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Security as A Service Model for Cloud Computing

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ABSTRACT

This work deals with the design and implementation of a secure cloud computing system by using a combination of hardware and software tools. Collage E-Exam system was developed to be used over the cloud. One of the main security concerns that the proposed system offered is "high availability", by providing two synchronized nodes (NODE1 and NODE2) in case of system or hardware failure the other NODE carry up the traffic and the service reach clients smoothly, this procedure known as "Replication". The proposed system offered efficient, secure and reliable system to be used to supply services to the connected clients. And the development of Collage E-Exam system over the proposed cloud may decrease cost of development, by providing virtual servers and machines and increase the level of security inside system.

INTRODUCTION

Cloud computing is a recently evolved computing terminology based on utility and consumption of computing resources. Cloud computing involves deploying groups of remote servers and software network that allow centralized data storage and online access to computer services or resources. Cloud computing uses client-server technology like web site service, but cloud uses virtual resources to execute tasks. Cloud computing depends on the way and flexibility of using Virtual Machine (VM) and using network for transferring information between Network Elements (NE) [1]. Cloud computing enhances following: [3].

- -Scaling
- -Agility
- -Availability
- -Cost reduction

Cloud computing technology face following vulnerabilities: [4]

- Getting computing services for free, this type of attacks known as attack against Cloud Service Provider (CSP).
- Dealing with cloud information, this attack known as attack against cloud consumer's data.
- Hacking the consumer network infrastructure through cloud service provider connections.

A. Cloud Computing Deploymnet Models

One of the most important classification methods of cloud computing system depends on the nature of how the cloud is located (Public-Private-Hybrid-Community cloud).

- Public cloud: The resources and services are automatically placed on internet. Cloud service providers offer services and resources to a large set of clients separately. Public cloud model also known as external cloud which means cloud computing infrastructure is hosted by cloud vendors located at vender premise, many companies offer service in this way such as (Amazon, Elastic Computer (EC2), Google, Microsoft and salesforce) [8]. This type of cloud is suitable for non-sensitive information with limited package because it is cheaper than private cloud [29].
- Private cloud: This cloud is set up and established internally inside the enterprise within organization. Private cloud infrastructure can give services for a specific organization which means it does not share its resources

with other parties. It gives resources such as storage space, processing cycle or an application for internal clients, these services and resources are grouped together and are available for end users inside cloud. Private cloud gives a good level of security more than other types [30].

- Hybrid cloud**:** Hybrid cloud is mixture of public and private cloud that has a combined infrastructure, like two separate cloud systems are joined with same physical connections so as to achieve a maximum cost reduction via outsourcing whilst maintaining the desired degree of control over. This cloud model is much more secure and provides different clients with an access to the network depending on certain privileges for each one [32].
- Community Cloud: It is a model in which the cloud infrastructure and its services are shared by a number of organizations, it supports a specific community that has shared concerns. Community cloud may be controlled by the organization itself or by a third party [33].

B. Cloud Computing Service Model

There are many models in which cloud computing systems can deliver service to customer side, the most three known models are: Infrastructure as a Service (IaaS), Software as a Service (SaaS), and Platform as a Service (PaaS). [6]

