Example Analysis of Cloud Services

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ABSTRACT

Cloud computing is reshaping the computing and Internet landscape. XaaS (acronym for "Anything-as-a-Service") plays a vital role in the evolution of cloud computing which refers to any of an increasing number of services provided over the Internet that have been traditionally provided locally. The as-a-Service model is gaining popularity in the computing world. It is about services instead of technologies because users usually care about the services they are getting. Users generally do not worry even about the technologies or resources involved. A host of providers including Amazon (AMZN), Salesforce.com (CRM), IBM (IBM), Oracle (ORCL) and Microsoft are helping corporate clients use the Internet to tap into everything from extra server space to software that helps manage customer relationships. This paper focuses on expanded delivery services of cloud computing. The offerings from some cloud service providers are analyzed and discussed in this paper.

INTRODUCTION

Cloud computing refers to the applications and services that run on a distributed network using virtualized resources and accessed by common Internet protocols and networking standards. It mainly concentrates on accessing, manipulating and configuring the applications online. It provides online storage for data, infrastructure and application. Most of us use cloud computing frequently on our daily basis without realizing it. When you sit with your computer or laptop to search something on Google and you type the query, the computer isn't playing much part in finding the answers you need it's no more than a messenger. The words you type are swiftly transferred over the Net to one of Google's thousands of clustered PCs, which search out your results and send them promptly back to you. Similarly, this applies to Web-based email. In earlier times, a program running on your computers (known as mail-client) was only used to send and receive email. But then, Web-based services such as Hotmail came along which made use of cloud computing and carried email off into the cloud. Now we are all used to the idea that emails can be stored and processed through a server in some remote part of the world, effortlessly accessible from a web browser, wherever we happen to be .Making use of cloud computing in the email world makes it supremely convenient to busy people, constantly on the move. Preparing documents over the Internet is the newer example of cloud computing. Simply, retrieve a Web-based service such as Google Docs and you can create document, spreadsheet, presentation or whatever you like using Web-based software. Rather than typing your words into a program like Microsoft Word running on your desktop computer, you are using similar software running on a PC at one of Google's world wide data centers. Cloud computing makes the long-held dream of utility computing possible with a pay-as-you-go, infinitely scalable and universally available system. The following definition of cloud computing has been developed by the U.S. National Institute of Standards and Technology (NIST) [12]:

"Cloud computing is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g. network, 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, four deployment models and three service models."

Some of the characteristics of cloud computing is as follows:

- *On-demand self service* means that customers (generally organizations) can demand and administer their own computing resource.
- *Broad network access* allows services to be obtainable over the Internet and private networks.
- *Resource pooling* means a cloud service provider create resources that are pooled together in a system that supports multi-tenant usage.
- *Rapid elasticity* means the system can add resources by either scaling up systems (more powerful computers) or scaling out systems (more computers of the same kind).
- *Measured service* means the use of cloud system resources is measured, audited and reported to the customer based on a metered system.

The deployment model tells you where the cloud is located and for what function. Public, private, community and hybrid clouds are deployment models.

Service models describe the type of service that the service provider is offering. The well known service models are Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS). The service models erect on one another and define what a vendor must manage and what the client's responsibility is.

For this paper, the cloud services are analyzed and for this analysis, recent studies and surveys in the field of cloud computing services, as well as information provided by the cloud service providers is considered. The remaining paper is organized as follows: Section 2 presents the details of cloud services. Then, the outlines the offerings from various cloud service providers are examined and explained in Section 3. Finally, the conclusion of this study is given in Section 4.

I. CLOUD SERVICES

Cloud computing is a set of network enabled services, providing scalable, Quality of service assured, normally personalized, reasonably priced computing infrastructures on demand, which could be accessed in a plain and influential way. According to this definition, Cloud computing refers to the practice of delivering software and infrastructure as a service on a pay-as-you-go basis. The main differences between the cloud computing services that are deployed are associated to the type of service offered, as

- Platforms for individual software deployment
- Online software applications
- Computing power and storage space

Based on these differences, the NIST has already proposed three major categories of cloud computing services. IaaS virtualizes the hardware equipment and offers computing services such as CPU, memory and storage. PaaS offers platform services such as web, application and database servers and an executable programming environment. Programmers

utilize this service to write the code, check, debug and run many kinds of applications. SaaS consists of various services accessible by the end users. Each end user should pay a payment.

