

Exploring the Cloud Deployment and Service Delivery Models

Mervat Adib Bamiah and Sarfraz Nawaz Brohi

Universiti Teknologi Malaysia, Kuala Lumpur, Malaysia

Email: mervatbamiah@yahoo.com, sarfraz_brohi@hotmail.com

Abstract – In the past when we used to search the word “cloud” on Google, it used to generate some results related to atmosphere, nature or water droplets. Nowadays when the same search query is submitted, Google returns results related to computing or internet, this is due to revolutionizing change in the era of technology. A new paradigm of computing is discovered that is cloud computing where word cloud is used as a metaphor for the internet. With the advent of this technology, organizations are rapidly shifting their IT systems from traditional client/server to cloud computing model where everything is offered as a service whether it’s a software, hardware or storage capacity. In order to fulfill the heterogeneous demands of users, cloud providers are offering variety of services (SaaS, PaaS, IaaS) and deployment models (Public, Private, Hybrid) to the organizations as well as individuals. However, considering the future of cloud computing, there is a need to provide more agile IT services as solutions to the organizations. In this research paper, we have described existing and upcoming cloud deployment and service delivery models that may be provided to the cloud users in near future.

Keywords – Service Delivery Models, Deployment Models

1. Introduction

Cloud computing is a model that enables convenient, on-demand network access to a shared pool of configurable computing resources such as networks, servers, storage, applications that can be rapidly provisioned and released with minimal management effort or service provider’s interaction [1]. In general cloud providers offer three types of services i.e. Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). With the exploit of this technology, users can access heavy applications via lightweight portable devices such as mobile phones, PCs and PDAs. Cloud computing moves computing and data away from desktops and portable PCs into huge data centers which saves cost and forms a new agile way of performing businesses [2]. There are various reasons for organizations to move towards IT solutions that include cloud computing as they are just required to pay for the resources on consumption basis. In addition, organizations can easily meet the needs of rapidly changing markets to ensure that they are always on the leading edge for their consumers.

2. Cloud Computing Deployment Models

National Institute of Standards and Technology (NIST) summarized the cloud computing characteristics as on-demand self-service, ubiquitous network access, resource pooling, rapid elasticity and pay per use. The rapid transition towards cloud computing has increased the demands for more deployment models. Selection of these models depends on clients’ data sensitivity and management requirements [1].

2.1. Private Cloud

Private cloud (internal cloud) infrastructure is dedicated to a single particular organization or group. It is not shared with other organizations. Private cloud can be owned or leased. It may be managed by the organization or a third

party and can exist at on-premises or off-premises. Private cloud is more expensive and secure when compared to public cloud [3]. Private cloud is hosted inside the organization’s firewall. It can be accessed by users within the organization via intranet as shown in figure 1 [5].

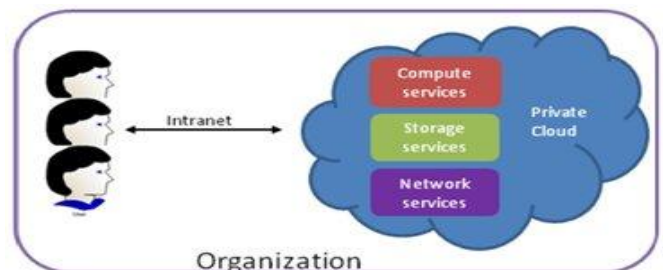


Figure 1. Private cloud.

Private clouds are flexible and service-based. Processes, services and data are managed within the organization. In private cloud there are no additional security regulations, legal requirements or bandwidth limitations that can be present in a public cloud environment, by using a private cloud, the cloud service providers and the clients have optimized control of the infrastructure and improved security, since user’s access and the networks used are restricted [4].

2.2. Public Cloud

Public cloud (external cloud) infrastructure is offered via web applications as well as web services over the internet to the public or a large industry group and is owned by an organization selling cloud services as shown in figure 2 [5].

