Software as a Service (SaaS) with Cloud Computing

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ABSTRACT
This paper explores how cloud computing can be leveraged to provide software as a service. In today’s enterprise systems, the dynamics of business requirements make it quite important to have the IT systems of the enterprise to be flexible enough to respond and adapt to the requirements as soon as possible and hence we see the emergence of new “On-Demand” solutions for addressing these scenarios. Cloud Computing is already synonymous with unparalleled scalability and good flexibility, both of which are key to adapting to dynamic business requirements which results in great turnaround times in terms of productivity for any enterprise. Software as a service implies network-based access to, and management of, commercially available software. Provision of using networked based “SaaS” applications to quickly achieve output in productivity enables organizations to virtually scale in terms of deployed infrastructure, while having higher returns on investment at the same time due to lower cost of operations. This paper outlines various aspects and key considerations to providing Software as a Service with Cloud Computing.

KEYWORDS
Cloud Computing, On-Demand\textsuperscript{1} solutions, Software-as-a-Service\textsuperscript{2} (SaaS).

1. INTRODUCTION.
Cloud computing infrastructures can allow enterprises to achieve more efficient use of their IT Hardware and software investments. Cloud computing is an example of an ultimately virtualized system, and a natural evolution for Data centers that employ automated systems management, workload balancing, and virtualization technologies. A cloud infrastructure can be a cost efficient model for delivering information services, reducing IT management complexity, promoting innovation, and increasing responsiveness through real-time Workload balancing. Application software, when used via a “cloud” provide benefits to an organization, which saves in terms of deployment of licenses of these software on individual workstations, eliminate or reduced downtimes.
A cloud is a pool of virtualized computer resources.
A cloud can:
• Host a variety of different workloads, including batch-style back-end jobs and interactive, user-facing applications
• Allow workloads to be deployed and scaled-out quickly through the rapid provisioning of Virtual machines or physical machines
• Support redundant, self-recovering, highly scalable programming models that allow Workloads to recover from many unavoidable hardware/software failures
• Monitor resource use in real time to enable rebalancing of allocations when Cloud computing environments needed support grid computing by quickly providing physical and virtual Servers on which the grid applications can run.

2. SOFTWARE AS A SERVICE RENDERED BY CLOUD BASED SERVICES.
Software as a Service (SaaS) encompasses various types of services which can be either be used individually to address specific issues or can be used collectively, as a stack. Software as a Service means delivering business applications, including collaboration software and line-of-business applications, to companies that require them to run their business. SaaS was initially widely deployed for sales force automation and Customer Relationship Management (CRM). Now it has become commonplace for many business tasks, including accounting software, computerized billing, ERP software, invoicing, human resource management, financials, content management, collaboration, document management, and service desk management. Small and medium size Businesses (SMBs) which do not have the expertise or capital budget to purchase, install, and manage your application, can subscribe to your hosted application for a recurring fee. From a cloud computing perspective, cloud based services can render various disparate systems (illustrated example below) which can provide a customized software solution to the Small to Medium Enterprise (SME) businesses. This profits the organization in terms of increase in average revenue per customer. The various resources consumed by web applications (e.g. bandwidth, memory, CPU) are tallied on a per-unit basis (starting from zero) by all major cloud computing platforms.
Only consumed resources incur in cost.
Cloud computing\textsuperscript{3} can provide for an array of services, which range from (all or any) of the below mentioned services.
• Storage-as-a-Service
• Database-as-a-Service
• Information-as-a-Service
• Process-as-a-Service
• Application-as-a-Service
• Platform-as-a-Service
• Integration-as-a-Service
• Security-as-a-Service

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2.1 STORAGE AS A SERVICE
Storage is provided on the cloud, i.e. web service is provided to store and access data. Different vendors provide various APIs and Interfaces to store and access data. Storage can thus be made highly customizable, in addition to having its resources tallied on a per unit basis, as well as being equipped to scale to larger loads on a case by case basis.

Examples for vendors providing storage as a service are:
- Amazon SimpleDB, which is an Amazon API based schema-less, low administrative overhead based storage service. This serves as building block for accessing the Amazon Simple Storage Service (S3) data. The Amazon S3 service can store objects between 1 byte and 5 gigabytes, has REST and SOAP interfaces, as well as authentication mechanisms and Objects are assigned a unique ID, with meta-data assignment done in Amazon SimpleDB for querying purposes.
- Google’s App Engine data tier has the following characteristics: Storage and retrieval based on either Java – available via Java Data Objects (JDO), Java Persistence API (JPA) or low-level data store API – as well as Python – available via a data modeling API and a SQL-like query language called GQL. Schema-less; requiring no up-front data modeling tasks. Built on Google infrastructure (i.e. BigTable, Google File System).

2.2 DATABASE-AS-A-SERVICE
Provides the ability to leverage the services of a remotely hosted database, sharing it with other users, and having it logically function as if the database were local.

2.3 INFORMATION-AS-A-SERVICE
Refers to the ability to consume any type of information, remotely hosted, through a well-defined interface such as an API, for example, stock price information, address validation, credit reporting, etc.

