Cloud computing

Ms.Sarika Yadav
Faculty
I.M.S.S.R. Pune

Traditional business applications have always been very complicated and expensive. The amount and variety of hardware and software required to run them are daunting. You need a whole team of experts to install, configure, test, run, secure, and update them.

When you multiply this effort across dozens or hundreds of apps, it's easy to see why the biggest companies with the best IT departments aren't getting the apps they need. Small and mid-sized businesses don't stand a chance.

Cloud computing is a term used to describe both a platform and type of application. A cloud computing platform dynamically provisions, configures, reconfigures, and deprovisions servers as needed.

Servers in the cloud can be physical machines or virtual machines. Advanced clouds typically include other computing resources such as storage area networks (SANs), network

equipment, firewall and other security devices.

Cloud computing also describes applications that are extended to be accessible through the Internet. These cloud applications use large data centers and powerful servers that host Web applications and Web services. Anyone with a suitable Internet connection and a standard browser can access a cloud application.

1.0 Definition

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 needed Cloud computing environments support grid computing by quickly providing physical and virtual servers on which the grid applications can run.
- Clouds also support nongrid environments, such as a three-tier Web architecture running Standard or Web 2.0 applications. A cloud is more than a collection of computer resources because a cloud provides a mechanism to manage those resources.
- Management includes provisioning, change requests, reimaging, workload rebalancing, deprovisioning, and monitoring.

2.0 Cloud computing concept

Cloud computing conceptual diagram

Cloud computing is location independent computing, whereby shared servers provide resources, software, and data to computers and other devices on demand, as with the electricity grid. Cloud computing is a natural evolution of the widespread adoption of virtualization, service-oriented architecture and utility computing. Details are abstracted from consumers, who no longer have need for expertise in, or control over, the technology infrastructure "in the cloud" that supports them.

Cloud computing describes a new supplement, consumption, and delivery model for IT services based on the Internet, and it typically involves over-the-Internet provision of dynamically scalable and often virtualized resources.

The National Institute of Standards and Technology (NIST) provides a somewhat more objective and specific definition here. The term "cloud" is used as a metaphor for the Internet, based on the cloud drawing used in the past to represent the telephone network, and later to depict the Internet in computer network diagrams as an abstraction of the underlying infrastructure it represents. Typical cloud computing providers deliver common business applications online that are accessed from another Web service or software like a Web browser, while the software and data are stored on servers.

Most cloud computing infrastructures consist of services delivered through common centers and built on servers. The major cloud service providers include Amazon, Rackspace Cloud, Salesforce, Skytap, Microsoft and Google. Some of the larger IT firms that are actively involved in cloud computing are Huawei, Cisco, Fujitsu, Dell, Red Hat, Hewlett Packard, IBM, VMware, Hitachi and NetApp.

3.0 Benefits

- 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 realtime workload balancing.
- The Cloud makes it possible to launch Web 2.0 applications quickly and to scale up applications as much as needed when needed. The platform supports traditional Java™ and Linux, Apache, MySQL, PHP (LAMP) stack-based applications as well as new architectures such as MapReduce and the Google File System, which provide a means to scale applications across thousands ofservers instantly.

4.0 Characteristics

The fundamental concept of cloud computing is that the computing is "in the cloud" i.e. the processing (and the

related data) is not in a specified, known or static place(s). This is in opposition to where the processing takes place in one or more specific servers that are known.

Generally, cloud computing customers do not own the physical infrastructure, instead avoiding capital expenditure by renting usage from a third-party provider. They consume resources as a service and pay only for resources that they use. Sharing "perishable and intangible" computing power among multiple tenants can improve utilization rates, as servers are not unnecessarily left idle, which can reduce costs significantly while increasing the speed of application development.

