



INTERNATIONAL JOURNAL OF  
RESEARCH IN COMPUTER  
APPLICATIONS AND ROBOTICS  
ISSN 2320-7345

## CLOUD COMPUTING: CURRENT SCENARIO AND PRIVACY ISSUES

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### Abstract

Key aspects of cloud computing are that there is an infrastructure shared between organisations that is off premise. Therefore, there are threats associated with the fact that the data is stored and processed remotely, and because there is an increased usage of virtualisation and sharing of platforms between users. Protection of personal, confidential and sensitive data stored in the cloud is therefore extremely important. Privacy is an important issue for cloud computing, both in terms of legal compliance and user trust, and needs to be considered seriously. In this paper the privacy challenges that consumers face when targeting the cloud as their production environment to offer services are assessed.

### 1. Introduction

In 21<sup>st</sup> century the use of computers has increased rapidly in education, government organizations and businesses for all purposes. Organizations like schools, companies, and government use computers to increase core services and provide service to gain efficacy. The advent of Internet has introduced a whole new opportunity to businesses in their daily interactions. These organizations are implementing cloud computing because of its ability to access remote resources and information in real time and anywhere in the world [7].

The success of Internet is the result of rapid development of processing and storage technologies; computing resources have become inexpensive and are accessible easily than ever before. Different software applications are provided efficiently and at a low price over the Internet. The various infrastructural facilities like servers, softwares, data center spaces, network equipments, the required computing platforms, solution stacks needed for building an application are also available on the Internet. In a cloud computing environment, the conventional role of service provider is divided into two: the *infrastructure providers* who manage cloud platforms and lease resources according to a usage-based cost benefit model, and *service providers*, who rent resources from one or many infrastructure providers to serve the end users. For the past few years, large business enterprises are changing their business models to take the benefit from the more powerful, consistent and cost-efficient cloud platforms.

Though cloud computing has been the answer for many organizations, some are still uncertain about the utilization of this new tool. Like everything else, cloud computing too has its pros and cons. While the

technology can prove to be a great asset to your company, it could also cause harm if not understood and used properly. The adoption of new paradigm is dependent on the nature of organizations largely up to the business owner and the kind of daily transactions that decide whether the platform is appropriate for them or not.

## 2. What is Cloud Computing?

According to Katzan [6], the cloud computing is one of the most significant transformations in Information Technology that provides computer facilities via the Internet, with many advantages to both companies and end users. Cloud computing offered a new way to access the computer services, users are not restricted to the resources of his own computer but can access what they really need from different locations and different computers through Internet. This technology promises to release the clients from the burden of administering more and more complex and expensive systems by offering them the possibility of using systems with state of the art computing capabilities, high availability and scalability [12].

Cloud computing has the potential to enhance partnership, dexterity, scaling and accessibility and provided opportunities for cost reduction through optimized and efficient use of computing resources. The cloud model is a way of organizing computers so that resources can be quickly organized, provisioned, executed and decommissioned, scaled up or down to provide an on demand service allocation. The term cloud is used to represent the data center hardware and software which will be transparent to the client offering him the capability of focusing his efforts on the main activity [10].

## 3. Advantages and Disadvantages of Cloud Computing

Cloud computing offers several advantages both to end users and businesses of all sizes. The apparent huge advantage is that you no more have to take the overhead of supporting the infrastructure or have the knowledge necessary to develop and maintain the infrastructure, development environment or application, as the load has been shifted to someone else who is taking care of all that. Businesses are now able to focus on their core business activities by outsourcing all the hassle of IT infrastructure. The government has also moved their services into the cloud to save more from their budget. A large number of government organizations are checking the benefits of cloud computing to obtain the hardware and software they need while making operations faster, cheaper and more sustainable. Ilias Tsagklis [11] has presented the benefits and short comings offered by the cloud computing which are summarized as follows.

**Cost Efficiency**-It is the most important features of cloud computing which eliminates the need of investing in stand-alone machines for hardware and software. It enhances organizations' capabilities by saving their cost on purchase of license softwares, data storage and maintenance costs, software updates etc. As compared to the conventional methods available cloud computing is much better for reducing overall IT expenses. The scalable and convenient cloud models also facilitate the working of the organizations by eliminating cost overheads.

**Convenient Resource availability**-Public clouds offer services that are provided to the end users irrespective of their geographic locations. This approach helps to enhance collaborations as information is available readily than ever before. As cloud vendors use multiple servers for maximum redundancy, system failures are immediately responded by uploading the alternate copy on some other machine.

