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Faculty of Information and Communication Technology

A PROPOSED STUDY OF CLOUD COMPUTING FOR IRAQI MINISTRY OF FINANACE

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Master of Computer Science in Internetworking Technology

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CLOUD COMPUTING FOR IRAQI MINISTRY OF FINANACE

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A thesis is submitted in fulfillment of the requirement for the degree of Master of Computer Science in Internetworking Technology

Faculty of Information and Communication Technology

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2014

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DECLARATION

I declare that this thesis entitled "A Proposed Study of Cloud Computing for Iraqi Ministry of Finance "is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : ……..

Name : ……..

Date : ……

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APPROVAL

I hereby declare that I have read this thesis and in my opinion this thesis is sufficient in terms of scope and quality for the award of Master of Computer Science in Internetworking Technology.

Signature **…….**

Supervisor Name **……...…….....**

Date **……...**

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DEDICATION

First and foremost I want to thanks Almighty ALLAH for giving me this chance to change my life and pursue my dreams for prosperous life in order to maintain my stability for better, then thanks to my parents, my family and especially my wife and my son to support me through the difficulties. And then thanks to my all lectures who taught me what I know especially my supervisor Dr.AbdulSamad Shibghatullah for guiding me to the right path for my research. Finally I am very appreciated full grateful for this project.

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CHAPTER 1

INTRODUCTION

1.1 Background

Cloud Computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlays in hardware to deploy their service or the human expense to operate it. They need not be concerned about over provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under provisioning for one that becomes wildly popular, thus missing potential customers and revenue. Moreover, companies with large batch-oriented tasks can get results as quickly as their programs can scale, since using 1000 servers for one hour costs no more than using one server for 1000 hours. This elasticity of resources, without paying a premium for large scale, is unprecedented in the history of IT. Cloud Computing refers to both the applications delivered as services over the Internet and the hardware and systems software in the datacenters that provide those services. The services themselves have long been referred to as Software as a Service (SaaS) [2]. The datacenter hardware and software is what we will call a Cloud. When a Cloud is made available in a pay-as-you-go manner to the general public, we call it a Public Cloud; the service being sold is Utility Computing. We use the term Private Cloud to refer to internal datacenters of a business or other organization, not made available to the general public. Thus, Cloud Computing is the sum of SaaS and Utility Computing, but does not include Private Clouds. People can be users or providers of SaaS, or users or providers of Utility Computing. We focus on SaaS Providers (Cloud Users) and Cloud Providers, which have received less attention than SaaS Users. From a hardware point of view, three aspects are new in Cloud Computing [3].

1. The illusion of infinite computing resources available on demand, thereby eliminating the need for Cloud Computing users to plan far ahead for provisioning [5].

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2. The elimination of an up-front commitment by Cloud users, thereby allowing companies to start small and increase hardware resources only when there is an increase in their needs (ibid).

3. The ability to pay for use of computing resources on a short-term basis as needed (e.g., processors by the hour and storage by the day) and release them as needed, thereby rewarding conservation by letting machines and storage go when they are no longer useful (ibid).

We argue that the construction and operation of extremely large-scale, commodity-computer datacenters at low cost locations was the key necessary enabler of Cloud Computing, for they uncovered the factors of 5 to 7 decrease in cost of electricity, network bandwidth, operations, software, and hardware available at these very large economies of scale. These factors, combined with statistical multiplexing to increase utilization compared a private cloud, meant that cloud computing could offer services below the costs of a medium-sized datacenter and yet still make a good profit.

Any application needs a model of computation, a model of storage, and a model of communication. The statistical multiplexing necessary to achieve elasticity and the illusion of infinite capacity requires each of these resources to be virtualized to hide the implementation of how they are multiplexed and shared. Our view is that different utility computing offerings will be distinguished based on the level of abstraction presented to the programmer and the level of management of the resources.