Public cloud provides an elastic, cost-effective way to deploy IT solutions. The term public doesn’t mean that users’ data is publicly visible. Public cloud involves applications such as customer relationship management (CRM), messaging and office productivity [6]. Public cloud providers

such as Google or Amazon offer an access control to their clients [4].

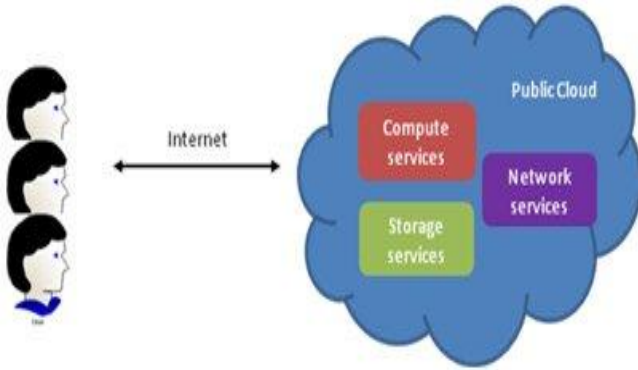


Figure 2. Public cloud.

2.3. Hybrid Cloud

This cloud deployment model exists due to mixed needs of an organization. It is combination of two or more cloud service deployment models (Private, Public, Community) as shown in figure 3 [5]. Organizations may host critical applications on private clouds and applications with relatively less security concerns on the public cloud [4].

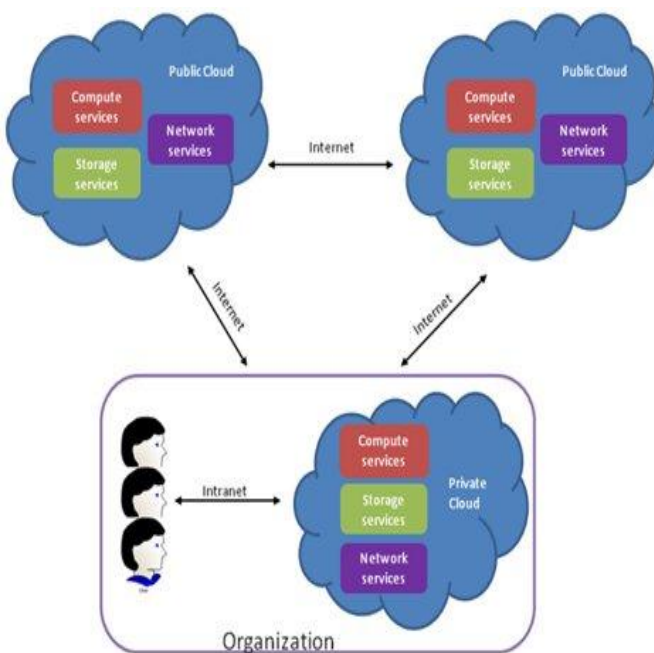


Figure 3. Hybrid cloud.

A combination of a public and a private cloud is joined together for the purpose of keeping business-critical data and services in their control on private cloud and outsourcing less-critical processing to the public cloud.

2.4. Community Cloud

Community cloud is a shared infrastructure by several organizations and supports a specific community that has shared concerns e.g., mission, security requirements, policy, and compliance considerations. It may be managed by the organizations or a third party and may exist at on-premises or off-premises [7]. Community cloud offers higher level of privacy, security and policy compliances. Examples of community clouds include Google's "Gov Cloud".

2.5. Combined Cloud

Combined cloud is formed of two clouds that have been joined together. It consists of multiple internal and external providers. By integrating multiple cloud services, users will be able to ease the transition to public cloud services while avoiding issues such as Payment Card Industry (PCI) compliance [8].

2.6. Inter Cloud (Cloud of Clouds)

Inter cloud refers to a mesh of clouds that are interconnected based on open standards to provide a universal environment for cloud computing. It is a concept based on the aggregation of deployed clouds similar to internet, which is a network of networks. It refers to an interconnected global cloud of clouds that provides massive collection of services to the users [9].

