

# Comparison of Cloud Computing Service Models: SaaS, PaaS, IaaS

<sup>1</sup>Sumit Khurana, <sup>2</sup>Anmol Gaurav Verma

<sup>1,2</sup>Dept. of CSE, Surya World, Punjab, India

## Abstract

Cloud computing brings advancement in the field of information technology. Cloud computing is based on several service models such as SaaS, PaaS, NaaS, DbaaS, IaaS and many more. In order to make clear the essential of cloud computing, we propose the characteristics of these service models which distinguish cloud computing from other research areas. These service models are compared from various angles in order to clearly define their origin, working, advantages, disadvantages and limitations from existing other service models. On the other hand, these service models are classified on various stages to differentiate their characteristics from several other service models. This paper strives to compare and contrast the three major service models i.e. software-as-a-service, platform-as-a-service and infrastructure-as-a-service from various angles and give insight into essential characteristics of these three service models.

## Keywords

Cloud Computing, IaaS, PaaS, SaaS, NaaS, DbaaS

## I. Introduction

Cloud computing is giving a start to new computing techniques in which local computers are not being used for computational processes as centralized facilities have overcome local computers which are being operated by cloud providers or by third-party computational and storage providers. Well said by JOHN McCARTHY that "computation may someday be organized as a public utility" as we won't have to unwrap the shrink-wrapped software for installing them into our pc's. The new idea is much more advanced than our approach. The term cloud computing refers to delivery of computing resources over the internet. It allows user to store their data over the internet instead of storing it into a hard drive. Cloud services allow consumers and businesses to use software and hardware managed by third party at remote locations. Cloud computing provides shared pool of resources (example: networks, storage, computer processing, user applications) that can be rapidly provisioned and can be released with minimal effort. There are several benefits of cloud computing such as cost savings, scalability, reliability, maintenance, mobile accessible etc. These benefits enhance the user to use cloud services widely and store their data over internet instead of storing into a hard drive. Instead of several benefits these services also have certain challenges including security and privacy, lack of standards, service delivery and billing, interoperability and probability, performance and bandwidth cost and availability.

Companies are increasingly aware of the business value that cloud computing brings and are taking steps towards transition to the cloud. A smooth transition entails a thorough understanding of the benefits as well as challenges involved. Like any new technology, the adoption of cloud computing is not free from issues

## II. Characteristics of Cloud

### A. On Demand Self Service

On demand self service refers to services requested by the customers to manage their own computing resources. These services are provided over the internet by a cloud provider to a customer who has requested for services and can manage their own computing resources.

### B. Resource Pooling

Cloud computing provides shared pool of resources that can be rapidly provisioned and can be released with minimal effort. Customers draw resources from remote data centers.

### C. Rapid Elasticity

As cloud computing provides services over the internet. These services can be managed or can be requested from cloud providers as per customers requirement. Rapid elasticity refers to services which can be smaller or larger as per user requirement.

### D. Measured Service

These are services which are billed according to customer demand for definite services. As customers can request for services as per their own requirement, services are billed according to customers demand.

## III. Service Models of Cloud Computing

Cloud computing is a computational process in which services are delivered over a network using computing resources. The name 'cloud' symbolises an abstraction for complex infrastructure it contains in system diagrams.

There are three main types of service models: [1]

- Software as a Service (SaaS).
- Platform as a Service (PaaS).
- Infrastructure as a Service (IaaS).

Business models using software as a service, multiple application software and databases are provided to users. Infrastructure and platforms on which applications run are managed by cloud providers. SaaS is also called as "on-demand software" and is priced on pay-per-use basis. SaaS allows a business to reduce IT operational costs by outsourcing hardware and software maintenance and support to the cloud provider. This enables the business to reallocate IT operational cost from hardware/software and personnel expenses, for achieving other IT goals. A web browser or a light-weight desktop or mobile application is required for accessing cloud-based applications by end users. Servers at a remote location are required to store business software and user's data. The improved manageability and less maintenance, and enables IT more rapidly to meet fluctuating and unpredictable business demand [2].

