International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume No.-1, Issue No.-1, July 2014)

Clearing The Clouds On Cloud Computing: Survey Paper

PS Yoganandani[1], Rahul Johari[2], Kunal Krishna[3], Rahul Kumar[4], Sumit Maurya[5]
[1,2,3,4,5]*Guru Gobind Singh Indraparasta University, New Delhi*

***Abstract*— The advent of Cloud Computing in 2006, has led to significant changes in computing in general and working pattern of users in particular. Starting from the definition of cloud computing, elements of cloud computing, cloud services, cloud deployment, cloud computing platforms & technologies and issues & challenges of cloud computing are described in this paper.**

***Keywords*— Cloud Computing, Cloud Deployment Models, Security and Challenges in Cloud Computing, Cloud Computing Platforms and Technologies, Cloud Database Cloud Services, Evolution of cloud, QoS**

I. Introduction

The term 'Cloud' has historically been used in the telecommunication industry as an abstraction of the network in system diagrams. It then became the symbol of the most popular computer network 'Internet'.

The internet plays a fundamental role in cloud computing since it represents either the medium or the platform through which many cloud computing services are delivered and made accessible.

Cloud computing refers to both the application delivered as a services over the internet and the hardware and the system software in the data centers that provide those services.

Cloud computing enables both, a single user hosting documents in the cloud and also making the entire IT infrastructure available for users globally. Considering this 'shareable' nature of cloud computing, it's definition proposed by the American National Institute of Standards & Technology (NIST) is as under:[1][3]

"Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (example: networks, servers, storage applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction"

In others words, a service can be said to have been delivered in Cloud computing, if:

a. The service is accessible via a web browser or web services API
b. Zero capital expenditure is necessary to get started
c. We pay for the services based on 'how much we use'

II. Evolution Of Cloud Computing

Figure 1 below represents an overview of the evolution of the technologies for distributed computing that have influenced cloud computing.

Cluster computing started as a low-cost alternative to the use of mainframes and supercomputers.

Mainframes & supercomputers eventually resulted in increased availability of cheap commodity machines. These machines could then be connected by a high bandwidth network and controlled by specific software tools that manage them as a single system or cluster

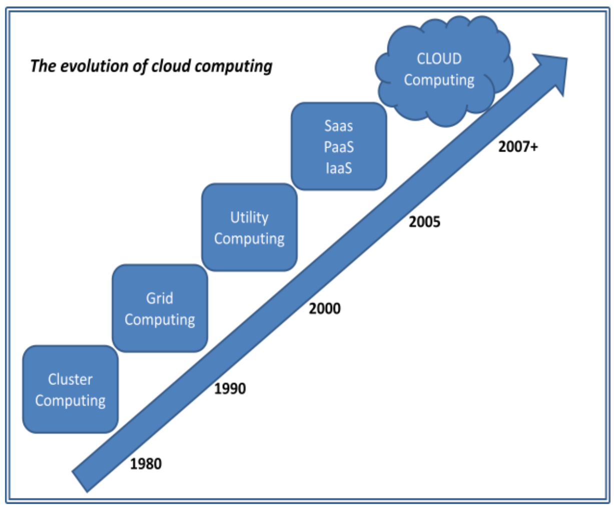

Figure 1: Evolution of cloud computing

Grid Computing appeared in early 90s as an evolution of cluster computing.[2] In analogy with the power grid, Grid computing proposed a new approach to access a large computational power, huge storage facilities, and a variety of services. Grids initially developed as aggregation of geographically dispersed clusters by means for internet connection. These clusters belonged to different organizations and arrangements were made among them to share the computational power. The key difference between a cluster and a grid is that a computing grid is a dynamic aggregation of heterogeneous computing nodes, and it scale could be nation-wide or worldwide. [5]

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume No.-1, Issue No.-1, July 2014)

Utility oriented computing was the first step towards 'pay by use' philosophy. Utility of computing was based on the idea of providing computing solutions as a utility like natural gas, water or power.

Then the recent development of Software as a service "SaaS" was the beginning of cloud computing in the real sense. It was purely a "on-demand" software service. It is an application that can be run from anywhere in the world as long as you have a computer with an internet connection. e.g. Gmail, Yahoo mail etc.

III. Evolving Cloud Database Requirements

The Cloud database patterns play a vital role in business applications in web technologies. User generated content, particularly in the form of social networking, have placed somewhat more emphasis on updates. Reads still outnumber writes in terms of the ratio, but the gap is narrowing. With support for transactional business applications, this gap between database updates and reads is further shrinking. Business applications also demand that the cloud database be ACID compliant: providing Atomicity, Consistency, Isolation and Durability. Perhaps it will be beneficial to consider two examples to better understand the differing cloud database requirements.

