

A Review of Security Challenges and Proposed Solutions in Cloud Computing

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Abstract—With significant progresses in information communication technology and science, heavy and voluminous computations and process of data is unavoidable and this issue has caused some challenges. Consequently, computations should be optimized from both software and hardware point of views, in order to reduce the costs and also use less complicated methods. Cloud computing is a new concept that has interesting features, including acceptable performance, low cost, high accessibility, and by providing many services for computations, customers (companies and organizations) can use considerably high space for data storage and maintenance. But due to lack of suitable and safe methods for data storage and also the security challenges, many companies are not able to use this service. In this paper, data storage, storage architecting, security challenges like personal privacy, data integrity, internal and external attacks are discussed and some solutions for these challenges are provided. In addition, some methods for control of accessibility and storage of important data in order to assure the security are proposed.

Keywords—cloud computing, cloud computing advantages and disadvantages, storage control, storage architecting, security.

I. INTRODUCTION

Today, with significant progresses in information communication technology and science, there is a serious need for heavy and voluminous computations. Consequently, computations should be optimized from both software and hardware point of views, in order to reduce the costs and also use less complicated methods. John McCarthy [1961] believed that, in the future, the computation will be organized as assistant tools, and nowadays, with increase in the speed and safety of networks like internet, this prediction is completely true [6]. For this purpose, in 2007, cloud computing concept is proposed.

Cloud computing is based on giant networks like internet, which provides the customers with flexible and scalable accessibility to the resources based on the requests and the time of requests. The word "cloud" is used for this type of computations, because all details are hidden to the users; in fact the users do

not need any information about the cloud infrastructures, store the data locally or provide hardware; all software are updated easily, costs are reduced and finally, the efficiency and accessibility to the services enhances.

Anyway, this new concept has obsessed many researchers from different aspects and faces challenges, which are discussed in this paper. Cloud computing systems, as an example of cooperating systems, require controlled access, security and controlled storage. In the case of security of the cloud and cloud computing, many researches has been done in the past years, but the security of access and storage in cloud are still challenging topics.

II. CLOUD COMPUTING

Cloud computing is a new concept introduced in 2007 and nowadays has received considerable attention from many researchers and universities. There is no comprehensive definition of cloud computing, but the definition proposed by National Institute of Standard and Technology (NIST) is as follow [8] :

"Cloud computing is a model for providing the users based on their requests with easy access to a complex of variable computation resources like: networks, servers, application programs storage space and services, in such a way that the access is made possible with minimum requirement for resources management or direct involvement of service provider."

Cloud computing provides an opportunity for storing data in cloud storage instead of storing in local disk. It is not necessary for users to keep big storage infrastructures. They can store, control and manage data in the remote data center using giant companies like Microsoft, Google, Apple, etc. Saved files in the cloud storage are accessible for all using networks like internet connection. Cloud storage is an essential part of cloud computing which requires abstract storage infrastructures and data storing using network by a third party.

III. CLOUD COMPUTING SERVICES

Three main and prevalent cloud computing services exist:

A. Software as a service (SAAS)

- Service is provided as application software for end users and users don't have any control on the underlying structures. SAAS can be used for

business purposes like CRM and ERP[2]. Google Applications, Sale force, email service and online word processors are examples of SAAS.

B. Platform as a service (PAAS):

• This service uses the executive tools and resources available in the cloud structure to provide the final users with the services [2]. Applications are created or extended by the users. In fact, PAAS is provides the end users with hardware resources like virtual machines. In this part, the user do not have any control over the underlying structures or operating system, but can control the extensions or self personal usage.

C. Infrastructure as a service (IAAS):

• this cloud services provides the clients with processing capability, storage space, networks and basic computational resources in such a way that the client can install the desired software and additionally execute the operating system and previous applications; and possibly control the his own firewall and virtual servers[10].



Fig1: Cloud computing services [10].

IV. KEY FEATURES OF CLOUD COMPUTING

- Commercial software access and management by network.
- Remote access of customers using web in the case of activities not positioned in a specific location.
- Software delivery model is closer to one-by-multiple model (one program is running – multi-tenancy) than one-by-one model.
- Software updating and upgrading is managed centrally and there is no need to download patches or upgrades.