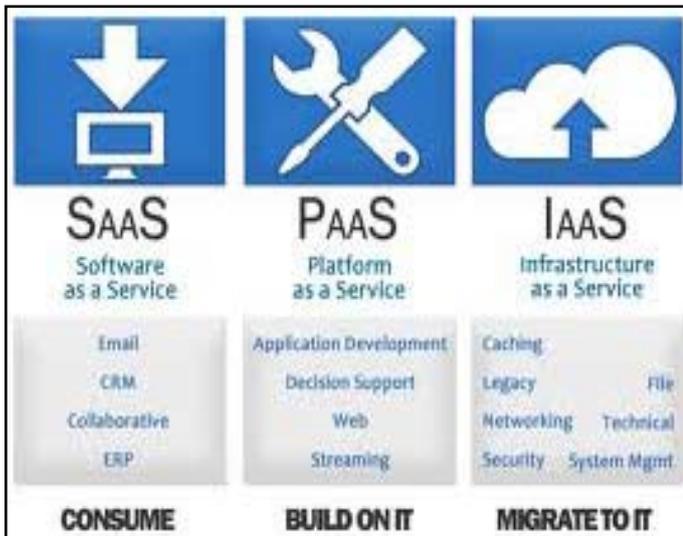


Fig. 1:

#### • Software-as-a-Service (SaaS).

'On-demand software' generally called as Software-as-a-Service is a software delivery model in which software and associated data are hosted on the cloud. Using a web browser SaaS is accessed by users. Now a days many business applications use SaaS as a common delivery model including accounting, collaboration, Customer Relationship Management (CRM) and service desk management [3]. In 2010, SaaS sales reached 10 billion \$ and increased to 12.1 billion \$ in 2011 i.e. 20.7% up from 2010. By 2015 SaaS revenue will be more than double from 2010 scale according to Gartner Group and may reach upto 21.3\$ billion. Customer Relationship Management (CRM) leads to be the largest market for SaaS [4]. SaaS revenue within CRM market was forecast to reach \$3.8 billion in 2011, up from \$3.2 billion in 2010.[5] The term 'software as a service' is considered to be the part of the nomenclature of cloud computing, along with platform as a service and infrastructure as a service and Backend as a service (BaaS) [6]

#### VI. Architecture

Software as a Service model is based on multi-tenant architecture. This model enables all customers (tenants) to use single version application with single configuration. To avoid conflicts and provide scalability, application is installed on multiple machines. In some cases, SaaS do not use multi-tenancy. They use other mechanisms such as virtualization where a large number of customers are managed in place of multi-tenancy. Some SaaS solutions do not use multi-tenancy, or use other mechanisms-such as virtualization-to cost-effectively manage a large number of customers in place of multi-tenancy [7].

#### VII. Criticism

Richard Stallman of Free Software Foundation considers the use of SaaS to be violating the principles of free software [8].

#### A. According to Stallman

As the executable file is on the server, the users can't touch or see it. It is impossible for users to modify or alter their data. SaaS provides power to the server operator to modify or alter data from software in use rather than giving user a chance. User have to send their data to the server in order to use it. This is similar as that of spyware as server operator has the only power to alter the data in the software.

#### B. Platform-as-a-Service (PaaS)

It is another type of service model of cloud computing which provides a computing platform and solution stack as a service. In this model user or consumers creates a software using tools or libraries from the providers. Consumer also controls software deployment and configuration settings. Main aim of provider is to provide networks, servers, storage and other services.[9] PaaS offers deployment of applications by reducing the cost and complexity of buying and maintaining hardware and software and provisioning hosting capabilities [10]. There are various types of PaaS vendors which offer application hosting and a deployment environment along with various integrated services. The services offers scalability and maintenance [11].

#### VIII. Types

A. Add-on development facilities: these facilities allow customization of software as a service applications which are equivalent to macro language customization with software applications such as Lotus Notes or Microsoft Word. Stand alone development environment: these do not include technical, licensing or financial dependencies on SaaS applications. Application delivery only environment: these do not include development, debugging and test capabilities as a part of service. These services generally focus on security and on-demand scalability. Open platform as a service. This type of PaaS provides open source software to allow a PaaS provider to run applications. Example, AppScale allows a user to deploy some applications written for google app engine to their own servers, providing data store access from standard SQL database.

#### IX. Key Characteristics

Multi-tenant architecture: this architecture maintains a trust relationship between the users in security, access, distribution of source code, navigation history, user profiles, interaction history and application usage.

Integration with web services and databases: PaaS offers to create composition of multiple web services. These services access databases and re-use services maintained inside private networks.

#### A. Infrastructure-as-a-Service (IaaS)

Infrastructure is the foundation of cloud computing. It provides delivery of computing as a shared service reducing the investment cost, operational and maintenance of hardware. Infrastructure should be reliable and flexible for easy implementation and operations of applications

#### X. Characteristics

Delivery of resources such as servers, storage and network components as a service. Lower total cost of ownership. Full scalability. Eliminate the need for administration and maintenance of hardware. Enterprise grade infrastructure for all subscribers.

