Cloud Computing Services – A comparison

Abstract

Recognized as one of the Top 10 technologies of 2010 by Gartner, Cloud Computing has generated a lot of interest and competition in the industry. With the emergence of new Cloud Providers, identifying one that best suits the business needs of an enterprise is a challenging and difficult task.

Adopting a Cloud Provider requires a detailed study of parameters like data security, SLA's and options that address the reduction of capital expenditure. In this White paper, Torry Harris Business Solutions carries out a high level comparison of the significant features delivered by key public cloud providers of the industry and key considerations that enterprises need to take into account while they embark on Cloud Computing.

An Overview

While there are many benefits of adopting the infrastructure, platforms & services offered by a Cloud Service provider, the applicability of these would depend on the nature & size of an enterprise. With an ever-growing list of cloud computing service providers , the decision for enterprises on how far to leverage computing platforms and with whom is a complex one.

Each of the Cloud providers have their own set of pricing, billing, flexibility, support and other important parameters in their model of computing the service.

The key considerations dealt in this White paper are from the perspective of Providers and vendors of Cloud Computing Services.

Choosing a Cloud provider

Figure 1: Key Cloud providers

The approach of choosing a cloud provider is a calculated and strategic one, which involves the analysis of who-provides-what. Some of the common questions that would surface while choosing a provider are mentioned below.

- How is a service outage defined?

- How is the customer credited or compensated for an outage?

- Is there an incident-reporting system?

- Are access/usage reports available?

- Is the data backed up — and if so, where are the backups stored?

- What happens to copies of the data if the relationship is terminated, or if the vendor fails?

- How do you extricate yourself from the relationship if there is a dispute?

- How safe is the data?

- What level of account access is present and how is access controlled?

- What is the billing model?

- Are there add on cost or fees for support?

- Are charges based upon traffic, usage or storage limits?

The nature of cloud providers that are considered for the comparison in this white paper are as follows:

Iaas (Infrastructure as a service) – services catering to the hardware, data storage, networking and bandwidth.

Paas (Platform as a service) – services catering to software and development tools.

Cloud Providers – A comparison table

The following table captures the comparison of significant features offered by key public cloud providers of the industry

	Amazon AWS	Google App Engine	Windows Azure	Force.com	Rackspace	GoGrid
Cloud Services	*Paas* *Iaas*	*Paas*	*Paas* *Iaas*	*Paas*	*Iaas*	*Iaas*
Features						

Platforms supported	**Operating systems**
	• Red Hat Enteprie Linux
	• Windows Server 2003/2008/2012
	• Oracle Enterprise Linux
	• OpenSolaris
	• OpenSUSE Linux
	• Ubuntu Linux
	• Fedora Gentoo Linux
	• Debian
	• CentOS
	• Amazon. -Linux
	• SUSE Linux.
	• FreeBSD
	
	Software
	• IBM DB2
	• IBM Informix Dynamic Server
	• Microsoft SQL Server Standard 2005
	• MySQL Enterprise
		Runtime
		• Java Runtime Environment
		• Python Runtime Environment
		• Go Runtime Environment
		Features
		• Integration with Google Accounts
		• URL Fetch
		• Mail
		• Memcache
		• Image Manipulation
		• Scheduled Tasks and Task Queues
		• XMPP
		• Blobstore (which supports objects up to 50MB in size)
		• Cloud SQL
		Software
		External software like AppServers Databases cannot be installed
		
		Hadoop
			Operating systems
			• Windows 7
			• Windows Server 2008
			• Windows Vista
			• System Center 2012
			• Windows Intune
			• Windows Azure
			
			Software
			Hadoop
				Software
				• Unlimited real-time database customizations
				• Programmable user interface.
				• Programmable cloud logic
				  Real-time workflow and approvals
				• Real-time web sites
				• Real-time mobile deployment
				  Integrated content library
				• Real-time analytics
				• Granular security and sharing
				• Hadoop
					Operating systems
					• Linux
					• Mac OS X
					• Windows
					Software
					Hadoop
						Operating systems
						• Windows server 2008
						• Windows server 2003
						• CentOS 5.1
						• CentOS 5.3
						• Redhat Linux 5.1
						• Redhat Linux 5.4
						
