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An Overview of Service Models of Cloud Computing

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Abstract

Since its inception Cloud Computing is making a paradigm shift in the world of computing technology. Based on pay-per-use principle it provides a variety of services to both individual and industry. The services it provides include Platform-as-a-Service (PaaS), Software-as-a-Service (SaaS) and Infrastructure-as-a-Service (IaaS) and it is still making its way to other similar services. These services models have certain requirements to be met and other security and design issues. This paper aims at discussing these three services models, important factors for these models and challenges currently faced by these services models.

Keywords: *Cloud computing, SaaS, PaaS, IaaS, Security Challenges.*

1. Introduction

Last decade witnessed a huge paradigm shift in the field of computing world. This shift is from traditional stand alone systems to Cloud Computing which is a shared pool of hardware and software resources combined to provide on demand services [9, 10]. The main idea is to utilize these cheap resources in order to provide efficient and in time distributed computing whenever and wherever it is needed. Cloud computing is being embraced by many fields and is most adoptable field of information technology at the moment. Due to its pay-per-use principle it is becoming very attractive and competitive solutions for even small organizations who cannot afford to have their own hardware or software infrastructure. Moreover, it's on demand changing scalability has made it very viable solution for organizations who need to change their acquired services with the changing workload.

Apart from being simple and easy to use it has other advantages over traditional framework. It works in distributed environment and serves the user according to his needs. Users just need to have internet to connect to the services and it is accessible from everywhere. It has minimized cost, improved throughput, fast access of software and hardware resources and can scale readily and easily as required [11].

Cloud computing provides different services to its users as it works as service provider including IaaS, PaaS and SaaS and it is still making its way to other similar services like network or database etc. this paper aims at discussing three mentioned service, their features and challenges in brief.

This paper is divided in two sections. After introduction section two describes a comprehensive overview of cloud computing infrastructure in focus with their advantages and challenges. In the end conclusion is given.

2. Cloud Services Models

Cloud computing is able to provide a variety of services at the moment but main three services are Infrastructure-As-A-Service, Platform-As-A-Service and Software-As-A-Service also called as service model of Cloud computing [12].

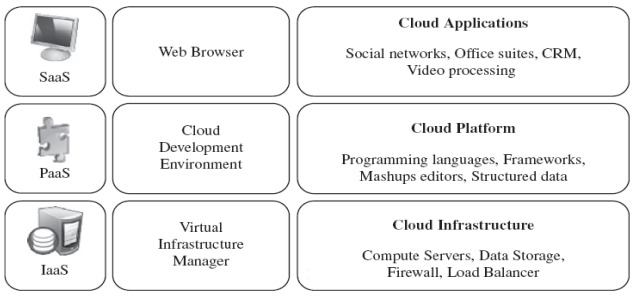

Figure 1: Cloud computing service model [1]

2.1 Infrastructure-As-A-Service (IaaS)

The core computing resources are hardware and software components. They lay the foundations of every computing infrastructure. Infrastructure-as-a-Structure service of cloud computing provides these services to cloud end users. In other words IaaS is making user free of these services. End users can hire any of these services at the level they desire. User has to pay only for the usage of his resources. IaaS is to provide computing

infrastructure and operating middleware [2]. Grid/Cluster architectures provide high performance infrastructures to the organizations on rent bases and make them free from their own resources. So organizations can put their attention on manufacturing and quality concerns [13]. The main concept behind IaaS is the resource virtualisation. It allows the user to have his own guest operating system on top of infrastructure provided by the cloud provider. This concept leads to automatic deployment of infrastructure which is both distributed and scalable. The administration, deployment, and maintenance is the responsibility of the service provider [13, 2].

2.1.2 Components of IaaS

Infrastructure of cloud has multiple components which are used in infrastructure service model. They are the shared resources among the users, so they have multiple challenges for service providers. Some components are: [14]

- Cloud Software
- Computer Hardware
- Network and Internet Connectivity
- Platform Virtualization
- Utility Computing
- Service Level Agreements

2.1.2.1 Service Level Agreements

Before deploying the service providing architecture of cloud computing, one of the desired concerns of the customers is the reliability and quality of the offered services [3]. The expectations of these services changes from customer to customer so a consensus is needed between service provider and the customer. This agreement about the quality and reliability of service is called Service level Agreement. It aims at defining, describing and negotiating on terms and conditions of contract between service provider and customers to reach a final verdict. QoS attribute is also part of SLA and it needs to be defined properly. QoS (Quality of Services) may include feature like response time, memory usage and throughput etc [4] and they need to be monitored closely.. It is very critical part because if any term or condition is skipped or not discussed, it will create problems for the users and service providers. SLA includes other features like services measurement, service condition evaluation and management services [3].

