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Cloud Computing Architecture& Services

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Abstract: *With the invention of new technology and the need of data storage cloud computing has become a scalable services in consumption and delivery in the field of Computing. Technically the goals of Cloud Computing include Service-Oriented Architecture (SOA) and Virtualizations of hardware and software. The Cloud Computing is to basically concern with the sharing of resources among the cloud service consumers, partners, and vendors in the cloud value chain. The resource sharing at various levels results in various cloud offerings such as infrastructure cloud, software cloud, application cloud (e.g., Application as a Service), and business cloud (e.g., business process as a service).Using cloud help us sharing the hardware and software resources which reduces the management and resources cost and gives good potential to the business.*

Keywords: *Cloud computing, Cloud Service Models, Service Model Architectures,Cloud Deployment Models, challenges & issues.*

I. Introduction

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].

In recent years, cloud computing as a new kind of advanced technology accelerates the innovation for the computer industry. Cloud computing is a computing model based on networks, especially based on the Internet, whose task is to ensure that users can simply use the computing resources on demand and pay money according to their usage by a metering pattern similar to water and electricity consumption. Therefore, it brings a new business model, where the services it provides are becoming computing resources [2].

Cloud computing is highly scalable and creates virtualized resources that can be made available to users. Users do not require any special knowledge about the concept of Cloud computing to connect their computers to the server where applications have been installed and use them. Users can communicate through Internet with remote servers. These servers can exchange their computing slots themselves [3]. "Comes from the early days of the Internet where we drew the network as a cloud… we didn't care where the messages went… the cloud hid it from us" – Kevin Marks, Google

- First cloud around networking (TCP/IP abstraction)
- Second cloud around documents (WWW data abstraction)
- The emerging cloud abstracts infrastructure complexities of servers, applications, data, and heterogeneous platforms [4].

In this paper will present the basic literature needed to understand the cloud infrastructure and its deployment models. Accordingly the paper is organized into sections, starting with introduction,the details of Cloud Infrastructures, explanation of different deployment models, data security,conclusion and future work.

II. Cloud Computing

Cloud computing gets its name as a metaphor for the Internet. Typically, the Internet is represented in network diagrams as a cloud. The cloud icon represents "all that other stuff" that makes the network work. Cloud computing is an on-demand service model for IT services, often based on virtualization and distributed computing technologies. Cloud computing architectures have:

- Highly abstracted resources.
- Instant scalability and flexibility
- Instantaneous provisioning
- Shared resources like hardware, database, memory, etc.
- 'Service on demand', usually with a billing system
- Programmatic management like through WS API.

We should rush to the cloud because there is valid and significant business and IT reasons for the cloud computing paradigm shift. The fundamentals of outsourcing as a solution apply:

• **Reduced cost:** Cloud computing can reduce both capital expense (CapEx) and operating expense (OpEx) costs because resources are only acquired when needed and are only aid for when used.
• **Refined usage of personnel:** Using cloud computing frees valuable personnel allowing them to focus on delivering value rather than maintaining hardware and software.
• **Robust scalability:** Cloud computing allows for immediate scaling, either up or down, at any time without long-term commitment [5].

III. Categories of Cloud Computing Infrastructure

3.1 Software as a service (SaaS): issoftware offered by a third party provider, available on demand, usually via the Internet configurable remotely that include online word processing and spreadsheet tools, CRM services and web content delivery services (Salesforce CRM, Google Docs, etc). Software as a Service (SaaS) is what traditionally comes to mind when we think of cloud computing (if any part of cloud computing can be considered traditional). In SaaS, an application is hosted by a service provider and then accessed via the World Wide Web by a client. Cloud consumers release their applications on a hosting environment, which can be accessed through networks from various clients (e.g. web browser, PDA, etc.) by application users. Cloud consumers do not have control over the Cloud infrastructure that often employs a multi-tenancy system architecture, namely, different cloud consumers' applications are organized in a single logical environment on the SaaS cloud 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 [6].

