Software as a Service(SaaS) Provided by Cloud Computing

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Abstract : Cloud computing is current buzzword in the market It is paradigm in which the resources can be leveraged on per use basis thus reducing the cost and complexity of service providers. Cloud computing promises to cut operational and capital costs and more importantly let IT departments focus on strategic projects instead of keeping datacenters running. It is much more than simple internet. The various services provided by cloud computing are Software as a service(SaaS), Infrastructure as a Service(IaaS), and Platform as a Service(PaaS).This paper gives the different models of the cloud computing. This paper contains the detailed study of Software as a Service (SaaS) which includes the characteristics of the SaaS, The requirements of SaaS Service delivery infrastructures, architecture of the SaaS, and gives where the SaaS will best fit and where it may be not best fit.

Keywords: Cloud, Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), Requirements of SaaS Service Delivery Infrastructures.

Introduction: Cloud computing represents significant opportunity for service providers and enterprises. Relying on the cloud computing, enterprises can achieve cost savings, flexibility, and choice for computing resources. They are looking to expand their onpromise infrastructure, by adding capacity on demand. Cloud computing, most, simply, extends an enterprise's ability to meet the computing demands of its everyday operation. Offering flexibility and choice, mobility and scalability, all coupled with potential cost savings, there is significant benefit to leveraging cloud computing. In addition, as cloud computing provides various services such as Infrastructure as a Service(IaaS), Software as a Service(SaaS), Platform as a Service(PaaS). Regarding all this services we give the introduction to all the services but try to cover SaaS in detailed such as architecture of the SaaS, requirements of SaaS services delivery infrastructures, architecture of SaaS and all the issues related with it.

Overview of cloud computing: This section contains the definition of the cloud computing and characteristics of cloud computing.

According to the NIST the definition of cloud computing is defined as: "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction. This cloud model

promotes availability and is composed of five essential characteristics**,** three service models, and four deployment models."[3]

Cloud Computing has been envisioned as the next generation architecture of IT enterprise, due to its long list of unprecedented advantages in the IT history: on-demand self-service, ubiquitous network access, location independent resource pooling, rapid resource elasticity, usage-based pricing and transference of risk [5].

The characteristics of the cloud computing is given as follows:

1. **Broad network access**: Cloud Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms such as mobile phones, laptops and Personal Digital Assistant (PDAs).
2. **On demand self services**: Cloud service providers providing on demand self services include Amazon Web Services (AWS), Microsoft, Google, IBM and Salesforce.com. New York Times and NASDAQ are examples of companies using AWS (NIST)[3].
3. **Resource pooling**: The resources include among others storage, processing, memory, network bandwidth, virtual machines and email services. The pooling together of the resource builds economies of scale (Gartner).
4. **Rapid elasticity**: Cloud services can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.
5. **Multi Tenacity**: It refers to the need for policy-driven enforcement, segmentation, isolation, governance, service levels, and chargeback/billing models for different consumer constituencies. Consumers might utilize a public cloud provider's service offerings or actually be from the same organization, such as different business units rather than distinct organizational entities, but would still share infrastructure.
6. **Measured service**: Cloud computing resource usage can be measured, controlled, and reported providing transparency for both the provider and consumer of the utilized service. Cloud computing services use a metering capability, which enables to control and optimize resource use. This implies that just like electricity or municipality water IT services are charged as per usage matrices- **Pay Per use.** The more users utilize the higher the bill. Just as utility companies sell power to subscribers, and telephone companies sell voice and data services, IT services such as network security management, data center hosting or even departmental billing can now be easily delivered as a contractual service.

Deployment Model of Cloud Computing: There are four main deployment model of cloud computing. This section contains all the information regarding the deployment model.

-Public cloud: The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services. Public clouds offer several key benefits to service providers, including no initial capital investment on infrastructure and shifting of risks to infrastructure providers. However, public clouds lack fine-grained control over data, network and security settings, which hampers their effectiveness in many business scenarios.