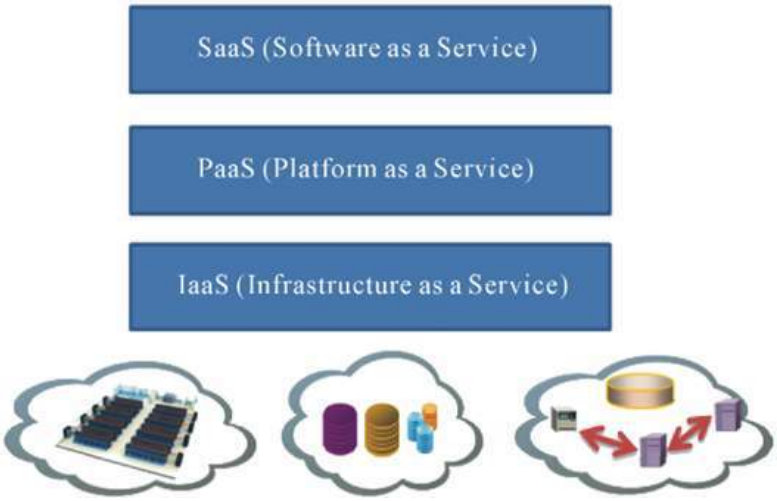

Figure 1: Cloud computing types

- Software as a Service (SaaS): This type of development model of clouds is dealing with delivering complete applications and software to customer side. SaaS model gives users the ability to utilize and modify services which are run inside the cloud environment. The main advantages is that no upfront investment in software licensing or servers are required. Although the services are available they are constrained by the provider design and capabilities. In this deployment model of cloud computing system the clients does not manage or take control over the underlying cloud environment. [10]
- Infrastructure as a Service (IaaS): This model is deliver hardware resource as a service to the customer who request a service. Clients can rent resources such as storage capacity, processing cycle, networks and other resources which can help customer to run and deploy arbitrary software or Operating System (OS) and application software. Clients do not deal with managing system and control the cloud infrastructure, but they have control on OS, storage, applications and network components. [35]
- Platform as a Service (PaaS): this type deals with delivering development environment and tools to consumer side. PaaS can supply user's different platform resources layer incorporating software development framework and OS support. (CSP) offers a large set of programming languages kit and software development tools to customer inside cloud, to give them a capability to develop and generate application and services. [10]

C. Main advanatage of using cloud computing

- Cost reduction: Cloud computing is mostly the best choice for efficient cost reduction to maintain, use and upgrade systems [16].
- Unlimited Storage: the fact that users store in the cloud gives flexibility access, data stored on the cloud could can be accessed from anywhere at any time [18].
- Data Backup and Recovery: All the data related to database (DB) applications or personal data related to each client is stored in the cloud [19].
- Auto Software Integration: Cloud clients don't need to deal with additional efforts (time and cost) to customize and combine their systems and application with cloud infrastructure [17].

- Quick Deployment**:** Cloud can offer for its users is the quick deployment for entire application. [20].
- Deliver new services: Cloud computing system is that the system (cloud computing) makes the possibility of finding new classes of software which can deliver a new services that are interactive inside the cloud [22].
- Easy Access**:** Is the ease access for their data [23].
- Service enhancement: it can develop system and application which serve the client for specific service [17].
- Scalability: cloud can give a good level of scalability to the system, where within a transaction the increase in data volume needs change in system itself [21].
- Rapid elasticity: Customers have the ability to add or remove the resources as they need [25].
- Measured service**:** Cloud have the ability of measuring features by automatically taking the resources usage measures regarding the type of services provided to the client side [25].

D. Virtualization Technology

Virtualization is known as an important topic appeared recently in IT industry, it refers to the ability for a device (computer or server) to share available resources such as memory (Storage), CPU, Network adapters. In another word, virtualization is a technique for hiding physical layer characteristics of server resources from the way in which other applications, systems or clients interact with these resources. So that single physical network element (NE) can represent numbers of virtual servers. [36]

E. Security Concern

The biggest issue that faces cloud computing development is how to deal with security issues. Due to this issues some users and organizations hesitate to start using cloud computing system in their environment. [4]

- Availability**:** Means ensuring users can use the services provided from CSP properly at any time and place [4].
- Privacy and Confidentiality: Confidentiality means all information and data related to particular client should be denied for any unauthorized user [43].
- Integrity: Integrity is one of security factors, which means modification of data, referring of information, hardware and software. This security process can be done only by authorized users and by authorized ways [46].
- Authentication: Is one of the most important security concerns dealing with establishing confidence of client identity (ID) [48].

  a) User password authentication
  b) Windows user based authentication
  c) Certificate based authentication
  d) Smart Card authentication
  e) Biometric:
  f) Known based authentication
  g) One Time Password (OTP)

F. Design and system layout of the proposed system

The design of the proposed cloud system is an important phase and a difficult task. There is a number of factors should be considered in designing and implementing the proposed system such as security, availability, portability, scalability and cost. In order to design a private cloud system there is a need to prepare the hardware requirements such as servers, network equipment (routers, switches, firewall and cables) and power and software requirements such as operating system and virtualization software.

- First layer is represented by the operating system (OS) (windows Server 2012 R2) which was used as an operating system for the proposed cloud system.

- The second layer is represented by Hyper-V, which is a virtualization software tool in windows server 2012 R2.