IaaS cloud offers resources such as images in a virtual-machine image-library, raw and file-based storage, firewalls, load balancers, IP addresses, virtual local networks and software bundles.

Examples of IaaS providers are Amazon cloud formation, amazon EC2, google compute engine, HP cloud, iland, joyent, oracle infrastructure as a service and rackspace cloud.

## XI. Comparison

Viewed broadly, the concepts of SaaS, IaaS and PaaS seems to have similar features. In this section, we put light on key features of SaaS, IaaS and PaaS and give an end-to-end comparison to differentiate in different perspectives.

Table 1: Cross-Concept Matrix of the Three Classifications of Cloud Computing

	Paradigm shift	Characteristics	Key terms	Advantages	Disadvantages and risks	When not to use
Infrastructure as a Service (IaaS)	Infrastructure as an asset	Usually platform-independent; infrastructure costs are shared and thus reduced; service level agreements (SLAs); pay by usage; self-scaling	Grid computing, utility computing, compute instance, hypervisor, cloudbursting, multi-tenant computing, resource pooling	Avoid capital expenditure on hardware and human resources; reduced ROI risk; low barriers to entry; streamlined and automated scaling	Business efficiency and productivity largely depends on the vendor's capabilities; potentially greater long-term cost; centralization requires new/different security measures	When capital budget is greater than operating budget
Platform as a Service (PaaS)	License purchasing	Consumes cloud infrastructure; caters to agile project management methods	Solution stack	Streamlined version deployment	Centralization requires new/different security measures	N/A
SaaS	Software as an asset (business and consumer)	SLAs; UI powered by "thin client" applications; cloud components; communication via APIs; stateless; loosely coupled; modular; semantic interoperability	Thin client; client-server application	Avoid capital expenditure on software and development resources; reduced ROI risk; streamlined and iterative updates	Centralization of data requires new/different security measures	N/A

## XII. Conclusion

The concept of cloud computing comes from the network diagrams illustrating the Internet as a cloud, where it is not possible, or not important, to know the information path. While the main reasons for adopting services based on cloud computing are cost saving, flexibility and start-up speed, there are still doubts about the security guarantees and the portability and integration options offered by this model of services.

The services offered in any of the cloud computing models (platform, infrastructure or software as a service) are closely related to mobility and, therefore, depend heavily on the continuity of the connectivity, the quality of the service and the security offered by the networks for an optimal user experience.

Cloud computing provides companies with new options for managing infrastructures and new business models. In particular, it can mean a big improvement for small and medium-size companies, for whom the cloud represents the opportunity to reduce costs in administration and in maintaining proprietary infrastructures, providing them with technological possibilities similar to those of large companies. Doubts over the security and management of these new systems, however, may slow the uptake in the short term. For this reason, the objectives of the TaaS project focus on three main areas:

Contribution to the family of IEEE 802 standards for making the handovers between the networks of different providers or even different technologies transparent for the applications. Adaptation

of the identity and access management (IAM) services to guarantee the security of the services provided in any of the cloud computing models (services for the cloud). Adaptation and migration of the trust services so that they can be managed and offered from the cloud, principally, to make them accessible for SMEs and organizations that need them from time to time (services in the cloud).

## References

- [1] Monaco, Ania (7 June 2012[last update]), "A view inside the cloud", The institute.ieu.org(IEEE) retrieved august 21, 2012.
- [2] Baburajan, Rajani, "The rising cloud storage market opportunity strengthens vendors", IT.tmcnet.com. 2011-08-24. Retrieved 2011-12-02.
- [3] "Software as a service(SaaS)", Cloud Taxonomy. Retrieved 24 April 2011.
- [4] McHall, Tom (7 July 2011), "Gartner says worldwide software as a service revenue is forecast to grow 21 percent in 2011", Gartner.com. Gartner. Retrieved 28 July 2011.
- [5] Barret, Larry (27 July 2010), "SaaS Market growing by Leaps and Bounds".
- [6] Anderson, Tim (5 May 2011), "Full form of SaaS", The Register.

- [7] Stallman, Richard (18 March 2010), "Who does that server really serve?", Boston review. Retrieved 10 October 2012.
- [8] "The NIST definition of Cloud Computing", National Institute of Science and Technology", Retrieved 24 July 2011.
- [9] Google angles for business users with, "Platform as a service".
- [10] Comparing Amazon's and Google's Platform-as-a-service (PaaS) offerings| Enterprise Web 2.0| ZDNet.com.
- [11] "Cloud platform as a service (PaaS) in cloud computing services". Cloud Computing Sec. 2011. Retrieved 2011-12-15.