

Challenges and Benefits for Adopting the Paradigm of Cloud Computing

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Abstract— Cloud computing is a rapidly emerging technology that has removed the saddle of buying licensed software and heavy hardware. By exploiting this technology, clients are able to access resources remotely by using a simple web browser. They are not required to maintain hardware devices or software applications, so it saves managing cost and time for organizations. Many industries, such as banking, healthcare, and education, are moving towards the cloud due to the efficiency of services provided by the pay-per-use pattern. The utilization and payment process of cloud computing is similar to other common utilities such as electricity. As the users of electricity are only required to pay for the amount of electricity consumed throughout the month. Similarly, cloud providers charge the users based on the exploitation of a cloud system or resources such as processing power used, transactions carried out, bandwidth consumed, data transferred, or storage space occupied. Cloud computing is a completely internet dependent technology where client data is stored in the data center of a cloud provider. There are various challenges for adopting cloud computing such as privacy, interoperability and reliability. Beside these challenges, there are also several benefits for adopting this technology such as cost savings, easy scalability, and increased productivity. This research paper introduces a big picture of cloud computing and analyzes the key challenges as well as benefits of adopting the paradigm of cloud computing.

Keywords: Pay-per-use, Interoperability, Scalability

I. INTRODUCTION

There are various reasons for business organizations to move towards IT solutions that include cloud computing. First of all, organizations are only required to pay when they use certain resources. Secondly, organizations are not required to pay maintenance costs for managing various resources across the enterprise. Finally, cloud computing models provide business agility. Since the entire IT infrastructure can scale up or down to meet desired demands, organizations can easily meet the needs of rapidly changing markets to ensure that they are always on the leading edge for their consumers. Cloud computing is the advanced picture of various technologies such as grid computing, distributed computing and Service-oriented Architecture (SOA) [1]. Cloud computing involves three types of stakeholders i.e. providers, adopters and users. Providers are the IT industries that provide the facility of cloud services to the adopters, i.e. business organizations. The users are involved in the use of provided services. The

complete structure of a cloud computing environment is shown in Fig.1. Cloud computing mainly provides three types of services to clients, i.e., Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). SaaS refers to running applications that are provided to clients as a service. These applications can be accessed through a thin layer interface such as a web-browser.

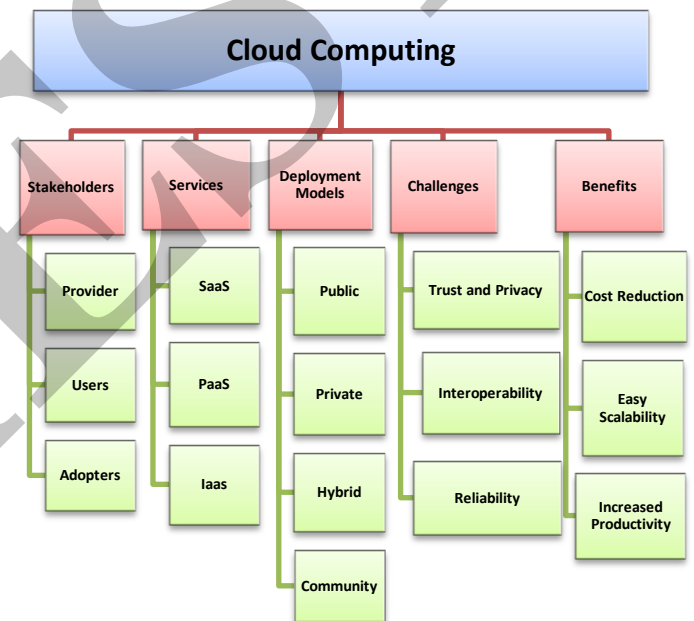


Figure 1. Complete structure of cloud computing

By using SaaS, clients don't need to install and buy licensed applications. They just need to follow the pay-per-use pattern. However, SaaS is not fully reliable when it comes to the use of real-time applications such as 3D games [1]. These applications require buffering time, so their performance becomes slower when users access them through the internet. PaaS is the delivery of a computing platform over the web as a service. PaaS enables clients to create web applications rapidly without the cost and complexity of buying and managing the underlying software or hardware.

