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A Review of SaaS Profit Maximization in Cloud Computing

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Abstract- **Amongst the various new technologies, Cloud Computing is one of the most important field in the current world. It has come out to be an attractive and useful way of changing the whole computing world. Migrating from conventional software to cloud enables on-going revenue for software providers. In order to deliver hosted services to the customers, SaaS providers can do two things either they maintain their own hardware or they rent it from the infrastructure providers. This incurs extra cost to the SaaS providers. In order to reduce this extra infrastructure cost and satisfy the customers need some methods should be developed. This paper focuses on the SaaS providers who want to minimise this extra cost and SLA violations without hampering the customer demands and to maximise their profit. This paper presents an extensive assessment study to analyse the literature survey of SaaS profit maximisation.**

Keywords—Cloud Computing, Software as a Service, Service Level Agreement.

I INTRODUCTION

Today a new technology widen in the IT market for delivering the computing services to the user on demand in pay per use manner any time anywhere, but user must be connected to the high-speed internet connection to enjoy these type of services. This technology known as [1]"Cloud Computing". Cloud computing is the delivery of computing as a service rather than a product, whereby shared resources, software and information are provided to users over the network. It is a new paradigm for delivery of applications and resources to the customers as pay per use manner over the internet[19]. Due to its advantages cloud has been more and more adopted in many areas such as banking, e-commerce [17][18] and many more. It provides secure, fast and convenient data storage and net computing services cantered by the internet. Cloud computing delivers three types of services as: Infrastructure as a Service, Platform as a Service, Software as a Service. Our main focus is on SaaS layer. With the emergence of Software as a Service (SaaS), applications are moving away from PC based or ownership-based programs to web delivered hosted services [7].

A. Infrastructure as a service (IaaS)

The prime goal of an organization is to reduce time & money required to acquire, provision, and install new hardware systems. IaaS fulfills this prime goal i.e. equipment is outsourced to support operations. It provides elastic ways to create, use and handle virtual machines. Customers are able to set up and run arbitrary software, which can include operating systems and applications. Customers do not manage or organize the underlying cloud infrastructure but have to manage its own virtual infrastructure typically constructed by virtual machines hosted by the IaaS vendor.
Examples of IaaS providers include: Amazon EC2, HP Cloud etc.

B. Platform as a service (PaaS)

Pass provides a toolkit for conveniently developing, deploying and administering application software that is structure to support large number of subscribers, process very large number of subscribers, process very large quantity of data, and can be accessed from any point in the internet. It focuses on providing the higher level capabilities more than just virtual machines required to supports applications. In the PaaS model, cloud providers deliver a computing platform and/or Solution stacks typically including operating system, programming language execution environment, database, and web server [3]. Application developers can develop and run their software on a cloud platform without having to manage or control the underlying hardware and software layers, including network, servers, operating systems, or storage, but maintains the control over the deployed applications and possibly configuration settings for the application-hosting environment.
Examples of PaaS include: Salesforce.com [2], Google App Engine[9], Orange Scape etc.

C. Software as a service (SaaS)

It includes implementation of specific business functions, customized business applications, etc. In SaaS, different software applications are used by the users from different servers through the Internet. It is the application that provides business value for users. With the emergence of Software as a Service (SaaS), applications are moving away from PC based or ownership-based programs to web delivered hosted services [16]. In the SaaS model, software applications are delivered as services that execute on infrastructure managed by the SaaS vendor. The provider does all the upgrades and patching while keeping the infrastructure running. Customers are enable to access services over various clients such as web browsers and programming interfaces, and are typically charged on a subscription basis [8]. The implementation and the underlying cloud infrastructure where it is hosted is transparent to consumers. Examples of SaaS include: Google Apps, Customer resource management (CRM), Video conferencing, IT service management, Accounting, Web content management etc.

Cloud Computing Deployment Models

Deploying cloud computing can be different depending on the needs, and the subsequent four deployment models have been identified [10], each with specific characteristics that support the requirements of the services and users of the clouds in particular ways.

A. Public cloud

It is a most popular form of cloud and many times referred as multi-tenant. In this resources are dynamically provisioned on a fine-grained, self-service basis over the internet, via web services, from an off-site third party provider who shares resources and bills on a fine-grained utility computing basis. You pay for what you use. Technically there is no difference between public and private cloud architecture. However, from security consideration it may be substantially different for different services (applications, storage, and other resources) that are made available by a service provider for un trusted networks. Generally, public cloud service providers like Amazon AWS[4], Microsoft and Google own and operate the infrastructure and offer access only via Internet.