						Software
						Hadoop

	Amazon AWS	Google App Engine	Windows Azure	Force.com	Rackspace	GoGrid
	Condor • Open MPI • Apache HTTP • IIS/Asp.Net • IBM Lotus Web Content Management • IBM WebSphere Portal Server • IBM sMash • JBoss Enterprise Application Platform • Ruby on Rails • IBM WebSphere Application Server • Java Application Server • Oracle WebLogic • Wowza Media Server Pro • Windows Media Server • Zeus software • Oracle Database 11g • Hadoop					
Languages Supported	Any	• Java • Python • Go	• VB.NET • C# • PHP • BASIC • JAVA • Python • .NET • Node.js	• Apex • Java • VB.Net • Perl • PHP • Python • Ruby • Windows language including VBA	• . Net • Python • PHP • Java • Ruby	• Java • PHP • Perl • C# • Python • Ruby

	Amazon AWS	Google App Engine	Windows Azure	Force.com	Rackspace	GoGrid
				s-controls and the AJAX Toolkit		
Cloud services and tools	• Amazon CloudWatch API Tools • Auto Scaling API Tools • Elastic Load Balancing API Tools • AWS Toolkit for Eclipse • AWS Management Console • Amazon EC2 API Tools • Amazon EC2 AMI Tools • Elasticfox Firefox Extension for Amazon EC2 • JavaScript Scratchpad for Amazon EC2 • Amazon S3 Authentication Tool for Curl • CloudBerry Explorer for Amazon S3 and CloudFront • Manager for Amazon CloudFront • Firefox Organizer for Amazon S3 and Amazon CloudFront (S3Fox) • AWSzone.com • JavaScript Scratchpad for Amazon SQS • Amazon Mechanical Turk Developer Sandbox • Amazon Mechanical Turk Command Line Tools	• Google Secure Data Connector • Private gadgets • Google Visualization API • Google Apps APIs • Google web toolkit • IDE support	• Windows Azure Platform Training Kit • Windows Azure Software Development Kit • Microsoft Visual Studio 2008 Service Pack 1 • Windows Azure platform AppFabric SDK V1.0 • Windows 7 Training Kit For Developers • Mobile SDK (Windows Phone 8 Android, iOS) • Service Bus EAI and EDI Labs SDK	• Apex Language Code Editor • Enhanced Metadata Support • Upgrade Wizard • Mobile SDK (Native, HTML5, Hybrid) • Chatter API • Visualforce Framework • Force.com IDE • Force.com Migration Tool	• Beanstalk – Hassle-free Subversion Hosting Attachment fu in Ruby • Cloudvox • Nautilus Cloud Files Plug-in by Chmouel Boudjnah • Paperclip-Cloudfiles • Olark Live Website Chat • Vanilla – Free Forum Hosting • Software Development Kit for Java, PHP, Python.	• GoGrid's Cloudcontrol Command Line Tool • Cloud Wizard's Open Source Cross Cloud Scripting Language • Mitch Denny's Windows PowerShell Snap-in • .NET API SDK

	Amazon AWS	Google App Engine	Windows Azure	Force.com	Rackspace	GoGrid
	LogAnalyzer for Amazon CloudFront • CloudBerry Explorer for Amazon S3 and CloudFront • Amazon CloudFront Authentication Tool for Curl • Firefox Organizer for Amazon S3 and Amazon CloudFront (S3Fox) • Manager for Amazon CloudFront • Amazon Elastic MapReduce Ruby Client • Amazon RDS Command Line Toolkit • JavaScript Scratchpad for Amazon FWS Outbound • JavaScript Scratchpad for Amazon FWS Inbound • Mobile SDK (Android, iOS) • Elastic Beanstalk API					

