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Cloud Computing: A Review

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Abstract – Cloud computing is the use of computing resources (hardware and software) that are delivered as a service over a network (typically the Internet). The emergence of Cloud computing and its promise to save money is making it imperative for organizations to examine whether Cloud computing really makes sense for them and whether they should invest in Cloud or not. Cloud computing is a general term for anything that involves delivering hosted services over the Internet. Cloud computing customers consume resources as a service and pay only for what they use. The goal of Cloud computing is to provide easy and scalable access to computing resources and IT services. This paper discusses various aspects of Cloud including basic concept, types of Cloud, benefits and limitations and future scope of Cloud computing.

Keywords – Cloud; Customer Relationship Management; Infrastructure as a Service; Platform as a Service; Security; Software as a Service.

I. Introduction

Cloud computing is a technology that uses Internet and central remote servers to maintain data and applications. It offers different ways to acquire and manage IT resources on a large scale. The term “Cloud” appears to have its origins in network diagrams that represented the Internet, or various parts of it, as schematic clouds. A simple example of Cloud computing is webmail. The webmail provider maintains the server space and provides access; the webmail user just plugs a web address into a browser and submits user information to access an account. The email client, i.e., Yahoo!, Gmail, Hotmail, and so on, takes care of housing all of the hardware and software necessary to support the email account. An email client is similar to how Cloud computing works. Except instead of accessing just your email, you can choose what information you have access to within the Cloud. An important element in Cloud Computing is that we shift processing, managing, storing and implementing our data from, locality into the Cloud; so it helps us to improve the efficiency. This computing approach relies on a number of existing technologies, e.g., the Internet, virtualization, grid computing, Web services, etc. It helps an organization in saving costs and creating new business opportunities. Fig. 1 displays a basic Cloud computing environment.



Fig. 1: A Cloud Computing Environment

Traditional business applications have always been very complicated and expensive. The amount and variety of hardware and software required to run them are daunting. You need a whole team of experts to install, configure, test, run, secure, and update them. When you multiply this effort across dozens or hundreds of apps, it's easy to see why even the biggest companies with the best IT departments aren't getting the apps they need. With Cloud computing, you eliminate those headaches because you're not managing hardware and software - that's the responsibility of an experienced vendor like salesforce.com. The shared infrastructure means it works like a utility: You only pay for what you need, upgrades are automatic, and scaling up or down is easy.

II. Basic Concept

Cloud computing is a computing paradigm, where a large pool of systems are connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage. It is more than a technology. Cloud computing comes into focus only when you think about what IT always needs: a way to increase capacity or add capabilities on the fly without investing in new infrastructure, training new

personnel, or licensing new software. The key advantages of this model are cost-effectiveness, high performance, accessibility, scalability (elasticity) and availability. Many companies are delivering services from the cloud. Some notable examples as of 2010 include the following (Fig. 2):

- Google: Has a private cloud that it uses for delivering many different services to its users, including email access, document applications, text translations, maps, web analytics, and much more.
- Microsoft: Has Microsoft® Sharepoint® online service that allows for content and business intelligence tools to be moved into the cloud, and Microsoft currently makes its office applications available in a cloud.
- Salesforce.com: Runs its application set for its customers in a cloud, and its Force.com and Vmforce.com products provide developers with platforms to build customized cloud services.