IaaS is the delivery of huge computing resources such as the capacity of processing, storage, and networks. It enables clients to use virtual software, hardware, datacenters and networking components as on-demand services. The clients are not required to purchase personal hard disks or other storage devices [1]. It seems to be that cloud computing is on its approach to remove the need for hardware devices and licensed applications. In the near future clients will be able to use software such as word processing applications and operating systems without the need for heavy hardware devices, as the client system is not required to process these applications [2].

II. DEPLOYMENT MODELS

The cloud providers offer different types of clouds (cloud deployment models) to an organization according to their business requirements. Normally there are four different types of cloud deployment models, i.e. public, private, hybrid and community cloud.

A. Public Clouds

Public clouds are cloud services provided by a third party vendor. These clouds exist beyond the company firewall as shown in Fig.2 [4]. These clouds are fully hosted and managed by the cloud provider.

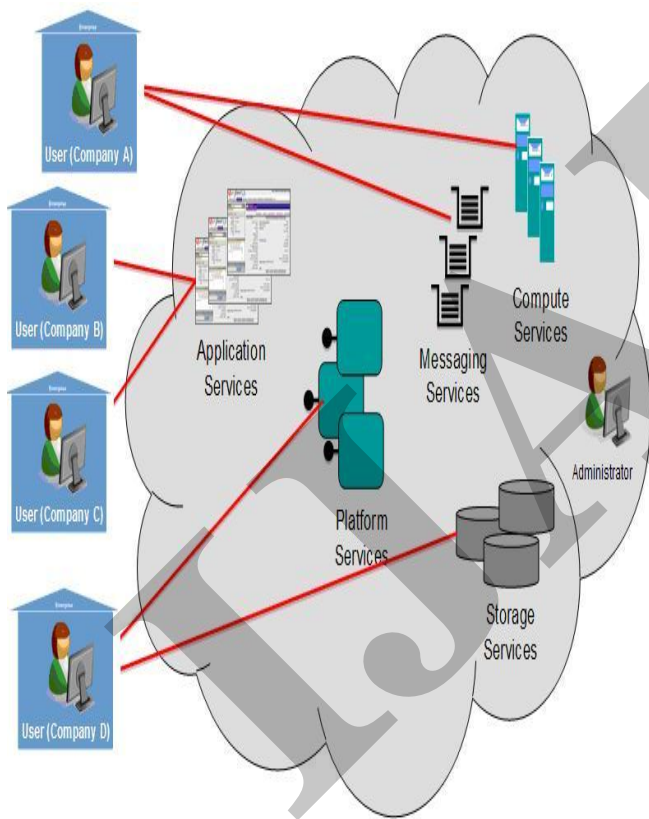


Figure 2. Public cloud model

Public clouds attempt to provide consumers with hassle-free IT elements. Whether it is software, application infrastructure, or physical infrastructure, the cloud provider

takes on the responsibilities of installation, management, provisioning, and maintenance. Customers are only charged for the resources they use, so under-utilization is eliminated. These services are usually offered with convention over configuration, meaning that they are delivered with the idea of accommodating the most common use cases. Configuration options are usually a smaller subset than what they would be if the resource was controlled directly by the consumer. Since consumers have little control over the infrastructure, processes requiring powerful security and regulatory compliance are not always a good fit for public clouds [3].

B. Private Clouds

Private clouds are cloud services provided within the enterprise as shown in Fig.3 [4]. These clouds exist within the company firewall and are managed by the enterprise.