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
	Iaas					
Integrated DB supported	• MySql	• GAE doesn't support external databases ; it provides a data store of its own which can be accessed through standard JDO and JPA APIs.	• Sql azure	Not applicable	• MySQL, Microsoft SQL Oracle	• MSSQL 2008 Workgroup (64-bit) - Microsoft SQL Server Workgroup Edition 2008 • MSSQL 2008 Standard (64-bit) - Microsoft SQL Server Standard 2008 • MSSQL 2005 Standard (32-bit) - Microsoft SQL Server 2005 Standard Edition • MSSQL 2005 Workgroup (32-bit) - Microsoft SQL Server 2005 Workgroup Edition
Maximum limits	• Amazon S3 -No limit on the number of objects stored in a bucket. -Each AWS account can own up to 100 buckets at a time. • Amazon EC2 [Elastic Block storage] - Volume sizes ranging from 1GB to 1TB • (20 TB/account limit while in beta)	• Automatic scaling is built in with App Engine • No mattar how many users you have or how much data your application stores, App Engine can scale to meet your needs	• Blobs: There are two types of blobs that can be stored in Windows Azure Storage, block and page blobs. A single block blob can be up to 200GB in size. Page blobs, can be up to 1TB in size A single storage account can contain up to 100TB of blobs.	In the unlimited edition, • Number of sites- 25 • [Features available more for additional fee] • 2,000 Database objects total • storage - 120MB/user • API calls/day - 5,000/user, 5 million total • Page views/month - 1,000,000 • [Features with rolling 24-hour time period] • Sites bandwidth/day - 40GB • Sites page generation time/day [Rolling 24-hour time period] -	• Infinite scalability	• Horizontal server scaling—use a GSI to rapidly deploy new servers to meet sudden spikes in demand. Delete the servers when demand drops, paying only for the resources used. • Vertical server scaling— scale RAM by deploying a GSI to a new server with a higher RAM allotment and then deleting the old server with insufficient RAM. • Server Parking—bundle and park a server in

				60 server hours		GoGrid's Cloud Storage for only $0.15 -- $3.00/month. This is ideal for users that don't want to pay for an entire month of service for a server used only a few days per month.
Support for human-only tasks	Amazon Mechanical Turk	Not available	Not available	Not available	Not available	Not available

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Support						
Service Level Agreements availability	• Amazon S3 - available with a Monthly Uptime Percentage of at least 99.9% during any monthly billing cycle • Amazon EC2 - available with an Annual Uptime Percentage of at least 99.95% during the Service Year	• 100% Uptime	• 99.9% Uptime	• 99.9+ percent uptime	• 100% Network Uptime Guarantee • 1-Hour Hardware Replacement Guarantee • 2-Hour Commencement of Onsite Data Restores	• 100% Uptime , which means • Network Outage: None • Packet loss < 0.1% • Latency < 5ms • Jitter < 0.5ms • Maximum Jitter: 10 milliseconds within any 15-minute period.
Support Pricing Policy	• Premium Support - Silver and Gold support available and are charged accordingly	• Free Support is available 24x7x365 from on-site cloud hosting experts	• Developer support is charged on a per incident basis. However, you are able to utilize support incidents hat you already have from existing programs such as the Microsoft Developer Network (MSDN) and the Microsoft Partner Network (MPN).	• Basic Support, Premier Support, Premier Support with Administration. Developer Support is only available for a fee, on a per-case basis.	• 24x7x365 Live Support & Expertise [Pricing details not mentioned in the website]	• FREE 24/7 Phone Support Free 24/7 Premium Support

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Support response time	**Severity level vs response time** • Urgent - 1 hour (available for Gold subscribers only) • High - 4 business hours • Normal - 1 business day • Low - 2 business days	Not available	Not available	**Support type vs response time** • Basic Support - 2 business days • Premier Support - 2 hours • Premier Support with Administration - 2 hours	24 x 7 x 365 online live chat and toll free phone support backed by Fanatical Support	EMERGENCY Cases - 30 minutes The following are the EMERGENCY categories: • Server down Packet loss • Routing issue All other Cases - 120 minutes
Service credit for an outage	**Monthly up-time percentage vs Service credit percentage** **Amazon S3** Equal to or greater than 99% but less than 99.9% - 10% less than 99% - 25% **Amazon EC2** If the Annual Uptime Percentage for a customer drops below 99.95% for the Service Year, that customer is eligible to receive a Service Credit equal to 10% of their bill (excluding one-time payments made for Reserved Instances) for the Eligible Credit Period	Not available	Microsoft will provide a 10 percent credit if compute connectivity falls below 99.95 percent uptime; a 10 percent credit if role-instance uptime or storage falls below 99.9 percent uptime. If it falls below 99 percent availability across anything, 25 percent credit will be provided	Not available	Not available	A "10,000% Service Credit" is a credit equivalent to one hundred (100) times Customer's fees for the impacted Service feature for the duration of the Failure