Example 1: Consumer Cloud Database

Consider a database powering a consumer-centric cosmetics website. If the user does a search for a certain shade of lipstick, it is important that the results be delivered instantaneously to keep the user engaged, so she doesn't click on another cosmetics site. If the site said that the chosen lipstick is in inventory and completed the sale, it wouldn't be the end of the world to later find out that, as a result of inconsistent data, that lipstick wasn't really in inventory. In this case, the consumer receives an email explaining that it is on backorder and will be shipped soon…no problem.

Example 2: Corporate Cloud Database

Consider a company that sells widgets to manufacturers. A large company purchases a load of widgets necessary to keep its production line running. In this example, if the inventory was incorrect, due to in consistent data, and the shipment is delayed, the company who purchased the widgets may be forced to shut down a production line at a cost of $1,000,000 per day…big problem!

With this understanding of the different stakes involved, it is easy to understand how corporate adoptions of cloud databases are changing the game considerably.

The Shared-Disk Database Architecture - Ideal for Cloud Databases

The database architecture called shared-disk, which eliminates the need to partition data, is ideal for cloud databases. Shared-disk databases allow clusters of low-cost servers to use a single collection of data, typically served up by a Storage Area Network (SAN) or Network Attached Storage (NAS). All of the data is available to all of the servers; there is no partitioning of the data. As a result, if we are using two servers, and our query takes .5 seconds, then we can dynamically add another server and the same query might now take .35 seconds. In other words, shared-disk databases support elastic scalability.

The shared-disk DBMS architecture has other important advantages—in addition to elastic scalability—that make it very appealing for deployment in the cloud.

IV. Elements Of Cloud Computing

The essential elements of cloud computing are:

On-demand Self Service: A user can avail computing services at a desired time slot in an automating fashion without resorting to human interactions with providers of these resources.

Broad Network Access: Here the computing resources are delivered over the network and used by various clients with heterogeneous platforms (such as mobile phones, laptops and PDAs) situated at consumer sites.

Resource pooling: A cloud service provider's computing resources are pooled together in an effort to serve multiple consumers using either multi tenancy or virtualization model. Here the users are not told where their data is stored in the cloud.

Rapid Elasticity: Users need not have to contract the resources permanently. Cloud computing enables them to scale up or scale down usage depending upon their need. Therefore the resource provisioning appears to be infinite to the users, with consumption matching the usage – high during peaks and low during low usage periods.

Measured Service: Although the computing resources are shared by multiple users, cloud computing offers metering capabilities which enable service providers to measure and accordingly charge the users based on their usage.

V. CLOUD SERVICES

Having now understood the elements of cloud computing, it would be appropriate now to dwell on the three service models to categorize the cloud services.

Software as a Service (SaaS): Cloud consumers release their applications on a hosting environment which can be accessed through networks from various clients (e.g. web browsers, PDAs etc.) by application users. Cloud consumers do not have control over the cloud infrastructure that often employs multi-tenancy system architecture. Different cloud consumers' applications are organized in a single logical environment on the SaaS, to achieve economies of scale and optimization in terms of speed, security, availability, disaster recovery and maintenance. Examples of SaaS include salesforce.com. Google mail, Google docs and so forth.

Platform as a Service (PaaS): PaaS is a development platform, supporting the full software life cycle, which allows cloud users to develop cloud services and applications (example SaaS) directly on PaaS cloud. Hence the difference between SaaS and PaaS is that, SaaS only hosts completed cloud applications whereas PaaS offers a development platform that hosts both completed and in-progress cloud applications. Example of PaaS is Google App Engine & Aneka.

Infrastructure as a Service (IaaS): Cloud users directly use IT infrastructure (processing, storage, networks and other fundamental computing resources) provided in the IaaS cloud. Virtualization is extensively used in IaaS cloud in order to integrate / decompose physical resources in an ad-hoc manner to meet growing or shrinking resource demand from cloud consumers. An example of IaaS is Amazons EC2.

A subset of IaaS is Data storage as a Service (DaaS). DaaS allows users to pay for the data used by them instead of paying for the complete database. Examples of this kind of DaaS include Amazon S3, Google Big Table etc.

VI. CLOUD DEPLOYMENT MODELS

The cloud community defines four cloud deployment models.[1][4] These are:

Private cloud: The cloud infrastructure is operated & managed solely by an organization for usage within their own firm. This is particularly driven by the needs of security and confidentiality of the information. Secondly, some organizations find data transfer to a public cloud is particularly expensive. Further, some organizations may want to keep full control on their mission critical operations and within their firewalls. Academics also build private cloud for research & teaching purposes.