**Backup and Recovery**-The backup and recovery process has become simpler because data resides on a cloud than on a standalone machine. Sometimes cloud can be treated as backup repository of data stored in local computers.

**Pro-environment**-The cloud is environment friendly as it makes use of minimal resources for computations and thereby saves energy. When less number of servers is used as infrastructure, resources become easily

available and also help to reduce energy consumption. Hence only those resources that are required at any point in time are used by the system.

**Robust and Superfluous**-The cloud computing is designed on an architecture which supports strong deployment models to serve the end users. The cloud offers automatic failover between hardware platforms out of the box, while disaster recovery services are also included.

**Scalability and Performance**-One of the important features of cloud computing is scalability wherein cloud instances are deployed as and when needed. The end user pays only for the storage or the services he uses; thus helps to provide infrastructure and other IT services. The systems make use of distributed architectures which offer tremendous speed of computation. It is the sole responsibility of the service provider to ensure that a customer's services run on cutting edge machinery. Instances can be added instantly for improved performance and customers have access to the total resources of the cloud's core hardware via their dashboards.

**Quick deployment and ease of integration**-Within a short span of time the cloud computing is gaining popularity because of its ability to deploy quickly. Similarly a new user can be accommodated in the system as quickly as possible, eliminating waiting periods. A cloud system can be up and running in a very short period, making quick deployment a key advantage. Furthermore, software integration occurs automatically and organically in cloud installations. A business is allowed to choose the services and applications that best suit their preferences, while there is minimum effort in customizing and integrating those applications.

**Increased Storage Capacity**-The cloud can accommodate and store much more data compared to a personal computer and in a way offers almost unlimited storage capacity. It eliminates worries about running out of storage space and at the same time. It spares businesses the need to upgrade their computer hardware, further reducing the overall IT cost.

**Device Diversity and Location Independence**-Cloud computing provides accessibility to its services through the medium of various electronic devices that are capable of accessing Internet. The devices include varied range from PCs to smart phones, tablets etc. This facilitates the end users to work on their own devices from any location in the world. Cloud computing is mainly beneficial for big companies as they offer flexibility to their employees to access data of the company from anywhere in the world.

### Disadvantages of Cloud Computing

While there are several cloud benefits, this method of computation is not for all businesses. There are certain disadvantages that might change your perception about cloud computing before making it a part of your system. It requires careful deliberation and professional advice to determine if this is the case in any specific condition.

**Security and Privacy in the Cloud**-Security is the biggest threat for cloud computing. A company provides its confidential and sensitive data and information to the cloud service provider for gaining access to remotely controlled cloud infrastructure. The provider's decisiveness is very essential as he has to manage, protect and retain the very crucial data of the company. The end user is always in a dilemma to provide his data to a third party. Hence before switching over to cloud computing, a company needs to explore all the possible alternatives. Similarly, privacy in the cloud is another concerned issue. Companies and users have to trust their cloud service vendors that they will protect their data from uninformed commercial use.

**Vendor lock-in**-One of the main drawbacks of cloud computing is the implicit dependency on the provider. It is the situation when company relies on a specific vendor and gets bound to that vendor for all cloud transactions. This is what the industry calls "vendor lock-in". Many a times it becomes difficult for the

company to switch over from one vendor to other because of the huge size of the data. This is another reason why you should carefully and thoroughly consider all options when selecting a vendor.

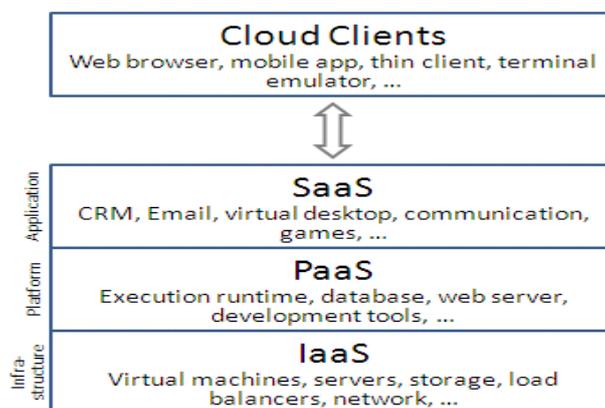
**Technical complexity and Downtime**-Smaller companies reap more benefits from cloud computing as they do not have to deal with the technicalities associated with daily transactions. However all systems might face dysfunctions from time to time. Outage and downtime is possible even to the best cloud service providers. In addition to that the whole setup is dependent on internet access, thus any network or connectivity problems will make the setup useless. It might take several minutes for the cloud to detect a server fault and launch a new instance from an image snapshot.