Amazon EC2 is at one end of the spectrum. An EC2 instance looks much like physical hardware, and users can control nearly the entire software stack, from the kernel upwards. This low level makes it inherently difficult for Amazon to offer automatic scalability and failover, because the semantics associated with replication and other state management issues are highly application-dependent. At the other extreme of the spectrum are application domain specific platforms such as Google AppEngine. AppEngine is targeted exclusively at traditional web applications, enforcing an application structure of clean separation between a stateless computation tier and a stateful storage tier. AppEngine's impressive automatic scaling and high-availability mechanisms and the proprietary MegaStore data storage available to AppEngine applications, all rely on these constraints

[1]. Applications for Microsoft's Azure are written using the .NET libraries, and compiled to the Common Language Runtime, a language-independent managed environment. Thus,

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Azure is intermediate between application frameworks like AppEngine and hardware virtual machines like EC2 [5]. When is Utility Computing preferable to running a Private Cloud? A first case is when demand for a service varies with time. Provisioning a data center for the peak load it must sustain a few days per month leads to underutilization at other times, for example. Instead, Cloud Computing lets an organization pay by the hour for computing resources, potentially leading to cost savings even if the hourly rate to rent a machine from a cloud provider is higher than the rate to own one. A second case is when demand is unknown in advance. For example, a web startup will need to support a spike in demand when it becomes popular, followed potentially by a reduction once some of the visitors turn away. Finally, organizations that perform batch analytics can use the ”cost associativity” of cloud computing to finish computations faster: using 1000 EC2 machines for 1 hour costs the same as using 1 machine for 1000 hours [1]. Iraqi Ministry of Finance includes a large number of sub-districts and agencies, which in turn are divided into branches dispersed throughout Iraq and the structure of the ministry, are set out as follows:

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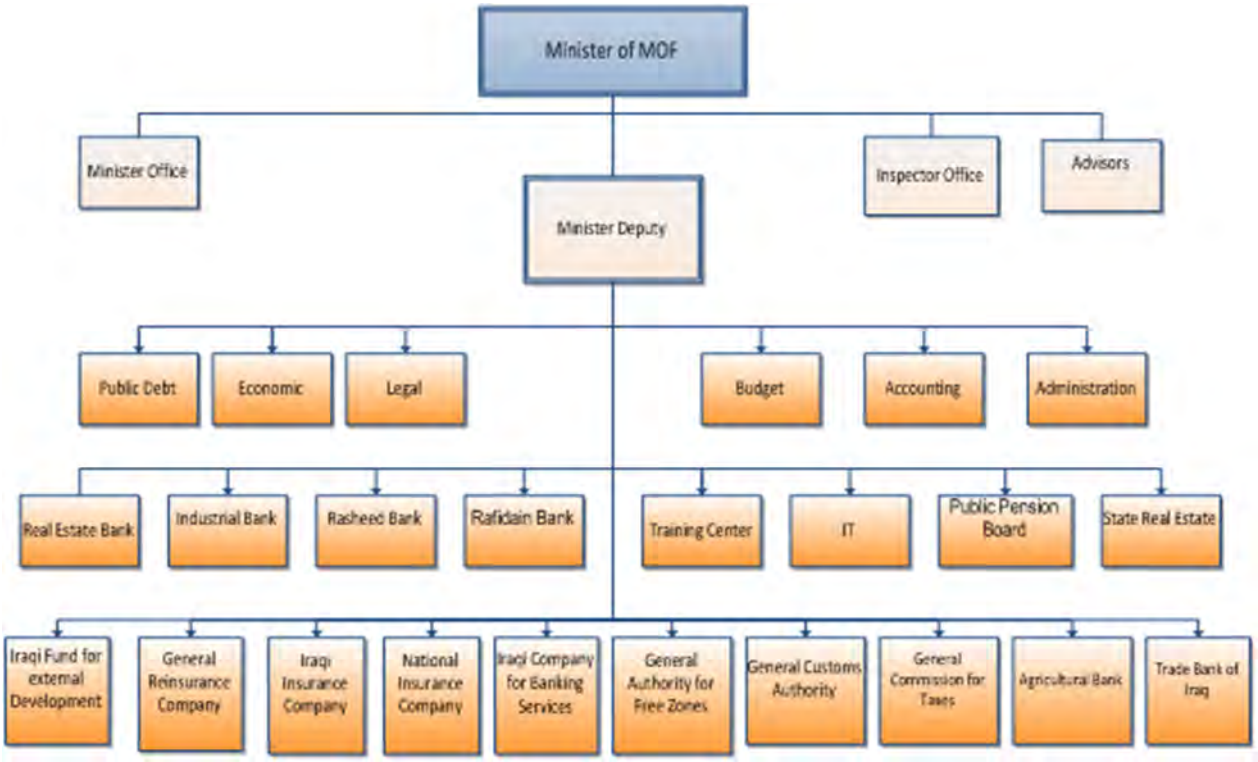

Figure (1) Iraqi ministry of Finance

And the ministry includes a huge number of employees and a huge number of computers and devices that are connected with each of the order to accomplish the business (some not directly linked) There is also a network linking internal and connecting the ministry with branches and contain these structural (Laptop + Desktop) and other linked devices, servers, routers and etc.