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Incidence notification approach	Amazon Web Services publishes the most up-to-the-minute information on service availability in Service Health Dashboard Amazon Web Services keeps a running log of all service interruptions	The user should subscribe to this announcement-only list to receive updates on system outages, maintenance periods, and other services disruptions. Go to the group: google-appengine-downtime-notify Subscribe via email: google-appengine-downtime-notify-subscribe@googlegroups.com Apart from the above, when there is a scheduled down time, GAE puts the data store in read-only mode. During that time any attempt to write data to the data store will throw an exception which can be caught in the application to show a user friendly message to the user	Microsoft may send periodic e-mails informing you of technical service issues related to a product or service you requested	Trust Site -trust.Salesforce.Com-for Incident Communications	Incident reports are mostly proprietary information between us and Rackspace customers	Not available
Access /usage reports	Amazon Cloudwatch	The Administrative console provides the following details, view access data and error logs, and analyze traffic browse the application's data store and manage indexes view the status of the application's scheduled tasks	"Dallas" Features allows users to get detailed access report containing the services/data assets that were accessed, grouped by date and by account key	Force.com Sites Usage Reporting Package gives you reports and a dashboard to analyze usage of the Force.com Sites Portal health check reports show sensitive administrative and user permissions, object permissions, field-level security, organization-wide default settings, and custom sharing rules	The Rackspace Cloud Control Panel provides specific usage metrics	GoGrid CDN (Content Delivery Network) provides, • Basic Reporting Advanced Reporting and Analytics • Real-Time Reporting Dashboard
Community News/Blogs	http://aws.typepad.com	http://code.google.com/appengine/community.html http://googleappengine.blogspot.com	http://blogs.technet.com/microsoft_blog/archive/tags/Azure/default.aspx	http://sites.force.com/blogs/ideaHome?c=09a30000000D9xo	http://www.rackspace.com/blog/	http://blog.gogrid.com/

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
	Pricing					
Service/Res pricing	**Amazon S3** - Storage Used / Data Transfer In or Data Transfer Out/PUT, COPY, POST, LIST or GET request (No charge for delete requests) **Amazon SimpleDB** - measures the machine utilization of each request and charges based on the amount of machine capacity used to complete the particular request (SELECT, GET, PUT, etc.), normalized to the hourly capacity of a circa 2007 1.7 GHz Xeon processor **Amazon CloudFront** - Charged based on the amount of data transfer out and the number of GET requests **Amazon Elastic MapReduce** – Charged per instance-hour consumed for each instance type, from the time job flow began processing until it is terminated. Each partial instance-hour consumed will be billed as a full hour **Amazon SQS -** Based on data transferred –in‖ and –out ‖ of Amazon SQS/based on Amazon SQS requests which includes CreateQueue, ListQueues, DeleteQueue, SendMessage, ReceiveMessage, ChangeMessageVisibility, DeleteMessage, SetQueueAttributes, Get QueueAttributes	An efficient application on a free account can use up to 1GB of storage and up to 5 million page views a month. When you are ready for more, you can enable billing, set a maximum daily budget, and allocate your budget for each resource according to your needs. Billing is based on the following parameters – Outgoing Bandwidth, Incoming Bandwidth, CPU Time, CPUStored Data Recipient s Emailed.	Billing is based on Compute, Storage, Storage transactions and Data transfers	Force.com Free, Force.com Enterprise, Force.com Unlimited	Cloud Server (virtual instance) by the hour bandwidth In and Bandwidth Out, Amount of data backed up, Additional public IP addresses	Resources that are charged are for the RAM usage and data transfer from the server to the Internet. Each account has the ability to deploy up to 200 servers Cloud Storage billing begins after you exceed t he initial 10GB storage quota