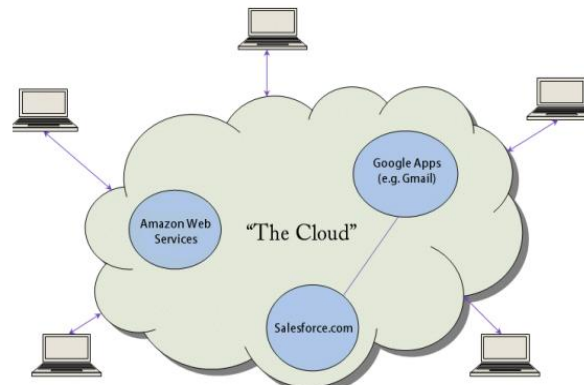


Fig. 2: Pioneers of Cloud Computing

Cloud computing focuses on providing a wide range of users with distributed access to scalable, virtualized hardware and/or software infrastructure over the Internet. The emergence of Cloud computing and its promise to save money is making it imperative for organizations to examine whether Cloud computing makes sense for them. Cloud computing allows consumers and businesses to use applications without installation and access their personal files at any computer with Internet access. This technology allows for much more efficient computing by centralizing storage, memory, processing and bandwidth. Cloud computing customers consume resources as a service and pay only for what they use. Hence we can say that Cloud makes it possible for you to access your information from anywhere at any time. A Cloud can host a variety of different workloads, including batch-style back-end jobs and interactive, user-facing applications. Moreover, a Cloud is more than a collection of computer resources because a Cloud provides a mechanism to manage those resources.

III. Types of Cloud

There are different types of Cloud computing as shown in Fig. 3. The user can subscribe to any type depending upon his or her computational needs:

- Public Cloud - A public Cloud can be accessed by any subscriber with an Internet connection and access to the Cloud space. Amazon Web Services is the largest public Cloud.
- Private Cloud - A private Cloud is established for a specific group or organization and limits access to just that group. It supplies hosted services to a limited number of people.
- Community Cloud - A community Cloud is shared among two or more organizations that have similar Cloud requirements.
- Hybrid Cloud - A hybrid Cloud is essentially a combination of at least two Clouds, where the Clouds included are a mixture of public, private, or community.

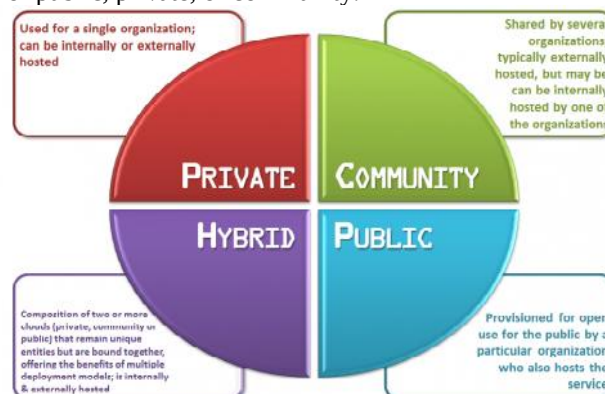


Fig 3: Types of Cloud

There are three types of Cloud providers (Fig. 4), which you can subscribe to: Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS). These three types differ in the amount of control that you have over your information, and conversely, how much you can expect your provider to do for you. Each provider serves a specific function, giving users more or less control over their Cloud depending on the type. When you choose a provider, compare your needs to the Cloud services available. Your Cloud needs will vary depending on how you intend to use the space and resources associated with the Cloud. If it will be for personal home use, you will need a different Cloud type and provider than if you will be using the Cloud for business. Keep in mind that your Cloud provider will be pay-as-you-go, meaning that if your technological needs change at any point you can purchase more storage space (or less for that matter) from your Cloud provider.

- **Software as a Service**

Software as a Service (SaaS) delivers business processes and applications, such as CRM, collaboration, and e-mail, as standardized capabilities for a usage-based cost at an agreed, business-relevant service level. All infrastructure and IT operational functions are abstracted away from the consumer.

- **Platform as a Service**

Platform as a Service (PaaS) delivers application execution services, such as application runtime, storage, and integration, for applications written for a pre-specified development framework. It provides an application platform or middleware as a service on which developers can build and deploy custom applications.

- **Infrastructure as a Service**

Infrastructure as a Service (IaaS) abstracts hardware (server, storage, and network infrastructure) into a pool of computing, storage, and connectivity capabilities that are delivered as services for a usage-based (metered) cost. Its goal is to provide a flexible, standard, and virtualized operating environment that can become a foundation for PaaS and SaaS.

