

# A survey of Cloud Computing Security challenges and solutions

Nidal Hassan Hussein

PhD. Program in Computer Science

Sudan University of Science and Technology  
Sudan

Ahmed Khalid

Community college

Najran University  
KSA

## Abstract

Cloud computing is the next generation networks which is soon going to revolutionize the computing world. It has much flexibility like on demand resources and services availability. Security is still critical challenge in the cloud computing paradigm. These challenges include user's secret data loss, data leakage and disclosing of the personal data privacy. In this paper a comprehensive survey of existing literature for cloud computing security challenges and solutions is presented. At the end of this paper the authors propose a model for cloud computing security.

**Key words:** Cloud computing, cloud computing security, IaaS, PaaS, SaaS

## 1-Introduction

Cloud Computing has recently emerged as new paradigm for hosting and delivering services over the Internet. The cloud computing is an internet based environment allows us to use software, data and services over the internet from any location on any web enabled device [3]. The researchers in the studies [8, 10, 9], define cloud computing as "a style of computing where massively scalable IT-enabled capabilities are delivered 'as a service' to external customers using Internet technologies. Cloud Computing is considered as the first among the top 10 most important technologies and with a better prospect in successive years by companies and organizations [2]. In [4] researchers estimated that 12% of software market will move toward cloud computing from 2011 to 2016 and the amount growth of cloud computing market will reach \$95 billion. The cloud computing provides different services, these services put forwarded three layers Infrastructure models which are infrastructure as Services (IaaS), Platform as

Services (PaaS) and Software as Services (SaaS) [5, 11].

IaaS Cloud computing providers offer physical, virtual computers and extra storage networking devices [13]. Example of IaaS vendor services includes Amazon Elastic Compute Cloud (EC2), GoGrid and Rackspace Cloud.

(PaaS) involves providing Infrastructure as a Service plus operating systems and server applications such as web servers [22]. Example of PaaS vendor services includes Google App Engine, Force.com, Amazon Web Services Elastic Beanstalk, and the Microsoft Windows Azure platform.

SaaS provides an application to customers either as a service on demand [12]. Example SaaS vendor services include Salesforce.com Customer Relationship Management (CRM), Google Docs and Google Gmail.

Security and privacy are considered as a critical issue in a cloud computing environment due to the sensitive and important information stored in the cloud for customers [6, 7]. Critics argue that cloud computing is not secure enough because data leaves companies' local area networks.

This paper presents a survey of the security of Cloud Computing focusing on the security challenges and solutions for the cloud computing layers models.

The rest of this paper is organized as follows: Section II introduces Infrastructure as Service security challenges. Section III describes the security challenges for Platform as Services. In section IV the security challenges for Software as Services is introduced. Section V presents a proposal model for cloud computing security. Section VI concludes the paper.

## II- Infrastructure as Services (IaaS) security challenges

Cloud Service Provider (CSP) outsources storage, servers, hardware, networking components, etc. to the consumer in IaaS model. CSP owns the equipment and responsible for housing, running and maintaining it. In this model, consumer pays on per-use basis. Characteristics and components of IaaS include [14]:

- Service Level Agreement (SLA)
- Dynamic scaling
- Automation of administrative tasks
- Utility computing service and billing model
- Internet connective
- Desktop virtualization

The virtualization risks and vulnerabilities that affect particularly IaaS delivery model are:

### 1- Security threats sourced from host

#### a- Monitoring VMs from host

The control point in virtual environment is the host machine there are implications that allow the host to monitor and communicate with VM applications up running. Therefore, it is more necessary to strictly protect the host machines than protecting distinctive VMs [25]. VM-level protection is crucial in cloud computing environment. The enterprise can co-locate applications with different trust levels on the same host and can defend VMs in a shared multi-tenant environment. This enables enterprises to maximize the benefits of virtualization. VM-level protection allows VMs to stay secure in today's dynamic data centers. Also, as VMs travel between different environments – from on-premise virtual servers to private clouds to public clouds, and even between cloud vendors. [15]

#### b- Communications between VMs and host

The data transfer between VMs and the host flow between VMs shared virtual resources; in fact the host can monitor the network traffic of its own hosted VMs. This can be considering useful features for attackers and they may use it such as shared clipboard which allows data to transfer between VMs and the host using cooperating malicious program in VMS [17].

