

Certain Investigations on the Security Issues in Cloud Computing

¹M. Newlin Rajkumar and ²S. Palaniswami

¹Department of Computer Science and Engineering, Anna University,
Regional Centre, Coimbatore, India

²Government College of Engineering, Bodinayakanur, India

Abstract: Cloud computing is an emerging technology holding a place for numerous applications. Understanding of cloud computing is still endlessly increasing and so it has to be clarified often in various aspects. This substantial technology coming forth provides flexibility and elasticity of dynamically scalable resources which are provided and delivered on-demand as a service offered by cloud environment providers in various fields over the internet which is supposed to lift the burden in several business needs without any motive of investing in new infrastructure or licensing new software. Cloud being popular plus transparent to users and applications its significant features have to be known necessarily. A clear perspective of different types of cloud, several characteristic features, various applications of cloud computing and security threats are outlined here which furnishes a beneficial basis for better understanding.

Key words: Cloud computing, types, characteristic features, applications, outline

INTRODUCTION

Cloud computing technology is being involved in the daily life. Researchers are utilizing it in one way or other through the mobiles, computers, servers, different software's, etc. but still most are unaware of the same. Being able to access all of the personal data at any given moment having the ability to organize and mine data from any online source, being able to share the data like photos, movies, contacts, e-mail, documents with your friends, family and coworkers in a moment and briefly all the information that we access instantly is possible in today's world through cloud computing.

The term "cloud" originated from the network diagrams where researchers drew a cloud to represent the internet. It is an environment with the availability of computing resources of all kinds-networks, servers, databases, online applications and services which will be always on, anywhere and any place at a lower cost (Knorr and Gruman, 2012). Various hardware and software services are also available to the clients. Cost saving is a major factor for organizations in considering the cloud services. The third parties who lease the computing resources to the customers based on 'pay as much as used and needed' type of utility computing are the CSPs-Cloud Service Providers (e.g., Google, Microsoft, Amazon) (Youssef, 2012). Companies and applications are dependent on the system infrastructure

while cloud computing makes them to be infrastructure-less and thus no need to know the underlying details of infrastructure.

The National Institute of Standards and Technology (NIST) provides a concise and specific definition which is mostly accepted: cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell and Grance, 2009).

Cloud environment allows access from a variety of end points such as mobile phones or a desktop as long as an electronic device has access to the web. The cloud services are spread based on the requirements of the customers which are accessible anytime, whenever needed and paid based on the usage of the service. Thus, the Cloud Computing Service Models (Vuyuru *et al.*, 2012; Srinivasa Rao *et al.*, 2009) are grouped based on the requirements or needs of the customer. The models are given:

Software as a Service (SaaS): Service providers applications are used by the consumers over the network on-demand and paid as per the usage of service. The advantage is that there is no need for the users to manage or control the various applications in the network. Examples: Google Docs, Salesforce.com, SAP Business by Design and Zoho.

Platform as a Service (PaaS): The customers deploy their own applications and software in the cloud by buying access to the platform. Therefore, the users control the applications and there is no need for them to manage the servers or storage. Examples: Force.com, Google App Engine, Aptana and Windows Azure.

Infrastructure as a Service (IaaS): The computing resources are provided by the service providers where the customers are responsible to control, run and maintain the operating systems, applications, storage and network connectivity but they doesn't need to control the cloud infrastructure. Examples: Amazon web service, Zimory, Elastichosts, Dropbox, Akamai.

As cloud computing is not limited to a specific service model, these service models are considered as particular usage pattern for a virtualization of resources with various increased capabilities. Cloud environment is a set of combined technology or approach offering assistance in almost all the fields and benefiting end users with different requirements for services in various aspects. Cloud computing have commenced to take hold

and cloud services are becoming popular as its purpose and benefits are uncountable and apparent. The following are some of the major and possible benefits of cloud environment:

- Users can synchronize all personal information with the cloud servers which will be protected
- As it is paid only for what they need and on demand the capital expenditures will be reduced
- Retrieve information and can access from anywhere whenever needed
- Without downloading or installing anything a huge range of applications can be accessed
- As there were instant updates users can make use of innovations
- Device independence when moved to portable device applications and documents are still available
- Scalability means that unlimited processing and storage
- Better collaboration as companies share documents in one place
- Reduced administration efforts

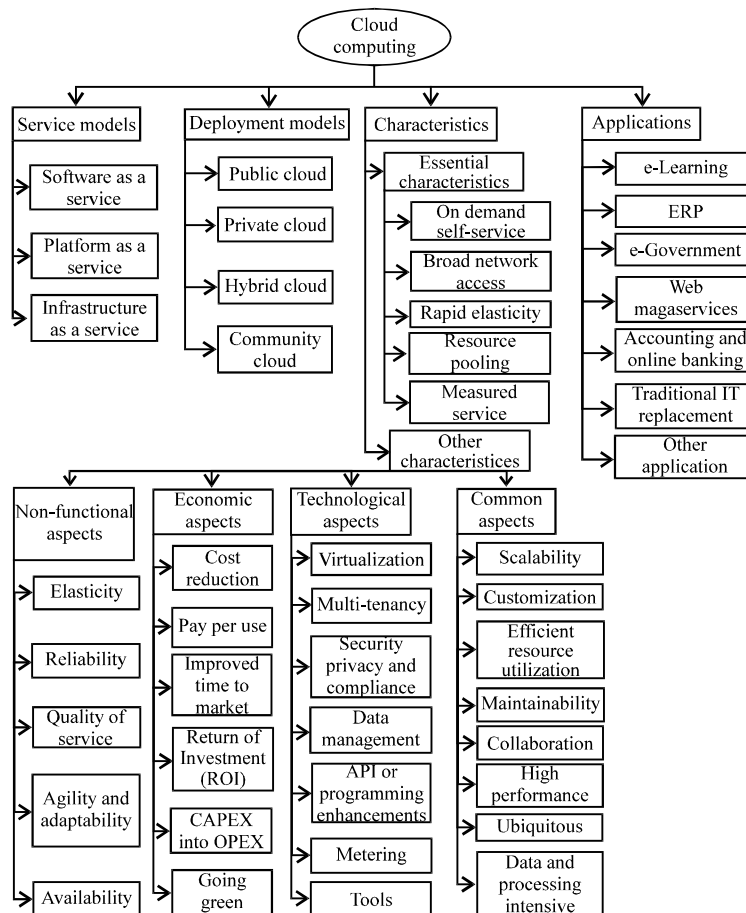


Fig. 1: Cloud computing characteristics an ample perspective

- No upfront investment as it is billed on-demand
- Increased data reliability in case of any crash of PC data is still accessible as cloud computing is data safe platform
- Location independent, virtualized and dynamic
- High level computing with 24/7 support

From the benefits described above, it is apparently clear that cloud computing is suited for almost all areas in business and these were the reasons for an organization to consider cloud services.

Therefore, a comprehensive perspective of cloud services, characteristic features and application is needed necessarily for understanding the cloud environment in better which is the main objective of this study. Figure 1 exploits a clear perspective of cloud computing which clearly depicts the cloud characteristics.

TYPES OF CLOUD

Cloud services generally earned a standard among companies and the driving force behind that are the needs to store most of the applicable data and services merely being accessed from anywhere efficiently. Depending on the requirements the types of cloud can differ and based on that four deployment models have been named, each with particular features that hold the needs as well as depict the scope of the services offered to the customers based on the motives of users of the clouds in specific ways (Youssef, 2012; Dialogic Corporation, 2010). The following are the types of cloud via which the cloud services are offered.

Public cloud: The services rendered by a public cloud are made available by cloud service providers who own and manage the cloud. The cloud infrastructure and other services are offered to the general public over the internet. This enables a consumer to develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options. The thing which makes customers uneasy in this type of cloud is security and privacy (Jansen and Grance, 2011; Dialogic Corporation, 2010; Vuyyuru *et al.*, 2012).