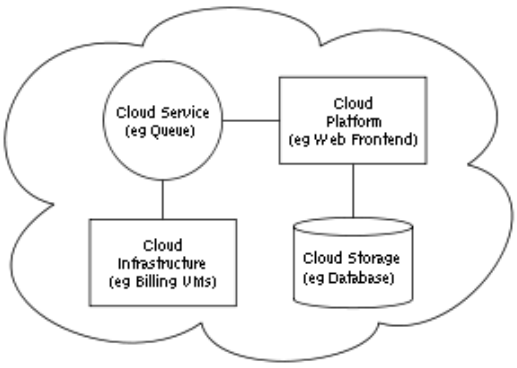
5.0 Economics

Cloud computing users avoid capital expenditure (CapEx) on hardware, software, and services when they pay a provider only for what they use. Consumption is usually billed on a utility (resources consumed, like electricity) or subscription (time-based, like a newspaper) basis with little or no upfront cost. Other benefits of this approach are low barriers to entry, shared infrastructure and costs, low management overhead, and immediate access to a broad range of applications.

According to Nicholas Carr, the strategic importance of information technology is diminishing as it becomes standardized and less expensive. He argues that the cloud computing paradigm shift is similar to the displacement of frozen water trade by electricity generators early in the 20th century.

Among the items that some cloud hosts charge for are instances (often with extra charges for high-memory or high-CPU instances), data transfer in and out, storage (measured by the GB-month), I/O requests, PUT requests and GET requests, IP addresses, and load balancing. In some cases, users can bid on instances, with pricing dependent on demand for available instances.

6.0 Architecture



Cloud computing sample architecture

Cloud architecture, the systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over application programming interfaces, usually web services.

The two most significant components of cloud computing architecture are known as the front end and the back end. The front end is the part seen by the client, i.e. the computer user. This includes the client's network (or computer) and the applications used to access the cloud via a user interface such as a web browser. The back end of the cloud computing architecture is the 'cloud' itself, comprising various computers, servers and data storage devices.

7.0 History

The underlying concept of cloud computing dates back to the 1960s, when John McCarthy opined that "computation

may someday be organized as a public utility." Almost all the modern-day characteristics of cloud computing (elastic provision, provided as a utility, online, illusion of infinite supply), the comparison to the electricity industry and the use of public, private, government and community forms was thoroughly explored in Douglas Parkhill's 1966 book, The Challenge of the Computer Utility.

The actual term "cloud" borrows from telephony in that telecommunications companies, who until the 1990s primarily offered dedicated point-to-point data circuits, began offering Virtual Private Network (VPN) services with comparable quality of service but at a much lower cost. The cloud symbol was used to denote the demarcation point between that which was the responsibility of the provider from that of the user. Cloud computing extends this boundary to cover servers as well as the network infrastructure. The first scholarly use of the term "cloud computing" was in a 1997 lecture by Ramnath Chellappa.

Amazon played a key role in the development of cloud computing by modernizing their data centers after the dot-com bubble, which like most computer networks. Amazon initiated a new product development effort to provide cloud computing to external customers, and launched Amazon Web Service (AWS) on a utility computing basis in 2006.

In 2007, Google, IBM and a number of universities embarked on a large scale cloud computing research project. In early 2008, Eucalyptus became the first open source AWS API compatible platform for deploying private clouds. In early 2008, Open Nebula, enhanced in the RESERVOIR European Commission funded project, became the first open source software for deploying private and hybrid clouds and for the federation of clouds [. By mid-2008, Gartner saw an opportunity for cloud computing "to shape the relationship among consumers of IT services, those who use IT services and those who sell them" and observed that "Organizations are switching from company-owned hardware and software assets to per-use service-based models" so that the "projected shift to cloud computing ... will result in dramatic growth in IT products in some areas and significant reductions in other areas."

8.0 Key features

Ability improves with users' ability to rapidly and inexpensively re-provision technological infrastructure resources.

Application Programming Interface (API) accessibility to software that enables machines to interact with cloud software in the same way the user interface facilitates interaction between humans and computers. Cloud Computing systems typically use REST based APIs.