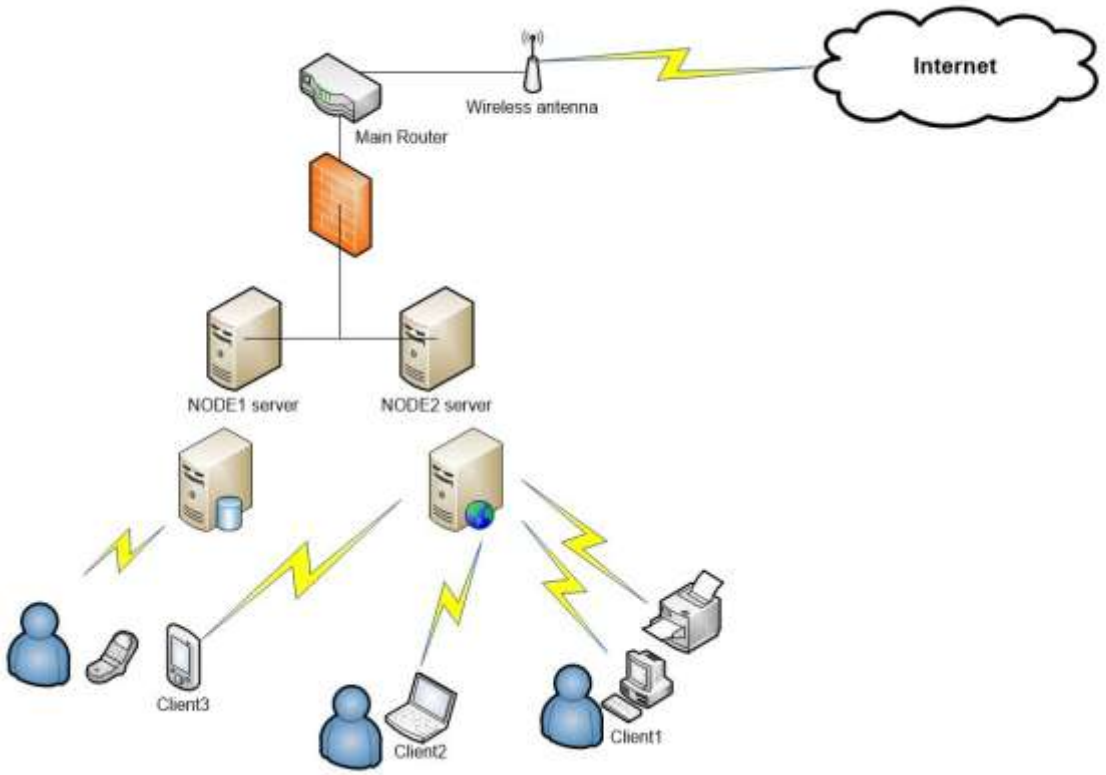

Figure 2: Proposed system layout

For Security issues, Cisco PIX firewall (PIX 515e) is used to provide high level of security to the proposed system. The firewall is configured to work as a getaway to the proposed system, so that each data inside or outside the cloud should pass through the firewall to ensure secure environment to the cloud.

G. Hyper-V Manager

Hyper-V manager is the proposed hypervisor application used in the proposed private cloud computing system as a proper solution inside Microsoft windows server environment which offers many features of virtualization, resources allocation and managing cloud system. In Hyper-V manager admin can replication service process which is one of the most important function that gives system good level of availability and non-stopping service by making replica between two identical server nodes and synchronize the data and information in the cloud and make it available when an event happened to one node the other one should be replaced and take action to make sure services not be suspended to any user inside the cloud.

H. College E-Exam System

College E-Exam system proposed as a secure application used in proposed private cloud computing system, it offered remotely secure connection for each user inside the cloud. It could serve any user inside the proposed cloud to perform exam stages such as (registration, exam and getting result) in secure environment. Designing and implementing E-Exam system was to give an easy access for each user inside the proposed cloud system. The network design of the proposed system was done by using the two server nodes and using virtualization technique. WAMP server has been used as apache, MySQL and PHP server which is installed over the web virtual server inside the cloud [50]. Fig-3 shows network structure of the proposed application. While Fig-4 shows the flowchart of proposed application from starting and registration point till getting result.