Private cloud: The cloud infrastructure is deployed, maintained and operated solely for a single company even though it is managed within the company or by a trusted third-party with certain assumptions and hosted internally or externally. As this cloud is private, users are trusted inside the system and so it is thought to be more

secure than public clouds. Still have to buy, build and manage them is the concern of users for this type of cloud (Sharma, 2012; Youssef, 2012).

Community cloud: In community cloud the infrastructure and computing resources are shared among a number of organizations with similar interests, policy, mission and other common concerns like security requirements. It may be managed internally or by a third-party and may be hosted internally or externally. This helps in limiting the capital expenditure costs for its establishment as the costs are shared among the organizations. An educational cloud shared by universities and institutes providing educational and research services is an example (Sharma, 2012; Dialogic Corporation, 2010; Youssef, 2012).

Hybrid cloud: Hybrid cloud is a composition of two or more public, private or community clouds whose components are bound together with unique entities extending benefits of Multiple Deployment Models. The clouds have the ability to move data and/or applications from one cloud to another through their interfaces. Companies and individuals apply this architecture to get levels of fault tolerance parallel with immediate usability without dependency on internet connectivity. This architecture requires both on-premises resources and off-site (remote) server based cloud infrastructure. In the hybrid cloud important actions can be run under the private cloud other various tasks can be done with public component (Youssef, 2012; Sharma, 2012; Dialogic Corporation, 2010).

CHARACTERISTICS OF CLOUD

Cloud computing being a paradigm with superior capabilities it is mandatory to detail the important characteristics that enable the cloud services satisfying the anticipations of customers. Therefore, the variety of characteristics of cloud that makes them hopeful can be categorized as: the essential characteristics of cloud, other characteristics based on non-functional aspects, economic aspects, technological aspects and common characteristics of cloud (Schubert *et al.*, 2010; Youssef, 2012).

Essential characteristics of cloud: The five essential characteristics for cloud computing is defined by the National Institute of Standard and technology (Jansen and Grance, 2011). The following five characteristics are considered essential because they are required in any cloud environment. Thus, the essential characteristics (GTSI Group, 2009; Youssef, 2012) are listed.

On-demand self service: The customers can get computing capabilities such as network or server service, storage, applications, email automatically whenever needed without requiring human interaction with each service providers.

Broad network access: The various resources available over the internet are accessed by the customers through different platforms like desktop, laptop, PDA, mobile phone.

Resource pooling: The service providers computing physical and virtual resources which are allotted and reassigned based on the customers demand are pooled into the cloud to provide service to multiple clients. These pooled resources are location independent; in general the customer has no control or knowledge over the exact location of the provided resources but the location can be determined at a higher level of abstraction may be of country level, state level or data center level.

Rapid elasticity: Based on the demand of the customers cloud services can be rapidly and elastically provisioned. It is the ability to rapidly scale in and scale out of the service. The resource available for provisioning frequently seems to be limitless to the consumer and in any quantity can be purchased at any time.

Measured service: As cloud computing is transparent to both the providers and the users, the service used by the customer can be measured, controlled and reported. This metering capability enables to control and optimize resource as per usage. Thus, the services are used in a manner similar to the basic services like water, gas and electricity where it is charged as per the usage-‘pay per use’.

Other characteristics of cloud

Characteristics based on non-functional aspects: Non-functional aspects represent qualities or properties of a system, rather than particular technological requirements. Absolutely, they can be recognized in multiple fashions and understood in different ways which strongly differ between providers as they follow their own approaches to take in their respective requirements. This may lead to strong issues between service providers. Non-functional views are one of the key reasons why “clouds” vary so sturdily in their interpretation. The most important non functional characteristics are given (Expert Group Report, 2010).

Elasticity: It is one of an essential characteristic of cloud system and it is the capability of the primary infrastructure

to adjust to changes, potentially non-functional requirements for example amount and size of data supported by an application, number of concurrent users, etc.

Reliability: It refers the potential to ensure stable operation of the system without trouble, i.e., no loss of data, no code reset during execution, etc. Reliability is typically achieved if multiple redundant sites are utilized which makes well-designed cloud computing appropriate for business continuity and disaster recovery.