**Limited influence and elasticity**-The applications and services run on remote, third party virtual environment hence companies and users have limited control over the function and execution of the hardware and software. Since remote software is being used, it usually lacks the features of an application running on stand-alone machine.

**Increased susceptibility**-As cloud based services are accessible through the public network called Internet they are more prone to malicious attacks by the hackers. Nothing on the Internet is completely secured and even the leading companies suffer from serious attacks and security breaches. Because of the interdependency of the system, if the machine storing data gets negotiated there might be a leakage of sensitive information to the world.

#### 4. Cloud Delivery Model

Cloud computing is making use of a modern concept called Service Oriented Architecture (SOA). The technique focuses on the delivery of an integrated and well organized suite of functions to an end-user through the use of different functions or services. These services are well defined functionalities that are built as software components and that can be used in different combinations to achieve different goals [3]. Cloud computing providers offer services built around three fundamental models: Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), as displayed in Figure 1.



**Figure 1:** Cloud Computing Fundamental Models  
Source: [www.wikipedia.com](http://www.wikipedia.com)[1]

Infrastructure as a Service (IaaS) is the capability provided to the cloud user that provides the processing, networks, storage, and other fundamental computing resources. All of the above enable the user to deploy and run arbitrary applications and even operating system softwares. The cloud user does not manage or control the underlying cloud infrastructure, but has control over operating systems, storage, deployed applications, etc. In this model, it is the cloud user who is responsible for patching and maintaining the operating systems and

application softwares. Infrastructure-as-a-Service is a platform through which businesses can avail equipment in the form of hardwares, servers, storage space etc. at pay-per-use service.

Platform as a Service (PaaS) is the capability provided to the cloud user to deploy onto the cloud infrastructure consumer-created applications using programming languages and tools supported by the provider. In such a case the cloud user can develop and run its own software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. He cannot manage or control the underlying cloud infrastructure, network, servers, operating systems, or storage.

Software as a Service (SaaS) facilitates the use of the provider's applications running on a cloud infrastructure and accessible from various client devices through a thin-client interface such as a web browser. The consumer does not manage or control the underlying cloud infrastructure, network, servers, operating systems, storage, or even individual application capabilities, but only some limited user-specific application configuration settings. Examples include online word processing and spread sheet tools, customer relationship management (CRM) services and web content delivery services.

Viewed in terms of data security the three ways of service provision differ radically because of the extent to which the user has access to the software used and its settings.

## 5. Cloud Deployment Model

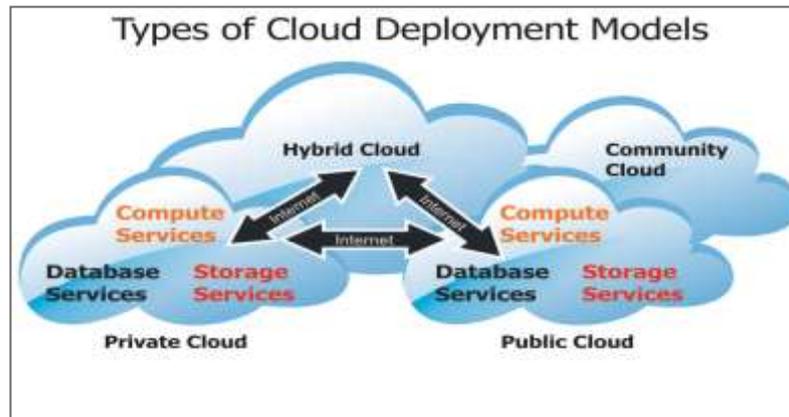
Depending on the user requirements different Deployment models are used in cloud computing. Each model has specific characteristics that support the needs of the services and users of the clouds in particular ways [3].

**Private Cloud** is the cloud infrastructure that is deployed and maintained for specific organization. The cloud may be hosted within the organization or externally and is managed internally or by a third-party. This model does not benefit from the less hands-on management, or from the economic advantages that make cloud computing such a fascinating concept.

**Public Cloud** is the cloud infrastructure made available to the public on a commercial basis by a cloud service provider. This enables a consumer to develop and deploy a service in the cloud with very little financial implications compared to the capital expenditure requirements normally associated with other deployment options.

**Community Cloud** is the cloud infrastructure shared among a number of organizations with similar interests and requirements. It can be managed internally or by a third party and hosted within the organization or externally. The costs are shared among fewer users than a public cloud. Hence a community cloud benefits from medium costs as a result of a sharing policy. By means of comparison, with the private cloud the costs increase alongside the level of expertise needed.