-Private cloud: private clouds are designed for exclusive use by a single organization. A private cloud may be built and managed by the organization or by external providers. A private cloud offers the highest degree of

control over performance, reliability and security. The drawback of the private cloud is user need to invest upfront amount before to use.

Several SaaS applications, such as SugarCRM, provide options to their clients to maintain their data on their own premises to ensure data privacy maintained according to the requirements of the particular business.

Amazon also provides the option of a virtual private cloud

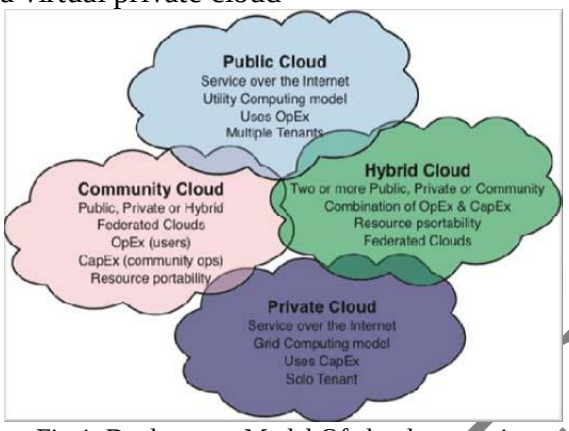

Fig 1. Deployment Model Of cloud computing

-Hybrid cloud: A hybrid cloud is a combination of public and private cloud models that tries to address the limitations of each approach. In a hybrid cloud, part of the service infrastructure runs in private clouds while the remaining part runs in public clouds. Hybrid clouds offer more flexibility than both public and private clouds.

-Community Cloud: Private cloud (also called internal cloud or corporate cloud) is a marketing term for a proprietary computing architecture that provides hosted services to a limited number of people behind a firewall. Advances in virtualization and distributed computing have allowed corporate network and datacenter administrators to effectively become service providers that meet the needs of their "customers" within the corporation. Marketing media that uses the words "private cloud" is designed to appeal to an organization that needs or wants more control over their data than they can get by using a third-party hosted service such as Amazon's Elastic Compute Cloud (EC2) or Simple Storage Service (S3).

Services Provided By Cloud Computing :

-Platform as a Service (PaaS): "PaaS is the delivery of a computing platform and solution stack as a service without software downloads or installation for developers, IT managers or end-users. It provides an infrastructure with a high level of integration in order to implement and test cloud applications. The user does not manage the infrastructure (including network, servers, operating systems and storage), but he controls deployed applications and, possibly, their configurations.

The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly application hosting environment configurations.

There are a number of different takes on what constitutes PaaS but some basic characteristics include[12]

- Web based user interface creation tools help to create, modify, test and deploy different UI scenarios.
- Multi-tenant architecture where multiple concurrent users utilize the same development application.
- Integration with web services and databases via common standards.
- Support for development team collaboration – some PaaS solutions include project planning and communication tools.
- Tools to handle billing and subscription management

Examples of PaaS providers include Google App Engine [10], Microsoft Windows Azure [26], and force.com [18].

-Infrastructure as a Service (IaaS): Infrastructure as a service (IaaS) refers to the sharing of hardware resources for

executing services using Virtualization technology. Its main objective is to make resources such as servers, network and storage more readily accessible by applications and operating systems. Thus, it offers basic infrastructure on-demand services and using Application Programming Interface (API) for interactions with hosts, switches, and routers, and the capability of adding new equipment in a simple and transparent manner. In general, the user does not manage the underlying hardware in the cloud infrastructure, but he controls the operating systems, storage and deployed applications. The service provider owns the equipment and is responsible for housing, running and maintaining it.

There are some core characteristics, which describe what IaaS is.