Quality of service: It is a significant capability which guarantees metrics like response time, throughput, etc., so as to ensure that the quality guarantees of the cloud user are met.

Agility and adaptability: It relates to the elastic potential. On-time effect to changes in the quantity of requests and volume of resources and also adjustment to changes in the environmental conditions, e.g., require different types of resources, different quality, etc. Users’ ability is improved to re-provision technological infrastructure resources.

Availability: It is the ease of use of the cloud services by the users whenever needed. With increasing simultaneous access, availability is mainly achieved in the course of replication of data/services and distributing them across different resources to realize load-balancing. This can be regarded as the new essence of scalability in cloud systems.

Characteristics based on economic aspects: One of the major factors and interest for an organization to consider the cloud services is typically reduction in cost. Thus, the various characteristics of cloud systems considering the economic aspects it should fulfill the following (Expert Group Report, 2010).

Cost reduction: It is one of the primary concerns to develop a cloud system so as to become accustomed to varying consumer behavior and reduce cost for infrastructure maintenance and acquisition. Whenever using web-based applications, PC can be less pricey with a smaller hard disk and less memory.

Pay per use: An ability to charge granting to the actual utilization of resources is a relevant feature of cloud systems.

Improved time to market: It is necessary especially for small, medium and large enterprises that wish to sell their

services rapidly and easily with small delays caused by acquiring and setting up the infrastructure. Clouds can support this by providing infrastructures, potentially dedicated to specific use cases that take over essential capabilities to support easy provisioning and thus, reduce time to market.

Return of Investment (ROI): It is essential for all capitalists and cannot be guaranteed for all time in reality some cloud systems presently fail this feature.

Turning CAPEX into OPEX: It is a hidden and much pointed characteristic of cloud systems. The Capital Expenditure (CAPEX) that have to be spent on building an infrastructure is saved using cloud services as it makes infrastructure dependent companies to be infrastructure-less. And thus it can be spent on other operational needs as Operation Expenditure (OPEX).

Going green: As the resources are shared among users it does not require large resources that consume a lot of power thus reduces additional cost of energy consumption. It also reduces carbon footprint that is carbon emission by machines during scaling up.

Characteristic based on technological aspects: The various technological challenges utterly begin as of from the non-functional and economical aspects when trying to realize those capabilities specifically. Thus, the various technological characteristics identified commonly in the cloud systems are the following (Expert Group Report, 2010; Sharma, 2012).

Virtualization: It is a necessary technological characteristic of clouds which conceals the physical resources from the user and in the course of aggregation, routing and translation improved flexibility is enabled. Further, virtualization supports the following characteristics.

Ease of use: As virtualization hides the complexity of the infrastructure it is made easier for the user to build up new applications, in addition also cuts down the overhead intended for controlling the system.

Infrastructure independency: In standard, the code platform is made independent which leaves higher interoperability.

Flexibility and adaptability: As a virtual execution environment is exhibited, the essential infrastructure can vary more flexible by allotting more resources according to different conditions and requirements of users.

Location independence: It is easy to access the services independent of the physical location of the user and the resource.

Multi-tenancy: Multi-tenancy helps resource sharing to multiple users at the same time and costs across a large pool of users thus allowing for:

- Minimizing costs, since the infrastructure is centralized in locations
- Peak-load capacity increases the need of the users but does not wangle for highest possible load-levels
- Optimizing the utilization and enhancing efficiency for the systems that are seldom utilized

Security, privacy and compliance: It is apparently necessary for every cloud as it deals with potentially sensitive data and code where private cloud will be more secure than the other.

Data management: It is an important feature especially for storage clouds where data is disseminated throughout multiple resources flexibly where the system desires being aware of the data location accounting various latencies and specifically the load. In the broad distribution of data sources, data consistency needs to be preserved.

Application Programming Interface (API): It is an essential which is the accessibility to software that enables machines to interact with cloud software in the same way the user interface facilitates interaction between humans and computers. It is a fashion that permits the user to leave such management to the system.

