

REVIEW: SERVICES AND APPLICATIONS OF CLOUD COMPUTING

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ABSTRACT- The rapid growth in the internet technology and infrastructure has improved the way to develop and access the application. Cloud computing offers many benefits to organizations. It is very popular and IT giants as Google, Amazon, Microsoft, and IBM have started cloud computing infrastructure. Also, many applications are moving to the interactive web-based development. Cloud computing setting provides a good flexibility and availability of computing resources at a lower price. This emerging technology opens a brand new era of e-services in numerous disciplines.

This Paper explores cloud computing services and applications with examples of cloud services) like Amazon EC2, Salesforce.com, GoGrid and also gives innovative applications for cloud computing in education, research, and healthcare.

1 INTRODUCTION

CLOUD computing as defined by NIST, is a model for enabling always on-convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction [1]. Cloud computing is a construct that allows you to access applications that actually reside at a location other than your computer or other internet connected devices like data center.

Cloud computing is the convergence of several concepts from resource pooling, virtualization, dynamic provisioning, utility computing, and on-demand deployment, Internet delivery of services, to enable a more flexible approach to deploying and scaling applications. Applications are easily deployed where the underlying technology components can expand and contract with the flow of the business cycle [2]. Cloud computing is a new method to add capability to a computer without licensing new software, investing in new hardware or infrastructure or training new personnel. Applications are purchased and run over the network listed users' desktop [3].

Most of the current clouds are built on top of modern data centers. It incorporates Infrastructure as a Service (IaaS), Platform as a Service (PaaS), and Software as a Service (SaaS), and provides these services like utilities, so the end users are billed by how much they used [4]. Cloud Computing includes IT resource consolidation Web-based applications, and mobile users who access browser-based application on mobile PC's, PDAs an smart phones. Deployment models include Public cloud, Private cloud, Hybrid cloud and Community cloud. Public clouds like Amazon AWS, Google App Engine, and Microsoft Azure

offer infrastructure and platforms as services.

This new environment implies nice flexibility and availableness of computing resources at totally different levels of abstraction at a lower cost. Cloud Service Suppliers (CSPs) (e.g., Google, Microsoft, Amazon) area unit vendors who agency lease to their customers cloud computing resources and services that area unit dynamically used supported customer's demand according to a precise business model [5].

The characteristics of cloud as listed by NIST are On-demand self-service, broad network access, resource pooling, rapid elasticity and measured service. In the current scenario every enterprise wants to implement cloud computing to fulfill their computing needs and social responsibility.

Although cloud computing has been widely adopted by the industry, still there are many research issues to be fully addressed like fault tolerance, workflow scheduling, workflow management, security etc [6].

2 CLOUD COMPUTING SERVICES

Cloud computing provides three services where the term services is the concept of being able to use reusable, fine grained components across a vendor's network.[7]. In a marketplace of IT utilities, a good range of cloud services could also be offered. Cloud services are encapsulated, have Application Programming Interfaces (APIs), and are accessible over the network. Cloud Services represent any kind of IT capability that is provided by Cloud Service provider (CSP) to Cloud Service Customers (CSCs). Typical classes of cloud services are Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), or Business process as a Service. In distinction to traditional IT services, cloud services have

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attributes related to cloud computing, such as a pay-per-use model, self-service usage, flexible scaling, and shared underlying IT resources [8].

2.1 Infrastructure as a Service (IaaS)

It provides service such as memory, CPU and storage. The customer can deploy and run software. It reduces hardware cost. That means customer use a virtualized server and running software on it. Amazon EC2, GoGrid are the best example of IaaS for storage and maintaining virtual servers.

i. Amazon EC2

It is a web service that provides resizable computing capacity in the cloud. Amazon EC2's simple web service interface allows business to obtain and configure capacity with minimal friction. It provides control of computing resources and lets organizations run on Amazon's computing environment. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. Eli Lilly and Company is one company that has moved to Amazon EC2 as part of their IT operations.

Windows and SQL server support for Amazon EC2. In this customers can employ Amazon EC2 running windows server or SQL server with all the benefits of Amazon EC2. Amazon EC2 provides an environment for deploying ASP.NET web sites, high performance computing clusters, media transcoding solutions, and many other windows based applications.

Amazon EC2 running Windows Server with SQL Server offers the flexibility to run a database server for as much or as little time as you need. Several versions of Microsoft SQL Server are:

- *SQL Server Express Edition 2005, 2008, 2008 R2, and 2012*

It is an entry-level database product that enables small database applications. The maximum size of a database supported is 10 GB. This product is offered at no-additional cost over the base Microsoft Windows Server instance price on EC2.

