ENHANCING SECURITY AND PRIVACY IN THE CLOUD COMPUTING

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ABSTRACT

Cloud computing is current buzzword in the market. Security to this Service is an important issue. PKI (Public key Infrastructure), as a Service and its focus is to evaluate the possibility to deploy a Public Key Infrastructure as a Cloud service. This is interesting since more and more organizations are moving their services and infrastructure to the cloud to benefit from the possibilities and advantages of cloud services and avoid problems with having own infrastructures. It is also interesting since the cloud could utilize the distributed architecture of PKI and in this way increase the reliability and availability and decrease the response times for validation of certificates.

Keywords:- Cloud computing; Security; Public cloud, Private cloud, Hybrid Cloud, cloud computing; security; privacy issue.

Introduction

In the Introduction of cloud computing and explains various related technologies like distributed computing, grid computing and various cloud categories and the services cloud offers along with the organisation of the thesis.

Evolution

In the 1980s and 1990s, with the rise of PCs, the shrinking costs of networking and computing infrastructure, and a need for more agility, client/server provided the ability to split the application tier away from the server tier . This was done to support distributed clients

running richer user interfaces and also to reduce costs by offloading the user handling, application workloads off monolithic servers. 2000 onwards, as data centers started to fill out, and power, space and cooling became more and more expensive, concepts such as commodity grid computing and virtualization started to become established . Cloud computing takes theseconcepts further by allowing self-service, metered usage and more automated dynamic resource and workload management practices.

1.2 What is Cloud Computing?

In late 90s or even now, ask any web developer, solution architect or anyone involved in web application development in any capacity:

Which symbol do you use to represent Internet on numerous white-board meetings? Obviously the most widely used metaphor for Internet was/is cloud. Cloud computing has derived its name from the same line of thinking.

Cloud Computing is a *style of computing which* must cater to the following computing needs:

1. Dynamism

2. Abstraction

3. Resource Sharing

1. Dynamism

Your business is growing exponentially. Your computing need & usage is getting bigger with every passing day. Would you add servers & other hardwares to meet the new demand? Assume, Recession is back & your business is losing customers. The servers & hardwares you added during last quarter's peak season is now idle. Will you sale them? Demand keeps on changing based on world/regional economy, sometimes seasonal traffic burst as well. That's where Cloud Computing comes to your rescue! You just need to configure & your provider will take care of fluctuating demand.

2. Abstraction

Your business should focus on your core competency & should not worry about security, OS, software platform , updates and patches etc. Leave these chores to your provider. From an end users perspective, you don't need to care for the OS, the plug-ins, web security or the software platform. Everything should be in place without any worry.

3. Resource Sharing

Resource Sharing is the beauty of Cloud Computing. This is the concept which helps the cloud providers to attain optimum utilization of resources. Say, a company dealing in gifts may require more server resources during festive season. A company dealing in Payroll management may require more resources during the end or beginning of the month. http://www.techno-pulse.com/

The cloud architecture is implemented in such a way that it provides you the flexibility to share application as well as other network resources (hardware etc). This will lead to a need based flexible architecture where the resources will *expand* or *contract* with little configuration changes.

1.3 Cloud Computing Services

  i. Infrastructure-as-a-Service
 ii. Platform-as-a-Service
iii. Software-as-a-Services

Infrastructure-As-A-Service

Infrastructure as a Service is a provision model in which an organization outsourcers the equipment used to support operations, including storage, hardware, servers and networking components. The service provider owns the equipment and is responsible for housing, running and maintaining it. The client typically pays on a per-use basis.

Characteristics and components of IaaS include:

  i. Utility computing service and billing model.
 ii. Automation of administrative tasks.
iii. Dynamic scaling.
 iv. Desktop virtualization.

v.   Policy-based services.
vi. Internet connectivity.

Infrastructure-as-a-Service like Amazon Web Services provides virtual server instances with unique IP addresses and blocks of storage on demand. Customers use the provider's application program interface (API) to start, stop, access and configure their virtual servers and storage. In the enterprise, cloud computing allows a company to pay for only as much capacity as is needed, and bring more online as soon as required. Because this pay-for-what-you-use model resembles the way electricity, fuel and water are consumed it's sometimes referred to as utility computing. Infrastructure as a Service is sometimes referred to as Hardware as a Service (HaaS).