2.1 Infrastructure-as-a-Service (IaaS):

The Infrastructure-as-a-Service is a provision model in which an organization outsources the equipment used to support operations, including networking components, storage, servers and hardware. IaaS is the delivery of computer infrastructure (virtual storage, virtual machines, virtual infrastructure and other hardware assets) as a fully managed client service. The IaaS service provider manages the entire infrastructure, while the client has the responsibility for all other aspects of the deployment. This can include the user interactions with the system, applications and the operating system. The customers buy the resources, instead of having to setup servers, software and data center space and all the necessary networking components (such as routers, switches, firewalls, load balancers, VPNs etc) themselves, and get billed based on the resources consumed. The virtual instances can be borrowed for as long as necessary, which can be as short as an hour. To fulfill the customer's needs, the amount on instances can be either scaled up or scaled down dynamically. On the basis of this amount, the duration and the additional services used (such as additional storage space), billing is done. An important advantage is that it allows users to always use latest technologies and customers can achieve a much faster service delivery and time to market.

Characteristics and components of IaaS include [11]:

- Utility computing service and billing model
- Automation of administrative tasks
- Dynamic scaling
- Desktop virtualization
- Policy-based services
- Internet connectivity

Examples of IaaS service providers are as follows:

- *Amazon EC2:* The Amazon EC2 (Elastic Compute Cloud) is a Web-based service that allows customers to run application programs and offer scalable computing capacity in the Amazon Web Services (AWS) cloud.
- *Eucalyptus:* It is a set of Web services that is compatible with Amazon Web Services. Eucalyptus incorporates components from over 100 open source projects, tested and packaged into a single product that is easy-to-set up and easy-to-utilize and that runs on virtualized infrastructure.
- *GoGrid:* It is a cloud infrastructure service, hosting Linux and Windows virtual machines managed by a multi-server control panel and a RESTful API.
- *Rackspace cloud:* Thousands of customers look to rackspace to deliver the best-fit infrastructure for their IT needs, leveraging a product portfolio that allows workloads to run where they perform best-

whether on the public cloud, private cloud, dedicated servers or a combination of platforms.

- *Flexiscale:* it is a utility computing platform launched by XCalibre Communications which not only allows users to benefit from a wholly scalable hosting infrastructure but also reaches out to the wider world of IT services delivery companies who have the opportunity to extend their offering to their customers, whilst differentiating their services in a progressively demanding marketplace.

Some providers make it possible to connect the virtual instances to the company's network via VPN, to make the company network seem like one big scalable IT infrastructure. These solutions are called hybrid clouds, as they connect the company's private cloud with the public cloud of IaaS provider.

2.2 Platform-as-a-Service (PaaS):

Platform-as-a-Service goes a stage further than IaaS and includes the operating environment. It offers a managed higher-level software infrastructure, where customers can construct and deploy particular classes of applications and services without the cost and complexity of buying and managing the underlying hardware and software layers. Therefore, PaaS service provides, operating systems, services, applications, development frameworks, virtual machines transactions, and control structures. According to the requirements of hardware, software installation and data access demands, users can on demand subscribe to their suitable computing platforms. The service provider manages the operating systems, the enabling software and the cloud infrastructure. The client has the responsibility for installing and managing the application that is deploying. Platform services are mostly aimed at specific domains such as the development of web applications, and are dependent on the programming language. The end user of the provided platform need not to worry about how many servers are running the software or what kind of database it is. The advantage is that as compared to the conventional application development, this strategy can sharply lessen development time by offering hundreds of readily available tools and services.

Characteristics of PaaS include:

- Multi-tenant architecture
- Customizable/Programmable user interface
- Unlimited database customizations
- Robust workflow engine/capabilities
- Granular control over security/sharing
- Flexible "services enabled" integration model

Examples of PaaS service providers include:

- *Google App Engine:* GAE or simply App Engine is a PaaS cloud computing platform which allows you to develop your application easily using en suite services that make you more productive and hosting them in Google managed data centers. Applications are sandboxed and executed across multiple servers.

- *Force.com:* It is a PaaS service system from Salesforce.com which consists of set of tools and services that make it faster and easier to create employee-facing applications that are instantly social and mobile without worrying about hardware or infrastructure.

- *OpenShift:* It is a PaaS product from Red Hat. The software that executes the service is open-sourced under the name OpenShift Origin, and is available on GitHub. Developers make use of Git to deploy web applications in different languages on the platform.