3. Cloud Computing Service Delivery Models

Cloud computing consists of various types of services that are delivered to the users as on-demand. The cloud service delivery models are described as follows:

3.1. Software as a Service (SaaS)

In this model, provider facilitates the clients with licensed applications running on a cloud infrastructure through a thin client interface such as a web browser over the internet on pay-per-use pricing pattern. Clients are not required to manage or control the underlying cloud infrastructure including network, servers, operating systems or storage [11].

Currently, SaaS is a perfect model to access the light weight applications such as word processor, media player etc. However when it comes to heavy weight applications such as playing online 3D games, the performance of SaaS may go down due to buffering time. SaaS is provided by several vendors such as Zoho Suite, Apple's MobileMe and Google Docs [10]. Normally the provider resides and maintains client hired applications on a specific virtual machine in a virtualized cloud environment.

3.2. Platform as a Service (PaaS)

In this model, provider facilitates the clients with the programming language platforms and software such as but not limited to Java, Python or .Net, to deploy their created or acquired applications on the cloud infrastructure over the internet with Application Program Interfaces (APIs) or website portals [11]. PaaS providers facilitate several services for application developers such as virtual development environment, application standards based on the developers' requirements, configured toolkits for the virtual development environment and ready-made distribution channel for public application developers [3]. Clients have control over the deployed applications and possibly application hosting environment configurations. However, clients don't have control over the underlying cloud infrastructure including network, servers, operating systems or storage [11]. In PaaS model, it's the cloud provider's responsibility to secure the computing platform and development environment, while the clients must secure their applications themselves [12]. Example of PaaS providers are Google App Engine, Force.com, and Microsoft Azure [3].

3.3. Infrastructure as a Service (IaaS)

In this cloud service delivery model the provider facilitates the capability to clients for provision processing, storage, networks and other fundamental computing resources where the clients are able to deploy and run arbitrary software that includes operating systems and applications. IaaS delivers a platform virtualization environment as a service [15]. Clients have control over memory, CPU, IP addresses, operating systems, storage, deployed applications and possibly limited control of selected networking components e.g., host firewalls. Clients do not manage or control the underlying cloud infrastructure [11]. In IaaS model, cloud providers must provide a trusted host and Virtual Machine Monitoring (VMM) environment for the clients. Example of IaaS providers are Amazon EC2 and S3, Sun Microsystems and Dropbox [3].

3.4. Integration as a Service (IaaS)

Integration as a Service is a delivery model that inputs the functionality of system integration into cloud, providing data transport between the organization wide systems and third parties (suppliers and other trading partners) on-demand. Small and Medium Business (SMBs) use IaaS because it enables any type of B2B integration at low cost with a light IT footprint which allows SMEs to focus their resources on their core business instead of managing costly IT infrastructure [18]. IaaS providers include Amazon SQS, OpSource Connect, Boomi and Mule On-Demand.

3.5. Business Process as a Service (BPaaS)

Business Process as a Service (BPaaS) sometimes called as Business Process Management as a Service (BPMaaS) refers to any business process delivered within a cloud service model (multitenant, self service provisioning, elastic scaling and usage metering or pricing) through the internet accessing via web-centric interfaces and exploiting web-oriented cloud architecture [19]. BPaaS is an emerging cloud service model whereby the clients can consume business outcomes (payroll processing or human resource) by accessing business services via web-centric interfaces on multi-tenant and shared infrastructures.

3.6. Desktop as a Service (DaaS)

Desktop as a service, also referred as virtual desktop or hosted desktop services, is a multi-tenant architecture that is based on outsourcing of a virtual desktop infrastructure (VDI) to a third party service provider. Clients can use the services on subscription basis. In this delivery model, the service provider manages the back-end responsibilities of data storage, backup, security and upgrades. The client's personal data is copied to and from the virtual desktop during logon/logoff. However, access to the desktop is device, location and network independent [13].