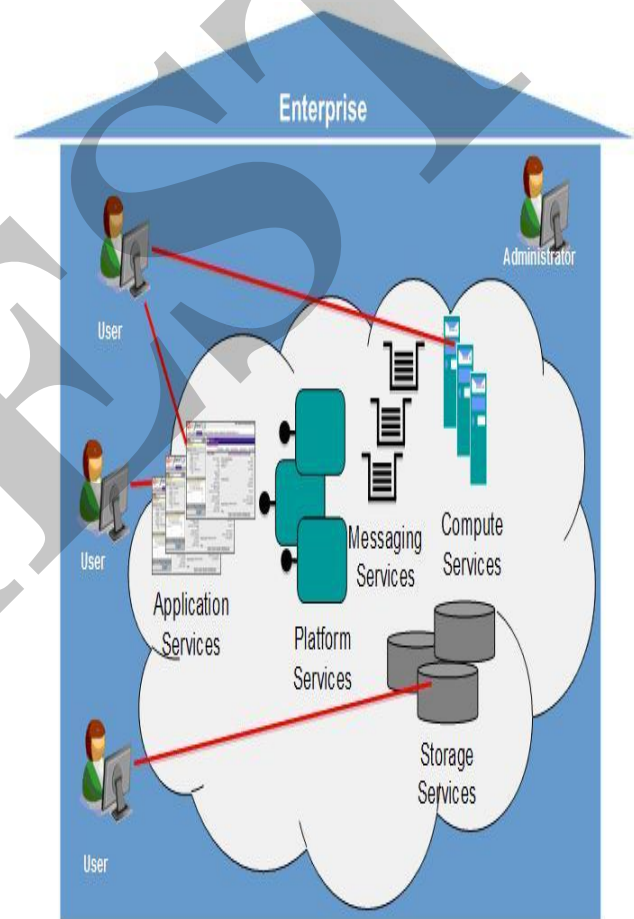


Figure 3. Private cloud model

Private clouds offer several similar benefits to those of public clouds but with one major difference that the enterprise is in charge of setting up and maintaining the cloud. The difficulty and cost of establishing an internal cloud can be very expensive, and the cost of continual operation of the cloud might exceed the cost of using a public cloud. Private clouds offer some advantages compared to public clouds such

as control over managing the cloud. Organizations feel in control over their cloud services and security [3].

C. Hybrid Clouds

Hybrid clouds are a combination of public and private clouds. These clouds would typically be created by the enterprise, and management responsibilities would be split between the enterprise and the cloud provider. The hybrid cloud provides services that are in both the public and private clouds as shown in Fig.4 [4]. Hybrid clouds are required when a company needs to employ the services of both a public and private cloud. In this case, a company can outline the goals and needs of services, and obtain them from the public or private cloud as appropriate. A well-constructed hybrid cloud can be useful for providing secure services such as receiving customer payments, as well as those that are secondary to the business, such as employee payroll processing.