Cost is claimed to be greatly reduced and capital expenditure is converted to operational expenditure. This ostensibly lowers barriers to entry, as infrastructure is typically provided by a third-party and does not need to be purchased for one-time or infrequent intensive computing tasks. Pricing on a utility computing basis is fine-grained with usage-based options and fewer IT skills are required for implementation (in-house).

Reliability is improved if multiple redundant sites are used, which makes well designed cloud computing suitable for business continuity and disaster recovery. Nonetheless, many major cloud computing services have suffered outages, and IT and business managers can at times do little when they are affected.

Scalability via dynamic ("on-demand") provisioning of resources on a fine-grained, self-service basis near real-time, without users having to engineer for peak loads. Performance is monitored, and consistent and loosely coupled architectures are constructed using web services as the system interface.[One of the most important new methods for overcoming performance bottlenecks for a large class of applications is data parallel programming on a distributed data grid.[

Security could improve due to centralization of data, increased security-focused resources, etc Security is often as good as or better than under traditional systems, in part because providers are able to devote resources to solving security issues that many customers cannot afford. Providers typically log accesses, but accessing the audit logs themselves can be difficult or impossible.

Maintenance of cloud computing applications is easier, since they don't have to be installed on each user's computer. They are easier to support and to improve since the changes reach the clients instantly.

Metering means that cloud computing resources usage should be measurable and should be metered per client and application on a daily, weekly, monthly, and yearly basis.

9.0 Layers

As described in OSI Model once an Internet connection is established among several computers It is possible to share services within any one of the following layers i.e. Client, Application, Platform, Infrastructure & Server.

Client :- A cloud client consists of computer hardware and/or computer software that is used for application delivery, or that is specifically designed for delivery of cloud services It includes computers, phones and other devices, operating systems and browsers.

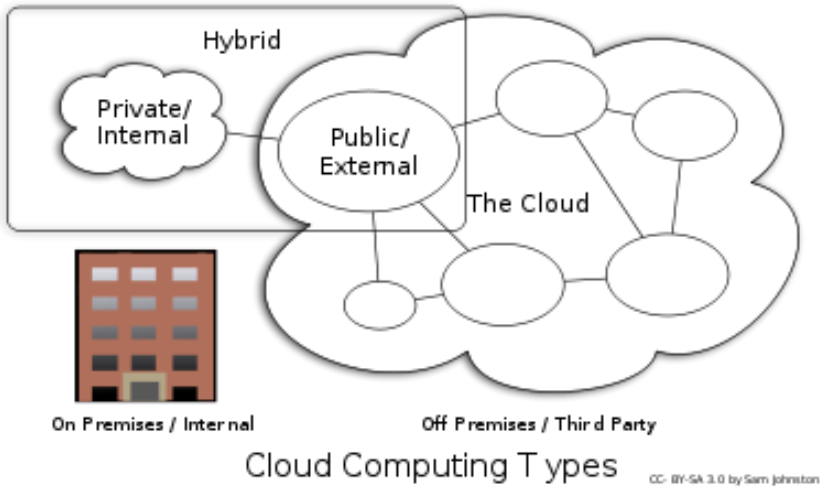
Application :- Cloud application services or "Software as a Service (SaaS)" deliver software as a service over the Internet, eliminating the need to install and run the application on the customer's own computers and simplifying maintenance and support.

Platform:- Cloud platform services or "Platform as a Service (PaaS)" deliver a computing platform and/or solution stack as a service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of applications without the cost and complexity of buying and managing the underlying hardware and software layers.

Infrastructure:- Cloud infrastructure services, also known as "Infrastructure as a Service (IaaS)", delivers computer infrastructure - typically a platform virtualization environment - as a service. Rather than purchasing servers, software, data-center space or network equipment, clients instead buy those resources as a fully outsourced service. Suppliers typically bill such services on a utility computing basis and amount of resources consumed (and therefore the cost) will typically reflect the level of activity. IaaS evolved from virtual private server offerings. Cloud infrastructure often takes the form of a tier 3 data center with many tier 4 attributes, assembled from hundreds of virtual machines.