- *Windows Azure:* It is a cloud computing platform and infrastructure, created by Microsoft, and is available to application developers as Web role and Worker role abstractions deployed into a resource container titled cloud Service. You can run applications by means of the Web role, plus host middle tier applications within the Worker role.

- *AppScale:* It is a open source platform that automatically deploys and scales unmodified Google App Engine applications over popular public and private cloud systems. AppScale has support for PHP, python, Go and Java applications and is modeled on App Engine API.

PaaS suited to the organizations that are committed to a given development environment for a given application but like the idea of someone else maintaining the deployment platform for them.

2.3 Software-as-a-Service (SaaS):

Software-as-a-Service is a model of software deployment whereby a provider licenses an application to customers for use as a "service on demand". The basic concept is that software or an application is hosted as a service in the cloud environment and provided to customers over a network, typically the Internet. It allows millions of users to use this hosted service through the browser and eliminates the need to install and run the application on the customer's local computer. It provides the complete operating environment with applications, management, and the user interface. With SaaS, the service provider supplies the hardware infrastructure along with the software product and interacts with the user through a front-end portal. SaaS therefore alleviates the customer's load of software maintenance, and reduces the cost of software purchases by on-demand pricing. Services can be anything from Web-based email to Enterprise resource planning, inventory control, database processing, and web conferencing including an increasingly wide range of other applications. The end user is free to use these services from anywhere. SaaS is becoming an increasingly prevalent delivery model as underlying technologies that support Web services and service-oriented architecture (SOA) mature and new developmental approaches become popular.

A good way to understand the SaaS model is by taking an example of a bank, which protects the

confidentiality of each customer while providing service that is reliable and secure- on a enormous scale. A bank's customer all use the same financial systems and technology without worrying about anyone accessing their personal information without authorization.

The key characteristics of SaaS model include:
- Multi-tenant architecture
- Easy customization
- Better access
- Open integration protocol
- Collaborative (and 'social') functionality
- Scalability

Examples of SaaS service providers are:
- *Salesforce.com:* It is a cloud computing and social enterprise Software-as-a-Service provider which is well known for its Salesforce customer relationship management (CRM) product, which is composed of Sales Cloud, Service Cloud, Marketing Cloud, Force.com, Chatter and work.com.[7]
- *Google Apps:* It is a productivity suite of Google applications that is free for anyone to use and brings together essential services to help your business. All you have to do is log in to google.com and you instantly have access to a powerful documents creator, email service (Gmail), play store, maps, calendar, news, drive etc.

- *Oracle on demand:* Oracle on demand's SaaS applications such as Oracle CRM on demand, Oracle Beehive on demand, and Oracle Sourcing on demand quickly deliver the business results you need while eliminating start-up costs and reducing your IT budget to a predictable monthly fee.
- *FreshBooks:* It is a cloud based accounting software service designed for owners of the types of small client-service businesses that send invoices to clients and get paid for their time and expertise. By logging in to its account, you can generate reports for your accounting department, access to your account history, review open invoices, consent estimates, and more.
- *Dropbox:* It is a simple cloud-based storage service that allows users to access their files from anyplace from just about any device. The service can be used on Smartphone, computers and tablets.

In the SaaS model, the application is provided to the client through a thin client interface (a browser, usually) and everything from the application down to the infrastructure is the responsibility of the vendor. The responsibility of the customer begins and ends with entering and administrating its data and user interaction.