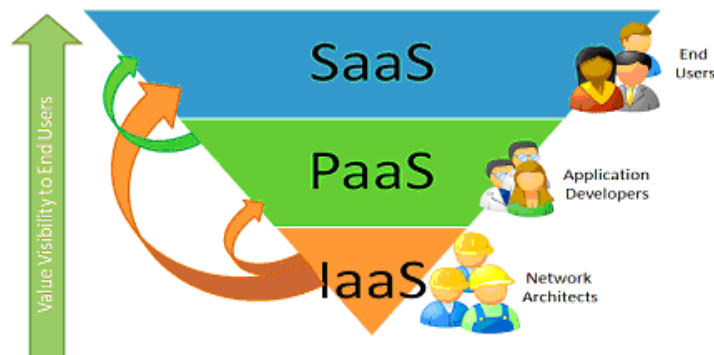


Fig 4: Types of Cloud Providers

As you go down the list from number one to number three, the subscriber gains more control over what they can do within the space of the Cloud. Thus, the Cloud provider has less control in an IaaS system than with an SaaS agreement. What does this mean for the home user or business looking to start using the Cloud? It means you can choose your level of control over your information and types of services that you want from a Cloud provider.

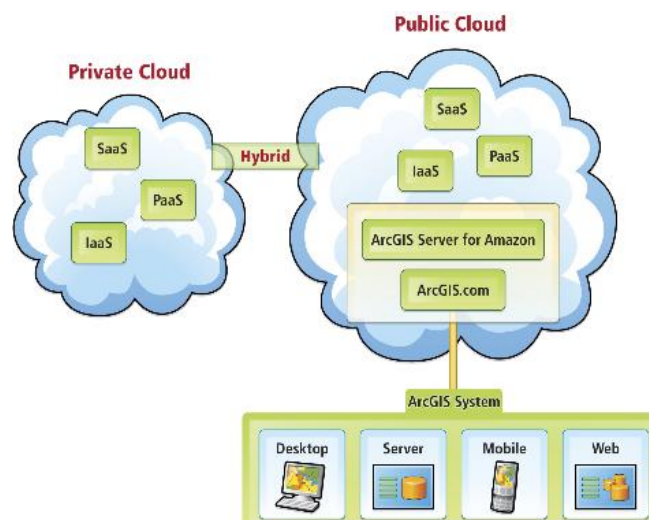


Fig 5: Cloud Computing Deployment Model

For example, imagine you are starting up your own small business. You cannot afford to purchase and store all of the hardware and software necessary to stay on the cutting edge of your market. By subscribing to an Infrastructure as a Service Cloud, you would be able to maintain your new business with just as much computational capability as a larger, more established company, while only paying for the storage space and bandwidth that you use. However, this system may mean you have to spend more of your resources on the development and operation of applications. As you can see, you should evaluate your current computational resources, the level of control you want to have, your financial situation, and where you foresee your business going before signing up with a Cloud provider. If you are a home user, however, you will most likely be looking at free or low-cost Cloud services (such as web-based email) and will not be as concerned with many of the more complex Cloud offerings.

There are several types of Cloud computing deployment scenarios (Fig. 5). The user can choose any Cloud type or Cloud provider based on his or her needs. Public Cloud is the most commonly implemented, where the infrastructure and applications are owned by the organization selling Cloud services. Some organizations, concerned about security, may opt for a private Cloud or a hybrid deployment model. The user can opt for any Cloud provider (SaaS, PaaS or IaaS) depending upon control level requirement.