Server:- The servers layer consists of computer hardware and/or computer software products that are specifically designed for the delivery of cloud services, including multi-core processors, cloud-specific operating systems and combined offerings.

10.0 Deployment models



Cloud computing types

Public cloud /External cloud :- Public cloud or external cloud describes cloud computing in the traditional main stream sense, whereby resources are dynamically provisioned on a fine-grained, self-service basis over the Internet, via web applications/web services, from an off-site third-party provider who bills on a fine-grained utility computing basis.

Community cloud :-A community cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud (but more than a single tenant) this option is more expensive but may offer a higher level of privacy, security and/or policy compliance. Examples of community cloud include Google's "Gov Cloud".

Hybrid cloud :- The most correct definition of the term "Hybrid Cloud" is probably the use of physical hardware and virtualized cloud server instances together to provide a single common service. Two clouds that have been joined together are more correctly called a "combined cloud".

Private cloud:-Douglas Parkhill first described the concept of a "Private Computer Utility" in his 1966 book The Challenge of the Computer Utility. The idea was based upon direct comparison with other industries (e.g. the electricity industry) and the extensive use of hybrid supply models to balance and mitigate risks.

11.0 Cloud engineering

Cloud engineering is also known as cloud service engineering. Cloud engineering is the application of a systematic, disciplined, quantifiable, and interdisciplinary approach to the ideation, conceptualization, development, operation, and maintenance of cloud computing, as well as the study and applied research of the approach, i.e., the application of engineering to cloud.

12.0 Cloud storage

Cloud Storage is a model of networked computer data storage where data is stored on multiple virtual servers, generally hosted by third parties, rather than being hosted on dedicated servers. Hosting companies operate large data centers; and people who require their data to be hosted buy or lease storage capacity from them and use it for their storage needs. The data center operators, in the background, virtualized the resources according to the requirements of the customer and expose them as virtual servers, which the customers can themselves manage. Physically, the resource may span across multiple servers.

13.0 Issues

1. Privacy

The Cloud model has been criticized by privacy advocates for the greater ease in which the companies hosting the Cloud services control, and thus, can monitor at will, lawfully or unlawfully, the communication and data stored between the user and the host company.."

2. Compliance

In order to obtain compliance with regulations including FISMA, HIPAA and SOX in the United States, the Data Protection Directive in the EU and the credit card industry's PCI DSS, users may have to adopt community or hybrid deployment modes which are typically more expensive and may offer restricted benefits. This is how Google is able to "manage and meet additional government policy requirements beyond FISMA" and Rack space Cloud are able to claim PCI compliance. Customers in the EU contracting with Cloud Providers established outside the EU/EEA have to adhere to the EU regulations on export of personal data.

3. Legal

In March 2007, Dell applied to trademark the term "cloud computing" (U.S. Trademark 77,139,082) in the United States. The "Notice of Allowance" the company received in July 2008 was canceled in August, resulting in a formal rejection of the trademark application less than a week later. Since 2007, the number of trademark filings covering cloud computing brands, goods and services has increased at an almost exponential rate. As companies sought to better position themselves for cloud computing branding and marketing efforts, cloud computing trademark filings increased by 483% between 2008 and 2009. In 2009, 116 cloud computing trademarks were filed, and trademark analysts predict that over 500 such marks could be filed during 2010.

4. Open source

Open source software has provided the foundation for many cloud computing implementations. In November 2007, the Free Software Foundation released the Affero General Public License, a version of GPLv3 intended to close a perceived legal loophole associated with free software designed to be run over a network.

5. Open standards

Most cloud providers expose APIs which are typically well-documented (often under a Creative Commons license) but also unique to their implementation and thus not interoperable. Some vendors have adopted others' APIs and there are a number of open standards under development, including the OGF's Open Cloud Computing Interface. The Open Cloud Consortium (OCC) is working to develop consensus on early cloud computing standards and practices.