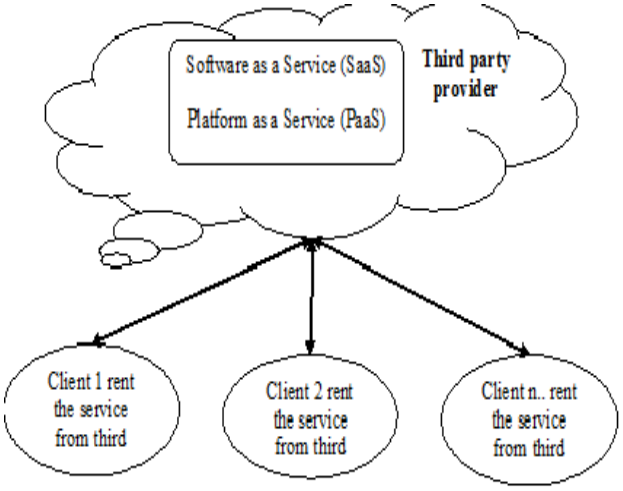

Fig. 1 Public Cloud Deployment

B. Private cloud

Private cloud is set of standardized computing resources that are dedicated to an organization, usually on-premises in the organization data centres [11]. It is implementation of cloud service on resources that are devoted to an organization, whether they exist on-premises or off-premises. A private cloud shares many of the features of public cloud computing including resources pooling, self-services, elasticity and pay by use delivered in consistent manner with the additional control and customization available from dedicated resources. In general a customer's internally hosted data centre is regarded as a Private Cloud. If we add virtualization and automation, such a setup may very well be regarded as a Private Cloud. A Private Cloud is therefore mostly suited for sensitive data, where the customer is dependent on a certain degree of security. Examples of private cloud are Microsoft ECI[5] data centre etc.

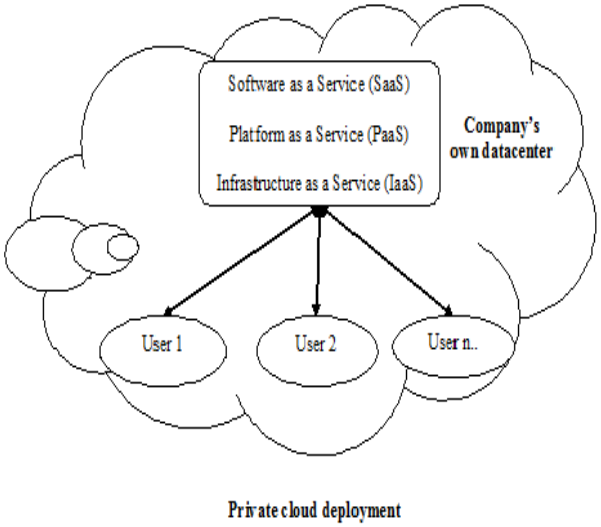

Fig.2 Private Cloud Deployment

C. Community cloud

A community cloud refers to cloud computing environment shared and managed by several organization that have similar requirement and are sharing the infrastructure in order to realize some of the benefits of cloud computing. This may help limit the capital expenditure costs for its establishment as the costs are shared among the organizations. The operation may be in-house or with a third party on the premises. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized. This helps to further reduce costs as compared to a private cloud, as it is shared by larger group. Examples of community cloud are Microsoft government community cloud, Google apps for government etc.

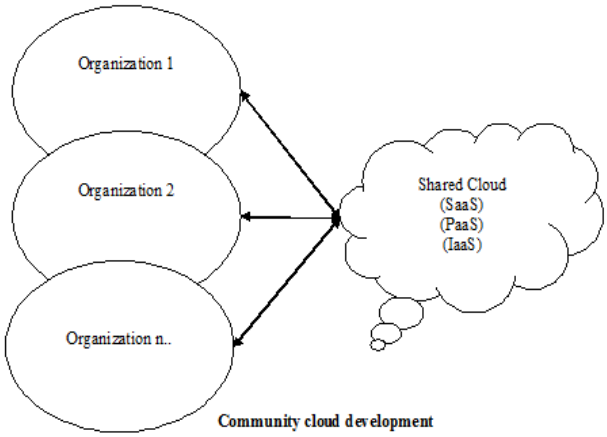

Fig. 3 Community Cloud Deployment

D. Hybrid cloud

A hybrid cloud is an environment where in an organization provides and manages some of resources in-house and has others provided externally. An organization might use a public cloud services, service for archived data but continue to maintain in-house storage for operational customer data. This deployment model helps businesses to take advantage of secured applications and data hosting on a private cloud,

while still enjoying cost benefits by keeping shared data and applications on the public cloud. This model is also used for handling cloud bursting, which refers to a scenario where the existing private cloud infrastructure is not able to handle load spikes and requires a fallback option to support the load. Hence, the cloud migrates workloads between public and private hosting without any inconvenience to the users. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized. Hybrid approach allows a business to take advantage of the capability and cost-effectiveness that a public cloud computing.

Microsoft Azure and Force.com are two examples of this model.