**Hybrid cloud** is a combination of two or more clouds that remain unique entities but are bound together, offering the benefits of multiple deployment models. By utilizing "hybrid cloud" architecture, companies and individuals are able to obtain degrees of fault tolerance combined with locally immediate usability without being entirely dependent on third party services. Hybrid Cloud architecture requires both on-premises resources and off-site server based cloud infrastructure. Hybrid clouds lack the flexibility, security and certainty of in-house applications. However, they provide the flexibility of in-house applications with the fault tolerance and scalability of cloud based services.



**Figure 2:** Types of Cloud Deployment Models

Source: <http://www.edureka.in/blog/what-is-cloud-computing/>

## 6. Privacy in Cloud Computing

The concept of privacy refers to the protection of the individual's identity or integrity, as well as the protection of an individual's right to influence the use and dissemination of personal information about him. Every individual has the right to control his or her own data, whether private, public or professional. Privacy issues are increasingly important in the online world. It is observed that if the privacy issues are well taken care of; they boost up consumer's faith in online transactions and thereby promote economic growth. However, the secure release, management and control of personal information into the cloud represent a huge challenge for all stakeholders, involving pressures both legal and commercial [5].

The cloud computing possesses a serious threat to data integrity, confidentiality and privacy principles as data is not under the direct control of the end user. The Madrid Resolution approved by data protection authorities from fifty countries, gathered in Madrid in 2009 within the framework of the 31<sup>st</sup> International Conference of Data Protection and Privacy, defines universal principles for the protection of personal data and privacy. It states the vital need to protect privacy in a world across borders and reach a mutual proposal for the establishment of international standards on privacy and data protection [8]. Its purpose is to identify a set of principles and rights assuring the valuable and internationally homogeneous protection of privacy with regard to the processing of personal data, and to assist the international flows of personal data intrinsic in a globalized world.

## 7. Privacy Challenges in Cloud Computing

The five major characteristics features of cloud computing are on-demand self-service, ubiquitous network access, location-independent resource pooling, rapid flexibility and measured service, all of which are equipped towards flawless and lucid cloud use. Rapid flexibility enables the scaling up or down of resource pool. Measured services are mainly derived from business model properties whereby cloud service providers manage and optimize the use of computing resources through automated resource allocation, load balancing and metering tools. This growing quantity of personal data will drive demand for cloud services, particularly if cloud computing delivers on the assurances of lower costs for customers and the surfacing of new business models for providers. Among the key privacy challenges for cloud computing are as mentioned below [9].

**Complex risk assessment-**The intricacy of cloud services introduces a number of unidentified parameters. Service providers and consumers are guarded, respectively, about offering guarantees for compliance-ready services and taking up the services. With service providers promoting a simple way to flow personal data

across countries, a real dispute arises in terms of checking the data processing life cycle and its conformity with official frameworks [5].

**Influence of new business models on consumer privacy**-A survey report by the Federal Trade Commission on "Protecting consumer privacy in an era of rapid change" studied the repercussions for consumer privacy in an era of technological advances in the IT sphere. According to FTC, companies are able to collect, store, examine, utilize and share vast amounts of consumer data for commercial use which incurred very less price. These technological advances have led to an explosion of new business models that depend on capturing consumer data at a specific level and over time, including profiling, online behavioural advertising, social media services and location-based mobile services [2].

**Regulatory agreement**-It is widely accepted that data protection and regulatory compliance are the top security concerns IT advocates. According to the Pew Internet and American Life Project, an overwhelming majority of users of cloud computing services expressed serious concern about the possibility of a service provider disclosing their data to others. Ninety per cent of cloud application users said they would be very concerned if the company at which their data were stored sold them to another party. Eighty per cent indicated that they would be very concerned if companies used their photos or other data in marketing campaigns. Sixty-eight percent of users of at least one of the six cloud applications said they would be very concerned if companies providing such services analyzed their information and then displayed adverts to them based on their actions [4].

## Conclusion

The global dimension of cloud computing requires standardized methodologies and technical solutions to enable stakeholders to assess privacy risks and establish adequate protection levels. From a business point of view, privacy should represent an opportunity for cloud providers to promote brand image and differentiate services. However, privacy challenges require the involvement of a wide range of stakeholders to cover multidisciplinary approaches benefiting all areas of society. Robust privacy protection needs interoperable built-in privacy components capable of ensuring compliance with principles such as data minimization in complex architectures. Privacy standards will play an important role in fostering the adoption of cloud services by promoting social responsibility and addressing privacy challenges.

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