It is not generally considered a bug or limitation when one can initiate monitoring, change, or communication with a VM application from the

host. The host environment needs to be more strictly secured than the individual VMs.

The host can influence the VMs in the following ways[ 16]:

- The host can Start, shutdown, pause, and restart VMs.
- Monitoring and configuration of resources which are available to the VMs, these include: CPU, memory, disk, and network usage of VMs.
- Adjust the number of CPUs, the amount of memory, the amount and number of virtual disks, and a number of virtual network interfaces which are available to a VM.
- Monitoring the applications which are running inside the VM.
- View, copy, and possibly modify, data stored on the VM's virtual disks.

Unfortunately, the system admin or any authorized user who has privileged control over the backend can misuse these procedures. [17]

### 2- Security threats sourced from other VM

#### a- Monitoring VMs from other VM

Monitoring VMs could violate security and privacy, but the new architecture of CPUs, integrated with a memory protection feature, could prevent security and privacy violation. A major reason for adopting virtualization is to isolate security tools from an untrusted VM by moving them to a separate trusted secure VM [14, 15].

#### b- Communication between VMs

One of the most critical threads that threaten exchanging information between virtual machines is how it's deployed. Sharing resources between VMs may strip security of each VM for instance collaboration using application such as shared clipboard that allow exchanging data between VMs and the host assisting malicious program in VMs, this situation violate security and privacy. Also, a malicious VM can has chance to access other VMs through shard memory [16 ].

#### c- Denial of Service (DoS):

A DoS attack is a trying to denial services that provide to authorize users for example when trying to access site we see that due to overloading of the server with the requests to access the site, we are unable to access the site and observe an error. This happens when the number of requests that can be handled by a server exceeds its capacity, the Dos attack marking carting part of clouds inaccessible to the users [26]. Usage of an Intrusion Detection System (IDS) one of the useful method of defense against this type of attacks [27].

### 3- Networks & Internet Connectivity attacks

Practical solutions and techniques for eliminating these attacks or reducing their impacts are listed as follows:

- 1- Logical network segmentation
- 2- Firewalls implementing
- 3- Traffic encryption
- 4- Network monitoring

### III- Platform as Services (PaaS) security challenges

PaaS is a way to rent hardware over the Internet, PaaS provide capability to manage application without installing any platform or tools on their local machines, PaaS refers to providing platform layer resources this layer including operating system support and software development frameworks in which it can used to build higher – level services. [23], developer gets many advantages from PaaS these are:

- OS operating system can be changed and upgraded as many time as need.
- PaaS allow geographically distributed teams to sharing information to develop software projects [14].

The use of virtual machines act as a motivated in the PaaS layer in Cloud computing. Virtual machines have to be protected against malicious attacks such as cloud malware. Therefore maintaining the integrity of applications and well enforcing accurate authentication checks during the transfer of data across the entire networking channels is fundamental[18]

PaaS security threat can be summarize as:

#### a- Data location

The actual platform is not in a single host, the platform can be thought as group of cluster hosts, in fact the location of your data cannot be isolated to specific sector on specific host, this will add more security over head as far as a single location is easier to secure than many.

Another security issue is that the duplication of data creates high availability of data for developers and users this distributed data remains like other data the big difference in this case in the exact location is unknown [ 24].

#### b- Privileged access

One of the most popular features in PaaS is the advertised software developers to use debug. Debug grants access to data and memory locations in order to allow the developers to modify values to test various outcomes we consider the debug provide the desired tool for both developers and hackers. [20]

#### c- Distributed systems

The PaaS file system is often highly distributed. The nodes can be independent while cloud service provider (CSP) owns the cluster so most likely to standardized configuration paths will be in place. The CSP should be able to provide the necessary

security, but the responsibility for verifying this belongs to the client [1].