Metering: It is a main feature as elastic pricing, charging and billing is offered based on the resource and service consumption since the storage capacity is unlimited. It is therefore a pre-condition for the elasticity of clouds.

Tools: These are commonly needed to sustain development, variation, usage of cloud services and updating latest software's.

Other common characteristics: Various other characteristics of cloud computing are (Youssef, 2012).

Scalability: With small changes to the cloud infrastructure and software the providers can add new resources to the cloud can be a new server or node.

Customization: It based on user demand the cloud can be customized and changes can be made in terms of infrastructure and software which is a reconfigurable environment.

Efficient resource utilization: Resources are efficiently utilized as they are delivered only when needed.

Maintainability: As provided by the provider's user's burden for maintaining the systems is reduced.

Collaboration: Several users can collaborate easily on documents and projects inside an organization or among different companies.

High performance: As the cloud environment is with enormously large storage and potential resources the users are provided with high performance computing.

Ubiquitous: Various cloud services can be accessed at anytime from anywhere over the internet by the consumers.

Data and processing intensive: Though the personal computer crashes, all the data is still out there in the cloud, still accessible by the users used based on their demand.

APPLICATIONS OF CLOUD

Cloud systems come across a wide range of application in changing scenarios. The most promising benefits and characteristics have been outlined previously in detail. In this study the various applications towards cloud computing is presented which may serve as a "principle" for next upcoming application of cloud technologies (Expert Group Report, 2010; Youssef, 2012; Sarna, 2011).

Cloud for e-Learning: This powerful, cost-effective cloud services are provided for universities and research centers which benefits-the students as they can bond to their campus educational services with their mobile devices, faculty members can cover an efficient access to their class material, researchers can come across important articles and even can run their experiments in the cloud which will be faster. The various services of an e-Learning cloud are: class recording, virtual classroom, education forums, surveys, virtual conference and meeting, files broadcasting, e-mail, simulation tools, etc.

Cloud for ERP: No need for managers to be bothered about installing various software applications, upgrading and maintaining applications inside their organizations while all these were necessary in traditional ERP. They can get in lease instead of purchasing new one. Generally, ERP providers provide scalable resources with

low cost where the capital expenses of organizations are reduced attaining higher Return on Investment (ROI) and with appropriate availability of information's. The various services of an ERP cloud are: supply chain and vendor, projects and HR management, Customer Relationship Management (CRM), finance and accounting, manufacturing, production, delivery, etc.

Cloud for e-Government: This also has several benefits as before no need for upgrading, maintaining, licensing as the environment provides scalable, customizable and potential resources. This assists in improving the government roles to citizens, organizations and mutual aid with other governments. The various services of an e-Governance cloud are: complaint resolution system, employee management system, education management system, e-Police, e-Court, payment and tax system, transportation, water, electricity, gas, healthcare and insurance system, agriculture and food, industries, etc.

Web megaservices: In the existing services megaservices are the lead as they provide improved capabilities when they were combined and extended. Examples of accessible megaservices are prominent search engines working throughout large quantity of resources (Google Search, MS Bing, etc.) and social network sites incorporating media and unlike service types (Facebook, StudiVZ, etc.).

Accounting and online banking in the cloud: Accounting and banking are done using various cloud services, e.g.: Quickbooks, CapitalOne, NetSuite for small business accounting which are interfaced with online banking. Web based bill payment is also done by the cloud services (e.g., intuit financial services). Pitney Bowes application is that which is used when shipping an order online.

Traditional IT replacement: Mostly the cloud services and its capabilities are benefiting IT more rather than other user. As IT always needs additional capabilities are added without investing in new infrastructure, no need invest in buying new software, it also gives importance to security and privacy concerns in addition to that data management and federation issues are also covered. Thus, the cloud services are extending IT's current capabilities (Knorr and Gruman, 2012; Expert Group Report, 2010).

