Basics of Cloud Computing

Mr. Bali Kumar Patel[1] Miss. Sumitra Patel[2] Mr. Ankit Naik[3]
[1,2]Student [3]Faculty
[1,2,3] Department Of Computer Science & Engineering
[1,2,3]Kirodimal Institute Of Technology, Raigarh, Chhattisgarh, INDIA

Abstract— Cloud Computing is a versatile technology that can support a broad-spectrum of applications. The low cost of cloud computing and its dynamic scaling renders it an innovation driver for small companies, particularly in the developing world. Cloud deployed enterprise resource planning (ERP), supply chain management applications (SCM), customer relationship management (CRM) applications, medical applications and mobile applications have potential to reach millions of users. In this paper, we explore the different concepts involved in cloud computing. Leveraging our experiences on various clouds, we examine clouds from technical, and service aspects. We highlight some of the opportunities in cloud computing, underlining the importance of clouds and showing why that technology must succeed. Finally, we discuss some of the issues that this area should deal with. The paper aims to provide a means of understanding the model and exploring options available for complementing your technology and infrastructure needs.

Keywords: Cloud Computing, SaaS, PaaS, IaaS

I. INTRODUCTION

This section gives an introduction to Cloud computing. "Cloud computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction [1].

Cloud computing has emerged as a popular solution to provide cheap and easy access to externalized IT (Information Technology) resources. An increasing number of organizations (e.g., research centre, enterprises) benefit from Cloud computing to host their applications. Through virtualization, Cloud computing is able to address with the same physical infrastructure a large client base with different computational needs [2]–[3]. In contrast to previous paradigms (Clusters and Grid computing), Cloud computing is not application-oriented but service-oriented; it offers on demand virtualized resources as measurable and billable utilities [4], [5]. Fig. 1 shows a basic cloud computing environment. The remainder of this paper deals with characteristics, opportunities, issues and challenges of cloud Computing. At the end we discuss about the future scope of Cloud.

II. WHAT IS THE CLOUD?

Cloud computing is receiving a great deal of attention, both in publications and among users, from individuals at home to the U.S. government. Yet it is not always clearly defined[1]. Cloud computing is a subscription-based service where you can obtain networked storage space and computer resources. One way to think of cloud computing is to consider your experience with email. Your email client, if it is Yahoo!, Gmail, Hotmail, and so on, takes care of housing all of the hardware and software necessary to support your personal email account. When you want to access your email you open your web browser, go to the email client, and log in. The most important part of the equation is having internet access. Your email is not housed on your physical computer; you access it through an internet connection, and you can access it anywhere. If you are on a trip, at work, or down the street getting coffee, you can check your email as long as you have access to the internet. Your email is different than software installed on your computer, such as a word processing program. When you create a document using word processing software, that document stays on the device you used to make it unless you physically move it. An email client is similar to how cloud computing works. Except instead of accessing just your email, you can choose what information you have access to within the cloud.

III. ESSENTIAL CHARACTERISTICS

In this section we describe the essential characteristics that a cloud must possess. Any cloud is expected to have these five characteristics that are being described below.

A. On-demand self-service

A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider.

B. Broad network access

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and personal digital assistants (PDAs)).

C. Resource pooling

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the subscriber generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or data centre). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines.

D. Rapid elasticity

Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

E. Measured Service

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage,

processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service.

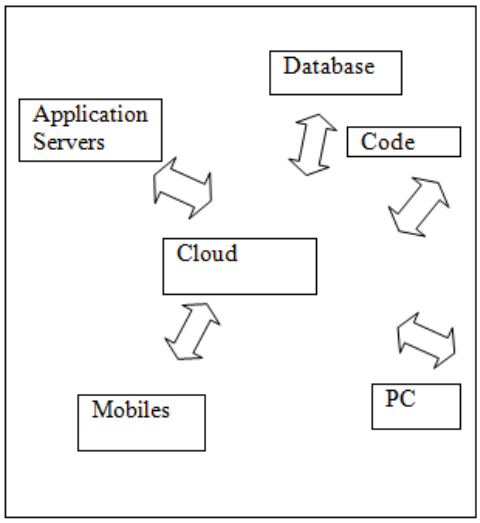

Fig. 1: Cloud computing

IV. CLOUD DEPLOYMENT STRATEGIES

This section explains the basic cloud deployment strategies. A cloud can be deployed using any of the below mentioned strategies.

A. Public Cloud

Public clouds are owned and operated by third parties; they deliver superior economies of scale to customers, as the infrastructure costs are spread among a mix of users, giving each individual client an attractive low-cost, "Pay-as-you-go" model. All customers share the same infrastructure pool with limited configuration, security protections, and availability variances. These are managed and supported by the cloud provider. One of the advantages of a Public cloud is that they may be larger than an enterprises cloud, thus providing the ability to scale seamlessly, on demand.

Example: Amazon, Google Apps, Windows Azure.