IaaS is generally accepted to comply with the following:

- Resources are distributed as a service
- Allows for dynamic scaling
- Has a variable cost, utility pricing model
- Generally includes multiple users on a single piece of hardware

Examples of IaaS providers include Amazon EC2[3], GoGrid[2], Flexical[6].

-Software as a Service: SaaS is the software as a service which ensures that the complete applications are hosted on the internet and users use them.

It eliminates the need to install and run the application on the customers local computer, thus eliminate the customer's burden for software maintenance. Also the payment is being made on a pay per use model.

Thus the SaaS can be defined as "…software that is deployed over the internet… With SaaS, a provider licenses an application to customers either as a service on demand, through a subscription, in a "pay-as-you-go" model, or (increasingly) at no charge when there is opportunity to generate revenue from streams other than the user, such as from advertisement or user list sales. "

Characteristics of SaaS: Some defining characteristics of SaaS include:

- Web access to commercial software.
- Software is managed from a central location.
- Software delivered in a "one to many" model.
- Users not required to handle software upgrades and patches.
- Application Programming Interfaces (APIs) allow for integration between different pieces of software.

Examples of SaaS providers are include Salesforce.com [18], Rackspace [8] and SAP Business ByDesign [14].

Requirements of SaaS Service Delivery Infrastructures: Scientific applications process large amounts of information, require a lot of computing power and high storage capacity for input, output, intermediate or final data. These applications do not provide an immediate response, in most scenarios it is acceptable to deliver the result after several hours/days or more [9].

A SaaS service delivery infrastructure differentiates by a number of characteristics and requirements that are structured according to the role played by the observer (user, administrator, Developer etc) [26].

- **User perspective:** quick access to information, resource availability, access to latest software features, stored information security, transaction security [7], [1].
- **Administrator perspective:** easy scalable by adding new machines, rapid detection of infrastructure failures, fast replacement of damaged machines, monitoring capabilities, automatic reorganization of the infrastructure on failure, upgrade software without service interruptions, ability to statistically determine when and how the infrastructure can fail or lose data [4], [15].
- **Developer perspective:** separation of the application code from the infrastructure

code, availability of structured and unstructured storage services, availability of communication services in the infrastructure, infrastructure complexity not exposed to the application. [26].

There are also economical and business requirements such as: provider's independence from the hardware vendor, customer independence from the cloud provider, proprietary software independence, resistance to disasters, and predictable operating cost [17].

Developers have major issues with cloud infrastructures because they have to accommodate the existing software to the new infrastructures or to write new scalable software without any previous experience in distributed applications [4].

Software as a Service Environment: The purpose of this section is to describe the architecture and basic operation of SaaS, or Software as a Service, in a cloud-computing environment. This information is important for the one who need to evaluate whether a SaaS cloud offering can satisfy particular reliability, compliance, or security requirements, and also for them who want to understand operational mechanisms.
Fundamentally, cloud computing provides convenient rental of computing resources. These resources, which are typically accessed by subscribers over a network, must be measurable in units that can be individually allocated to specific subscribers, and paid for based on factors such as how long the units are retained, who has access to them, how they are used, etc. For public or outsourced SaaS, most application program logic is executed on the cloud provider's servers. The subscriber's browser provides: (1) the subscriber interface that captures subscriber keystrokes and other inputs, and produces output in the form of graphics/sound, and (2) the data export that outputs data to local storage devices such as USB devices or printers. To protect application data exchanged between the subscriber's browser and the cloud provider over the network, cryptography is required.

Generally, a subscriber provides an account name and password or other authentication credential such as a time-based hardware token value. While the server side could also provide credentials, in practice the client often does not receive credentials to authenticate the server and instead relies on the Domain Name System to have correctly translated the URL specified by the client and thus to have located the real server rather than a fraudulent one.