Other applications: Cloud is used for various applications if you are using Gmail and Google Docs then you are already using cloud computing technology. To electronically send and receive faxes cloud-based Rcfax.com can be used, the call to published phone

number are handled by cloud based Google voice where the call can be accepted by any number linked to the Google voice account can try those based on priority, chatting with customers and partners in any language, can organize travel using tripit.com, ensuring business continuity can securely share and collect information like images, videos, documents, etc are the various other applications with several benefits (Sarna, 2011).

SECURITY THREATS IN CLOUD COMPUTING

As internet is wide open for attackers, cloud computing is prone to security attacks. The sharing of resources is possible only through the internet and the connection is exposed to virus, worms, trojans, bots and also to malicious users. There cyber attackers form a team to exploit the vital resources of an organization and utilize them for their malafide intentions. The result is loss of data, compromise in confidentiality, integrity and authenticity. Due to advancement in internet services, the number of hackers increases day by day and as a result the cost of protecting data is also increased. This is a major issue for any organization using cloud computing standard. Some specific examples regarding the vulnerability aspects in cloud computing around the globe is listed below (Bisong and Rahman, 2011; Rimal *et al.*, 2009):

Google was hacked: Google, the most popular search engine and an important service provider was hacked by some attackers from China. Data is available all over the world but the legal security aspect between countries differs in sharing the data. Even the neighborhood countries have different norms and protocols in data sharing. The original location of the data and the host nation holding the data matters a lot and plays an important factor in the security context. Moreover, some sort of errors which crept in Google programming created an outage in Google search engine for almost 40 min and made a huge negative impact on the security features of cloud computing. This vulnerability scenario worsens, if there are not enough security principles or procedures in the host nation which stores confidential data or sensitive resources. In some cases, the data sharing nation may not be supporting data sharing properly or the sharing restrictions may be very rigid or the protocols of sharing may be taut. Since, there are many security constraints in data sharing, it is not a simple task for secure data transfer in cloud computing.

Shutdown of cloud applications: Due to bugs in the cloud environment, in some cases all the cloud applications

were not available to the users for hours and sometimes for days. This is a major issue due to the creeping of bugs inside the cloud scenario. A huge loss could have happened for the organizations that have been linked up with the above said issue.

A service of Gmail was unavailable: The Gmail server of Google was shut down for 2 h due to the vulnerability threats in the working environment.

Gmail and Google Apps engine was shut down: The services provided by Google server based Google Apps Engine was shut down for two and half hours and made a major loss to the business personnel.

Partial malfunction in Google Apps engine: This partial malfunction was caused due some programming errors and the duration of malfunction was a massive 5 h.

Failure causing unavailability of services: This deficiency in service was caused due to the overload, in the time of authentication by the authentication service. The unavailability of service prolonged for 2 h.

Failure causing gossip protocol blowup issue: This failure was the result of not identifying single bit error problem and the service block continued to an extent of 6-8 h.

Flexiscale's core failure: The Flexiscale, Europe's premier service oriented cloud computing platform was completely shut down for >18 h due to core network failure.

Ctrix's GoToMeeting and GoToWebinar was not available: Ctrix's GoTo Meeting, a global forum to share worldwide desktop resources was not available for a short span of time. Moreover, Ctrix's GoToWebinar, an online conference website for webhosting and conduction of web based events was also not available temporarily.

Amazon.com's simple storage service-stopped functioning for 8 h: Amazon.com's simple storage service was "out of commission for excruciating an 8 h duration".

Microsoft's azure malfunctioned: This malfunctioning was a massive "Denial of Service" aspect in cloud computing and continued for 22 h.

All the above state 11 cases are just samples of loop holes prevailing in the cloud computing scenario and ended up with a huge loss in time, money and trust. Lot of research works are in progress especially in this hot topic. The next part of this study surveys the type of threats, reasons for posing such threats and possible notions to

defend the threats in cloud computing. Based on the detailed research by the cloud security alliance the following seven threats are given (Bisong and Rahman, 2011):

- Abusively and nefariously using the cloud computing resources
- Application Programming Interfaces (API) utilized is not secure
- Malicious insiders
- Shared technology vulnerabilities
- Data loss/leakage
- Account, service and traffic hijacking
- Unknown risk profile

The characteristics and the menace caused by such security threats in the cloud environment are listed (Help Net Security, 2010; CSA, 2010).