- *SQL Server Web Edition 2008 R2 and 2012*

A mid-level database product that is restricted to Web facing applications and available at a low cost over the base Windows Server instance price on EC2. This product offers unlimited database size, easy manageability, and is suitable for small to large-scale Web applications.

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- *SQL Server Standard Edition 2005, 2008, 2008 R2, and 2012*

It is a higher-end database product that allows unrestricted use for building enterprise-scale Windows-based applications, and massively scalable websites. SQL Server Standard includes support for Mirroring, and is suitable for applications with High Availability need [7].

2.1.2 GoGrid

GoGrid is a service provider of windows and Linux cloud-based server hosting, and offers 32-bit and 64-bit editions of Windows Server 2008 within its cloud computing infrastructure. GoGrid becomes one of the first Infrastructure as a Service (IaaS), provides to offer Windows Server 2008 in the cloud. The windows Server 2008 operating system from Microsoft offers increased server stability, manageability, and security over previous offers increased server stability, manageability, and security over previous versions of Windows Server.

GoGrid enables system administrators to quickly and easily create, deploy, load-balance, and manage Windows and Linux cloud servers within minutes. GoGrid users select the desired operating system and then choose preconfigured templates in order to minimize time to deploy. Preconfigurations include:

- Windows Server 2008 Standard with Internet Services 7.0 (IIS 7)
- Windows Server 2008 Standard with IIS 7 and SQL Server 2005 Express Edition
- Windows Server 2008 standard with IIS 7, SQL Server 2005 Express Edition, and ASP.NET [7]

2.2 Platform as a Service (PaaS)

Platform as a Service supplies all the resources required to build applications and services completely from the internet, without having to download or install software. Platform as a Service include application design, development, testing, deployment and hosting. Other services include team collaboration, web service integration, database integration, security, scalability, storage, state management and versioning. Google App Engine, Loadstorm are the instances of PaaS for running Web applications and testing their performance. Rightscale and Google are the examples of Platform as a Service.

i. RightScale

Rightscale entered in to a strategic product and

partnership, broadening its cloud management platform to support emerging cloud from new vendors, including Flexiscale and GoGrid, while continuing its support for amazon's EC2. Rightscale is also working with Rackspace to ensure compatibility with their cloud offerings, including Mosco and CloudFS. Rightscale offers an integrated management dashboard, where applications can be deployed once and managed across these and clouds.

Customer can leverage the Rightscale cloud management platform to automatically deploy and manage their web applications scaling up when traffic demands and scaling back as appropriate allowing them to focus on their core business objectives [7].

ii. *Salesforce.com*

Salesfoece.com offers Force.com as its on-demand platform. Force.com features breakthrough Visualforce technology, which allows customers, developers and ISVs to design any app, for any user, anywhere with the world's first User Interface as a Service. The force.com platform offers global infrastructure and services for database, logic, workflow, integration, user interface, and application exchange.

A capability of the Force.com platform, Visualforce provides a framework for creating user experiences, and enables the creation of new interface designs and user interactions to be built and delivered with no software or hardware infrastructure requirements. Force.com Platform as a service provides the building blocks necessary to build business apps, whether they are simple or sophisticated, and automatically deploy them as a service to small teams or entire enterprises. The force.com platform gives customers the power to run applications within the same saleforce instances, allowing all of a company's Salesforce applications to share a common security model, data model and user model.

Visualforce uses Internet technology, including HTML, AJAX and Flex, for business applications. Visualforce enables the creation and delivery of any user experience, offering control over an application design. Visualforce provides a page-based model built on standard HTML and web presentation technologies, and is complemented with both a component library for implementing common user interface elements and a controller model for creating new interactions between those elements [7].

2.3 Software-As-A Service (Saas)

It is the model in which an application is hosted as a service to customer who accesses it via the internet. It provide the

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customer with ready to use application running on the infrastructure of service provider. Salesforce, Zoho, workday are instances of SaaS are used for different purposes such as email, billing, human resource management etc [10].

Software as a service, or SaaS, is probably the most common type of cloud service development. With SaaS, a single application is delivered to thousands of users from the vendor's servers. Customers don't pay for owning the software; rather, they pay for using it. Users access an application via an API Accessible over the web. Each organization served by the vendor is called a tenant, and this type of arrangement is called a multitenant architecture. The vendor's servers are virtually partitioned so that each organization works with a customized virtual application instance. For customers; SaaS requires no upfront investment in servers or software licensing. For the application developer, there is only one application to maintain for multiple clients.

