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Security Issues & Controls in Cloud Computing

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ABSTRACT

Cloud computing, a rapidly evolving landscape has been defined as the use of a collection of distributed services, applications, information and infrastructure comprised of pools of computer, network, information and storage resources. These components can be rapidly grouped, provisioned, implemented and decommissioned using an on-demand utility-like model of allocation and consumption.

Cloud Computing neither more nor less secure environment like any new technology creates new risks and new opportunities. In some cases moving to the cloud, provides an opportunity to re-architect older applications and infrastructure to meet or exceed modern security requirements. At other times the risk of moving sensitive data and applications to an emerging infrastructure might exceed your tolerance (Cloud Security Alliance, 2009).

Organizations should adopt a risk-based approach to moving to the cloud and selecting security options. This paper deals with the current state of cloud computing security in the organizations and the most significant changes awaited by cloud computing users as computing resources migrate from on-premise to the cloud. Cloud users believe that Sensitive or Confidential information is too risky to be moved to the cloud.

Keywords : Cloud Computing, Security, Risk, Vulnerability

Gartner (2008) defines Cloud Computing as "massively scalable IT-enabled capabilities are delivered 'as a service' to external customers using Internet technologies." Amazon's EC2 service and Google's Google App Engine are examples of Cloud Computing.

Three service delivery models of a Cloud are Software as a Service (SaaS), are Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Cloud provider organizations say SaaS (55%) is the most frequently offered cloud service, followed by IaaS (34 %) and PaaS (11 %).

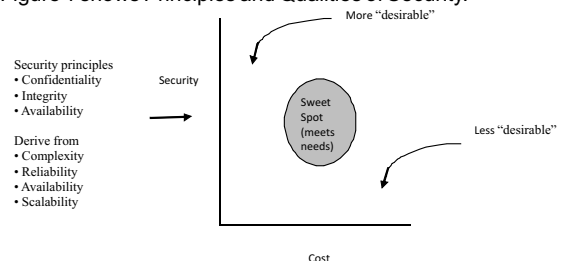
Four Deployment models of a cloud are Public, Private, Community and Hybrid. 65% of cloud providers deploy their IT resources in the public cloud environment, 18 % deploy in the private cloud and 18% are hybrid (Ponemon Institute, 2011).

Cloud computing has become an important trend in information technology throughout the world. Reduced Costs and Increasing Productivity are the benefits for business and IT. But the focus on cost and speed and not on security or data protection creates a security hole. Many organizations are moving swiftly to the cloud without making sure that the information they put in the cloud is secure. Figure 1 here.

Data is king, and today the Confidentiality, Integrity, and Availability of data is more important than ever. Distributed information use and management is the reality of today. According to Tim Mather et al. (2009), Cloud computing offers the promise of more efficient and cost-effective computing to facilitate information use, but also expands known risks and introduces new risks yet to be discovered and managed.

It has become a common mantra in the high-technology industry to chant "Cloud computing good", while at the same time saying "Cloud security bad".

Figure 1 shows Principles and Qualities of Security.



Whether "security in cloud computing a bad thing" depends on what you use cloud computing for, and your expectations. If you are a large organization with significant resources to devote to a sophisticated information security program, you need to overcome a number of security, privacy, and compliance challenges. If you are a small to medium-size business (SMB), the security of cloud computing might look attractive, compared to the resources you can afford to spend on information security today.

There is a great deal of uncertainty about how security at all levels (e.g., network, host, application, and data levels) can be achieved. That uncertainty has consistently led information executives to state that, "Security is their number one concern" with cloud computing.

Security: A Major Concern

Security is always a major concern in Open System Architectures. Security concerns arising because both customer data and program are residing in Provider Premises.

Security is to save data and program from Danger and Vulnerability (ACIS, 2009).

Dangers

- Disrupts Services.
- Theft of Information.
- Loss of Privacy.
- Damage information.

Vulnerabilities

- Hostile Program.
- Hostile people giving instructions to good programs.

Bad guys corrupting or eavesdropping on communications. Security is simply a set of systems properties that are sub-definitions of quality. Once IT security plans are aligned with business goals, the IT security team can enjoy broad organizational support for investment in time and cost to build better infrastructure security. Security can be described as having three interdependent goals: Prevention, Detection, and Response. In operation, we will achieve cost benefits if we protect against security risks rather than reacting over and over in response to avoidable security incidents.