Abusively and nefariously using the cloud computing resources: Reasons for this type of threat:

- Registration policies of IaaS solutions are easy and simple
- Cyber offenders and hackers easily crack the solutions provided by IaaS and the comparative vagueness divulged by these solutions

Methods of initiation of this threat:

- Solutions provided by IaaS are identified by hackers
- Cracking mechanisms are employed which includes password cracking, key cracking, etc.

Possible notions to defend this threat:

- IaaS solution providers should take care of tightening up their links that are weak and easily exposed to threats
- The registration policies should be refined and re-formulated based on the service provided
- Proper observation of customer network traffic should be done which proves vital in defending this type of threat

Application Programming Interfaces (API) utilized are not secure

Reasons for this type of threat: Application Programming Interfaces (API) or the interfaces of the software's, are the mediators which serve between the customers and the Cloud services. If there is a leach or flaw existing in any section or code of the application programming interfaces, then this type of threat could be posed and generally expected to be initiated in a large firm.

Possible notions to defend this threat:

- Systematic analysis of application programming interfaces and implementation of proper security procedures at the right time, is always the prime and in turn, the best solution
- Authentication schemes should be secured in an intense manner
- All the procedures and policies of access control should be constricted
- Utilizing secure encryption standards and periodical scrutiny/monitoring techniques for the undergoing activities should be followed
- Whenever third party authentication comes into picture the above mentioned solution has to be stretched more

Malicious insiders

Reasons for this type of threat: Any malicious employee, the insider of an organization can pose this type of threat. This malicious employee is difficult to be identified because the HR policy details of the organization, in terms of recruitment of employee, privileges given to the employee for of accessing the assets or resources of the organization and the system followed to monitor the employees activities in an organization are concealed.

Possible notions to defend this threat

- Following the policy of transparency will suit this type of threat and will be of core importance for achieving security in cloud computing, in this case, vital to a secure cloud offering
- Demanding compliance report is an advisable standard along with a robust notification of the identified breach proves worthy

Shared technology issues

Reasons for this type of threat: Sharing technology is the core perspective of any IaaS provider and done through sharing the infrastructure. This type of threat is posed, when the design of the components does not suit the infrastructure which is based on the components.

Possible notions to defend this threat

- It is necessary to restrict the customers not to lace on their neighbor's zone
- Periodic monitoring, each other's "territory", monitoring and high level of partitioning is strongly recommended for implementation

Dataloss or leakage

Reasons for this type of threat:

- Data are deleted and lost. No backup scheme is available

- When encoding key is lost, it is possible for a huge data loss
- Personnel who are not authorized to use the system and the resources try using the system and thereby could create damage to the data or total data loss

Possible notions to defend this threat:

- Effectively using standard encryption techniques
- Proper usage of restoration from disaster and quality disaster recovery to defensible backup schemes
- Employing securable standards of destruction

Account or service hijacking

Reasons for this type of threat: Hacking an email account is possible nowadays and so hacking an account in a cloud environment is highly possible.

Effects of this threat:

- The hacker could gain access to the data, capture data, modify it and break the integrity of data transaction
- Moreover, the hacker can manipulate the transactions and also divert the legible client who is the solution seeker to a phishing website controlled by the hacker

Methods employed by the hacker to pose this threat: The hacker posses a phishing website and well pursued social engineering skills.

Possible notions to defend this threat:

- Using robust authentication schemes
- Employing updated and suitable security policies
- Eventual and effective surveillance should be carried out to overcome this type of threat

Unknown risk profile

Reasons for this type of threat: Thinking of minimum security measures is the main reason for this type of threat.