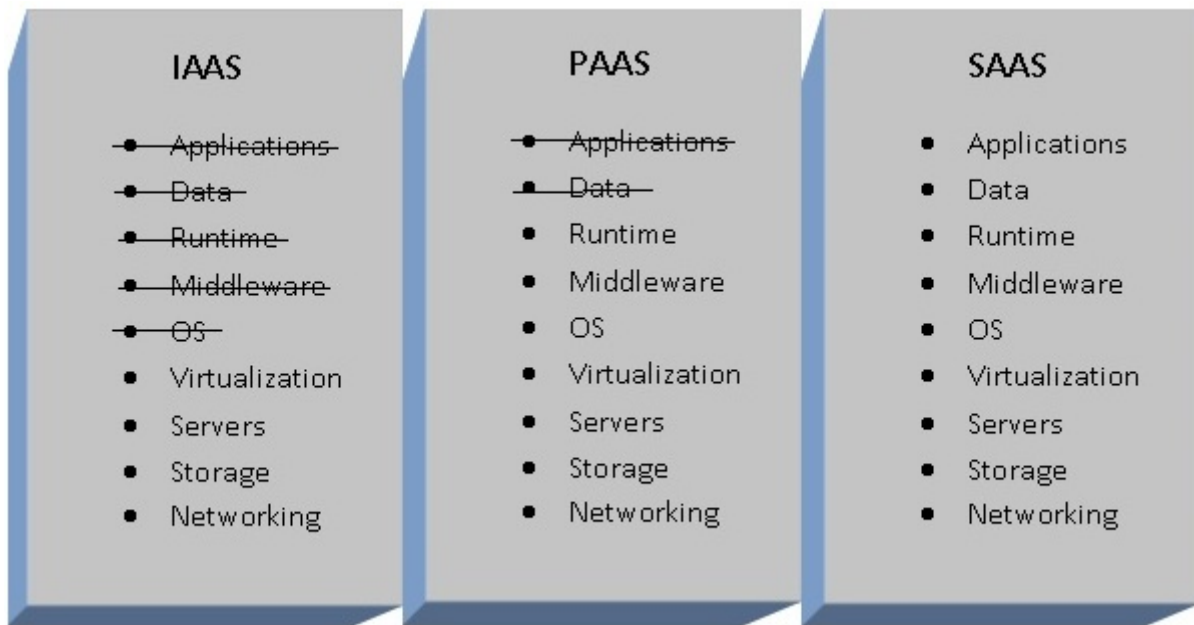The fundamental differences between the three services are illustrated in the following figure:

Figure 1:

II. EXAMPLE ANALYSIS
Presently, the industrial world already had very many companies to gather in the cloud calculates under this kind of new computation concept, proposed separately own in view of the cloud computing understanding, achieved the above goal with the different technology, mainly including under important cloud computing realization system.

3.1 Amazon EC2:
The Amazon Elastic Compute Cloud (EC2) is a Web-based service that allows business subscribers to run application programs in the Amazon.com computing environment. It provides scalable computing capacity and eliminates your need to invest in hardware upfront, so you can develop and deploy applications faster. Amazon EC2 facilitates with launching of as many or as few virtual servers as you need, configuring security and networking, and managing storage

To use the EC2, a subscriber creates an Amazon Machine Image (AMI) containing the operating system, application program and configuration settings. Then the Amazon Machine Image is

uploaded to the Amazon Simple Storage Service (Amazon S3) and registered with Amazon EC2, creating a so-called AMI Identifier (AMI ID). Once this has been done, the subscriber can request virtual machines on an as-desired basis. Capacity can be increased or decreased in real time from as few as one to more than 1000 virtual machines concurrently. Billing takes place according to the computing and network resources consumed. You can add or subtract servers elastically as needed; cluster, replicate, and load balance servers; and locate your different servers in different data centers or "zones" throughout the world to provide fault tolerance. The term 'elastic' refers to the ability to size your capacity quickly as needed.

Amazon EC2 has the following features:

- *Instances:* Virtual computing environments
- *AMIs:* Preconfigured templates for your instances that consists of the bits you need for your server
- *Instance types:* Various configurations of memory, CPU, networking capacity and storage for your instances
- *Key pairs:* Secure login information for your instance using key pairs. You store the private key in a secure place and AWS stores the public key
- *Instance store volumes:* Storage volumes for temporary data that's deleted when you stop or terminate your instance
- *Amazon Elastic Block Store (EBS) volumes:* Persistent storage volume for your data
- *Availability zones:* Multiple physical location for your resources
- *Security groups:* A firewall that permits you to state the source IP ranges, protocols and ports that can reach your instance using security groups
- *Tags:* Metadata that you can create and assign to your Amazon EC2 resources
- *Amazon Virtual Private Cloud:* Amazon VPC lets you provision a logically isolated section of the Amazon Web Services (AWS) cloud where you can launch AWS resources in a virtual network that you define. You have full control over your virtual networking environment, including construction of subnets, configuration of route tables and network gateways and selection of your own IP address range.