Practical solutions and techniques for eliminating these attacks or reducing their impacts are listed as follows:

- Encapsulation Encapsulating access control policies with objects can be one of the solutions to resolve Privileged access
- Policy enforcement points (PEPs) A Policy Enforcement Point (PEP) is the logical entity or place on a server that makes admission control and policy decisions in response to a request from a user wanting to access a resource on a computer or network server. And this consider solution for distributed system [20]
- Trusted Computing Base (TCB) is a collection of executable code and configuration files that is assumed to be secure. TCB is thoroughly analyzed for security flaws and installed as a layer over the operating system and provides a standardized application programming interface (API) for the user objects, encryption seems to be the best possible solution.[21]

### IV- Software as Services (SaaS) security Challenges

SaaS also called "software on demand" using SaaS provider licenses an application to customers either on demand through a subscription or at no charge and this consider part of utility computing model, where all technology in the cloud accessed over internet as service. SaaS was basically widely deployed for sales force automation and Customer Relationship Management (CRM). Now, it has become common place for many business tasks, including computerized billing, invoicing, human resource management, financials, document management, service desk management and collaboration [14]. Software as a service applications are accessed using web browsers over the Internet. Therefore, web browser security is vitally important. Information security officers will need to consider various methods of securing SaaS applications. Web Services (WS) security, Extendable Markup Language (XML) encryption, Secure Socket Layer (SSL) and available options which are used in enforcing data protection transmitted over the Internet [18]

The service provider has to verify that their multiple users do not violates privacy of the other users, also it is very essential for user to verify that the right security measures are in place mean while it is difficult to get an assurance that the application will be available when needed [19].

SaaS security threat can be summarize as

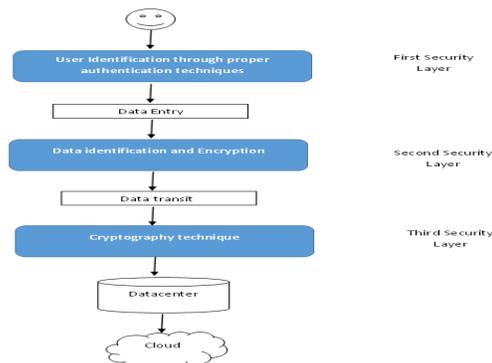
- Authentication and authorization
- Data confidentiality
- Availability
- Information security
- Data access
- Data breaches
- Identity management and sign on process

Navneet Singh [19] suggested practical solutions to assess the security threats in SaaS in which the customer must be asked:

- What metrics can be used for reporting?
- What is the level of access controls?
- Is the provided data can be easily adapted in the internal monitoring tools?
- How important and critical the enterprise data is?

## V- proposed model

The proposed cloud security model is composed of three layers. In the first layer user's identification can be checked through proper authentication techniques. Security in the second layer depends on data identification and encryption. At the last layer cryptography technique is used to secure the transmission of the data. The architecture of the proposed model has been shown in figure (1)



## VI-Conclusion

This paper gives a survey of different threats and solutions in cloud computing environment with respect to security and privacy of user's sensitive data in the cloud environment. The paper focusing on the security challenges and solutions for the cloud computing layers models. Authors have proposed model for cloud computing security.

## References

[1] M.H.Nerkar, Sonali Vijay Shinkar, "Cloud Computing in Distributed System", International Journal of Computer Science and Informatics ISSN (PRINT): 2231-5292, Vol-1, Iss-4, 2012.  
[2] Keiko Hashizume, David G Rosado, Eduardo Fernández-Medina, Eduardo B Fernandez, "An analysis of security issues for cloud computing",

Journal of Internet Services and Applications 2013, 4:5 .

[3] Deepaklal. K. B, " fuzzy keyword search over encrypted data in multicloud ", Discovery, Volume 21, Number 67, July 3, 2014

[4] S. Subashini and V. Kavitha, A survey on security issues in service delivery models of cloud computing, Journal of Network and Computer Applications (2011), pp. 1-11.

[5] Hassan Takabi , James B.D. Joshi, Gail Joon Ahn , "Cloud Computing Security and Privacy Challenges in Cloud Computing Environments ", COPUBLISHED BY THE IEEE COMPUTER AND RELIABILITY SOCIETIES,1540-7993/10/\$26.00 © 2010 IEEE.

[6] Mohammed A. AlZain, Ben Soh, Eric Pardede, "A Survey on Data Security Issues in Cloud Computing: From Single to Multi-Clouds", JOURNAL OF SOFTWARE, VOL. 8, NO. 5, MAY 2013.