Possible notions to defend this threat:

- The first, the foremost and the prime priority should be given to security
- Regular updation of the codes should be done
- Proper, consistent and systematic security principles should be practiced
- Vulnerability records should be maintained properly
- The attempts of intrusion activities should be noted and monitored periodically

CONCLUSION

The main principle of cloud systems is the dynamic delivery of information technology resources, capabilities and latest updates as a service over the web. It is a style of computing which enables to be dynamically scalable and repetitively virtualized resources are rendered as a service over the Internet which are predominantly useful for composite event, data and stream processing connecting, from and to devices. In this study, the various types of services of cloud computing are explored which generally incorporates Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS). The various benefits of cloud due to which it became popular, the deployment models of cloud which attracts the user, a variety of promising and interesting significant characteristic features of cloud which ensures business continuity are outlined to an extent. Finally, the wide range of applications of cloud in various discipline are covered. It is expected that this comprehensive perspective of cloud characteristics will be the basis for adopting the technology and help the individuals and organizations to understand the impact of clouds in better.

As exploiting in a cloud environment is becoming most recent fashion, beyond its advantages it erects questions concerning its security dynamics and privacy. Though, the providers assure about security in accessing the personal information still users and organizations are concerned about sensitive data as chances are there for the providers to access or accidentally alter or delete some data. Thus, the security problems, management problems, soft and hard privacy have to be investigated a lot in future which could be useful and encouraging for the end-users.

REFERENCES

Bisong, A. and S.S.M. Rahman, 2011. An overview of the security concerns in enterprise cloud computing. *Int. J. Network Secur. Applic.*, 3: 30-45.

CSA, 2010. Top threats to cloud computing V1.0. Cloud Security Alliance, March, 2010. <https://cloudsecurityalliance.org/topthreats/csathreats.v1.0.pdf>.

Dialogic Corporation, 2010. Introduction to cloud computing. White Paper, Dialogic Corporation, Montreal, Quebec, Canada.

GTSI Group, 2009. Cloud computing-building a framework for successful transition. White Paper, GTSI Corporation, USA.

Help Net Security, 2010. Top 7 threats to cloud computing. <http://www.net-security.org/secworld.php?id=8943>.

- Jansen, W. and T. Grance, 2011. Guidelines on security and privacy in public cloud computing. The National Institute of Standard and Technology, U.S. Department of Commerce, NIST Special Publication 800-144. <http://csrc.nist.gov/publications/nistpubs/800-144/SP800-144.pdf>.
- Knorr, E. and G. Gruman, 2012. What cloud computing really means. Agency Sales, 42, 2, ABI/INFORM Complete, pp: 52.
- Mell, P. and T. Grance, 2009. The NIST definition of cloud computing. Version 15, National Institute of Standards and Technology, October 7, 2009. <http://www.nist.gov/itl/cloud/upload/cloud-def-v15.pdf>.
- Rimal, B.P., E. Choi and I. Lumb, 2009. A taxonomy and survey of cloud computing systems. Proceedings of the 5th International Joint Conference on INC, IMS and IDC, Seoul, South Korea, August 25-27, 2009, IEEE Computer Society Washington, DC, USA., pp: 44-51.
- Sama, D.E.Y., 2011. Implementing and Developing Cloud Computing Applications. Taylor and Francis Group, Auerbach Publications, USA.
- Schubert, L., K. Jeffery and B. Neidecker-Lutz, 2010. The future of cloud computing opportunities for european cloud computing beyond 2010. Expert Group Report, Public Version 1.0. The Commission of the European Communities, Information Society and Media. <http://cordis.europa.eu/fp7/ict/ssai/docs/cloud-report-final.pdf>.
- Sharma, R., 2012. What does cloud computing exactly means? Novice to technical. <http://yourravi.com/what-does-cloud-computing-exactly-means-novice-to-technical/>.
- Srinivasa Rao, V., N.K. Nageswara Rao and E.K. Kumari, 2009. Cloud computing: An overview. J. Theoret. Applied Inform. Technol., 19: 71-76.
- Vuyyuru, M., P. Annapurna, K.G. Babu and A.S.K. Ratan, 2012. An overview of cloud computing technology. Int. J. Soft Comput. Engin., 2: 244-246.
- Youssef, A.E., 2012. Exploring cloud computing services and applications. J. Emerg. Trends Comput. Inform. Sci., 3: 838-847.