The SaaS provider's main responsibility to the subscriber is to ensure that the software that it supplies is solidly supported and tested. Another key requirement is that SaaS applications be scalable to increasingly larger subscriber workloads. Maintaining an infrastructure to carry this out in a secure environment with specified uptime for the subscriber is a critical aspect. Many subscribers may have valuable organizational data stored in the cloud and some of this information may be proprietary and business-sensitive, therefore a secure environment is paramount.
-Providers/Subscribers Scope of Control in SaaS: In SaaS, the cloud provider(s) controls most of the software stack. Figure 2 illustrates how control and management responsibilities are shared. In the center, the figure depicts a traditional software stack comprising layers for the hardware, operating system, middleware, and application. The figure also depicts an assignment of responsibility either to the cloud provider, the cloud subscriber, or both.

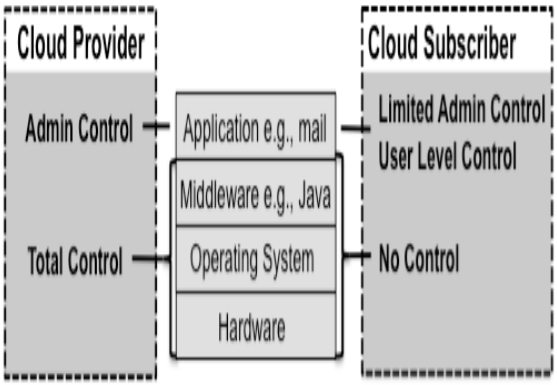

Fig 2: SaaS Provider/Subscriber Scope of Control

In the SaaS service model, a subscriber possesses control over the application-specific resources that a SaaS application makes available. For example, if a provider is providing an email application, the subscriber will typically have the ability to create, send, and store email messages.

In some cases, a subscriber also has limited administrative control of an application. For example, in the example of an email application, selected subscribers may have the ability to create email accounts for other subscribers, review the activities of other subscribers, etc.

In contrast, a provider typically maintains significantly more administrative control at the application level. A provider is responsible for deploying, configuring, updating, and managing the operation of the application so that it provides expected service levels to subscribers.

The middleware layer depicted in Figure 2 provides software building blocks for the application. A middleware layer can take a number of forms, ranging from (1) traditional software libraries, to (2) software interpreters (e.g., the Java Virtual Machine [13] or the Python runtime environment [11] or implementations of the Common Language Infrastructure, to (3) invocations of remote network services. Middleware components may provide database services, user authentication services, identity management, account management, etc. In general, a cloud subscriber needs and possesses no direct access to this layer. Similarly, subscribers require and generally possess no direct access to the operating system layer or the hardware layer. Optionally, a provider may employ a Virtual Machine Monitor (VMM) as part of the software stack. In this case, the VMM resides between the hardware and the operating-system layers. A VMM can be a useful tool to help a provider manage available hardware resources however SaaS subscribers do not require or generally possess direct access to it.

Benefits of Using SaaS cloud: Compared with traditional computing and software distribution solutions, SaaS clouds provide scalability and also shift significant burdens from subscribers to providers. The following sections describe five key benefits of SaaS clouds

- **Very Modest Software Tool:** SaaS application deployment has become increasingly convenient and efficient with little or no client-side software required. Several factors contribute to this value proposition:

- Unlike shrink-wrapped software applications, SaaS applications can be accessed without waiting for complex installation procedures.
- Because SaaS applications have very small footprints on client computers, risk of configuration interference between applications on client computers is reduced.
- Distribution costs for the software are fundamentally reduced. Distribution costs allow for economical development and deployment of software features even if they appeal to only a small portion of subscribers.

- **Efficient Use of Software Licenses:** License management overheads can be dramatically reduced using SaaS. As discussed in [20], subscribers can employ a single license on multiple computers at different times instead of purchasing extra licenses for separate computers that may not

be used and thus over-provisioning the license.