2.1.2.2 Utility Computing

Cloud computing provides utility computing and it includes computations, storage, connection bandwidth and other similar resources. The main focus of utility computing is to reduce optimization cost and provide resources to the end user and charge them an appropriate cost for the usage. It also ensures that the scalability of infrastructure of cloud is managed properly. It allows the service provider to enhance the system without quitting the services, as the number of users is increased.

2.1.2.3 Cloud Software

Cloud software is used to integrate different components of cloud infrastructure and make them synchronized. There are many open source software available in the market i.e. Eucalyptus and Nimbus, but they are not clear from bugs and vulnerabilities which can harm the cloud system. Furthermore cloud service provider develop and use APIs (Application Programming Interfaces) i.e. SOAP, REST and HTTP with xml, for performing different functions i.e. access control etc.

2.1.2.4 Platform Virtualization

Virtualization is the basic task in cloud infrastructure because it provides multiple virtual systems on a single system so that multiple tasks are performed simultaneously. It reduces the hardware maintenance because it shared the hardware resources. In the described way it reduces the complexity and enhances the scalability of cloud resources.

2.1.2.5 Network and Internet Connectivity

Cloud infrastructure is distributed on different locations to minimize the delay and damage of resources. These cloud infrastructure components are locally connected with LANs and then these components are connected with each other via high speed internet. These individual components construct the overall cloud infrastructure.

2.1.2.6 Computer Hardware

An interface is provided by IaaS to its customers or users to access the distributed resources of cloud infrastructure. These resources are CPU, Storage and network connecting components. These cloud resources need a high level security measure; as if they are vulnerable then the whole cloud is under threat. Any damage to of flaw in hardware will result in failure of services.

2.2 Software-As-A-Service (SaaS)

SaaS is the top layer of cloud computing services. It is different than traditional software services, where traditional software need own hardware and software components, Where SaaS makes users, independent of their own resources. Users use the integrated services provided by cloud operator. One of the best examples of SaaS is Google Docs [15, 16].

2.2.1 Quality Model

To evaluate and understand SaaS there is a need to define a quality model [17].

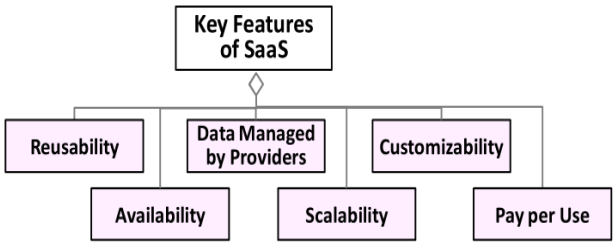

Figure 1: Quality model of SaaS [18]

2.2.1.1 Reusability

Reusability refers to using software elements to create different other applications and it is an important feature in the context of cloud computing. To reuse different types of internet-based services is the primary fundamental of CC. while focusing the SaaS, over the internet software that is to be reused, is supplied to service consumers. Delivery of SaaS services often creates one –to-many relationships. For example, number of customer uses services by Google map which provides a number of operations to make use of shared information locally and on map.

2.2.1.2 Data Managed by Provider

SaaS is and on demand service, that provides license application for the use of customers and is used as a software development model as well. It is the responsibility of service providers to manage data and install services on their own servers. That is why; the most of data produced by service consumers is stored and managed in data centers by data providers. Therefore two things are not perceived by service customers, in details:

- Where, their data is stored?
- How could be the data managed?

That's why if reliability functions and data security is not provided by service providers, the services may be doubted by the customers and the utilization of services becomes lower.

2.2.1.3 Service Customizability

Customizability means that the consumers can change the services based on their requirements. It is very essential to ensure customizability as service providers are able to satisfy varying requirements of multifarious user by having customizability.

The customers, who use internet, can easily use these cloud services and can become potential users of it. Only because of this characteristic, for many service consumers, service providers can never modify their cloud services. So service consumer can easily change or modify their services according to their own need. In case of lack of customizable SaaS service availability, service consumers should simply avail the services. It will also limit the usage of SaaS services.