Cloud computing, from hardware point of view, offers three innovations in comparison with similar technologies like network computing, self-autonomous computing, client-server model, giant computer, public computing, peer to peer):

- Creating the imagination of access to unlimited information technology resources at the time of request and consequently, obviating the need to planning for information technology resources for future usage.
- Obviating the need to make advance investment in information technology resources. Commercial companies can initiate their works at

smaller scales and increase or reduce their hardware resources at the time based on their requirements.

- Possibility of paying for using information technology resources at short time scales for those resources.

V. MAIN PRIVILEGES OF CLOUD COMPUTING

A. Agility:

- The user can increase or reduce the extent of used resources at the time.

B. Reducing the cost and transforming the capital costs into the operational costs[11].

C. Users independency from location and devices:

- User can access the system at any location and using any devices (like PC, tablet, laptop, or cell phone) using a web browser.

D. Multi-tenancy: sharing the resources and the costs among a group of users at the same time.

E. Reliability enhancement:

- From the websites that are used in multiple ways[3].

F. Scalability:

- The users can dynamically configure the resources at the time of request; the is no need to prior configuration for the peak load of resources use[12].

G. Security enhancement:

- Due to concentrated data; and higher number of more complicated security resources[5].

H. Easier maintenance with lower cost:

- Due to no obligation to install each application for each of users.

I. Measurability:

- resources in the cloud computing should be measurable and it is necessary that the extent of resources usage by each user be measured based on hour, daily, weekly and monthly basis.

J. Increase in storage capacity:

- One of consequences of this method is the considerable increase in computer storage capacity and so the users are not obliged to upgrade their hardware. This sharing occurs by the extension of high speed bandwidth that enables the users to receive the concentrated infrastructure responses located in other spaces simultaneously.

VI. CLOUD COMPUTING DISADVANTAGES

All technologies have both advantages and disadvantages, including the cloud computing technology; which had the following disadvantages:

- Permanent connection to the internet: cloud computing is not possible without connection to the

internet, because there is no access to required information and documents. Cloud computing does not work offline and this is challenging.

- In the case of low speed connections, cloud computing is not efficient.
- Efficiency and capability of programs in the clouds may be limited: this state is changing but many of web based applications are not as complete and efficient as their PC counterparts.
- Lack of sufficient security of stored data in the clouds: considering the distribution of data among several machine, users' important data and information can be accessed by the hackers. For this reason, in 2009, the senior analyst of IDC institution, considers the security as the main concern of organizations (75 percent of IT managers) in use of cloud computing.
- Lack of control over the processes: because all processes are hidden from the users, they do not have any control over it.
- Possibility of internal attacks: because of accessibility of all of codes and information in an organization, employees can misuse the data like hackers.
- Law challenges: because the cloud computing technology is new, strict laws for prosecution of guilty persons.

VII. CLOUD STORAGE ARCHITECTURES

Cloud storage service is an emerging infrastructure which provides the platforms as a service (PAAS). In industry, the Amazon simple storage service (S3) is considered as the best reference for cloud computing services; which provides the virtual flexibility and infinite storage space, and it is possible to access the storage services based on internet through a simple set of interfaces. Different architectures are available in the area of storage (figure 2).