3.7. Testing as a Service (TaaS)

The aim of this delivery model is to enable the organizations to do a realistic proof-of-concept test before they decide to transform their IT to the required cloud computing model via an emulator such as iTrinegy. This service will allow the clients to monitor how significant factors can affect the network such as packet loss, bandwidth,

latency and response time for better decision making [14].

3.8. Management as a Service (MaaS)

Management as a Service is on-demand service that provides the ability to manage one or more cloud services such topology, resource utilization, virtualization and uptime management. Common Cloud Management Platform (CCMP) contains a set of business and operational management focused services for managing and delivering instances of cloud services of any category to the clients and allowing them to manage their cloud service instances in a self-service mode [17].

3.9. Security as a Service (SecaaS)

Security as a Service refers to delivery of secure platform and applications to the clients as per their request. If security is fully under the management of provider, clients will feel lack of control on their personal data. The security must be a shared agreement between clients and provider. When the clients are able to maintain their own personal security keys, it will provide them a sense of confidence for storing their confidential data on cloud. In order to ensure the safety of client's data, provider needs to offer anti-virus, anti-malware and several other security related software to clients as services.

4. Conclusion

A survey was conducted from several organizations about the deployment of cloud computing and its provided services. The survey results are shown in figure 4 [20].

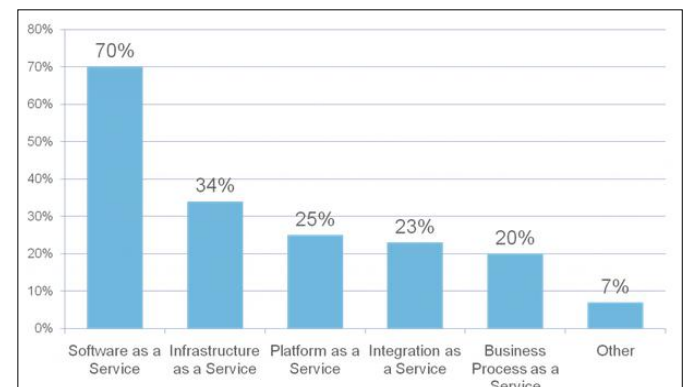


Figure 4. Survey on Cloud Service Model.

One-third of the companies involved in the survey are already deploying cloud-based solutions. With SaaS ranking among 70% of respondents as the number one cloud platform implemented or planned for implementation. SaaS was followed by IaaS with 34% and PaaS with 25%. This survey shows the utilization of general cloud service models, however there is need to implement and deploy new cloud based service delivery models to fulfil the emerging requirements of cloud users in the near future.

Acknowledgment

The glory of accomplishing this research paper goes to our parents for their moral support. We are also thankful to our supervisor for encouraging us to write this research journal. Finally, we are thankful to science academy

publishers for assisting us to review this journal and providing us timely response. Miss Mervat Adib Bamiah is thankful to Mr. Muhammad Imran Bamiah for his encouraging support.