B. Private Cloud

Private clouds are built exclusively for a single enterprise. They aim to address concerns on data security and offer greater control, which is typically lacking in a public cloud. There are two variations to a private cloud:

- *On-premise Private Cloud:* On-premise private clouds, also known as internal clouds are hosted within one's own data center. This model provides a more standardized process and protection, but is limited in aspects of size and scalability. IT departments would also need to incur the capital and operational costs for the physical resources. This is best suited for applications which require complete control and configurability of the infrastructure and security.
- *Externally hosted Private Cloud:* This type of private cloud is hosted externally with a cloud provider, where the provider facilitates an exclusive cloud environment with full guarantee of privacy. This is best suited for enterprises that don't prefer a public cloud due to sharing of physical resources.

  Example: eBay

C. Hybrid Cloud

Hybrid Clouds combine both public and private cloud models. With a Hybrid Cloud, service providers can utilize 3rd party Cloud Providers in a full or partial manner thus increasing the flexibility of computing. The Hybrid cloud environment is capable of providing on-demand, externally provisioned scale. The ability to augment a private cloud with the resources of a public cloud can be used to manage any unexpected surges in workload.

V. CLOUD COMPUTING MODELS

Cloud Providers offer services that can be grouped into three categories.

A. Software as a Service (SaaS)

In this model, a complete application is offered to the customer, as a service on demand. A single instance of the service runs on the cloud & multiple end users are serviced. On the customer's side, there is no need for upfront investment in servers or software licenses, while for the provider, the costs are lowered, since only a single application needs to be hosted & maintained. Today SaaS is offered by companies such as Google, Sales force, Microsoft, etc.

B. Platform as a Service (PaaS)

Here, a layer of software or development environment is encapsulated & offered as a service, upon which other higher levels of service can be built. The customer has the freedom to build his own applications, which run on the provider's infrastructure. To meet manageability and scalability requirements of the applications, PaaS providers offer a predefined combination of OS and application servers, such as LAMP platform (Linux, Apache, My sql and PHP), restricted J2EE, Ruby etc. Google's App Engine, Force.com, etc are some of the popular PaaS examples.

C. Infrastructure as a Service (IaaS)

IaaS provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment, data centre space etc. are pooled and made available to handle workloads. The customer would typically deploy his own software on the infrastructure. Some common examples are Amazon, GoGrid, 3 Tera, etc.

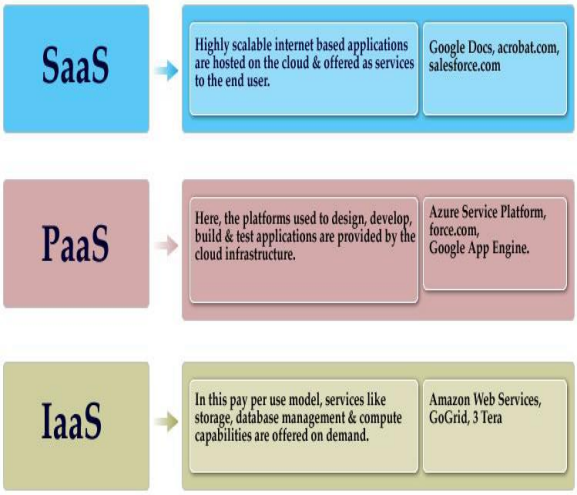

Fig. 2: Cloud model

VI. OPPORTUNITIES

In this section we explain the vast opportunities the cloud computing field offers to IT industry. Cloud Computing is concerned with the delivery of IT capabilities as a service on three levels: infrastructure (IaaS), platforms (PaaS), and software (SaaS). By providing interfaces on all three levels, Clouds address different types of customers [6]:

A. End consumers

These consumers mainly use the services of the SaaS layer over a Web browser and basic offerings of the IaaS layer as for example storage for data resulting from the usage of the SaaS layer.

B. Business customers

These consumers access all three layers – the IaaS layer in order to enhance the own infrastructure with additional resources on demand, the PaaS layer in order to be able to run own applications in a Cloud and eventually the SaaS layer in order to take advantage of available applications offered as a service.

C. Developers and Independent Software Vendors

Independent Software Vendors that develop applications that are supposed to be offered over the SaaS layer of a Cloud. Typically, they directly access the PaaS layer, and through the PaaS layer indirectly access the IaaS layer, and are present on the SaaS layer with their application. In general, for all different kinds of Cloud customers, a Cloud offers the major opportunities known for X-as-a-Service offerings. From the perspective of the user, the utility-based payment model is considered as one of the main benefits of Cloud Computing. There is no need for up-front infrastructure investment: investment in software licenses and no risk of unused but paid software Thus, capital expenditure is turned licenses, and investment in hardware infrastructure and related maintenance and staff. In to operational expenditure.

VII. CHALLENGES & ISSUES

In this section we explain the challenges & issues cloud computing has to face. As a lot of economics is tied to this field it will be better that these issues are resolved as early as possible. Fig. 2 depicts the summary of the survey conducted by us on the basic issues of the cloud computing. The client's primary concern is taken in to account. Hence only the percentage of 4, 5 is being shown. The following are the issues that a cloud computing environment has to still resolve.