1.4 Platform-As-A-Service

Platform as a Service (PaaS) is a way to rent hardware, operating systems, storage and network capacity over the Internet. The service delivery model allows the customer to rent virtualized servers and associated services for running existing applications or developing and testing new ones. Platform as a Service (PaaS) is an outgrowth of Software as a Service (SaaS), a software distribution model in which hosted software applications are made available to customers over the Internet. PaaS has several advantages for developers. With PaaS, operating system features can be changed and upgraded frequently. Geographically distributed development teams can work together on software development projects. Services can be obtained from diverse sources that cross international boundaries. Initial and ongoing costs can be reduced by the use of infrastructure services from a single vendor rather than maintaining multiple hardware facilities that often perform duplicate functions or suffer from incompatibility problems. Overall expenses can also be minimized by unification of programming development efforts.

On the downside, PaaS involves some risk of "lock-in" if offerings require proprietary service interfaces or development languages. Another potential pitfall is that the flexibility of offerings may not meet the needs of some users whose requirements rapidly evolve. Software-As-A-Service

Software as a service sometimes referred to as "software on demand," is software that is deployed over the internet and/or is deployed to run behind a firewall on a local area network or personal computer. With SaaS, a provider licenses an application to customers either as a

service on demand, through a subscription, in a "pay-as-you-go" model, or at no charge. This approach to application delivery is part of the utility computing model where all of the technology is in the "cloud" accessed over the Internet as a service.

SaaS was initially widely deployed for sales force automation and Customer Relationship Management (CRM). Now it has become commonplace for many business tasks, including computerized billing, invoicing, human resource management, financials, content management, collaboration, document management, and service desk management.

1.5 Advantages of Cloud Computing

Save Hardware Cost.

Companies can cut down on hardware investment because by using cloud computing they do not have to purchase additional server, peripherals and other network gear.

Backup & Recover with Ease

Servers that run inside a virtual machine can be stored in one image file containing the entire system configuration and settings. In case a server crashes, you don't have to scratch from beginning to perform reinstallation and reconfiguration. Simply take a copy of the saved image, restore data from last backup and the server will be back up and running again. You can save time, effort and resources.

Easy To Deploy

Virtual servers can be cloned as much as possible and can be run on another machine without having to change configuration hence reducing the workload of IT staff and expedite the process.

Save on Energy Bills

Using cloud computing technology will be spared the need to maintain room temperature room to cool down server therefore reduce cost of electricity usage

Reduced Space

The fewer the number of servers the lesser space to store the network equipment I the server is placed on a shared server or data center.

Easier Maintenance and Management

Fewer number of servers will automatically reduce the time and cost to manage server.

Hardware standardization

Hardware virtualization in cloud computing involves emulation and encapsulation so that the process of introduction and removal of a particular hardware can be carried out with ease.

Easier to replace and upgrade.

Replacing or upgrading a server specification can be easier to execute using cloud computing. If the parent server is overloaded and specifications are not sufficient anymore, we can easily upgrade the specification or move a virtual machine to another, more powerful server

Remote Accessibility: With cloud computing, your business is not restricted to a particular location. This applies to individuals also. You can access the services from anywhere. All you need is your ID and password. In some cases, there may be extra security requirements but as they too are mobile, you can easily access your cloud services from any part of the world.

Easy Expansion: As of the characteristics of cloud computing is its flexibility, you can quickly access more resources if you need to expand your business. You need not buy extra infrastructure. You just need to inform your cloud provider about your requirements and they will allocate resources to you. In most cases, the entire process is automated so the expansion takes just a few minutes. The same is applicable if you wish to use fewer resources. One of the best advantages of cloud computing is easy re-allocation of resources.

Security: Though people doubt cloud computing, clouds tend to be more secure than the traditional business models. Clouds offer real-time backup which results in less data loss. In case of outage, your customers can use the backup servers that sync with the main ones as soon as they are up. Your business gets maximum uptime without any loss of data during

the transitions. Other than this, clouds are less prone to hacks and DDoS attacks as people don't know the whereabouts of your data.

Environmentally Friendly: Usage of ready-made resources tailored to your needs helps you reduce the electricity expenses. While you save on electricity, you also save on resources required to cool off computers and other components. This reduces the emissions dangerous to environment.

1.6 Disadvantages of Cloud Computing

Cloud computing requires a stable internet connection, when there is no reliable internet connection you cannot expect to get the most of it. This can particularly be a hindrance for those living in remote areas without access to a reliable connection.

Of the most prominent disadvantages of cloud computing is when a data center crashes all the virtual machines will be affected. This can be prevented by backing up your data on a regular basis and using the so-called fail over or clustering though.

Another worst scenario is that if a parent server becomes a target in a hacking attack then the intruders will most likely be able to gain access to virtual servers using data stored on the parent server.