2.2.1.4 Availability

Using a web browser and internet service consumer can easily access SaaS services in Cloud Computing. Provider's server which runs and deploys SaaS services does not give ownership to customers for SaaS. Due to this reason, to achieve best availability of services is the main focus of most of venders. If SaaS services are not available any functionality of SaaS cannot be accessed by customers. Gmail service is one of the examples of this statement, which was completely down at September 1st, 2009. Which caused unavailability of read and writes service of email for Gmail users. In cloud computing, customers expect 24/7 availability from SaaS which means there should not be single source of failure [5]. Service should be available at all times in spite of failures, maintenance, upgrading or any attack.

2.2.1.5 Scalability

It is a pivotal requirement of cloud to be scalable because it decides how a system or software is flexible and dynamic. It is also indicate the growing ratio of software usage. As the resources of cloud are controlled by service provider and the customer could not controlled resources used by services. So it is the responsibility of service provider to enhancing the capacity of resources so the customer requests are fulfilled without interruption and informing the customer.

2.2.1.6 Pay par Use

While using the software services, it is important that customers have not paid cost as they are the owner of the service. But they should pay according to the service usage. This is about; when a customer wants to use the service he will connect with the cloud and leave the services after use of it. And then, he will pay for that time of service usage.

2.3 Platform-As-A-Service (PaaS)

Platform as a service provides a development platform to its users so that they can develop and maintain their applications and cloud specific utilities. It is different from SaaS because SaaS is a developed and deployed application and PaaS provides a platform or ground to develop those applications. PaaS provides development environment and platform, so all supporting material i.e. programming environment, development tools and infrastructure etc. must be provided by cloud provider [20].

2.3.1 Stakeholders of Platform-As-A-Service

Table 1 Features and challenges of cloud computing services models [5-8, 13, 18-19]

Attribute System	Features	Challenges
Infrastructure-as-a-Service	1. Elasticity 2. Transferring the risks 3. Reduced operational costs 4. Availability of latest infrastructure 5. Inter-operatability 6. Disaster recovery	1. Temperature of cloud places need to be maintained 2. System should be power failure tolerant 3. Selection of infrastructure hardware is very important 4. Connection between cloud and hardware should be a high bandwidth channel 5. Storage of cloud should be able to fulfill the changing demands of large data size 6. Loss of control
Software-as-a-Service	1. Cost minimization 2. High throughput 3. Time saving 4. Availability of high tech services 5. High availability 6. Reduced administration cost	1. Data security is highly preferred feature 2. High availability requirement 3. Authentication and authorization 4. Data integrity 5. Data privacy 6. Network security 7. Cloud standardization 8. Deployment of cloud resources in different countries results in conflict of rules 9. Data backup 10. Web application security 11. Data confidentiality 12. Virtualization
Platform-as-a-Structure	1. Access of high level infrastructure 2. Flexibility 3. Ready to use services 4. Scalability 5. Less administration cost	1. Limited APIs 2. Data Lock-in 3. Auditability 4. Performance is unpredictable 5. Lack of control over low level security 6. Data inaccessibility between applications 7. Vulnerabilities of web applications and SOA

According to usage of resources and control of infrastructure, there are three types of PaaS stakeholders [21].

2.3.1.1 PaaS Hoster

PaaS hoster is responsible for deploying hardware infrastructure through IaaS, Which are necessary for accomplishing user demands.

2.3.1.2 PaaS Provider

PaaS provider is responsible for providing development platform to developers so they can work on their web application development without having knowledge about servers and front end applications.

2.3.1.3 PaaS User

PaaS user is the developer, who will develop applications. They must have browser based utility to work on that platform. They will pay for services as much they use

3. Opportunities and Challenges of Services Models of Cloud Computing

This section provides the detail about the challenges and issues faced by IaaS, PaaS and SaaS as well as the features and opportunities these models provide.

Conclusion

Cloud computing is an emerging technology which introduced itself as a service oriented technology. It is working on the principle of on demand service and scalability. It is providing services in many ways including software, platform and infrastructure and making the users free of installing and administering these services. In spite the fact that cloud computing provide high performance, high available, fault tolerant services; the issues it comes with are also very serious in nature. Of the worth mentioning are data and network security, data authenticity and audit ability, lack of user control over data and security polices and virtualization problem. In order to attract the organizations and build the confidence of customer, these issues need to be well researched and resolved.