Benefits:

- Easy to use
- Secure
- Inexpensive
- Completely Controlled
- intended for use with other Amazon Web Services
- Flexible Cloud Hosting Services
- Elastic Web-scale Computing
- Reliable

The pricing of the AMIs depends on the operating system used, which data center the AMI is located in, and the amount of time that the AMI runs. Rates are quoted based on an hourly rate. The charges are applied additionally on:

- The amount of data transferred
- Whether elastic IP addresses are assigned
- Your virtual private server's use of Amazon EBS
- Whether you use Elastic Load Balancing for two or more servers
- Other features

In addition to providing the flexibility to easily choose the number, the size and the configuration of the compute instances you need for your application, Amazon EC2 provides customers three different pricing models that give you the flexibility to optimize the costs:[5]

- *On-Demand Instances:* lets you pay for compute capacity by the hourly rate with no long term commitments. You can increase or decrease the compute capacity depending on the demands of your application and only pay the specified hourly rate for the instances you use. On-Demand Instances are recommended for the users that want the low cost and flexibility of Amazon EC2 without any long term commitment, for the applications with short term, spiky, or unpredictable workloads that cannot be interrupted and for the applications being developed or tested on Amazon EC2 for the first time.[5]
- *Reserved Instances:* lets you make a low, one-time, upfront payment for an instance; reserve it for a one or three year term, and a significantly lower hourly rate for that instance. You are assured that your Reserved Instance will always be available for the operating system and Availability Zone in which you purchased it. Reserved Instances are recommended for applications with steady state or predictable usage, for the applications that require reserved capacity, including disaster recovery and for the users able to make upfront payments to reduce their total computing costs even further.[5]
- *Spot Instance:* provide the ability for customers to purchase compute capacity with no upfront commitment and at hourly rates usually lower than the On-Demand rate. Spot Instances allow you to specify the maximum hourly price that you are willing to pay for the running of the particular instance. Amazon EC2 sets a Spot Price for each instance type in each Availability Zone, which is the price all customers will pay to run a Spot Instance for that given period. The Spot Price fluctuates based on the supply and demand for the instances, but customers will never pay more than the maximum price they have specified. If the Spot Price moves higher than a customer's maximum price, the customer's instance will be shut down by Amazon EC2. Spot Instances are recommended for the applications that have flexible start and end

times, for the applications that are only feasible at very low compute prices and for the users with urgent computing needs for large amounts of additional capacity.[5]

3.2 Google App Engine:

Google App Engine (GAE) is a Platform-as-a-Service (PaaS) cloud-based Web hosting service on Google's infrastructure. This service allows developers to build and deploy Web applications and have Google manage all the infrastructure needs, such as monitoring, failover, clustering, machine instance management, and so forth. Just download the SDK and start building immediately. For an application to run on GAE, it must comply with Google's platform standards, which narrows the range of applications that can be run and severely limits those applications' portability.

GAE supports apps written in a variety of programming languages: [6]

• *Java:* You can build your application using App Engine's runtime environment and standard java technologies. App Engine runs your Java Web application using a Java 7 JVM in a safe sandboxed environment. It uses the Java Servlet standard for web application. The secured sandboxed environment isolates your application for service and security. Any bytecode that operates within the sandbox restrictions can be executed by JVM. App Engine for Java makes it especially easy to develop and deploy world-class web applications using Google Web Toolkit (GWT).

• *Python:* App Engine features a fast python interpreter and standard python libraries. App Engine executes your Python application code using the pre-loaded Python interpreter in a safe sandboxed environment. App engine includes web application framework, called webapp2, to make it easy to get started. Mature third party frameworks, such as Django, works well with App engine for larger applications.

• *PHP:* App Engine uses Google's cloud platform services under the hood when you call standard PHP functions. The PHP runtime executes your application code in a sandboxed PHP 5.4 environment. App Engine runs its own web server, which can be configured using an app.yaml file that's uploaded with your code. This file specifies how incoming HTTP requests to your application are directed to PHP scripts. The PHP runtime provides a built-in Google Cloud Storage Stream Wrapper that allows you to use many of the standard PHP file system functions to access Google Cloud storage.[6]

• *Go:* App Engine features a Go runtime environment that runs natively compiled Go code. It runs Go version 1.2. The SDK provides an interface similar to standard Go http package and includes Go compiler and standard library.

To encourage developers to write applications using GAE, Google allows for free application development and deployment up to a level of certain level of resource consumption. GAE uses following pricing scheme:

• CPU time measured in CPU hours is $0.10 per hour

• Stored data measured in GB per month is $0.15 per GB/month

• Incoming bandwidth measured in GB is $0.10 per GB

• Outgoing bandwidth measured in GB is $0.12 per GB

• Recipients e-mailed is $0.0001 per recipient

Applications running in GAE are isolated from the underlying operating system, which Google describes as running in a sandbox. This allows GAE to optimize the system so Web requests can be matched to the current traffic load. Applications are limited in that they can only read files; they cannot write to the file system directly. To access data, an application must use data stored in the memcache, the datastore or some other persistent service. GAE has a distributed datastore system that supports queries and transactions. The App Engine relies on Google accounts API for user authentication which eliminates the need for an application to develop its own authentication system.