Risk: Risk is a function of threats as they seek to exploit vulnerabilities, and in light of the counter measures, we apply to protect our assets.

The risk formula we use in information security:

$$\text{Risk} = \frac{\text{Threats} \times \text{Vulnerabilities}}{\text{Countermeasures}} \times (\text{Asset value})$$

Since risk is expressed in terms of threats that exploit vulnerabilities and the value of assets are hanging in the balance, we want to get our security strategy right in terms of the exposure side. But we also want to get it right from the cost side as well. We have a budget for managing risk and if we are going to implement cost-effective security, we need to quantify risk at an appropriate order of magnitude (Vic (J.R.) Winkler, 2011)

Common Security Requirements: Confidentiality, Integrity, Availability and Non-Repudiation.

Confidentiality

Ensuring that Information is not disclosed to unauthorized persons.

Integrity

Ensuring that Information held in a system is a proper representation of the Information intended and that it has not been modified by an unauthorized person.

Availability

Ensuring that Information processing resources are not made unavailable by malicious action.

Non-Repudiation

Ensuring that agreements made electronically can be proven to have been made.

Need for Cloud Security

Enterprises and individuals have been very comfortable storing and maintaining their data on their private computers in their own network environments. With the advent of cloud computing, the data storage will be provided by the provider hence the enterprises and individuals would have to part with their data if they want to enjoy the benefits of the cloud; and this is where the concerns for security originate from.

Once the data leaves our network and goes into the cloud we lose control over it as well as the security around it. In the cloud we rely on the provider to provide these services; we lose most of the control. Most of the providers don't take responsibility for the data stored in their cloud! Their contracts have been written so that they are not held liable in the case of any breach of cloud data regardless whose mistake caused that breach. For example, Amazon Provider.

Apart from the lack of acute consciousness and responsibility from the providers, the threat of hackers getting access to the

cloud data is real. Recent Amazon cloud outage, though not related to the security, caused many websites and services to go down for the considerable period of time.

Cloud Security, A broad term not only encompasses the security of data sitting in the provider's cloud but also includes authorization to data access, security of data en route, encryption at the source, and other related aspects (Manny Siddiqui, 2011).

Key Issues in Cloud Computing

Issues that cause most serious impact on their organization's security posture as a result of cloud computing are as follows (in ascending order of importance):

- Not knowing where information assets are physically located
- Inability to limit physical access to IT infrastructure
- Inability to enforce security policies
- Inability to identify and properly authenticate users before granting access rights
- Inability to secure sensitive or confidential information at rest
- Inability to conduct independent audits
- Inability to prevent data loss or theft

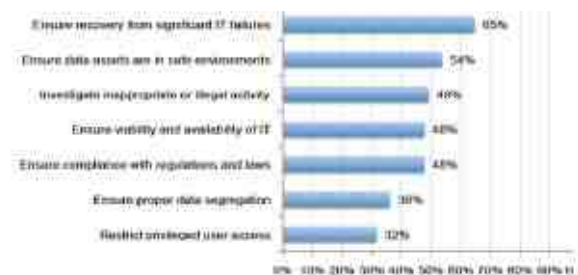
While on-premise computing is not without inherent security risks, cloud computing poses new threats and challenges that need to be seriously considered before adoption.

Seven cloud computing security risks cited in the security literature

As predicted by leading IT analysts, seven known security risk areas that are more prominent in the cloud environment are

- Ensure the physical location of data assets are in secure environments
- Restrict privileged user access to sensitive data
- Ensure compliance with all applicable privacy and data protection regulations and laws
- Ensure long-term viability and availability of IT resources
- Ensure recovery from significant IT failures
- Ensure proper data segregation requirements are met
- Investigate inappropriate or illegal activity

Figure 2 shows the Combined results of US and Europe Study. Figure 2: Cloud Computing Security Risks



With respect to these seven risk areas, cloud providers are most confident about their ability to ensure recovery from significant IT failures and ensure the physical location of data assets are in secure environments. IT service providers that enable private clouds attach more importance and a higher level of confidence in their organization's security posture than providers of public cloud solutions.

Data assets that cloud users believe too risky for the cloud computing environment are Intellectual property, Financial business information, Health information, Employee records, Non-financial business information and Credit card information.

