting specific areas routinely, what kind of tools can use.

5. Reporting Control

Rationale: cloud control structure should be there with or without cloud presence. It is required by SOX. Although SOX is for public trading companies, private companies are recommended to do so too. With cloud presence, the reporting and responsible extend to third parties as cloud providers.

What: Reporting structure should be all the way to CIO, CEO or Board of Directors. It includes incidents and response mechanisms involving cloud providers.

Usually it is written in an agreement with cloud providers.

C. SaaS

Software as a Service (SaaS) is a popular cloud service model. Applications are accessible various web browsers. It pays for usage. Many checklist items are similar as those from IaaS. Now we list some of special toward to SaaS.

1. Data Activity Surrender

Rationale: Some countries require to that data and activity from SaaS providers should be kept within the national boundaries so that government agencies can access them when needed. USA has USA Patriot Act that mandates SaaS providers keeps all the customer data that can be accessed under special occasions such as court order. This is not a pleasant outcome many SaaS users want. Therefore SaaS

users should ask if there is a possibility that can avoid such intrusion.

2. Data Format

Rationale: If data format from specific software can be read by many freely available readers like adobe, work, open office and notepad, SaaS users can avoid pay extra software usage. Data can be format using to support the specific software.

What: Check available data format from the software service.

How: It auditors should test out all availability data format and check if these format can be accessed by general reader applications. They should talk to users to find out reasons that specific format being used or not used.

3. Monitoring for Availability

Rationale: From SaaS providers, assuring high level of availability and performance is the key for their business success. For SaaS users, monitoring high availability and performance is an important control.

What: The monitoring control should collect availability and performance data and use the data to work with providers to fine tune SaaS service's can collect the availability and the performance

How: Talk to cloud coordinator about such type of controls and data for offline analysis.

4. Community Cloud IT Architecture

Rationale: Clear cloud community IT architecture will help the community understand its computing resources and its capacity. It can help to community. It can help to build responsible community.

What: The Community Cloud IT architecture should include core infrastructure, resource layer and service layer. Data life cycle, user identifies and trusts are important elements. Use case analysis is proper. If the cloud is built upon the contribution of the community, the relation among own computing resources and the community resource should be marked clearly.

How: Talk to cloud administrators to get a sense of its architecture. If possible, get technical documents that describe the community cloud.

5. Community Cloud Management

Rationale: Because community cloud is used by a group of industrials of same regions or of same interests, they are collaborative and in the mean time competitive. Clear community cloud management structure will prevent any future arguments. Community cloud can be managed by a third party or by a technical committee made from the community.

What: It should include clear management structure and responsibility. It should include the procedure in case of argument and disagreement.

How: IT auditors from a specific member of the community should have access the latest documents on management.

D. Checklist for Private Cloud

Checklist for a private cloud is a very practical approach and attractive option to many security sensitive enterprises. The private cloud gives not only the self control but also the benefits of cloud computing, it is mainly sharing computing resources including processing power and storage capacity among different departments within an enterprise. Traditionally, department computing resources are not shared due to data sensitivity, self control and different business nature of departments. Private cloud could remove or blur these boundaries

Each department is allocated by computing resources from the pool by provisioning need on demand. From the department point of view, the computing resource is unlimited. Therefore achieving a task faster or making a task not achievable before due to computing power constrain.

In most cases, a private cloud could cut IT cost down; it is increase the flexibility and scalability also, make available 24x7 and even do applications that are impossible before the cloud. Private cloud certainly poses a great management challenging as well as auditing challenging. It virtualizes of all computing resources from the different departments into the computing resource pool.

E. Private Cloud IT Architecture

Rationale: Different enterprise implements private cloud differently from actual technology in real situation. Therefore it understand to the cloud IT architecture is vital for meaningful of IT auditing

What: IT architecture included those technical details about virtualization as well as provisioning, workflow, access

control, etc. It is also details about virtualization for data movement.

How: Talk to cloud administrators to get a sense of its architecture. If possible, get technical documents that describe the cloud. 20. Private cloud reporting control

Rationale: Like public cloud, reporting is required not only by the regulation but also vital to the success of the business. Private cloud reporting is more of internal control. Because of sharing computing resources, private cloud has to make sure that sharing does not hamper security and privacy. Any incidents should be logged and reported immediately. The reporting structure should be established and updated often.

What: Reporting structure should includes incidents and response mechanisms and who is in charge. The escalating reporting structure can guarantee any incident and disaster can be handled properly.

V. WORK DONE

In this work we have implemented the proposed approach of security with incident management system. The application of Checklist Generation or incident management system is based on online problem solving of the user by simply specifying some necessary details of the user. The major purpose of this application is that the users can generate the request through online process and can view the related solutions by the same source. By using this system one can get solutions without any waste of time.

One more benefit is that the checklist generation helps to keep the record of the system in a log format. This helps in solving the future upcoming problems related to the devices.

VI. CONCLUSION

Thus, according to our discussion above, we presented the framework of IT auditing cloud computing to assure secure cloud computing. It is more toward Cloud than a complete list of IT Auditing. IT auditors should refer general requirements for IT auditing. The checklist also gives a reference point to those want to dive into cloud computing wave and a question set to answer if cloud is good for the business in long run. We would like to discuss on PaaS service model in the future work as we are still looking for a feasible PaaS business model.

REFERENCES

- [1] NIST, Definition of Cloud Computing , Vol. 15, accessed on 4/15/2010, <http://csrc.nist.gov/groups/SNS/cloudcomputing/cloud-def-Vol.15.doc>.
- [2] Will Forrest, Clearing the Air on Cloud Computing, Discussion Document from McKinsey and Company, March 2009.
- [3] Luis M Vaquero, et al, "A Breaks in the Clouds: Toward the Definitions", *ACM SIGCOMM Computer Communication Review*, Vol. 39, No.1, January 2009, pp 50-55.
- [4] Open crowd cloud computing taxonomy, <http://www.opencrowd.com/views>.
- [5] Gramm-Leach-Bliley Act (GLBA, the Financial Services Modernization Act), <http://www.gpo.gov/fdsys/pkg/PLAW106publ102/contentdetail.html>.
- [6] HIPAA U.S. Department of Health & Human Services, Office of Civil Rights, HIPAA, <http://www.hhs.gov/ocr/hipaa/privacy.html>
- [7] IDE Enterprise Panel, August 2008, n = 244
- [8] Cloud Computing, the role of internal auditing, Ernst and Young, PPT presentation, October 8, 2009
- [9] Sarbanes-Oxley Act 2002, U.S. Securities and Exchange Commission (effective July 30, 2002), <http://www.sec.gov/about/laws/soa2002.pdf>
- [10] Payment Card Industry Data Security Standard, https://www.pcisecuritystandards.org/security_standards/pci_dss.shtml
- [11] SAS 70 Audit: <http://www.aicpa.org/download/members/div/auditstd/AU-00324.PDF>
- [12] Security Guidance for Critical Areas of Focus in Cloud Computing, Vol. 2, by Cloud Security Alliance, December 2009.
- [13] OpenSecurityArchitectureGroup <http://www.opensecurityarchitecture.org/cms/library/patternlandscape/251-pattern-cloud-computing>
- [14] Gerard Briscoe, Alexandros Marinos: "Digital Ecosystems in the Clouds: Towards Community Cloud Computing", *IEEE Digital Ecosystems and Technologies DEST (2009)*, online access at http://arxiv.org/PS_cache/arxiv/pdf/0903/0903.0694v3.pdf
- [15] Data is cited from several IBM presentations. For Example the IEEE Services I (2009) keynote.