[7] Meenu Bhati, Puneet Rani, "Review of Passive Security Measure on Trusted Cloud Computing", International Journal of Scientific Engineering and Applied Science (IJSEAS) - Volume-1, Issue-3, June 2015.

[8] M. P. Boss G, Quan D, Legregni L, Hall H. , Cloud computing, White Paper, IBM (2007).

[9] J. Heiser, What you need to know about cloud computing security and compliance, Gartner, Research, ID (2009).

[10] B. Whyman, Cloud Computing, information Security and Privacy Advisory Board (2008), pp. 11-13.

[11] Mahesh U. Shankarwar and Ambika V. Pawar, "Security and Privacy in Cloud Computing: A Survey", Proc. of the 3rd Int. Conf. on Front. of Intell. Comput. (FICTA) 2014.

[12] Harshitha. K. Raj, "A Survey on Cloud Computing ", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 7, July 2014.

[13] Nidal M. Turab, Anas Abu Taleb Shadi R. Masadeh, "CLOUD COMPUTING CHALLENGES AND SOLUTIONS", International Journal of Computer Networks & Communications (IJCNC) Vol.5, No.5, September 2013.

[14] P. R. Jaiswal, A. W. Rohankar, "Infrastructure as a Service: Security Issues in Cloud Computing ", International Journal of Computer Science and Mobile Computing, Vol.3 Issue.3, March- 2014, pg. 707-711.

[15] Trend Micro, "Virtualization and Cloud Computing Threat Report.", August 2011.

[16] J. Kirch, "Virtual machine security guidelines," 2007. [Online]. Available: [http://www.cisecurity.org/tools2/vm/CISn\\_VMn\\_Benchmark\\_v1.0.pdf](http://www.cisecurity.org/tools2/vm/CISn_VMn_Benchmark_v1.0.pdf).

[17] Wesam Dawoud, Wesam Dawoud, Christoph Meinel, "Infrastructure as a service security:

Challenges and solutions Informatics and Systems", (INFOS), 2010 The 7th International Conference on Source.

[18] Ibikunle Ayoleke, " Cloud Computing Security Issues and Challenges", International Journal of Computer Networks (IJCN), Volume (3) : Issue (5) : 2011

[19] Navneet Singh Patell, " Software as a Service (SaaS): Security issues and Solutions ", International Journal of Computational Engineering Research (IJCER) ISSN (e): 2250 – 3005 // Vol, 04 // Issue, 6 // June – 2014

[20] Devi T\*1, Ganesan R2," Platform-as-a-Service (PaaS): Model and Security Issues ", TELKOMNIKA Indonesian Journal of Electrical Engineering Vol. 15, No. 1, July 2015, pp. 151 ~ 161

[21] Mehmet Tahir, Ali Emre, "Security Problems of Platform-as-a-Service (PaaS) Clouds and Practical Solutions to the Problems" International Symposium on Reliable Distributed Systems 2012 31<sup>st</sup>

[22] Australian government department of defense, "Cloud Computing Security Considerations", CYBER SECURITY OPERATIONS CENTRE APRIL 2011, UPDATED SEPTEMBER 2012.

[23] Dr. Jayant Shekhar1," An analysis on security concerns and their possible solutions in cloud computing environment ", 3rd International Conference on Role of Engineers as Entrepreneurs in Current Scenario - 2014 (ICREECS-2014) ISBN:978-93-5174-583-9.

[24] Waleed Al Shehri, "CLOUD DATABASE DATABASE AS A SERVICE", International Journal of Database Management Systems ( IJDBMS ) Vol.5, No.2, April 2013 .

[25] Jenni Susan Reuben, " A Survey on Virtual Machine Security", KK T-110.5290 Seminar on Network Security 2007-10-11/12

[26] Rohit Bhadauria, " Survey on Security Issues in Cloud Computing and Associated Mitigation Techniques", International Journal of Computer Applications 47(18):47-66, June 2012.

[27] K. Vieira, A. Schulter, C. B. Westphall, C. M. Westphall, "Intrusion detection techniques for Grid and Cloud Computing Environment", IT Professional, IEEE Computer Society, vol. 12, issue 4, 2010, pp. 38-43.