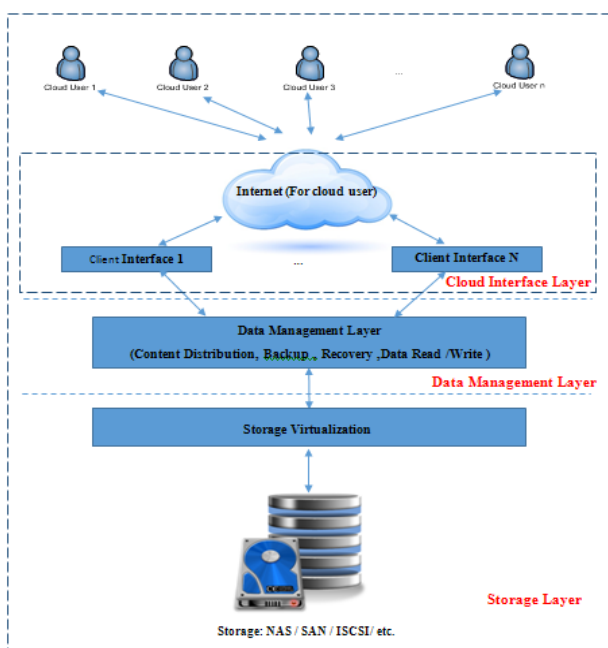


Fig2: Cloud storage architectures[1].

A. Cloud interface layer

- Cloud interface layer is a software interface which is provided by the cloud storage servers for connecting the cloud users to cloud storage services through the internet. This layer employs the users' identification and authentication for confirming the users' identity.

B. Data management layer

- Data management layer, like the cloud interface layer, has a software structure which is used for the data management of a specific cloud client. This layer has the functionality of data storage, conceptual data distribution throughout the storage location, partitioning, synchronization, keeping the consistency, repetition, control of data displacement through the network, backup, information recycling, management of millions users, preserving meta and catalog data and etc.

C. Storage layer

1) Storage layer has two parts :

- a) Virtualization: storage virtualization provides the integrated storage for the users and maps the inhomogeneous distributed storage devices for a simple continuous storage space; and creates a common dynamic platform and provides the quantitative characteristics like accessibility, security and scalability, which are designed for the applications.
- b) Basic storage: includes inhomogeneous storage devices like NAS, SAN, DAS, ISCSI, etc.

VIII. SECURITY CHALLENGES IN CLOUD STORAGE AND THEIR SOLUTIONS:

Cloud computing, like other technologies, faces great challenges in storage, such as the security challenges.

Security requirements

A. Accessibility

- This means that the user can access his information at any time or location. Regarding the fact that cloud computing is provided on the web, information accessibility is based on network connections and the server should be always accessible. For this purpose, two different methods are used: 1-use of redundancy 2- cloud service servers using the virtual machines, which control and filter the service traffics based on the network ID, in order to prevent the server failure as a result of high traffic. Also in order to decrease the accessibility problems and increase the accessibility and performance, establishing a service level agreement (SLA) between the server and client, using powerful identification authentication and authentication process is necessary.

B. Information confidentiality

• Many users are not assured to give their important information to the cloud servers. Because in the past years, these services are used in public network, and the risk of attacks is increased. Of course two solutions are proposed:

a) *Information encryption is a proper method, because in this method, the encrypted information are saved on the cloud servers and only the user is aware of how information is encrypted.*

b) *Physical separation: considering the high volume of information and also using the public network and internet, using the physical separation method is not completely possible and confidentiality issue is not completely resolved by this method. If local networks are the own organization virtual networks, this method can be used and it is not so costly. In this condition, external inputs are blocked, they do not have accessibility and service storage security increases.*

C. Data integrity

• This means that, data are not changed unless they are recognized and confirmed by the user. Also, data should not be lost due to keeping on different servers. This issue can be covered by employing different algorithms.

a) *Key generation or encrypting at the end of each segment.*

b) *Using cases like digital signature, data security is preserved and prevent lost of data.*

D. Control

• At the cloud level and cloud storage, because data are bulky and extensive, it is possible to be attacked from different aspects. Various solutions are available in order to block these attacks:

a) *Accessibility control.*

b) *Allowing the authenticated users to change, addition and deleting the data.*

c) *Using accessibility surveys by inserting a virtual layer which can supervise the system trends.*

d) *Control over the running of applications and changes in the data.*

E. Multi-tenancy and resources sharing

• Considering the design of information storage services, different users' information are kept in the same location and resources are shared. So, policies should be employed in order to avoid the transfer of information belonging to one user to another. These policies requires final controls at the application level.