Those are the advantages and disadvantages of cloud computing you should take into account before jumping on the virtualization and cloud computing wagon. While cost and ease of use are two great benefits of cloud computing, there are significant security concerns that need to be addressed when considering moving critical applications and sensitive data to public and shared cloud environments. To address these concerns, the cloud provider must develop sufficient controls to provide the same or a greater level of security than the organization would have if the cloud were not used. Listed here are ten items to review when considering cloud computing.

1. Where's the data? Different countries have different requirements and controls placed on access. Because your data is in the cloud, you may not realize that the data must reside in a physical location. Your cloud provider should agree in writing to provide the level of security required for your customers.

2. Who has access? Access control is a key concern, because insider attacks are a huge risk. A potential hacker is someone who has been entrusted with approved access to the cloud. If anyone doubts this, consider that in early 2009 an insider was accused of planting a logic bomb on Fanny Mae servers that, if launched, would have caused massive damage. Anyone considering using the cloud needs to look at who is managing their data and what types of controls are applied to these individuals.

3. What are your regulatory requirements? Organizations operating in the US, Canada, or the European Union have many regulatory requirements that they must abide by (e.g., ISO 27002, Safe Harbor, ITIL, and COBIT). You must ensure that your cloud provider is able to meet these requirements and is willing to undergo certification, accreditation, and review.

4. Do you have the right to audit? This particular item is no small matter; the cloud provider should agree in writing to the terms of audit.

5. What type of training does the provider offer their employees? This is actually a rather important item, because people will always be the weakest link in security. Knowing how your provider trains their employees is an important item to review.

6. What type of data classification system does the provider use? Questions you should be concerned with here include: Is the data classified? How is your data separated from other users? Encryption should also be discussed. Is it being used while the data is at rest and in transit? You will also want to know what type of encryption is being used. As an example, there is a big difference between WEP and WPA2.

7. What are the service level agreement (SLA) terms? The SLA serves as a contracted level of guaranteed service between the cloud provider and the customer that specifies what level of services will be provided.

8. What is the long-term viability of the provider? How long has the cloud provider been in business and what is their track record. If they go out of business, what happens to your data? Will your data be returned, and if so, in what format? As an example, in 2007, online storage service MediaMax went out of business following a system administration error that deleted active customer data. The failed company left behind unhappy users and focused concerns on the reliability of cloud computing.

9. What happens if there is a security breach? If a security incident occurs, what support will you receive from the cloud provider? While many providers promote their services as being UN hackable, cloud based services are an attractive target to hackers.

10. What is the disaster recovery/business continuity plan (DR/BCP)? While you may not know the physical location of your services, it is physically located somewhere. All physical locations face threats such as fire, storms, natural disasters, and loss of power. In case of any of these events, how will the cloud provider respond, and what guarantee of continued services are they promising? As an example, in February 2009, Nokia's Contacts On Ovi servers crashed.

2. Literature Survey

[2.1] On Technical Security Issues in Cloud Computing

"Meiko Jensen, J¨org Schwenk,*Horst G¨ortz Institute for IT Security Ruhr University Bochum, Germany , 2009*"

The Cloud Computing concept offers dynamically scalable resources provisioned as a service over the Internet. Economic benefits are the main driver for the Cloud, since it promises the reduction of capital expenditure (CapEx) and operational expenditure (OpEx). In order for this to become reality, however, there are still some challenges to be solved. Amongst these are security and trust issues, since the user's data has to be released to the Cloud and thus leaves the protectionsphere of the data owner. Most of the discussions on this topics are mainly driven by arguments related to organisational means. This paper focusses on technical security issues arising from the usage of Cloud services and especially by the underlying technologies used to build these cross-domain Internet-connected collaborations.

[2.2] Cloud computing security issues and challenges

"Krešimir Popović, Željko Hocenski Institute of Automation and Process Computing,Faculty of Electrical Engineering Osijek,Kneza Trpimira 2b, Osijek, 31000, Croatia 2010, May"

In the last few years, cloud computing has grown from being a promising business concept to one of the fastest growing segments of the IT industry. Now, recession-hit companies are increasingly realizing that simply by tapping into the cloud they can gain fast access to best-of-breed business applications or drastically boost their infrastructure resources, all at

negligible cost. But as more and more information on individuals and companies is placed in the cloud, concerns are beginning to grow aboutjust how safe an environment it is. This paper discusses security issues, requirements and challenges that cloud service providers (CSP) face during cloud engineering. Recommended security standards and management models to address these are suggested for technical and business community.