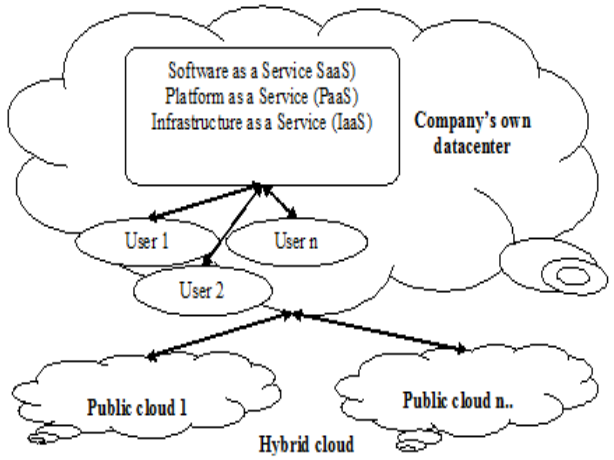

Fig. 4 Hybrid Cloud Deployment

II RELATED WORK

Linlin Wu et al. [12]Software as a Service (SaaS) provides access to applications to end users over the Internet without upfront investment in infrastructure and software. To serve their clients, SaaS providers utilise resources of internal data centres or rent resources from a public Infrastructure as a Service (IaaS) provider. In-house hosting can increase administration and maintenance costs whereas renting from an IaaS provider can impact the service quality due to its variable performance. To overcome these limitations, we propose innovative admission control and scheduling algorithms for SaaS providers to effectively utilise public Cloud resources to maximize profit by minimizing cost and improving customer satisfaction level. Furthermore, we conduct an extensive evaluation study to analyse which solution suits best in which scenario to maximize SaaS provider's profit. Simulation results show that many proposed methods provide substantial improvement (up to 40% cost saving) over reference ones across all ranges of variation in QoS parameters.

In [6] author proposed architecture SLA-based Resource Allocation for Software as a Service Provider (SaaS) in Cloud Computing Environments, which is based on SLA. SaaS providers who want to minimize infrastructure cost and SLA violations. These methods are designed in a way to ensure that Saas providers are able to manage the dynamic change of customers, mapping customer requests to infrastructure level parameters and handling heterogeneity of Virtual Machines. We take into account the customers' Quality of Service parameters such as response time, and infrastructure level parameters such as service initiation time. The paper also presents an extensive evaluation study to analyse and demonstrate that the proposed methods minimize the SaaS provider's cost and the number of SLA violations in a dynamic resource sharing Cloud environment.

Popovici et al. [13] mainly considered QoS parameters on the resource provider's side such as price and offered load, but did not focus on the user side. However, our proposed work differs on QoS parameters from both the customer's and the SaaS provider's point of view and focuses on user driven scenarios.

Bichler and Setzer proposed an admission control strategy for media on demand services, where the duration of service is fixed [14]. Our approach allows a SaaS provider to specify its expected profit ratio according to the cost, for example; the SaaS provider can specify that the service request which can increase the profit in 3 times will be accepted. The cloud is dynamic in nature it responds to the instant request of the user. Hence any system that tries to enforce a SLA need to embrace this dynamic nature. Author [10] proposed WSLA (web service layer agreement) architecture which is used to monitor the SLA violation and reduce the burden of cloud provider and end-user. Author describes three common WSLA services and some of their adaptations required in the cloud context. A measurement service is responsible of getting the results from measurement services and evaluating the Service Level Objectives. If there are violations the Management service will be contacted. Management service is responsible for taking corrective actions on violation of the Service Level Objectives. Measurement services are responsible for measuring the runtime parameters of cloud provider's resources. In this author major concern is how to make the trust on the client and ensure the reliability and quality of service by monitoring them. Author proposed a framework for mechanism for managing SLAs in a cloud computing environment using the Web Service Level Agreement(WSLA) framework, developed for SLA monitoring and SLA enforcement in a Service Oriented Architecture (SOA). Author used the third party support feature of WSLA to delegate monitoring and enforcement tasks to other entities in order to solve the trust issues. In this architecture, author assumed that the cloud provider and the cloud consumer already participated in the negotiation process and have an agreed set of service parameters, i.e. the negotiation and SLA establishment steps are considered out of scope for this work. Once the SLA document is established, it needs to be deployed. In the term SLA deployment is defined as the process of validating and distributing the SLA, in part or full, to the involved parties. The work identifies that the provider and the consumer may not want to share the complete SLA document with supporting parties due to security considerations. Author describes three common WSLA services and some of their adaptations required in the cloud context.

III CONCLUSION

Cloud computing is the technology of the next generation which unifies everything into one. It is an on demand service because it offers dynamic flexible resource allocation for reliable and guaranteed services in pay as-you-use manner to users. The review shows that SaaS is very important layer in cloud computing because all the allocation of resources to the application is done by SaaS providers. This paper focused on the review of customer requests for SaaS providers with the explicit aim of cost minimization or to increase the profit with dynamic demands handling. An effective strategy is required for achieving user satisfaction and maximizing the profit for cloud service providers. This paper discusses just about the review of SaaS layer in cloud computing based on the QoS parameter and SLA.

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