Many different types of companies are developing applications using the SaaS model. Perhaps the best-known SaaS applications are those offered by Google to its consumer.

Customers who are not inclined to perform software development but have need of high power applications can benefit from SaaS. Some of this applications include Customer Resource Management (CRM), Video conferencing, IT service conferencing, IT service management, Accounting, Web analytics, Web content management [7].

According to Bessemer Venture Partners's Cloud Index, here is an list of the top 30 SaaS companies [11]:

Company	Ticker	Price	MarketCap	EV	Revenue 2011
Althimetrics	ALTM	\$115.05	\$4,239	\$4,452	\$505
Bazaarvoice	BV	\$10.77	\$797	\$702	\$181
BroadSoft	BFTT	\$30.37	\$854	\$792	\$183
Concur Technologies	CHQR	\$100.24	\$5,618	\$5,336	\$576
Constant Contact	CTCT	\$17.97	\$519	\$480	\$286
CornerstoneOnDemand	CSOD	\$52.72	\$2,710	\$2,638	\$185
Dealertrack Technologies	TRAK	\$41.17	\$1,801	\$1,802	\$467
Demandware	DWRE	\$44.31	\$1,217	\$1,213	\$100
Eduplan	EDPN	\$15.24	\$496	\$466	\$172
Flextronics Group	FLTK	\$42.18	\$1,302	\$1,421	\$172
IntraLink	IL	\$8.58	\$459	\$459	\$224
Jive Software	JIVE	\$13.39	\$921	\$792	\$545
LifeLock	LOCK	\$12.24	\$1,086	\$917	\$363
LinkedIn	LNKD	\$122.81	\$26,058	\$25,224	\$1,511
Livestream	LPSN	\$16.34	\$519	\$484	\$177
LogMeIn	LOGM	\$29.71	\$721	\$520	\$163
Marm Software	MARM	\$12.53	\$407	\$392	\$77
Marketo	MARK	\$26.55	\$1,280	\$1,264	\$90
Medidata Solutions	MDSO	\$88.06	\$2,349	\$2,209	\$276
NetScout	NS	\$98.12	\$7,279	\$7,085	\$409
Procept	PROPT	\$29.00	\$1,424	\$910	\$130
Qualys	QLYS	\$18.05	\$578	\$473	\$108
Rally Software	RALLY	\$29.35	\$712	\$608	\$73
RoadPage	RP	\$21.10	\$1,425	\$1,391	\$187
Repsage	REPS	\$16.90	\$710	\$644	\$197
Salesforce	CRM	\$45.21	\$26,471	\$26,265	\$1,972
ServiceNow	NOW	\$42.49	\$5,813	\$5,559	\$409
The Ultimate Software Group	ULTV	\$145.19	\$4,414	\$5,383	\$409
Vocus	VOCS	\$10.01	\$211	\$254	\$189
Workday	WDAY	\$76.37	\$12,866	\$12,082	\$439

Salesforce: The founder of SaaS industry, this American-based company is best known for its Customer Relationship Management (CRM) software, although they also offer other services, like PaaS (Platform as a Service), AppExchange (a

market for cloud computing applications), or Work.com, a social performance management platform. They also offer a SOAP/REST Web service API that enables integration with other systems.

LinkedIn: Although some may argue whether to include in the list of Software-as-a-Service, BVP has chosen to include the leading social networking site for professionals on their list.

Workday: Based in the United States, what makes this cloud-based management software vendor from others is that they offer “online services at a fraction of the cost of upgrading from their incumbent vendors”. They offer financial management, human capital management and cloud integration applications.

Netsuite: The well-known American software company offers SaaS integrated business management software that includes software for ERP (Enterprise Resource Planning), accounting, order management, inventory, CRM, PSA (Professional Services Automation) and e-commerce applications.

ServiceNow: American-based, this SaaS Company was established in 2003 and provides IT service management (ITSM) software. It competes with companies such as IBM and Hewlett-Packard in ITSM applications, and with other SaaS/PaaS companies like Salesforce.com or Force.com [11].

3 RECENT APPLICATIONS OF CLOUD COMPUTING

There are various applications of cloud computing. Some of the applications designed by some researchers are as discussed here.