1.2 Problem Statement

The intricate relationship between people and machine in ITT means that culture impacts both how systems are designed and how they are received especially in Iraq be more specific the ministry of finance because they are not familiar with this techniques. Obstacles arise because people bring to the workplace what can be regarded as cultural baggage; that is, they come to their job with specific cultural biases about how the world function, how their job works, and how employees are supposed to conduct themselves. The computer system they interact with can be built, and are often built under a different set of cultural assumption. Therefore successful technology transfer involves communication and cooperation with the receiving country and understanding about the forms that resist the transference [4]. Several countries such as Middle East countries have

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been using several techniques in order to reach the highest possible performance. Performance differs from one department to another, and this difference is a result of variant aspects such as infrastructures, networking methods, services provided, and so on. Therefore, all these aspects should be taken in count in order to reach the optimum performance (ibid).

In the Iraqi ministry of finance we have several IT problems such as computer virus, improper use of the computer and unauthorized access these issues can be solved by applying cloud computing technologies. Problems that can be encountered:

1- Damage to the equipment due to the explosions, which may be exposed to institutions.
2- Using CDs and DVDs in the transfer and storage of data which may be damaged at any moment, causing a loss of this data .
3- The use of flash memory for data transfer and storage, which may contain viruses or may be used by unauthorized people.
4- The high cost of buying devices in large numbers and special specifications for the purpose of completion of work .
5- The high cost of providing applications and software to be licensed and Genuine all devices.
6- Needs a large number of devices to a large area and air-conditioned atmosphere (due to the heat in Iraq).
7- Difficulty of controlling the confidentiality of the data for this huge number of devices
8- The difficulty of maintaining such a huge number of devices and distributed in many places, which sometimes be very difficult to reach because of the deteriorating security situation causing stops working

1.3 Research Objective

The main objective of this study is to improve the computer maintenance department in the ministry of finance in Iraq by applying cloud computing to reduce the time, cost and the effort of maintenance.

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1.4 Scope of Study

There are many techniques can be used or adopted to improve the computer maintenance department in the ministry of finance in Iraq but we chose to apply the cloud computing to build a private cloud for departments that used computers or computer servers because it's easy to maintain and it will reduce time, cost and the effort of maintaining. In order to build private cloud considers the following:

1. Applications Software (MS office, Adobe Acrobat, etc.) needs to both scale down rapidly as well as scale up, which is a new requirement. Such software also needs a pay-for-use licensing model to match needs of Cloud Computing.
2. .Infrastructure Software (Windows Azure, Ubuntu Server, etc.) needs to be aware that it is no longer running on bare metal but on VMs. Moreover, it needs to have billing built in from the beginning.
3. Hardware Systems (Server Computers) should be designed at the scale of a container (at least a dozen racks), which will be is the minimum purchase size. Cost of operation will match performance and cost of purchase in importance, rewarding energy proportionality such as by putting idle portions of the memory, disk, and network into low power mode. Processors should work well with VMs, flash memory should be added to the memory hierarchy, and LAN switches and WAN routers must improve in bandwidth and cost.

1.5 Research schedule

Week	1	2	3	4	5	6	7	8	9	10	11
Introduction											
Literature Review											
Main design											
Hardware design											
Evaluation											
Documentation											

1.6 Conclusion Chapter 1

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Cloud computing system is based on internet service and it is shaping a large part of IT industries in the world right now and even making the software attractive as service, making the need of hardware less and also changing the design and purchasing. The developers for the new internet services no longer require the huge capital outlays in hardware to deploy their service and also human service in order to operate the hardware and main thing is to subscribe cloud computing system to provide a service over network. It is promising that cloud provide reliable service but the problem compromises the data security and is there will be any trust during using the system and this must be guaranteed from both sides the client and the providers. But when it comes to Iraqi ministry of finance we have several IT problems such as computer virus, improper use of the computer and unauthorized access these issues can be solved by applying cloud computing technologies, and also to improve the computer maintenance department in the ministry of finance in Iraq we must apply the cloud computing to build a private cloud for departments that used computers or computer servers because it's easy to maintain and it will reduce time, cost and the effort of maintaining finally the system should meet the requirement from both sides in terms of price ,performance ,scalability ,is the main parameter to consider because the must have ability to growth and expanded , because of the day by day the department is increasing so the data, although it depends on space that department subscribed. The department must meet reasonable requirement to improve their system and that goes same to the Cloud providers.