IV. CLOUD COMPUTING BENEFITS

- **Cost Reduction:** Cloud system can adapt to changing consumer behavior and reduce cost for infrastructure maintenance and acquisition. Upfront cost to run the system on the Cloud is very lower. Cloud is especially helpful for businesses that cannot afford the same amount of hardware and storage space as a bigger company. Small companies can store their information in the Cloud, removing the cost of purchasing and storing memory devices. Additionally, because you only need to buy the amount of storage space you will use, a business can purchase more space or reduce their subscription as their business grows or as they find they need less storage space. User is normally charged per resource usage. The cost is based upon actual usage of resource or on the number of users accessing the application. Cloud-based programs also tend to be simple to deploy and don't require a big upfront investment. It's easy to control and track the costs of your inventory management system since usually you pay a single fee monthly or yearly to the Cloud provider.
- **Enhanced Efficiency:** Cloud inventory systems increase your efficiency in a number of ways. One is real-time inventory monitoring. In addition, Cloud-based solutions offer greater accessibility. You no longer need to be on the premises in order to access inventory information; now you can see it anywhere you want – even in meetings with clients. Cloud solutions are also good at supporting a wide variety of devices including tablets and smart phones.
- **Improved Coordination:** Cloud inventory programs also allow departments within a company to work together more efficiently. Operations can run more smoothly and efficiently, enhancing your customer's experience.
- **Improved Performance:** A vast Cloud, which is made by thousands of computers that network together, provide this salient ability that we didn't have before.
- **Increased Storage Capacity:** In Cloud Computing we have extreme resources for storing data because our storage consists of many bases in the Cloud.
- **Mobility:** For doing our work, we need not have our personal computer for working with our documents because we can access them in the Cloud. The Cloud makes it possible for you to access your information from anywhere at any time. While a traditional computer setup requires you to be in the same location as your data storage device, the Cloud takes away that step. The Cloud removes the need for you to be in the same physical location as the hardware that stores your data. Your Cloud provider can both own and house the hardware and software necessary to run your home or business applications. With Cloud, you can access any document from wherever you are with any device that can access the Internet. These devices could be a desktop, laptop, tablet, or phone. This can also help your business to function more smoothly because anyone who can connect to the Internet and your Cloud can work on documents, access software, and store data. Imagine picking up your smartphone and downloading a .pdf document to review instead of having to stop by the office to print it or upload it to your laptop. This is the freedom that the Cloud can provide for you or your organization.
- **Risk Reduction:** Organizations can use the Cloud to test ideas and concepts before making major investments in technology.
- **Collaboration:** To many users, this is one of the most important advantages of Cloud Computing, the ability for multiple users to easily collaborate on documents and projects. It helps IT staffs to work simultaneously on a project and be connected to each other in the Cloud by Cloud services.
- **Maintenance:** Cloud apps are easier to maintain since they do not require installation over each client's machine and can be accessed remotely from anywhere.

V. CLOUD COMPUTING LIMITATIONS

- **Cost of Transition:** For Cloud Computing we must undertake the cost of transition, before we can save money in the Cloud. Furthermore we must transfer our users to Cloud Computing. In 1990s, users didn't have motive to be familiar with Internet. Now we must be grafted in the relation between users and Cloud Computing.
- **Network Dependency & Latency:** One requirement is that you need to have an Internet connection in order to access the Cloud. This means that if you want to look at a specific document you have housed in the Cloud, you must first establish an Internet connection either through a wireless or wired Internet or a mobile broadband connection. To add to it, like anything else dependent on Internet connectivity, it is susceptible to outages and service interruptions at any time. Furthermore, Cloud computing is also susceptible to simple bandwidth issues. Everyone has most likely experienced this when attempting to utilize the Internet at "peak hours". In the context of Cloud computing, if the vendor's servers are being strained at peak hours, both the performance and availability of its services suffers for its clients. While most vendors have the redundancy to handle their peak load, there is always the risk of unforeseen events, server failures, or outside attack; any of which would threaten client access. All these issues give rise to latency into every communication between the user and the provider.
- **Lack of Standards & Regulations:** There are concerns in the Cloud computing community over jurisdiction, data protection, fair information practices, and international data transfer - mainly for organizations that manage sensitive data. Clouds have documented interfaces; however, no standards are associated with these, and thus it is unlikely that most clouds will be interoperable.

VI. SECURITY AND RISKS

Security is incredibly important in today's environment. The information housed on the Cloud is often seen as valuable to individuals with malicious intent. There is a lot of personal information and potentially secure data that people store on their computers, and this information is now being transferred to the Cloud. This makes it critical for you to understand the security measures that your Cloud provider has in place, and it is equally important to take personal precautions to secure your data.