Approach to mitigate security risk

- First, take an inventory of all cloud computing resources in use today and assess the risk they pose to the organization's security posture. This assessment process should involve a core team led by corporate IT or security (depending on the expertise required).
- Second, for all high risk cloud applications make a decision about whether to discontinue their use to allocate more resources to make them more secure.
- Third, develop policies and procedures that require knowledgeable people such as the company's IT security function to evaluate the security posture of all future cloud computing providers.
- Fourth, to avoid bottlenecks in the process, procedures should enable mission-critical applications to be vetted as a priority before moving to a secure cloud environment. IT and IT security practitioners generally agree on the areas of focus that organizations need to consider before migrating to the cloud. These include:
 - Ensuring access rights, especially for privileged users, are effectively managed in the cloud computing environment.
 - Taking steps to locate sensitive or confidential data after deployment to the cloud.
 - Establishing oversight and control practices to ensure mission-critical applications and sensitive data too risky to move to the cloud are kept on-premise.
 - Modifying plans for business continuity, disaster recovery and e-discovery as information assets and critical infrastructure moves to the cloud.
 - Building control practices to thoroughly vet cloud providers before deploying their services.
 - Educating end-users on the security risks associated with cloud computing.
 - Establishing the right mix of enabling technologies and control practices to ensure that the migration from on-premise to cloud environments is executed safely and securely.

Top five critical areas of focus for organizations migrating to the cloud

1. Identity and Access Management.
2. Business continuity and disaster recovery
3. Procedures for electronic discovery
4. Compliance and audit
5. Encryption and key management

Most important technologies and control activities for cloud providers

The Study of Ponemon Institute (2011) reveals that , The enabling security technologies most often used by providers in the cloud computing environment are Firewalls,Anti-virus and anti-malware,Encryption for data in motion, Patch management, Log management, Single sign-on, Data loss prevention, Correlation or event management, Access governance systems, Encryption for wireless communication.

But, the Technologies believed to be most important in securing the cloud computing environment are shown in Table 1

Enabling Security Technologies	Percent deployed or will be deployed
Network intelligence systems	25%
Virtual private network (VPN)	25%
Log management	44%
Identity federation	31%
Encryption for data at rest	43%
User management and provisioning	15%

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For enabling technologies, the control procedures that can be deployed by cloud providers as a service are

- certifications such as PCI DSS, ISO, and NIST,
- training of data handlers,
- surveillance of data center operations,
- quality assurances
- external audit and
- help desk activities.

Finally, Cloud providers are most confident about their ability to accomplish the following stated security requirements:

- Access to highly qualified IT security personnel
- Prevent or curtail viruses and malware infection
- Secure sensitive or confidential information in motion
- Achieve compliance with leading self-regulatory frameworks

In contrast, cloud providers are least confident about the following security requirements:

- Identify and authenticate users before granting access
- Secure vendor relationships before sharing information assets
- Prevent or curtail external attacks
- Encrypt sensitive or confidential information assets whenever feasible
- Determine the root cause of cyber attacks

However, Security should not be entirely the responsibility of the end-user. Security in the cloud is a shared responsibility between the cloud provider and the enterprise. IT security vendors, cloud users, and cloud providers need to collaborate to build security into cloud environments. (Ponemon Institute, 2010)

The security responsibilities of both the provider and the consumer greatly differ between cloud service models. Amazon's AWS EC2 infrastructure as a service offering, as an example, includes vendor responsibility for security up to the hypervisor, meaning they can only address security controls such as physical security, environmental security, and virtualization security. The consumer, in turn, is responsible for security controls that relate to the IT system (instance) including the operating system, applications, and data.(Cloud SecurityAlliance,2009)

The inverse is true for Salesforce.com's customer resource management (CRM) SaaS offering. Because the entire 'stack' is provided by Salesforce.com, the provider is not only responsible for the physical and environmental security controls, but it must also address the security controls on the infrastructure, the applications, and the data. This alleviates much of the consumer's direct operational responsibility.

Enhancing security practices will likely increase the cost of cloud computing resources, which diminishes one of the main reasons for choosing the cloud.

Conclusion

Cloud computing resource providers are not focused on the security in the cloud. Rather, their priority is delivering the features to their customers such as low cost solutions with fast deployment that improves customer service and increases the efficiency of the IT function. As a result, providers conclude that they cannot warrant or provide complete assurance that their products or services are sufficiently secure(Cloud Tweaks,2011). About 91% of cloud providers do not provide security as a service from the cloud today, but about one-third are considering offering this type of service at some point in the next two years.



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