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CHAPTER 2

LITERATURE REVIEW

2.1 Characteristics

Here are plenty of definitions for "cloud computing" online, and for the most part, they generally point to the same thing: taking applications and running them on infrastructure other than your own. Companies or individuals who offload or effectively "outsource" their hardware and/or applications are running those apps "in the cloud."

However, this may not be the complete definition for you. As a developer, you need a more detailed definition. You may be outsourcing actual hardware, application development and hosting, or only wish to run online software from other providers. In other words, what you outsource to cloud vendors may and will be different from what other people or companies do... every situation is different, as are the cloud service levels.

Several reasons drive companies to investigate or adopt cloud computing services, with the primary reason being cost. Small companies can't afford a large amount of hardware nor the staff that goes along with it. Large companies may find the costs of maintaining and managing their own datacenters to be prohibitive, or perhaps they have made a significant investment only to discover that much of their resources idling away. Why not outsource to companies who specialize in running data centers and providing hardware/virtualization services and only pay for what you use? It's the classic "buy vs. rent" scenario.

If you choose to outsource everything (your apps and the hardware they run on), you're saving on the capital expenditures yet still responsible for everything above the hardware layer, meaning the operating system and any other services required to run your application(s).

Vanquero et al. provide a brief overview definition of Cloud Computing: “Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the infrastructure Provider by means of customized SLAs” [1].

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There are more detailed definitions of Cloud Computing are drawn largely from the exposition of Al Jumeily et al (2010) [2]. Cloud computing can be broken down into 3 major components:

1- ***IaaS*** - *Infrastructure as a Service* comprises the layer of storage, hardware, servers and networking components. The supplier maintains and upgrades these resources and the user pays for the service depending on the amount of usage. The major advantage is that users only pay for the exact amount of resources used, and resources available can be easily scaled to accommodate rapidly changing needs. Architecture scalability is achieved through Full- or Para-virtualization, such that multiple systems or operating systems can be run at the same time on a virtual machine or across multiple machines.

2- ***PaaS*** - *Platform as a Service* can also be supplied by the Cloud and allows software and service development without downloading tools and software to client machines. Using the Cloud, large and complicated software packages can be developed, tested and disseminated, again leveraging the benefits of virtualization and scalability (for unforeseen development needs requiring more CPU hours).

3- ***SaaS*** - *Software as a Service* is one of the most common uses of Cloud Computing, exemplified by Google's Gmail. Clients access software services such as email, word processing, spread sheets, etc. from the Cloud instead of running these applications directly on their client computers.

Cloud computing provides computation, software, data access and storage services that do not require end users knowledge of the physical location and configuration of the system that delivers the services. Cloud computing encompasses any subscription based or pay-per-use services that in real time over the Internet extends information technology's existing capabilities. This may take the form of web-based tools or applications that users can access and use through a web browser as if they were programs installed locally on their own computers [3].

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2.2 Components of Cloud

Once the Internet protocol connection is established among several computers, it is possible to share services within any one of the cloud layers. Following are the cloud layers :

1. Client: A cloud client consists of computer hardware or software that relies on cloud computing for application delivery. It includes some computers, phones, some devices, operating systems and browsers.

2. Platform: Cloud platform services is also known as Platform-as-a-Service (PaaS), delivers a computing platform or solution stack as service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of application without the cost and complexity of buying and managing the underlying hardware and software layers.

2.3 Characteristics of (PaaS)

There are a number of different takes on what constitutes (PaaS) but some basic characteristics include

•Services to develop, test, deploy, host and maintain applications in the same integrated development environment. All the varying services needed to fulfil the application development process .

• Web based user interface creation tools help to create, modify, test and deploy different UI scenarios

• Multi-tenant architecture where multiple concurrent users utilize the same development application

• Built in scalability of deployed software including load balancing and failover

• Integration with web services and databases via common standards

• Support for development team collaboration some (PaaS) solutions include project planning and communication tools

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• Tools to handle billing and subscription management (PaaS), which is similar in many ways to Infrastructure as a Service that will be discussed below, is differentiated from (IaaS) by the addition of value added services and comes in two distinct flavors.