The first thing you must look into is the security measures that your Cloud provider already has in place. These vary from provider to provider and among the various types of Clouds. What encryption methods do the providers have in place? What methods of protection do they have in place for the actual hardware that your data will be stored on? Will they have backups of my data? Do they have firewalls set up? If you have a community Cloud, what barriers are in place to keep your information separate from other companies? Many Cloud providers have standard terms and conditions that may answer these questions, but the home user will probably have little negotiation room in their Cloud contract. A small business user may have slightly more room to discuss the terms of their contract with the provider and will be able to ask these questions during that time. There are many questions that you can ask, but it is important to choose a Cloud provider that considers the security of your data as a major concern.

No matter how careful you are with your personal data, by subscribing to the Cloud you will be giving up some control to an external source (Fig. 6). This distance between you and the physical location of your data creates a barrier. It may also create more space for a third party to access your information. However, to take advantage of the benefits of the Cloud, you will have to knowingly give up direct control of your data. On the converse, keep in mind that most Cloud providers will have a great deal of knowledge on how to keep your data safe. A provider likely has more resources and expertise than the average user to secure their computers and networks.



Fig 6: Cloud comes with Security Risks

Cloud computing safety includes more than the potential risk of hackers or criminals. It also means ensuring that your provider has a strong record for uptime and availability, as business-critical documents and files shouldn't become inaccessible. Provider should have multiple redundancy plans in place and be able to provide details of what happens in the event of an unforeseen outage. Talking other way round, security could improve due to centralization of data, increased security-focused resources, etc., Security is often as good as or better than other traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. However, the complexity of security is greatly increased when data is

distributed over a wider area or greater number of devices and in multi-tenant systems that are being shared by unrelated users. In addition, user access to security audit logs may be difficult or impossible. Private Cloud installations are in part motivated by users' desire to retain control over the infrastructure and avoid losing control of information security.

VII. Future of Cloud

With the arrival of Cloud computing, the conventional way of computing has gone for a change. Using email and connecting to social media through smart phones, watching movies over smart phones and uploading and accessing pictures from websites like Flickr are common examples of Cloud computing in our day-to-day life. The future of Cloud computing is very bright. It is no longer necessary to purchase hard drives with large storage capacity, as it can be stored on Cloud. So keep the fear of losing your data away. All your data with complete back up can be stored on the Cloud. Uploading latest software and buying games from the market is going to be things of the past. In the future, there will be mobile 3D games to entertain your kids. With lot of educational institutions offering free course material for everyone over the Internet, Cloud computing can play a great role delivering education on the doorsteps of learners over an interface. It is now possible to store all your valuable certificates and documents like driving license and voter identity online and access them easily as and when required. In the near future, Cloud computing will be accompanied with more specialized application services.

In today's world, new business opportunities heavily depend on their IT infrastructure availability. Cloud computing technology will dramatically change the way we compute. Business applications are moving to the Cloud. The shift from traditional software models to the Internet has steadily gained momentum over the last 10 years. Looking ahead, the next decade of Cloud computing promises new ways to collaborate everywhere, through mobile devices. A small petty shop can use a CRM available on the Cloud to send SMS greetings to their customers. Multimedia digital content can be distributed to various consumers for a lower price.

VIII. Conclusions

Cloud makes it possible for you to access your information from anywhere at any time. Cloud provides many options for the everyday computer user as well as large and small businesses. It opens up the world of computing to a broader range of users and increases the ease of use by giving access through any Internet connection. At the same time, there is also an issue of privacy. Regulations will need to change to keep up with this fact. You have less control over who has access to your information and little to no knowledge of where it is stored. You also must be aware of the security risks of having data stored on the Cloud. The Cloud is a big target for malicious individuals and may have disadvantages because it can be accessed through an unsecured Internet connection. If you are considering using the Cloud, be certain that you identify what information you will be putting out in the Cloud, who will have access to that information, and what you will need to make sure it is protected. Additionally, know your options in terms of what type of Cloud will be best for your needs, what type of provider will be most useful to you, and what is the reputation and responsibilities of the provider you are considering before you sign up.

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