3.1 Cloud Computing in Higher Education [12]

In the current financial crisis and being challenged by growing needs, universities are facing problems in providing necessary information technology (IT) support for educational, research and development activities. There is an alternative to the use of IT, while leading universities to improve agility and obtain savings. A migrating strategy towards cloud formed of the following stages [12]:

Developing the knowledge base about Cloud Computing
Evaluating the present stage of the university from the point of view of the IT needs, structure and usage
Experimenting the Cloud Computing solutions
Choosing the Cloud Computing solution
Implementation and management of the Cloud Computing solution
Management plan

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the Cloud Computing solution.

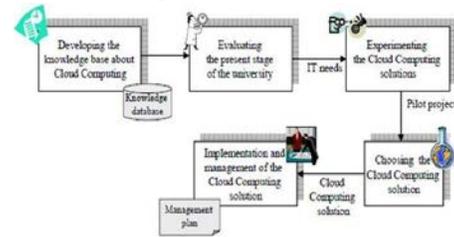


Figure 3.1: Cloud Strategy in Higher Education [12]

3.2 Cloud Computing for Education and Research in Developing Countries [16]

Cloud computing promises a new way of provisioning elastic computational resources and software applications by enabling people to have timely access to resources and services, with reasonable costs, guaranteed SLA and reduced entry effort and investment [13],[14],[15]. This vision is attractive to and are still lacking resources (and funding for acquiring resources) to sufficiently support their research and education activities [16].

To satisfy these needs, typically, a private cloud computing model is used to virtualize teaching and research laboratories top private cloud infrastructures, thus optimizing and saving money on IT infrastructures. For public cloud computing models, commonly, IaaS is used for executing applications while SaaS is for IT services within education and research institutions [16].

3.3 The Application Of Cloud Computing To The Creation Of Image Mosaics And Management of Their Provenance [17]

The Montage image mosaic engine is designed to investigate the cost and performance of processing images on the Amazon EC2 cloud, and to inform the requirements that higher-level products impose on provenance management technologies. The goal is to determine which types of scientific workflow applications are cheaply and efficiently run on the Amazon EC2 cloud (hereafter, AmEC2) [17].

Workflows are loosely coupled parallel applications that consist of a set of computational tasks linked via data and control flow dependencies. Unlike tightly coupled applications, in which tasks communicate directly via the network, workflow tasks typically communicate using the file system. Given that AmEC2 uses only commodity hardware and given that applications make very different demands on resources, it is likely that cost and performance will vary dramatically with application. It was therefore important to study applications that make different demands on resources [17].

There are four steps in the production of an image mosaic:

- Discover the geometry of the input images on the sky from the input FITS keywords and use it to calculate the geometry of the output mosaic on the sky.
- Re-project the input images to the spatial scale, coordinate system, World Coordinate System (WCS)-projection, and image rotation.
- Model the background radiation in the input images to achieve common flux scales and background level across the mosaic.
- Co-add the re-projected, background-corrected images into a mosaic. Each production step has been coded as an independent engine run from an executive script [17].

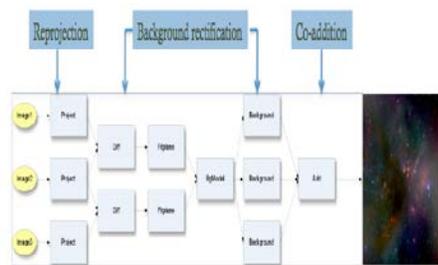


Figure 3.2: The processing steps used in computing an image mosaic with the Montage engine.

3.4 MedBook: A Cloud-Based Healthcare Billing and Record Management System

Electronic health records (EHR) and electronic billing systems have been designed as mechanisms to help curb the rising costs of health care in the United States. The research idea of using open-source cloud computing technologies as the mechanism to build an affordable, secure, and scalable platform that supports billing as well as EHR operations. This platform is called as MedBook [18].



Figure3.3: MedBook Operational Architecture [18]

MedBook provides patients, health care providers, and health care payers a platform for exchange of information about EHR, billing activities, and benefits inquiries.

MedBook is a Software-as-a-Service (SaaS) application

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built on top of open source technologies and running on an Infrastructure-as-a-Service platform. The client applications are mobile apps run from iPhone and iPad device [18].

4. CONCLUSIONS

Cloud computing is an inexpensive way of providing services of storage and software. Cloud computing is a really cheap way for companies to have all the resources they need in once place. Cloud computing is adopted by many organizations and giving best benefits to them. In cloud computing three services as Infrastructure-as-a-Service, Platform-as-a Service, Software-as a-Service are available for the customer. Applying the cloud computing in education system, healthcare has many advantages. Separate cloud adoption for teaching and for research is required.

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