- **Centralized Management and Data:** For public and outsourced scenarios, the SaaS service model implies that the majority of the data managed by an application resides on the servers of the cloud provider. The provider may store this data in a decentralized manner for redundancy and reliability, but it is centralized from the point of view of subscribers. One implication is that, for public and outsourced scenarios, the SaaS provider can supply professional management of the data, including for example, compliance checking, security scanning, backup, and disaster recovery.

The "on demand" network access of SaaS applications also relieves subscribers from the need to carry their data with them in some settings, thus potentially reducing risks from loss or theft. When supported by the application's logic, remote data management also facilitates sharing among other subscribers.

- **Platform Responsibilities Managed by Providers:** Generally, for outsourced or public SaaS clouds, subscribers need not become involved with the management of provider's infrastructure. For example, subscribers need not be distracted by which operating system, hardware devices or configuration choices, or software library versions underlie a SaaS application. In particular, providers have responsibility for operational issues such as backups, system maintenance, security patches, power management, hardware refresh, physical plant security, etc. As SaaS providers implement new application features and provide the server side hardware that runs them, SaaS providers also have advantages in managing the introduction of new features while mitigating the need for subscribers to upgrade their hardware systems to use the new features.

- **Savings in Up-front Costs:** Outsourced and public SaaS clouds allow a subscriber to begin using an application without the up-front costs of equipment acquisition, but potentially with a recurring usage fee. Additionally, cloud providers should be able to provision their hardware, power, and other computing resources at scale and more efficiently than individual subscribers, which may reduce ongoing costs to subscribers. As with any buy vs. rent decision, a careful analysis of all the cost considerations should be performed, including anticipated future prices, before committing to a single approach.

Where SaaS May be the Best Option: organizations considering a move to the Cloud will want to consider which applications they move to SaaS. As such there are particular solutions we consider prime candidate for an initial move to SaaS:

- "Vanilla" offerings where the solution is largely undifferentiated. A good example of a vanilla offering would include email where many times competitors use the same software precisely because this fundamental technology is a requirement for doing business, but does not itself confer a competitive advantage.
- Applications where there is significant interplay between the organization and the outside world. For example, email newsletter campaign software.
- Applications that have a significant need for web or mobile access. An example would be mobile sales management software.
- Software that is only to be used for a short term need. An example would be collaboration software for a specific project.
- Software where demand spikes significantly, for example tax or billing software used once a month.

As one of the earliest entrants it is not surprising that CRM is the most popular SaaS application area,[14] however e-mail, financial management, customer service and expense management have also gotten good uptake via SaaS.

Where SaaS May Not be the Best Option: While SaaS is a very valuable tool, there are certain situations where we believe it is not the best option for software delivery. Examples where SaaS may not be appropriate include:

- Applications where extremely fast processing of real time data is required.
- Applications where legislation or other regulation does not permit data being hosted externally.
- Applications where an existing on-premise solution fulfills all of the organization's needs.

Software as a Service may be the best known aspect of Cloud Computing, but developers and organizations all around the world are leveraging Platform as a Service, which mixes the simplicity of SaaS with the power of IaaS, to great effect.

Conclusion: Cloud computing is the fascinating subject for the many users as this is the new technology. Many questions are still in mind that what is the exactly mean by cloud computing, where the user can use it or how to implement the services which are provided by cloud computing. In this paper I have tried to explain what is the cloud computing and then I concentrate on the service Software as a Service (SaaS) which is provided by cloud computing. This paper covers the topics related with the SaaS such as Requirements of SaaS Service Delivery Infrastructures, software as a service environment, Benefits of using SaaS in cloud and where the SaaS is best fit and where may not be best fit**.** We try to cover all the points related with the SaaS so that whenever anyone decide to go for the SaaS this paper will help them and give the vague idea about the SaaS with the cloud.

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Annexes:
1. SaaS- Software as a Service.
2. PaaS- Platform as a Service.
3. IaaS- Infrastructure as a Service.
4. CRM- Customer Relation Model.
5. VMM- Virtual Machine Monitor