A. Security

When using cloud-based services, one is entrusting their data to a third-party for storage and security. Can one assume that a cloud-based company will protect and secure ones data (Cloud computing presents specific challenges to privacy and security. back it up, check for data errors, defend against security breaches) if one is using their services at a very low cost? Or often for free? Once data is entrusted to a cloud based service, which third-parties do they share the information with? Cloud-sourcing involves the use of many services, and many cloud based services provide services to each other, and thus cloud-based products may have to share your information with third parties if they are involved in processing or transferring of your information. They may share your information with advertisers as well. Security presents a real threat to the cloud.

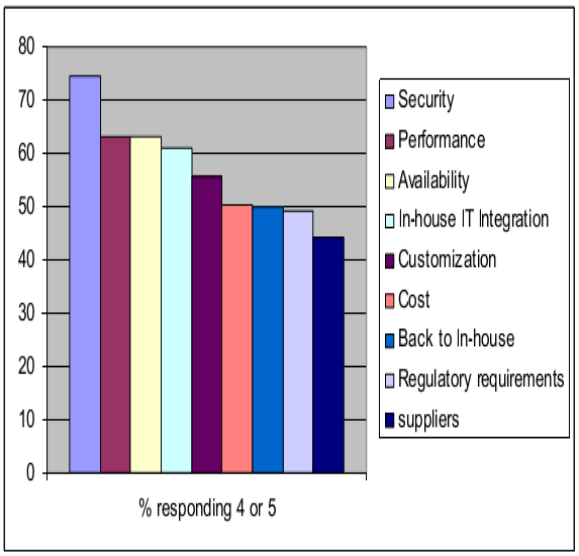

Fig. 3: Graph depicting the concern of clients on cloud computing issues.

	Total Hour	Average Hour	Availability	Cost (USD)
Amadeus	1	0.167	99.998	89,000
Face book	3	0.500	99.994	600,000
Server Beach	4	.667	99.992	400,000
PayPal	5	.833	99.990	1,125,000
Google	5	.833	99.990	1,000,000
Yahoo!	6	1.000	99.989	1,200,000
Twitter	7	1.167	99.987	1,400,000
Amazon	24	4.000	99.954	4,320,000
Microsoft	31	5.167	99.941	6,200,000
Host way	72	12.000	99.863	7,200,000
BlackBerry	72	12.000	99.863	14,400,000
Navistar	168	28.000	99.680	16,800,000
OVH	170	28.333	99.667	17,000,000
Total	568	94.667	99.917	71,734,000

Table 1: Economy Impact Table Due To Cloud Outages

B. Performance

Cloud computing suffers from severe performance issues. The cloud provider must ensure that the performance of the service being provided remains the same all through. There may be peak time break downs, internal flaws, and technical snags arising. Load balancer, data replicators, high end servers must me installed when needed.

C. Availability

Even though cloud promises to be a 24X7X365 service, cloud outages occur frequently. Outages can be scheduled or unscheduled. Table 1 provides details about the downtime in hours and the economic impact of cloud outages of various cloud providers from 2007 to 2012.

D. Cost

Cloud computing can have high costs due to its requirements for both an "always on" connection, as well as using large amounts of data back in-house.

E. Regulatory requirements

What legislative, judicial, regulatory and policy environments are cloud-based information subject to? This question is hard to ascertain due to the decentralized and global structure of the internet, as well as of cloud computing. The information stored by cloud services is subject to the legal, regulatory and policy environments of the country of domicile of the cloud service, as well as the country in which the server infrastructure is based. This is

complicated by the fact that some data in transit may also be regulated.

F. Bandwidth, quality of service and data limits

Cloud computing requires "broadband of considerable speed" Whilst many websites are usable on non-broadband connections or slow broadband connections; cloud-based applications are often not usable. Connection speed in Kilobyte per second (or MB/s and GB/s) is important for use of cloud computing services. Also important are Quality of Service (QoS), indicators for which include the amount of time the connections are dropped, response time (ping), and the extent of the delays in the processing of network data (latency) and loss of data (packet loss).

G. Major suppliers

Only handful providers are available in the market which is still holding back many SME's to join a cloud.

VIII. Conclusion

We've looked at the basics of cloud. There are interests and concerns in the cloud. From a technology point of view, there are interesting technical problems to solve. From a service or consumer point of view, there are essential usability, stability, and reliability problems to solve. We are at a crossroads with cloud technology. On one hand, there are many stories of problems with clouds, from data loss, to service interruption, to compromised sensitive data. To stay relevant, to remain meaningful, to grow in the service space, the cloud providers must step up their game and produce robust cloud implementations. On the other hand, the world is poised to explode with a billion new devices that will be desperate for the very technology that clouds almost offer today. It is possible that the wave of users, applications and demand will just wash over the cloud landscape, regardless of how robust they are. If the cloud providers are too slow to provide safe, secure, reliable data storage and application services, they may miss one of the greatest opportunities of this century.

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