	Add Permision, and Remove Permission **Amazon RDS -** Based on per DB Instance-hour consumed, from the time a DB Instance is launched until it is terminated. Each partial DB Instance-hour consumed will be billed as a full hour/based on provisioned storage and number of I/O requests /After the DB Instance is terminated, backup storage/ data transferred –in‖ and –out‖ of Amazon RDS **Amazon EC2 -** Pricing is per instance-hour consumed for each instance type, from the time an instance is launched until it is terminated. Each partial instance-hour consumed will be billed as a full hour. **Amazon FWS** - No charge					
Prepaid plan availability	Available	Available	Available	Available	Available	Available
Special Payment Services	Amazon Flexible Payments Service (Amazon FPS) and Amazon DevPay. AWS also provides consolidated Billing feature which lets you designate one AWS account as a paying account and a set of other accounts as linked accounts to form a simple one-level hierarchy	No special service available	No special service available	No special service available	No special service available	No special service available

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Data						
Choices of data hosting location	**United States of America** • North Virginia, • North California, • West Oregon, • South America- • Sao Paul **Asia Pacific** • Singapore, • Tokyo, • Sydney **Europe** • Ireland	Not available	**Asia** • Hong Kong (East), • Singapore(south east), **Europe** • Ireland (North), • Netherlands(West) **United States of America** • Illinois(North Central), • Texas(South Central), • Virginia,(East), • California,(West) Information that is collected by or sent to Microsoft may be stored and processed in the United States or any other country in which Microsoft or its affiliates, subsidiaries, or service providers maintain facilities]	Not available	**North America** • Grapevine, • Richardson, • Chicago, • Herndon, • Ashburn **Europe** • London UK, • Slough UK **Asia** • Hong Kong	• San Francisco • Netherlands, • California • Virginia, • Amsterdam, • Ashburn

Data backup	Amazon RDS automatically patches the database software and backs up the database, storing the backups for a user-defined retention period	The user is solely responsible for securing and backing up the Application and any Content.	The user is solely responsible for securing and backing up the data.	• All networking components, SSL accelerators, load balancers, Web servers, and application servers are configured in a redundant configuration.	Although the Rackspace Cloud service may be used as a backup service, you agree that you will maintain at least one additional current copy of your programs and data stored on the Rackspace Cloud system somewhere other than on the Rackspace Cloud system.	Whether or not Customer's Signup calls on GoGrid to maintain back-ups, Customer will have to keep a back-up copy of all data hosted by GoGrid.
	Amazon AWS may delete, without liability of any kind, any of the Amazon SQS Content that sits in a queue or any queue that remains inactive for more than the number of days specified in the user documentation.	Google has no responsibility or liability for the deletion or failure to store any Content and other communications maintained or transmitted through use of the Service.		• All customer data is stored on a primary database server that is clustered with a backup database server for redundancy		
	Amazon SimpleDB, in during the previous six (6) months you if there are no incurred fees for SimpleDB and have registered no usage of the Amazon SimpleDB Content, Amazon AWS may delete, without liability of any kind, the Amazon SimpleDB Content upon thirty (30) days prior notice to you.			• All customer data is stored on disk storage that is mirrored across different storage cabinets and controllers		
	Amazon S3 versioning provides an additional layer of protection for your S3 objects. You can easily recover from unintended			• All customer data, up to the last committed transaction, is automatically backed up to a primary tape library on a nightly basis		
				• Backup tapes are immediately cloned to a second tape library to verify their integrity, and the clones are moved to secure, fire-resistant, off-site storage on		