1. A collaborative platform for software development, focused on workflow management regardless of the data source being used for the application. An example of this approach would be Heroku, a PaaS that utilizes the Ruby on Rails development language.

2. A platform that allows for the creation of software utilizing proprietary data from an application. This sort of (PaaS) can be seen as a method to create applications with a common data form or type. An example of this sort of platform would be the Force.com PaaS from Salesforce.com which is used almost exclusively to develop applications that work with the Salesforce.com CRM.

3. Infrastructure: Cloud infrastructure services also known as Infrastructure-as-a-Service (IaaS) deliver computer infrastructure typically a platform virtualization environment as a service along with block storage and networking. Rather than purchasing servers, software, data center space or network equipment, clients instead buy those resources as a fully outsourced services. Suppliers typically bill such services on a utility computing basis, the amount of resources consumed that will reflect the level of activity.

2.4 Characteristics of (IaaS)

As with the two previous sections, SaaS and PaaS, IaaS is a rapidly developing field. That said there are some core characteristics which describe what IaaS is. IaaS is generally accepted to comply with the following;

• Resources are distributed as a service.

• Allows for dynamic scaling .

• has a variable cost, utility pricing model .

• generally includes multiple users on a single piece of hardware.

There are a plethora of (IaaS) providers out there from the largest Cloud players like Amazon Web Services and Rackspace to more boutique regional players.

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As mentioned previously, the line between (PaaS) and (IaaS) is becoming more blurred as vendors introduce tools as part of (IaaS) that help with deployment including the ability to deploy multiple types of clouds.

4. Server: The server layer consists of computer hardware or computer software products that are specifically designed for the delivery of cloud services, including multi-core processors, cloud specific operating systems and combined offerings.

2.5 Cloud Computing in Developing Countries

Cloud computing has gained the reputation as an online buzzword with a nebulous definition. However, the full effects of the ability to host content on a remote server as well as access data from any location with internet has begun to have a dramatic effect on the tech presence of developing countries around the world. According to a 2010 Cisco study by 2015, global cloud computing traffic will equal 1.6 zettabytes annually (this is equivalent to a trillion terabytes). As this traffic picks up, although the growth remains international, developing countries, according to a separate study will further outpace the speed of growth in developed nations.

In the context of the benefits of cloud computing, this acceleration in developed countries should not come as a surprise. Cloud computing and hosting has already begun to make a mark on the tech landscape. It allows companies to lower their hosting costs, giving an opportunity for start-ups and developers to get their projects online without the high overhead of dedicated hardware and employees to run the servers. These same factors that have changed the overall hosting landscape are especially prominent catalysts to the growth in developing countries. In general, there are three main factors spurring expansion in those nations: the ease of launching a cloud instance, the low cost associated with the cloud servers, and adoption of devices to access the cloud.

Cloud computing allows countries, users, institutions, to spin up, quickly and at will servers of whatever capacity is needed for certain tasks. When large amounts of data, in the case of ‘big data’ or scientific results, need to be processed, cloud servers allow the virtualized supercomputers to be spun up in minutes. Instead of having to spend precious resources to create these high tech capabilities in house, institutions can spin up large cloud servers or clusters, replicating that functionality. Furthermore as cloud usage is

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traditionally charged by the hour (rather than month or year), high-powered machines can be created on a strict budget.

Just as powerful servers can be spun up without the extraordinarily high cost associated with them, individuals and start-ups in developing countries are taking advantage of the capabilities to expand their tech presence. As many developing countries and smaller companies were not able to invest into the heavy infrastructure required before the cloud hosting, with the much lower price of cost of entry, these countries are experiencing booms in tech growth. With no legacy hardware to maintain nor to hold them back from the capabilities of cloud computing, these countries are able to take full and complete advantage of the new opportunities posed.

At the same time as there is tremendous growth in developing countries, the cloud cannot be considered a panacea. In effect, although the availability of the cloud may assist citizens with trying out new tech features, learning to code, and helping them start up their businesses, data sovereignty laws restrict users to only using data centers in their home country. These legal statutes complicate the otherwise growing and exciting landscape of international cloud hosting. Nonetheless, cloud hosting has been a strong levelling force in the global landscape, the ramifications of which we have yet to see completely.