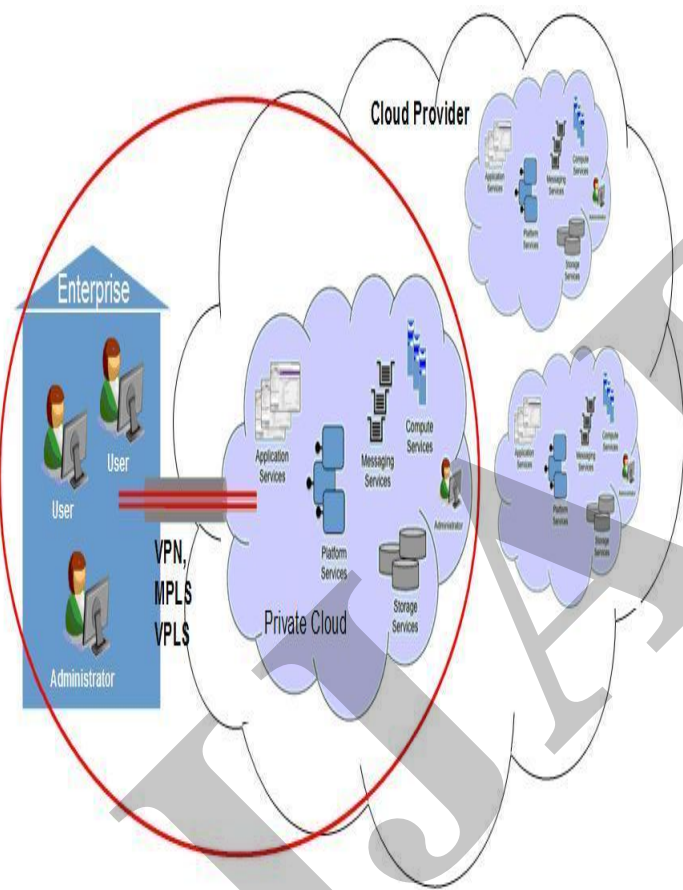


Figure 4. Hybrid cloud model

The major drawback to the hybrid cloud is the difficulty in effectively creating and governing such a solution. Services from different sources must be obtained and provisioned as if they originated from a single location, and interactions between private and public components can make the

implementation even more complicated [3].

D. Community Clouds

The community cloud is a new and rarely offered cloud model. These clouds are based on a group of several organizations that jointly construct and share the same cloud infrastructure as well as policies, requirements, values, and concerns. These community clouds are normally based on an agreement between related business organizations such as banking or educational organizations. The cloud infrastructure can be hosted by a third-party vendor or one of the organizations within the community [5].

III. CHALLENGES FOR ADOPTING THE PARADIGM OF CLOUD COMPUTING

The key challenges that create barriers between cloud computing and its adopters are privacy, interoperability, and reliability.

A. Trust and Privacy

Nowadays cloud computing is completely moving towards virtualization. In a virtualized cloud environment, the cloud provider allocates a virtual machine (VM) for each client. The VM runs the client's applications and maintains virtual storage. The VM runs on the underlying provider's operating system. The advantage of virtualization in cloud computing is the isolation of VMs where the VM of each client is isolated from other clients, so that if any client's VM is infected with a virus or becomes malicious, it will not affect the other clients under the same provider because they are residing on separate VMs. But there is an issue related to the privacy of information and trust. When security is managed by a cloud provider, clients often don't trust the level of security provided if the information stored is very critical and confidential [6]. Normally organizations in the healthcare and banking sectors are not satisfied enough with the security. Conversely, some organizations are not satisfied enough to trust the provider. They may feel that the provider may leak their confidential information. Thus, even if a cloud provider creates powerful security procedures to block hackers from accessing the cloud environment, clients may be hesitant to adopt this technology due to issues of privacy and trust of provider.

B. Interoperability

This is the ability of two or more systems work together in order to exchange information and use that exchanged information. Many public cloud networks are configured as closed systems and are not designed to interact with each other. The lack of integration between these networks makes it difficult for organizations to combine their IT systems in the cloud and realize productivity gains and cost savings. To overcome this challenge, industry standards must be developed to help cloud service providers design interoperable platforms and enable data portability. Organizations need to automatically provision services, manage VM instances, and

work with both cloud-based and enterprise-based applications using a single tool set that can function across existing programs and multiple cloud providers. In this case, there is a need to have cloud interoperability. Efforts are under way to solve this problem. For example, the Open Grid Forum, an industry group, is working on the Open Cloud Computing Interface, which would provide an API for managing different cloud platforms. Until now it has remained a challenging task in cloud computing [7].

C. Reliability

The challenge of reliability comes into the picture when a cloud provider delivers on-demand software as a service. The software needs to have a reliability quality factor so that users can access it under any network conditions (such as during slow network connections). There are a few cases identified due to the unreliability of on-demand software. One of the examples is Apple's MobileMe cloud service, which stores and synchronizes data across multiple devices. It began with an embarrassing start when many users were not able to access mail and synchronize data correctly. To avoid such problems, providers are turning to technologies such as Google Gears, Adobe AIR, and Curl, which allow cloud based applications to run locally, some even allow them to run in the absence of a network connection. These tools give web applications access to the storage and processing capabilities of the desktop, forming a bridge between the cloud and the user's own computer [8]. Considering the use of software such as 3D gaming applications and video conferencing systems, reliability is still a challenge to achieve for an IT solution that is based on cloud computing.