3.3 *Google Apps:*

Google Apps are one of the leading cloud-hosted office productivity/collaboration suite which offer hosted email and calendaring option, web-based document editing plus cloud-based storage – and for business users, the ability to communicate and work collaboratively. Switching to Google Apps is both quick and easy. Pricing is probably the biggest reason to consider Google Apps. Focusing on email alone, not many IT organizations can internal deliver the same service for that price. Many more would find it complicated to even come to a cost. There are two types of pricing plans:

• Google Apps for business flexible plan or Monthly pricing: $2.8 per user per month. Add user account anytime for $2.8 user account/month. You will be billed at the end of each month and only pay for the number of users you had in that month.

• Google Apps for business annual plan or Yearly pricing: $28 per user per year. You commit to a set of accounts for one year at a discounted rate of $28/user account/year.

A browser is all you really need to use Google Apps and you can use any browser you like such as Firefox, Chrome or Internet Explorer etc. Indeed, one of the big selling points of Google Apps is how easy it is to access regardless of what you happen to be using- Windows PC, Chromebook, Apple Mac, Apple iOS or Android device.

Benefits of Google Apps:

- *Collaboration:* It works more speedily and efficiently, with Google Docs shared with a small number of clicks and all your team members have access to the accurate version of any document, presentation or spreadsheet. Everyone can open and make changes simultaneously.

- *Support:* you don't require spending much time in managing IT infrastructure. You always have access to the newest versions of software. Google provides support 24 hours every day of the year, in your language, and publishes in real time the status of their service.

- *Innovation:* Forget wait years to get a product upgrades. Google Apps is updated whenever you log to provide you the new features as they become available.

- *Mobility:* With Google Apps, all your work is automatically saved to the cloud. You will have access to email, documents, calendar and websites, and you can work safely, no matter what device you use or where you are. This means all the people with whom you work can be productive from anywhere place, using any device with Internet connection.

The features of Google Apps include:

- *Google Docs:* As the keystone of Google Apps, Google Docs make possible real-time document sharing and collaboration. It has long provided word processing and spreadsheet functionality, working with .doc, .rtf, .xls and .csv file formats. You can also collaborate on and share presentations with Google Docs using .ppt format.

- *Google Calendar:* Based on AJAX, Google calendar proposes a rich end-user experience, letting you make schedule meetings and appointments. It also provides cool Short Message Service (SMS) scheduling and notifications that can send text messages to mobile devices.

- *Gmail:* One of the stalwart applications in the Google Apps is Gmail. Google Apps premier edition allows 25GB storage for each Gmail account, and Google Apps provide tools for email routing and migration.

- *Google Talk:* Google's Instant Messaging component, Google Talk, is integrated with Gmail, letting you set off chat sessions from email messages. It also facilitates conversation logging, file transfer and voice communications using VoIP.

- *Google Gadgets:* A few of the existing Google Gadgets include a search function, a live TV feed, an MP3 player, a custom RSS reader and even Bejeweled and PacMan games.

- *Start Page:* The Google Apps Start Page is the User's entry point in to Google Apps. The Start Page can be personalized to provide your organization's logo and content.

- *Single Sign-on:* Google Apps allows single sign-on (SSO) capabilities with a variety of different LDAP –compatible authentication services by making use of Security Assertion Markup Language (SAML).

III. CONCLUSION

Cloud Computing is in constant development and many big organizations are going to implement Cloud Computing. By means of virtualization technology, Cloud Computing offers to end users a variety of services covering the entire service stack from the hardware to the application level. This paper examined current cloud computing services, presented the characteristics of Cloud computing, describes the Cloud Computing in present scenario of IT organizations and discusses the services offerings of some Cloud Service Providers. Amazon EC2 provides IaaS service which allows users to rent virtual computers on which to run their own computer applications. Google App Engine is a PaaS service provider for developing and hosting web applications in Google managed data centers. Google apps provide SaaS services with the suite of Google applications that brings together essential services to help your business. The advantages of Cloud Computing are satisfying Business requirements on demand, lowering the cost and energy-saving and improving the efficiency of resource management.

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