References

[1]W. Voorsluys, J. Broberg, and R. Buyya, "Introduction to cloud computing," *Cloud Computing,* pp. 1-41, 2011.
[2]R. Prodan and S. Ostermann, "A survey and taxonomy of infrastructure as a service and web hosting cloud providers," in *Grid Computing, 2009 10th IEEE/ACM International Conference on*, 2009, pp. 17-25.

[3]P. Patel, A. H. Ranabahu, and A. P. Sheth, "Service level agreement in cloud computing," 2009.
[4]A. Keller and H. Ludwig, "The WSLA framework: Specifying and monitoring service level agreements for web services," *Journal of Network and Systems Management,* vol. 11, pp. 57-81, 2003.
[5]M. Armbrust, O. Fox, R. Griffith, A. D. Joseph, Y. Katz, A. Konwinski*, et al.*, "M.: Above the clouds: A Berkeley view of cloud computing," 2009.
[6]S. Kaur and G. S. Bhathal, "OVERVIEW OF SAAS IN CLOUD COMPUTING," 2013.
[7]W. Yuan, "Infrastructure as a Service."
[8]S. Subashini and V. Kavitha, "A survey on security issues in service delivery models of cloud computing," *Journal of Network and Computer Applications,* vol. 34, pp. 1-11, 2011.
[9] Shyam Patidar, Dheeraj Rane, "A Survey Paper on Cloud Computing," Second International Conference on Advanced Computing & Communication Technologies, 2012.
[10] Mohiuddin Ahmed, Abu Sina Md. Raju Chowdhury, Mustaq Ahmed, Md. Mahmudul Hasan Rafee, " An Advanced Survey on Cloud Computing and State-of-the-art Research Issues," IJCSI International Journal of Computer Science Issues, Vol. 9, Issue 1, No 1, January 2012.
[11] Rahul Bhoyar, Prof. Nitin Chopde, "Cloud Computing: Service, models, Types, Database and issues,"International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 3, March 2013.
[12] Ms. Disha H. Parekh, Dr. R. Sridaran, "An Analysis of Security Challenges in Cloud Computing," (IJACSA) International Journal of Advanced Computer Science and Applications, Vol. 4, No.1, 2013.
[13] Aniruddha S. Rumale, D.N.Chaudhari, " Cloud Computing: Infrastructure as a Service," International Journal of Inventive Engineering and Sciences (IJIES) ISSN: 2319–9598, Volume-1, Issue-3, February 2013.
[14] Wesam Dawoud, Ibrahim Takouna, Christoph Meinel, " Infrastructure as a Service Security: Challenges and Solutions,"Hasso Plattner Institute Potsdam, Germany, Ministry of Education & Higher Education Palestine.
[15] Zhengxiong Hou, Xingshe Zhou, Jianhua Gu,Yunlan Wang,Tianhai Zhao, "ASAAS: Application Software as a Service for High Performance Cloud Computing," 12th IEEE International Conference on High Performance Computing and Communications, 2010.
[16] Wei-Tek Tsai, Xin Sun, Janaka Balasooriya, "Service-Oriented Cloud Computing Architecture," Seventh International Conference on Information Technology, 2010.
[17] Jae Yoo Lee, Jung Woo Lee, Du Wan Cheun†, and Soo Dong Kim, "A Quality Model for Evaluating Software-as-a-Service in Cloud Computing," Seventh ACIS International Conference on Software Engineering Research, Management and Applications, 2009.
[18] Choudhary V, "Software as a service: implications for investment in software development," International conference on system sciences, 2007, p. 209.
[19] Rashmi, Dr.G.Sahoo, Dr.S.Mehfuz, "Securing Software as a Service Model of Cloud
Computing: Issues and Solutions," International Journal on Cloud Computing: Services and Architecture (IJCCSA) ,Vol.3, No.4, August 2013.
[20] Santosh Kumar and R. H. Goudar, "Cloud Computing – Research Issues, Challenges, Architecture, Platforms and Applications: A Survey," International Journal of Future Computer and Communication, Vol. 1, No. 4, December 2012.
[21] Michael Boniface, Bassem Nasser, Juri Papay, Stephen C. Phillips, Arturo Servin, Xiaoyu Yang, Zlatko Zlatev, Spyridon V. Gogouvitis, Gregory Katsaros, Kleopatra Konstanteli, George Kousiouris, Andreas Menychtas, Dimosthenis Kyriazis, "Platform-as-a-Service Architecture for Real-time Quality of Service Management in Clouds," Fifth International Conference on Internet and Web Applications and Services, 2010.