[2.3] Cloud Computing Research and Security Issues

"Jianfeng Yang College of Computer Science and Technology Sichuan University ,Chengdu, China , 2010"

Cloud computing, a rapidly developing information technology, has aroused the concern of the whole world. Cloud computing is Internet-based computing, whereby shared resources, software and information, are provided to computers and devices on-demand, like the electricity grid [1]. Cloud computing is the product of the fusion of traditional computing technology and network technology like grid computing, distributed computing parallel computing and so on. It aims to construct a perfect system with powerful computing capability through a large number of relatively low-cost computing entity, and using the advanced business models like SaaS (Software as a Service), PaaS (Platform as a Service), IaaS (Infrastructure as a Service) to distribute the powerful computing capacity to end users' hands. This article introduces the background and service model of cloud computing. This article also introduces the existing issues in cloud computing such as security, privacy, reliability and so on. Proposition of solution for these issues has been provided also.

[2.4] Cloud Computing: Issues and Challenges, Tharam Dillon Digital Ecosystems and Business Intelligence Institute Curtin University of Technology Perth, Australia, 2010

Many believe that Cloud will reshape the entire ICT industry as a revolution. In this paper, we aim to pinpoint the challenges and issues of Cloud computing. We first discuss two related computing paradigms - Service-Oriented Computing and Grid computing, and their relationships with Cloud computing We then identify several challenges from the Cloud computing adoption perspective. Last, we will highlight the Cloud interoperability issue that deserves substantial further research and development.

[2.5] Analysis and Research about Cloud Computing Security Protect policy

"Haoyong Lv Network centerHuanggang normal university Huanggang, China, 2011."

This paper introduces cloud computing concepts and main features, and analyzes the security of cloud computing and the security strategies are proposed for security issues related to cloud computing.

2.6 The Characteristics of Cloud Computing

"Chunye Gong, Jie Liu, Qiang Zhang, Haitao Chen and Zhenghu Gong Department of Computer Sciences National University of Defense Technology Changsha, China 2010."

Cloud computing emerges as one of the hottest topic in field of information technology. Cloud computing is based on several other computing research areas such as HPC, virtualization, utility computing and grid computing. In order to make clear the essential of cloud computing, we propose the characteristics of this area which make cloud computing being cloud computing and distinguish it from other research areas. The cloud computing has its own conceptional, technical, economic and user experience characteristics. The service oriented, loose coupling, strong fault tolerant, business model and ease use are main characteristics of cloud computing. Clear insights into cloud computing will help the development and adoption of this evolving technology both for academe and industry.

3. PROBLEM FORMULATION AND OBJECTIVE

There are many advantages of cloud Computing but its usage has been Limitation due to security issues which need to be addressed. Identity management in cloud requires new dimensions to be understood. In a federated environment a seamless interaction is required between service providers and identity providers thus increasing user experience.

3.1 Objectives

- Analysis the Risk factors
- Design Dynamic Trust Policies for better decision making
- Establishing a public key infrastructure for a better trust environment.

4.1 Tools and Technology Used:

i. Visual Studio 2008
ii. Asp.net
iii. SQL Server 2008 R2
iv. Windows Azure SDK
v. Azure Fabric
vi. Java Script
vii. CSS

Visual Studio 2008

Visual Studio 2008 supports all the new technologies like Asp.net MVC, Silver light, Windows Azure SDK, Windows Azure Fabric. As I am using windows azure SDK in my cloud development that is why I am using VS 2008. As VS 2010 also supports new technologies but it has some bugs due to its Beta release.

Asp.net

As cloud computing is a web base technology, so asp.net is the best solution for this. Because I am using Azure SDK the product of Microsoft so for that purpose I must have web based language of Microsoft.

SQL Server 2008 R2

Windows Azure uses development storage in database. The only database server that supports storage of azure is SQL Server 2008 R2. This is the latest database related product of Microsoft and supports the azure technology. It will save all the user's uploaded data in its database for local storage purposes.

Windows Azure SDK

To run and deploy my cloud application I must have a mechanism that supports cloud related application. For this reason I have used Windows Azure SDK so that I could easily develop my application, test them locally and deploy them on cloud.

Azure Fabric

In cloud my application must have replicas in order to save my data being crashed. So for that purpose I must have a mechanism which could take information from me, and set the number of replicas of my application on the cloud as much as I want. Also the availability of my application to access them from anywhere. For this purpose I have used Azure Fabric which will take number of instances from me and set them on the cloud.

Java Script

It is client based scripting language. I am providing games and other software. So in order to put less burden on server I used java script so that application could run on client side having less size, save server to being under the heavy application burden also less size on the client side.

CSS

As everyone is familiar with cascading style sheet. It is used to the designing of website.

5.1 SYSTEM REQUIREMENT

Hardware Requirement:-

- Intel Dual core Processor
- 2GB RAM
- 20 GB HDD

Software Requirement:-

- Windows XP
- Visual Studio 2008

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