F. Restriction to one server

• In cloud storage services, any of servers performs according to selected standard frameworks in providing the services. Considering this fact, in the case of using multiple servers, connection and coordination among the servers is difficult and requires cost and software equipments .[17]

G. Portability

• Cloud servers, follow special rules in communication with the customers and the customers save their data and information on the server based on these rules. Since all of the servers do not follow a unique standard, so it is not possible for customers to move from one server to another; this is called "Lock in". For example, portability comparison among three servers, Google, Amazon and Force is shown below.

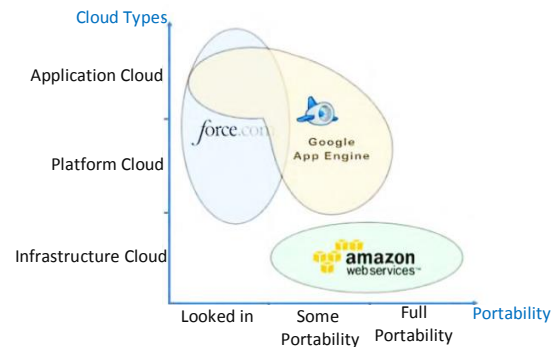


Fig3: portability comparison among three servers

As shown in figure 3, portability in Amazon from cloud infrastructure point of view is more than other servers. For increasing the portability among the servers, it is necessary to define a thorough and comprehensive standard and all servers should apply this standard[16].

• In addition to above mentioned challenges, cloud computing faces other challenges such as:

a) *Permanent connection to the internet.*

b) *Lack of efficient performance in low speed connections. Also in the clouds, capability of available applications is limited. Considering distribution of data among several machines, there is no sufficient security and be vulnerable to external and internal attacks. Furthermore, there are no strict laws\$ for prosecution of guilty persons.*

IX. ACCESS CONTROL AND STORAGE CONTROL SOLUTIONS:

Access and storage control methods ensure that only eligible users can access the system. In addition, because of reasons such as being economical, issues like accessibility, hacking detection and security control are considered [14].

A. Access control

• Access control methods ensure that only recognized users can access the data and system. This section discusses properties based on the access control mechanisms that are necessary for cloud computing. Access control, in general, is a policy or procedure that restricts or rejects access to a system and can be regarded as supervision or record of all effort for access to system. In addition, access control can detect the users attempt to access unrecognized systems and it is a mechanism that is seriously important for users security. Different

access control methods are proposed, which the most prevalent are:

- 1) *Mandatory Access Control (MAC)*
- 2) *Discretionary Access Control (DAC)*
- 3) *Role Based Access Control (RBAC)*[2].

B. Storage control:

• Storage systems in the cloud computing has obviated customers concerns about storage and management of data to some extent by factors such as cost reduction, scalability and location independent backgrounds. Although considering the fact that customers and users can't have physical possession anymore, this indicates some risks about the loss of or destroying the data. In order to avoid security risks, inspection services are critical for securing the thoroughness and accessibility of stored data and achieve some degree of credit in cloud computing. Proven data possession, which is an encryption method for confirming the data thoroughness without recycling on service, can be used for understanding the inspection service[14] on the other hand, nowadays, cloud computing has moved the software and application to very big data center, where data and services are not complete and reliable. Storage in cloud is a qualitative aspect of the service. Now, storage in an accessible space, recycling at any time by the identified user, is the simplest task that a computer can perform [9].

X. CONCLUSION:

Cloud computing is a big and complicated space which includes hardware, software and its security. Success or failure of cloud services depends on the confidence of users and the storage methods. By the spread of cloud systems and increase in volume of data, cloud storage service has significant importance. These systems share the resources and causes reduction in the hardware costs. Also, they are in access anywhere and anytime through the internet connection and there is no need to store data in physical memories. But, there are challenges that affect the advantages of cloud computing in negative ways. Security should be ensured in a public cloud, personal privacy should be honored and data should be transferred in networks in secure ways. For data management in different cloud servers, reasonable solutions should be implemented in order to ensure data integrity and independency. In this article, challenges about preserving the data security in cloud storage are discussed; and some solutions are proposed for reducing the hardware costs and increasing the confidence of organizations and users in cloud environment by security enhancement and honoring the personal privacy.

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