Community Cloud: Several organizations jointly construct and share the same cloud infrastructure as well policies, requirements, values and concerns. The cloud community forms into a degree of economic scalability and democratic equilibrium. The cloud infrastructure could be hosted by a third party vendor or within one of the organizations in the community. Example: Government departments.

Public Cloud: This is the dominant form of current cloud computing deployment model. The public cloud is used by the general public users and the cloud service provider has the full ownership of the public cloud with its own policy, values, profit, costing and charging model. Many popular cloud services are Amazon EC2, Google App Engine and salesforce.com.

Hybrid cloud: This cloud infrastructure is a combination of two or more clouds that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability. Organizations use the hybrid cloud model in order to optimize their resources to increase their core competencies by margining out peripheral business functions onto the cloud while controlling core activities on premise through private cloud.

VII. QOS FOR CLOUD COMPUTING

World-class security – Provision world-class security at every level.

Trust and transparency – Provide transparent, real-time, accurate service performance and availability information.

True multitenancy – Deliver maximum scalability and performance to customers with a true multitenant architecture.

Proven scale – Support millions of users with proven scalability.

High performance – Deliver consistent, high-speed performance globally.

Complete disaster recovery – Protect customer data by running the service on multiple, geographically dispersed data centers with extensive backup, data archive, and failover capabilities.

High availability – Equip world-class facilities with proven high-availability infrastructure and application software.

Force.com is the only cloud-computing platform that adheres to all seven of these standards.

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume No.-1, Issue No.-1, July 2014)

VIII. Computing Platforms & Technologies

The creation of cloud computing environments (see figure 2 below) encompasses the development of applications (can be compared to SaaS) and systems that leverage cloud computing solutions (comparable to PaaS) and the creation of frameworks, platforms & infrastructures (comparable to IaaS) delivering cloud computing services.[1]

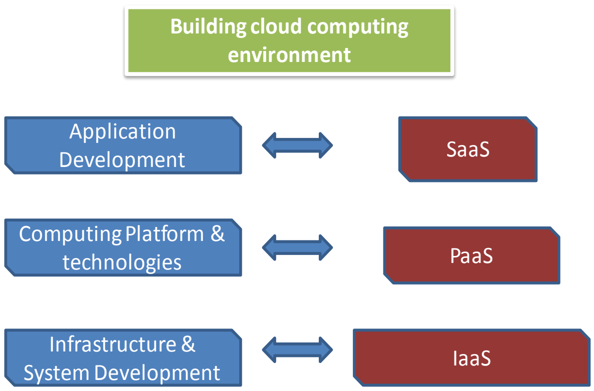

Figure 2: Cloud computing environment

Development of cloud computing application happens by leveraging platforms & frameworks that provide different types of services, from the bare metal infrastructure to customizable applications servicing specific purposes. Various such platforms or technologies (PaaS) that are available for the users to build and host an application are:

Amazon Web Services: AWS offers virtual compute, storage, networking & complete computing stacks. It is known for its on-demand services namely Elastic Compute Cloud (EC2) and Simple Storage Service (S3).

Google AppEngine: Launched in 2008, it provides an alternative to fixed applications (SaaS) and raw hardware (IaaS). App Engine managed infrastructure, provides a development platform to create apps, leveraging Google's infrastructure as a hosting platform.

Microsoft Azure: It is also a scalable runtime environment for web & distributed applications. However, it provides additional services such as support for storage (relational data & blobs), networking, caching, content delivery & others.

Force.com & salesforce.com: This is a platform available for developing social enterprise applications especially for customer relationship management function. Here, the user can develop his or her own components or integrate those available in app exchange into his or her application. This platform offers comprehensive solution comprising of:

a. Data layout-design
b. Business rules & work flows
c. User interface definitions
d. Hosting support on the cloud & access to all its functionalities through web service technologies.

Manjrasoft Aneka: In addition to being an effective runtime environment to develop and host an application, this offers the capability to run the application on a heterogeneous hardware (clusters, networked desktop computers & cloud resources). Developers have a choice to opt from various abstractions to design their applications, tasks, distributed threads and map-reduce. These applications are executable on the distributable service oriented run-time environment, which can dynamically integrate additional resource on demand.

IX. Security Issues & Challenges In Cloud Computing

It would be now pertinent here to recap the complete aspects of cloud computing, mentioned in this paper so far. This could be pictorially depicted as shown in the figure 3 below.