2.4 PROCESS-AS-A-SERVICE
Refers to a remote resource that’s able to bind many resources together, either hosted within the same cloud computing resource or remote, to create business processes. These processes are typically easier to change than applications, and thus provide agility to those who leverage these process engines that are delivered on-demand.

2.5 PLATFORM-AS-A-SERVICE
Application-as-a-service is the ability to leverage an enterprise-class application without having to buy and install enterprise software.

Characteristics of Application as a service are:
- A user interface.
- Predefined application behavior.
- Predefined data.
- Support for any number of client platforms, since they run through the browser.

Office automation applications-as-a-service, including e-mail, document management, word processing, spreadsheets, and other productivity applications can be delivered through a browser for a nominal subscription fee or advertisements. Salesforce.com is one such application-as-a-service vendor which provides various office operations applications to enable its customers to provide portable document management and on-field reporting, which saves its clients time and money. Heterogeneous applications like credit check systems and transaction systems can integrate over a cloud to provide a seamless wrapper service to the end user where he can shop online, and have access to various payment methods, and payment gateways. Cloud services can be effective in conduction of such transactions.

Application-as-a-service providers include Salesforce, Netsuite, Oracle On Demand, and Google Apps.
Is a complete platform, including application development, interface development, database development, storage, testing, etc., delivered through a remotely hosted platform to subscribers. Based upon the traditional timesharing model, modern platform-as-a-service providers provide the ability to create enterprise-class applications for use locally or on-demand for a small subscription price or for free.

2.6 INTEGRATION-AS-A-SERVICE
Is the ability to deliver a complete integration stack from the cloud, including interfacing with applications, semantic mediation, flow control, integration design, etc. In essence, integration-as-a-service includes most of the features and functions found within traditional EAI technology, but delivered as a service.

Integration-as-a-service providers include Amazon SQS, and Mule OnDemand.

2.7 SECURITY-AS-A-SERVICE
As you may have guessed, is the ability to deliver core security services remotely over the Internet. As a user of a cloud computing platform, your security concerns should span to contemplate the security vulnerabilities and security limitations inherent to a provider’s services, in addition to those of web applications in general.

Some of the vendors like Amazon EC2 provide full access to host operating system instance, and vulnerability and ‘hardening’ policies are the responsibility of a user, as with any other public operating system. Amazon EC2 also provides Amazon Security groups to facilitate and limit access to instances by port, protocol and or incoming IP. It provides optional multi-factor authentication, to limit access through a six-digit, single-use code from an authentication device in your physical possession (http://aws.amazon.com/mfa/).

Similarly, another security service vendor, Google App Engine has security characteristics like Access to underlying host provided entirely through a Google account. Google App Engine limits a user’s security accountability (e.g. no operating system to ‘harden’). No custom domain SSL certificate support (i.e. https:// access). SSL is supported, but only routed via a domain in the form https://your-app-id.appspot.com. It uses Google Secure Data Connector (SDC) support. Google App Engine allows data encryption between applications running on Google App Engine and a corporate network.

2.8 MANAGEMENT/GOVERNANCE-AS-A-SERVICE
Is any on-demand service that provides the ability to manage one or more cloud services, typically simple things such topology, resource utilization, virtualization, and uptime management. Governance systems are becoming available as well, such the ability to enforce defined policies on data and services.

Management/governance-as-a-service providers include RightScale, rPath, Xen, and Elasta.

2.9 TESTING-AS-A-SERVICE
Is the ability to test local or cloud-delivered systems using testing software and services that are remotely hosted. It should be noted that while a cloud service requires testing unto itself, testing-as-a-service systems have the ability to test other cloud applications, Web sites, and internal enterprise systems, and do not require a hardware or software footprint within the enterprise.

Testing-as-a-service providers include SOASTA.

The major cloud service providers include Amazon, Salesforce and Google. Some of the larger IT firms that are actively involved in cloud computing are Fujitsu, Microsoft, HewlettPackard, IBM, VMware, NetApp and Dell.

For a choice of cloud computing vendor providing support for various programming languages for implementation of solutions, Amazon EC2 certainly provides support for a vast array of technologies when compared with Google App Engine and Microsoft Azure (as illustrated).

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<th>Web application language</th>
<th>Amazon EC2</th>
<th>Google App Engine</th>
<th>Microsoft Azure</th>
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3. CONCLUSION
This paper discussed what Software-as-a-service (SaaS) encompasses and how providing services across multiple tiers like infrastructure, Database, Process, Security, and applications via virtualized networks can provide leverage on cost savings and operational efficiency to small and middle tier enterprise (SME) organizations. Choosing a cloud computing vendor which provides flexibility and high availability, organizations can get quickly productive and reduce spend on infrastructure, applications, and security. This allows organizations to focus and fine tune their core business processes.

Software-as-a-Service is still quite nascent given the challenges in terms of cross vendor portability of service solutions, service-level-agreement (SLAs) with respect to high availability and addressing security concerns surrounding the client data and the service applications providing access and management of the cloud itself.

REFERENCES
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