	user errors or application failures. You can also use Versioning for data retention and archiving. Once you have enabled Versioning for a particular S3 bucket, any operation that would have overwritten an S3 object (PUT, POST, COPY, and DELETE) retains the old version of the object.			a regular basis. Disaster recovery plans are in place.		
Data after termination	Amazon will not take any action to intentionally erase any of the data stored on the Services for a period of thirty (30) days after the effective date of termination Post termination retrieval of data stored on the Services will be conditioned on the payment of Service data storage charges for the period following termination, payment in full of any other amounts due Amazon, and the compliance with terms and conditions Amazon may establish with respect to such data retrieval	If Google suspends or terminates the use of the Service with cause (or if the user voluntarily discontinues the use of the Service), the user will have access to, and the ability to export, the Content for a period of ninety (90) days following such suspension or termination. Fees will continue to be assessed for usage of the Service in excess of any portion of the Fee Threshold during the 90 day period	Upon expiration or termination of your online service subscription, you must contact Microsoft and tell whether to: (1)disable your account and then delete your subscriber data; or (2) Retain your subscriber data in a limited function account for at least 90 days after expiration or termination of your subscription (the –retention period‖) so that you may extract the data. If you indicate (1), you will not be able to extract your subscriber data from your account. If you indicate (2), you will reimburse Microsoft for any applicable costs. If you do not indicate (1) or (2), Microsoft will retain your subscriber data in accordance with (2). Following the expiration of the retention period, Microsoft will disable your account and then delete your subscriber data.	Upon a request made by you within 30 days after the effective date of termination of Your Force.com Free Edition service, Force.com will make available to You for download a file of Your Data in comma separated value (.csv) format along with attachments in their native format 30-days after termination, Force.com shall have no obligation to maintain or provide any of Your Data and shall thereafter, unless legally prohibited, delete all of Your Data in the systems or otherwise in Force.com's possession or under its control.	You will not have access to your data stored on the Rackspace Cloud system during a suspension or following termination.	Not available

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Account						
Notice period before termination	Free Services - Notice period will be provided to via the email address provided to during registration for the Services Paid Services (other than Amazon FPS and Amazon DevPay) - sixty (60) days' advance notice Amazon FPS and Amazon DevPay - Notice period will be provided to via the email address provided to during registration for the Services	You may discontinue your use of the Service at any time. Google may, at any time, terminate your use of the Service if (A) you have breached any provision of the Terms (or have acted in manner that clearly shows that you do not intend to, or are unable to comply with the provisions of the Terms); or (B) Google is required to do so by law (for example, due to a change to the law governing the provision of the Service); or (C) the Service relies on data or services provided by a third party partner and the relationship with such partner (i) has expired or been terminated or (ii) requires Google to change the way Google provides the data or services through the Service; or (D) providing the Service could create a substantial economic burden as determined by Google in its reasonable good faith judgment; or (E) providing the Service could create a security risk or material technical burden as determined by Google in its reasonable good faith judgment.	There is no notice Period before termination or suspension, but upon expiration or termination of your online service subscription, you can contact Microsoft and tell whether to: (1) disable your account and then delete your subscriber data; or (2) retain your subscriber data in a limited function account for at least 90 days after expiration or termination of your subscription	Salesforce may terminate Your Force.com service at any time without cause upon 60 days' written notice to You, or (b) upon 7 days' written notice to You of a material breach of the Agreement if such breach remains uncured at the expiration of such period	Rackspace may terminate the Agreement for breach on written notice You may terminate the Agreement for breach on written notice if: (i) Rackspace materially fails to provide the Services as agreed and do not remedy that failure within five (5) days of your written notice describing the failure, or (ii) Rackspace materially fails to meet any other obligation stated in the Agreement and do not remedy that failure within thirty (30) days of your written notice describing the failure.	GoGrid will provide 30 days advanced written notice of any termination for convenience. Upon termination for convenience, GoGrid will refund any amounts prepaid for Service not yet provided.
New user trail credentials	Amazon SimpleDB users pay no charges on the first 25 Machine Hours, 1 GB of Storage, and 1 GB of Data Transfer Out consumed every month	An efficient application on a free account can use up to 1GB of storage and up to 5 million page views a month	During Community Technology Preview (CTP), services included in Windows Azure will be available without charge - subject to certain limits. Once Windows Azure is launched for commercial use, it will be priced and licensed through both packaged offers, and the consumption.	Force.com free edition	Not available	• Included free with every account, • f5 Hardware Load Balancing • 10GB of Cloud Storage per month