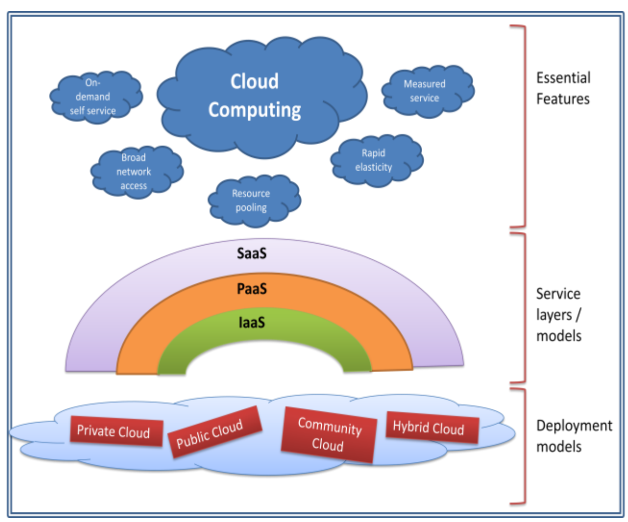

Figure 3: Aspects of cloud computing environment

International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347 - 6435 (Online)) Volume No.-1, Issue No.-1, July 2014)

The challenge of cloud computing is to ensure that only the authorized entities can access the data. Therefore, it requires suitable mechanisms to prevent cloud providers from using customer's data.[8][9] This can happen through both technical & non-technical interventions. The customers need to trust (by building suitable clauses in the contract) the service provider's technical competence and economic stability.

The responsibility of security and privacy is shared between the cloud providers & customers.

X. Real World Examples Utilizing The Cloud

Some examples from the real world harnessing the power of cloud computing at its best.

1. Time Machine

Times machine is a New York Times project in which one can read any issue from Volume 1, Number 1 of The New York Daily Times, on September 18, 1851 through to The New York Times of December 30, 1922. They made it such that one can choose a date in history and flip electronically through the pages, displayed with their original look and feel. The content was put in the cloud, in Amazon. They made use of 100 instances of Amazon EC2.

The PDF files were such that they were fully searchable. The image manipulation and the search ability of the software were done using cloud computing services.

2. SmugMug

SmugMug is an online photo hosting application which is fully based on cloud computing services. They do not use any hard drives for storage. Their complete storage is based on the Amazon S3 instances utilizing Amazon Cloud services.

3. IBM Google University Academic Initiative

Google and IBM together started with an initiative to advance large-scale distributed computing by providing hardware, software, and services to universities. In addition they provide services to advance training in large-scale distributed computing.

University of Washington, Carnegie-Mellon University, MIT, Stanford University, University of California at Berkeley and the University of Maryland are participating institutions in this program.

Students working with the cluster will have access to a Creative Common licensed curriculum for such a huge parallel computing network developed by Google and IBM.

XI. Conclusion & Future Work

In this paper we discussed the various aspects of cloud computing with a view to have an overall understanding of the subject, which would ultimately enable us to develop a working cloud based application.

As we have seen, cloud computing has indeed evolved in the recent years and is bringing about a paradigm shift in how computing is done. This have paved way for users to address their computing needs with enhanced flexibility both in terms of technical options / platforms available and economics of computing, since cloud computing offers variety of technology platforms and computing solutions as a 'pay by use' utility.

While cloud computing has brought about various positive changes in the world of computing, but it has its own share of security issues & challenges which need to be addressed.

References

[1] Mastering cloud computing by Rajkumar Buyya, 'Christian Vecchiola & S Tamarai Selvi

[2] "Cloud Computing " Principles and Paradigms by Rajkumar Buyya

[3] A view of cloud computing: M Armbrust, A Fox, R Griffith, AD Joseph 2010

[4] The NIST definition of cloud computing: P Mell, T Grance - NIST special publication, 2011

[5] Introduction to cloud computing: W Voorsluys, J Broberg, R Buyya - Cloud Computing, 2011

[6] High Performance Parallel computing with clouds and cloud technologies: J Ekanayake, G Fox -Cloud Computing, 2010

[7] Cloud computing privacy concerns on our doorstep: C Computing - Communications of the ACM, 2011

[8] Cloud Computing – Issues & Challenges: Tharam Dillon, Chen Wu & Elizabeth Chang – 2010 IEEE

[9] On technical security issues in cloud computing: Meiko Jensen, Jorg S & Nils G – 2009 IEEE

[10] Security and Privacy Challenges in Cloud computing Environments: Hassan Takabi, James BD Joshi, Gail – Joon Ahn, 2010 IEEE

[11] Cloud computing—The business perspective

[12] S Marston, Z Li, S Bandyopadhyay, J Zhang - Decision Support, 2011All authors should include biographies with photo at the end of regular papers.

[13] Cloud Computing and Databases-How Databases can meet the demands of cloud computing : www.scaled.com/pdfs/cloudcomputingdaas.pdf