IV. BENEFITS FOR ADOPTING THE PARADIGM OF CLOUD COMPUTING

Beside the challenges of cloud computing, there are numerous benefits of cloud computing that encourages business organizations to adopt IT solutions based on the cloud. The key benefits of adopting cloud computing are cost reduction, easy scalability and increased productivity.

A. Cost Reduction

The usage of SaaS enables business organizations to minimize payment costs for IT resources and maximize business performance as well as profit. Clients are required to pay according to the use of resources. If clients need an application for a short period of time, it is useless to buy the application by paying the complete licensing cost. The solution based on cloud computing cuts down the cost of paying for the applications and resources that are not in use any more. As the service provider owns and hosts the software, the users can benefit from ongoing upgrades and maintenance without the associated costs and time constraints. With the use of cloud technology clients are not required to create data backups. Cloud providers that use multiple redundant sites can provide reliable and secure locations for

data storage and are ideal for disaster recovery and business continuity, so business organizations are not worried about the loss of data and creating recovery backups [9].

B. Easy Scalability

Cloud computing is a flexible model and provides on-demand business scalability by using on-demand cloud services such as SaaS, PaaS or IaaS. Scalability is another aspect of cloud computing that can provide an advantage to business. Depending on service needs at any given time period, a company can scale back the amount of virtual server space they need, or raise it according to their pattern of growth. This is especially helpful for new businesses that are trying to save money at every possible turn. A smaller business does not have to pay a fixed rate for a certain amount of data center hosting that they might not even use. In this way, a company can scale up the level of space they need on a dedicated server through cloud computing. A low-cost dedicated server can easily save a business thirty to forty percent of their average annual cost for IT [9]. If an organization is a SaaS user, it can request to adopt PaaS or IaaS whenever required. With an on-demand integration solution, companies can quickly and easily increase or decrease connections, transactions, or the number of companies in their integration community, and then scale up when business requires it.

C. Increased Productivity

In this rapid era of technology and innovations, business is growing rapidly. The demands of customers are increasing with high speed and they need the products more quickly with less time. In order to achieve these demands, business organizations around the globe need to communicate and collaborate by using IT resources such as collaborative applications and remote access web services. Cloud computing provides these business demanded application on the cloud or internet. Users are able to access these applications at anytime and anywhere. Business people can arrange their meetings and share messages or emails by using cloud applications provided by various vendors. Cloud computing has moved mobility ahead in business, as well. Business people can access the services of cloud just by using a web browser on a Smartphone, tablet, or notebook. There is no need to use laptops or desktop computers. With the help of cloud applications, salespersons can view updated orders from customers at anytime. The quick processing of customer orders enables organizations to achieve customer satisfaction levels that automatically lead to increased productivity and profit.

V. CONCLUSION AND FUTURE WORK

By discussing the key challenges and benefits for adopting cloud computing, it is clear enough that adoption of cloud is still remained as a question mark for organizations. Due to these challenges, organizations are avoiding cloud computing, but because of the benefits, they are in favor of adopting cloud

computing. In order to abolish the challenges of cloud computing, several software enterprises such as Microsoft, IBM, Google, and Amazon are continuously contributing to the field of cloud computing by developing innovative cloud applications and platforms. Nowadays, some companies have started to adopt cloud computing. According to a survey conducted by International Data Corporation (IDC), 53% of organizations in the Asia-Pacific region are already using some form of cloud computing services, and the remaining 47% of the organizations have plans to adopt private or public cloud services in the next 12 months [10]. The survey results indicate that, at present, cloud computing is a not highly adopted technology, but due to growing contributions by researchers and IT industries, it seems that within a few short years, global business will be on the cloud and there will not be any need for using heavy hardware devices, desktop PCs, or laptops. A Smartphone or tablet will be the most in-demand device to run a business organization successfully. The future direction of this research will focus on developing and designing new techniques to eliminate cloud computing challenges.

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