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Security						
Data security	Amazon Elastic Compute Cloud (EC2) provides Host Operating System, Guest operating system and a complete firewall solution. It also provides a way to encrypt the API calls in transit with SSL to maintain confidentiality. AWS network provides significant protection and also enables customer to implement further protection Amazon Simple Storage Service (Amazon S3): Amazon S3 is accessible via SSL encrypted endpoints. Data stored within Amazon S3 is not encrypted at rest by AWS. However, users can encrypt their data before it is uploaded to Amazon S3 so that the data cannot be accessed or tampered with by unauthorized parties. SimpleDB APIs provide domain-level controls that only permit authenticated access by domain creator, therefore the customer maintains full control over who has access to their data. SimpleDB access can be granted based on an AWS Account ID. SimpleDB is accessible via SSL-encrypted endpoints.	App Engine runs Java applications using the Java 6 virtual machine (JVM). The JVM runs in a secured "sandbox" environment to isolate your application for service and security. The JVM can execute any Java bytecode that operates within the sandbox restrictions The Python interpreter also runs in a secured "sandbox" environment to isolate your application for service and security Go compiler runs inside a secured "sandbox" environment.	• Filtering Routers • Firewalls • Cryptographic Protection of Messages • Software Security Patch Management • centralized monitoring, correlation, and analysis systems • Network Segmentation • Service Administration Access Physical Security • limited number of Microsoft personnel may access customer information to respond to support requests and as part of incident response • Windows Azure compute provides optional sandboxing technology and mandatory sandboxing features that attempts to limit the harm to the infrastructure and all other customers from such bugs. • Windows Azure provides virtual machines to customers, giving them access to most of the same security options available in Windows Server. Updates to the software and configuration are	User authentication features such as SAML through to IP range restrictions on logons, session security and auditing. Security Addresses all layers, Physical Security Logical Network Security Host Security Transmission Level Security Database Security	Enterprise firewalls, email accounts include antivirus and spam protection. SSL capabilities available as an add on service	Provided via ServePath's secure infrastructure and telecom facility

			Controlled by SSL client certificates and protected by 128 bit encryption. • All Microsoft administrative operations are audited.			
Industry regulatory compliance	• SAS70 Type II • HIP AA • SOX	• US Safe Harbor	• US Safe Harbor	• US Safe Harbor • SAS 70 Type II and SysTrust Certified • ISO 27001 Certified	• US Safe Harbor	• SAS Type II • Safe Harbor Policy

	Amazon AWS	Google App Engine	Window Azure	Force.com	Rack Space	Go Grid
Others						
Virtualization Platform	EC2 uses modified Xen virtualization.	Not available	Modified Hyper-V hypervisor	Not available	Xen virtualization	Xen virtualization
Control Panel	Web based Interface	Web based Interface	Web based Interface	Web based Interface	Control panel is custom built by and for t he Rackspace Cloud service. management interfaces for the Cloud Sites, Cloud Servers and Cloud Files services as well as a web based file	Multi-server hosting control panel to manage servers, scale Web applications and networks
Age of Service	Since early 2006	Since July 2008	Since October 2008	Since 2007	Since 2006	March 2008

Table: Cloud providers' comparison

Disclaimer

The comparison table has been compiled based on latest information available on the websites of cloud providers.The contents are subject to change with time, as and when the cloud providers come up with new innovations and features.

Following are the links to the agreement and policies of the cloud providers compared in this paper.

http://aws.amazon.com/agreement - Dated March 15, 2012

http://www.google.com/accounts/TOS - Dated March 1, 2012

http://www.microsoft.com/about/legal/en/us/IntellectualProperty/Copyright/Default.aspx - Dated January 26, 2012

http://privacy.microsoft.com/en-us/fullnotice.mspx - Dated April, 2012

http://www.salesforce.com/company/privacy/ - Dated June 8, 2012

http://www.rackspace.com/information/legal/privacystatement.php - Dated February 22, 2010

http://www.gogrid.com/legal/terms-service.php,http://www.gogrid.com/legal/privacy-policy.php - Dated August 25, 2010