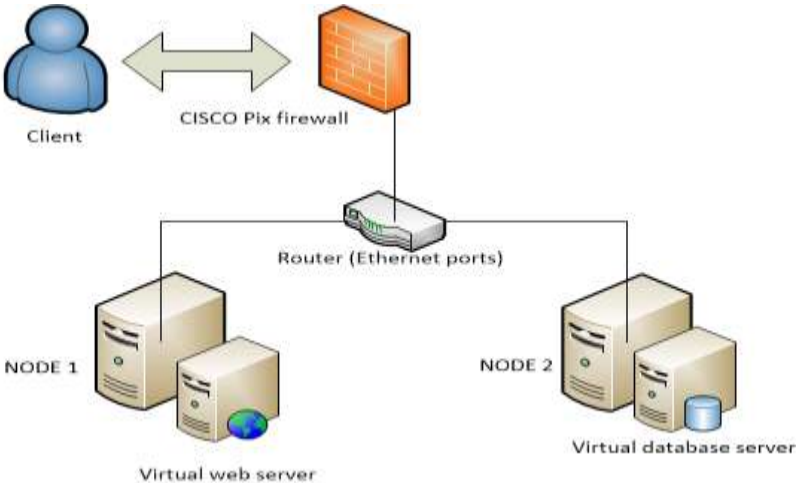

Figure 3: Network structure of college E-Exam System

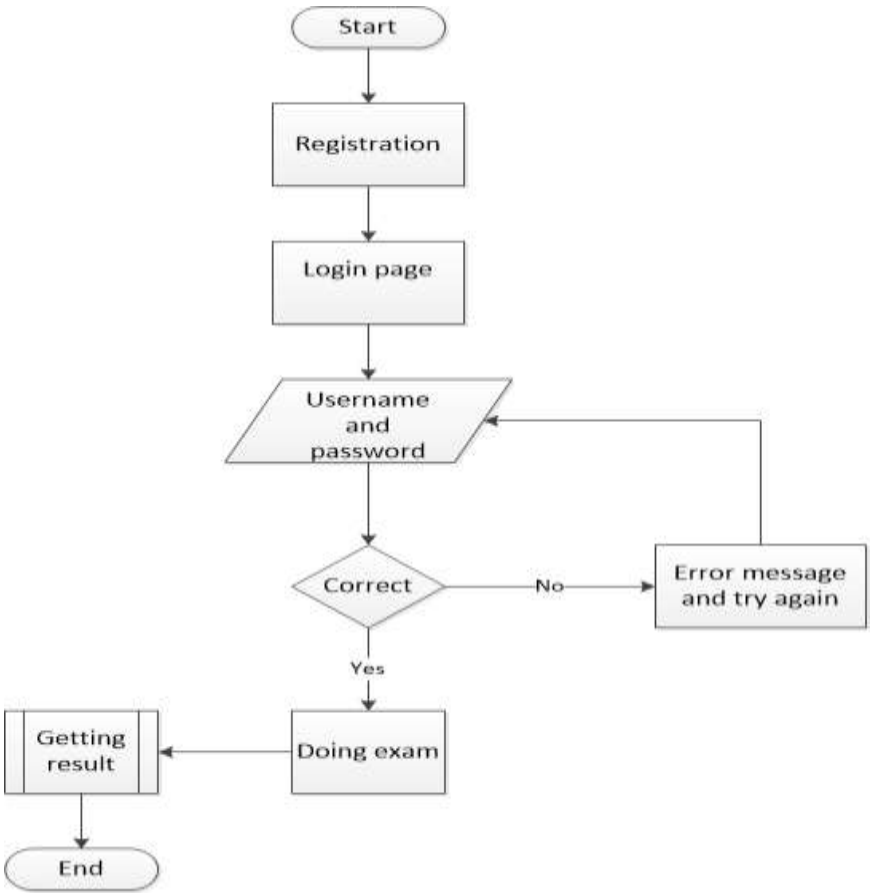

Figure 4: Proposed application flowchart

I. Security and Privacy in the proposed system

In the proposed E-Exam application, security and privacy acted as the main features system support. The main characteristics are:

- An important information like a password should never be entered as a plaintext, to prevent any expected problems by using message diversity (MD5) function to encrypt sensitive information.
- User name and password were used for each user to provide authentication and prevent any unauthorized user to access specific data.
- SQL injection is one of the known attack which enforce database structure, a specific function which denoted by mysql_real_escape_string ( ) was used to prevent this attack.

CONCLUSION

During the design and implementation of the proposed system it showed that using Hyper-V manager as a hypervisor may provide the proposed system some reliability, security and scalability with high performance environment to develop and manage applications and services over the proposed cloud. Replication provide high availability to cloud server nodes and all VMs inside the cloud, application and services over the proposed secure cloud computing system, by providing alternative server node with specific resources to handle services during hardware, O.S. and network failure, as well as in planned and unplanned downtime of proposed cloud system. Development and implementation of proposed secure collage E-Exam system could decrease the cost of renting virtual machines and servers, increase privacy and security by allowing only the authorized person to access the cloud.

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