The developing world's cloud computing sector has received considerable attention from global and local IT players, national governments, and international agencies. For example, IBM has established cloud computing centers in China, India, Vietnam, Brazil, and South Korea. Other global cloud players such as Microsoft, VMware, Salesforce, Dell, and Parallels are actively searching for opportunities in the developing world. Perhaps even more impressive is that developing-world-based firms have jumped on the cloud bandwagon. Cloud-related venture capital and other investments are also flowing into developing economies. It is probably fair to say that in no other major technological innovations has the developing world received this level of attention. However, findings and conclusions about the potential and impact of cloud computing in the developing world drawn from surveys, studies, and experiences of companies are confusing and remarkably inconsistent. Some analysts suggest that developing countries will be attractive markets for cloud services and predict that this technology will soon make "healthcare 2.0," "banking 2.0," and "education 2.0" realities in these countries[4].

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Cloud computing vendors are offering scalable services and applications via centralized data centers utilizing thousands of server computers which provide easy access to computing resources anytime and anywhere [5]; the capability of cloud computing to quickly scale and provide access to computing services and resources anytime and anywhere, allowing organizations to quickly respond to changing business needs without the expenditures of time, space, money, personnel, and other resources needed for traditional infrastructures for example, New York newspaper organization were able to convert 11 million scanned and archived hard copies into portable document format (PDF) files in 24 hours by renting 100 servers from Amazon's cloud services at a cost to the organization was approximately $250. Alternative methods for the conversion would have required cost and taken weeks or even months to complete [6].while cloud computing offers enormous potential for reducing costs and increasing an organization's ability to quickly scale computing resources to respond to changing needs, there are risks associated with cloud computing. Specifically, cloud computing may mean that an organization relinquishes control, resulting in exposure to breaches in confidentiality, losses in data integrity and availability. However; as with any technology, cloud computing has its own disadvantage such as releasing control of maintaining confidentiality, integrity, and availability of sensitive business data; In general, most cloud computing consumers want to be assured that cloud providers have effective security policies and controls in place to comply with data protection standards and meet regulatory compliance requirements prior to making a decision to migrate their data or applications to the cloud.

2.6 Cloud Security

As cloud computing is becoming increasingly more mainstream, it becomes harder to distinguish between the generic securities issues that an IT manager needs to tackle, from those that are specific to cloud computing. Things like roles and responsibilities, secure application development, least privilege and many more apply equally well in traditional environments as they do in the cloud.

- **So what are the new cloud computing security issues?**

First, there are definitely new threats relating to Cloud Computing Security Issues. There are whole new attack vectors that potentially give the attacker unlimited control over your IT infrastructure. If (as a moderately large enterprise) you have a group of 20 persons who

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have strong control ("power user") over your cloud computing account, or over your private cloud authentication framework, then you have a group of 20 people who have full, unmitigated control of your IT infrastructure's availability and the privacy of your business-critical data. And if one of these people is not careful, an attacker can get hold of the same powers.

More than that, in a cloud computing (specifically public cloud) environment you also trust your critical data with the cloud provider's personnel. Most cloud providers are doing a very good job protecting customer data from outsiders. But are they equally diligent protecting the same data from their own technical people?

Although the cloud computing infrastructure is generally very secure, it is also a very tempting target for the criminal underground. All public clouds have been engineered with cloud computing security as one of the top concerns. As a result, there have only been a small number of reported vulnerabilities. One example is reported here (PDF). Any such vulnerability reported or not, in your chosen cloud, might put your entire data at risk. In the "old world", infrastructural vulnerabilities sometimes actually pose a critical risk, but often are hidden behind multiple layers of security devices, both physical security and network/OS security.

Porticor mitigates most of the risk associated with cloud computing security issues. The Porticor Virtual Private Data System encrypts your business data and maintains the encryption keys secure but still under your control. You can rest assured that even if the cloud is somehow breached, your data will remain secure and private.

There are many benefits of cloud computing as well by virtue of abstraction, prevents the consumer from having the same level of influence over the computing resource [7] [8]. Great concern is the ability of consumer to assert quality of service [9]. QoS refers to aspects of a service that are not functional but are important considerations, this is leads to some of the following challenges with public cloud computing. "One of the key challenges in cloud computing is data-level security" [10]. Starting with the most important challenges which are:

a- Availability.
b- Data Residency

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