References

- [1] P., Mell, T., Grance. "The NIST definition of cloud computing", [Online], Available: <http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc>, 2009. [Accessed: 15-July- 2011].
- [2] S., Brohi, M., Bamiah, "Challenges and Benefits for Adopting the Paradigm of Cloud Computing" *International Journal of Advanced Engineering Sciences and Technologies*, (IAEST), vol. 8, pp.286-290, 2011.
- [3] L. Savu, "Cloud Computing: Deployment Models, Delivery Models, Risks and Research Challenges," in *Computer and Management (CAMAN), 2011 International Conference on*, 2011, pp. 1-4.
- [4] P., Metri, G., Sarote. "Privacy Issues and Challenges in Cloud Computing". *International Journal of Advanced Engineering Sciences and Technologies* (IAEST), vol. 5, pp.1-6, 2011.
- [5] T., Klančnik, "NIL - In the Core of the Cloud." [Online]. Available: <http://www.nil.si/ipcorner/CoreCloud/>. [Accessed: 15-Jul-2011].
- [6] "HPC in the Cloud: Frost & Sullivan: Australia Leads Asia Pacific Adoption of Cloud Computing." [Online]. Available: http://www.hpcinthecloud.com/hpccloud/2011-05/30/frost_sullivan_australia_leads_asia_pacific_adoption_of_cloud_computing.html [Accessed: 08-Jul-2011].
- [7] CSA, "Security Guidance for Critical Areas of Focus in Cloud Computing V2.1." Cloud Security Alliance, 2009 [Online]. Available: <http://www.cloudsecurityalliance.org/guidance/csaguide.v1.0.pdf> [Accessed: 08-July-2011].
- [8] "Different Types of Cloud | Cloud Consultancy." [Online]. Available: <http://www.cloudconsultancy.asia/?p=14> [Accessed: 15-Jul-2011].
- [9] "Cloud Services with Windows Azure : Cloud Computing 101 - Windows Azure - allcomputers.us." [Online]. Available: http://allcomputers.us/windows_azure/cloud-services-with-windows-azure---cloud-computing-101.aspx [Accessed: 15-Jul-2011].
- [10] Cisco Systems, "Cisco Cloud Computing - Data Center Strategy, Architecture, and Solutions" [Online]. Available: http://www.cisco.com/web/strategy/docs/gov/CiscoCloudComputing_WP.pdf, 2009. [Accessed: 12-March -2011].
- [11] Kai Hwang, S. Kulkareni, and Yue Hu, "Cloud Security with Virtualized Defense and Reputation-Based Trust Management," in *Dependable, Autonomic and Secure Computing, 2009. DASC '09. Eighth IEEE International Conference on*, 2009, pp. 717-722.
- [12] Xiao-Yong Li, Li-Tao Zhou, Yong Shi, and Yu Guo, "A trusted computing environment model in cloud architecture" in *Machine Learning and Cybernetics (ICMLC), 2010 International Conference on*, 2010, vol. 6, pp. 2843-2848.
- [13] "What is desktop as a service (DaaS)? - Definition from Whatis.com." [Online]. Available: <http://searchvirtualdesktop.techtarget.com/definition/desktop-as-a-service-DaaS>. [Accessed: 14-Jul-2011].
- [14] "Latest Cloud Computing, iTrinegy Testing As A Service (TaaS) | cloudingworld.com." [Online]. Available: <http://cloudingworld.com/cloud-news/latest-cloud-computing-itrinegy-testing-as-a-service-taas.html>. [Accessed: 14-Jul-2011].
- [15] Jianfeng Yang and Zhibin Chen, "Cloud Computing Research and Security Issues," in *Computational Intelligence and Software Engineering (CiSE), 2010 International Conference on*, 2010, pp. 1-3.
- [16] Chunye Gong, Jie Liu, Qiang Zhang, Haitao Chen, and Zhenghu Gong, "The Characteristics of Cloud Computing," in *Parallel Processing Workshops (ICPPW), 2010 39th International Conference on*, 2010, pp. 275-279.
- [17] "MaaS | What is Cloud Computing? | Cloud Consulting, Cloud Services and Cloud Computing Technology." [Online]. Available: <http://www.lizeversoll.com/2011/01/31/maas/>. [Accessed: 15-Jul-2011].
- [18] QLOGITEK, "Integration-as-a-Service (IaaS)." [Online]. Available: <http://www.qlogitek.com/en/services/Integration-as-a-Service.aspx>. [Accessed: 13-Jul-2011].
- [19] IBM, "Cloud Deployment and Delivery Models", 2010, Available from <https://www.ibm.com/developerworks/mydeveloperworks/c2028fdc>. [Accessed 13- July -2011].
- [20] M., Dawson. "SaaS Solutions Lead the Pack in Cloud Implementations – Hubspan.2010" [Online]. Available: <http://www.hubspan.com/cloud-computing/saas-solutions-lead-the-pack-in-cloud-implementations/>. [Accessed: 14-Jul-2011].