6. Security

Security Issues barring the adoption of cloud computing is due in large part to the private and public sectors unease surrounding the external management of security based services. It is the very nature of cloud computing based services, private or public, that promote external management of provided services.

12.0 Research

A number of universities, vendors and government organizations are investing in research around the topic of cloud computing. Joint government, academic and vendor collaborative research projects include the IBM/Google Academic Cloud Computing Initiative (ACCI). In October 2007 IBM and Google announced the multi- university project designed to enhance students' technical knowledge to address the challenges of cloud computing. In April 2009, the National Science Foundation joined the ACCI and awarded approximately $5 million in grants to 14 academic institutions.

In July 2008, HP, Intel Corporation and Yahoo! announced the creation of a global, multi-data center, open source test bed, called Open Cirrus, designed to encourage research into all aspects of cloud computing, service and data center management.

In July 2010, HP Labs India announced a new cloud-based technology designed to simplify taking content and making it mobile-enabled, even from low-end devices. Called SiteonMobile, the new technology is designed for emerging markets where people are more likely to access the internet via mobile phones rather than computers. In Nov. 2010, HP formally opened its Government Cloud Theatre, located at the HP Labs site in Bristol, England. The demonstration facility highlights high-security, highly flexible cloud computing based on intellectual property developed at HP Labs. The aim of the facility is to lessen fears about the security of the cloud. HP Labs Bristol is HP's second-largest central research location and currently is responsible for researching cloud computing .

13.0 Conclusion

In today's global competitive market, companies must innovate and get the most from its resources to succeed. This requires enabling its employees, business partners, and users with the platforms and collaboration tools that

promote innovation.

Cloud computing infrastructures are next generation platforms that can provide tremendous value to companies of any size. They can help companies achieve more efficient use of their IT hardware and software investments and provide a means to accelerate the adoption of innovations. Cloud computing increases profitability by improving resource utilization. Costs are driven down by delivering appropriate resources only for the time those resources are needed. Cloud computing has enabled teams and organizations to streamline lengthy procurement processes.

Cloud computing enables innovation by alleviating the need of innovators to find resources to develop, test, and make their innovations available to the user community. Innovators are free to focus on the innovation rather than the logistics of finding and managing resources that enable the innovation.

BIBLIOGRAPHY

1. Cloud computing insights from110 implementation projects
   IBM Academy of Technology Survey.
2. IBM - Cloud computing by Greg Boss, Padma Malladi, Dennis Quan, Linda Legregni,
   Harold Hall. Web Site www.ibm.com/developerworks/websphere/zones/hipods/
3. Towards Trusted Cloud Computing Nuno Santos Krishna P. Gummadi Rodrigo Rodrigues MPI-SWS
4. IDC EXECUTIVE BRIEF(IDC EB)Cloud Computing in the Midmarket :
   Assessing the Options.
5. Cloud Computing Defined 17 July 2010. Retrieved 26 July 2010.
6. "The Internet Cloud". Thestandard.com. http://www.thestandard.com/article/0,1902,5466,00.html. Retrieved 2010-08-22.
7. Buyya, Rajkumar; Chee Shin Yeo, Srikumar Venugopal (PDF). Market-Oriented Cloud Computing: Vision, Hype, and Reality for Delivering IT Services as Computing Utilities. Department of Computer Science and Software Engineering, University of Melbourne, Australia. pp. 9. http://www.gridBus.org/~raj/papers/hpcc2008_keynote_cloudcomputing.pdf. Retrieved 2008-07-31.
8. ""The Rise of Cloud Computing." Michael Otey. April 2010". windowsITpro.com. 2010-04-26. http://www.windowsitpro.com/article/cloud-computing2/The-Rise-of-Cloud-Computing/2.aspx. Retrieved 2010-08-22.
9. http://en.wikipedia.org/wiki/cloud computing-cite_note 117