3.2 Platform as a service (PaaS): Platform as a Service (PaaS) is another application delivery model. PaaS supplies all the resources required to build applications and services completely from the Internet, without having to download or install software. It allows customers to develop new applications using API deployed and configurable remotely. The platforms offered include development tools, configuration management, and deployment platforms. Examples are Microsoft Azure, Force and Google App engine. PaaS, you have to look at which applications are most appropriate for maintenance on the cloud. It will obviously differ from organization to organization, but you likely won't move your key mission-critical tasks to the cloud. For instance, a company that develops software for healthcare providers is going to have different needs than a financial advisor, for instance. But even within the same industry, different organizations will get different things out of the 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. This requires PaaS, in addition to supporting application hosting environment, to possess development infrastructure including programming environment, tools, configuration management, and so forth. An example of PaaS is Google AppEngine [6].

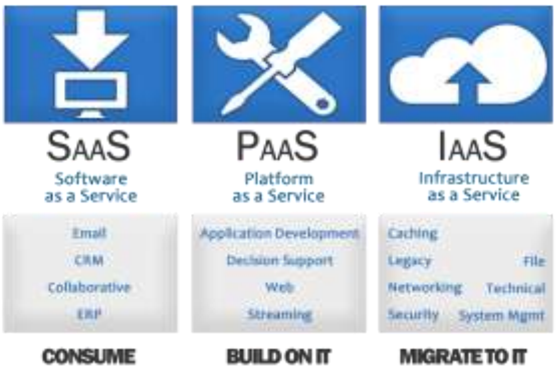

Figure 2: Basic Architectures of Cloud Infrastructure

3.3 Infrastructure as service (IaaS): Itprovides virtual machines and other abstracted hardware and operating systems which may be controlled through a service API. Examples include Amazon EC2 and S3, Terremark Enterprise Cloud, Windows Live Skydrive and Rackspace Cloud. as a Service (HaaS) is the next form of service available in cloud computing. Where SaaS and PaaS are providing applications to customers, HaaS doesn't. It simply offers the hardware so that your organization can put whatever they want onto it.The basic strategy of virtualization is to set up independent virtual machines (VM) that are isolated from both the underlying hardware and other VMs. Notice that this strategy is different from the multi-tenancy model, which aims to transform the application software architecture so that multiple instances (from multiple cloud consumers) can run on a single application (i.e. the same logic machine). An example of IaaS is Amazon's EC2 [6].

3.4 Database as a Services (DaaS): Another service offering that is becoming prevalent in the world of cloud computing is Database as a Service (DaaS). The idea behind DaaS is to avoid the complexity and cost of running your own database. DaaS allows consumers to pay for what they are actually using rather than the site license for the entire database. In addition to traditional storage interfaces such as RDBMS and file systems, some DaaS offerings provide table-style abstractions that are designed to scale out to store and retrieve a huge amount of data within a very compressed timeframe, often too large, too expensive or too slow for most commercial RDBMS to cope with. Examples of this kind of DaaS include Amazon S3, Google BigTable, and Apache HBase, etc. [6], [10].

3.5 DaaS offers following benefits:

- **Ease of use** There are no servers to provision and no redundant systems to worry about. You don't have to worry about buying, installing, and maintaining hardware for the database.
- **Power** The database isn't housed locally, but that doesn't mean that it is not functional and effective. Depending on your vendor, you can get custom data validation to ensure accurate information. You can create and manage the database with ease.
- **Integration** The database can be integrated with your other services to provide more value and power. For instance, you can tie it in with calendars, email, and people to make your work more powerful.
- **Management** Because large databases benefit from constant pruning and optimization, typically there are expensive resources dedicated to this task. With some DaaS offerings, this management can be provided as part of the service formuch less expense. The provider will often use offshore labor pools to take advantage of lower labor costs there. So it's possible that you are using the service in Chicago, the physical servers are in Washington state, and the database Administrator is in the Philippines. Cloud computing either has them too or has the potential to bring them to us. So cloud computing brings us applications, a way of viewing, manipulating, and sharing data. Like their desktop brethren, many "staple" applications exist in cloud computing, but what will differ for you is how you interact with those applications.

IV. Deployment Models

The delivery of virtualized storage on demand becomes a separate Cloud service - data storage service. Notice that DaaS could be seen as a special type IaaS. The motivation is that on-promise enterprise database systems are often tied in a prohibitive upfront cost in dedicated server, software license, post-delivery services, and in-house IT maintenance. DaaS allows consumers to pay for what they are actually using rather than the site license for the entire database. In addition to traditional storage interfaces such as RDBMS and file systems, some DaaS offerings provide table-style abstractions that are designed to scale out to store and retrieve a huge amount of data within a very compressed timeframe, often too large, too expensive or too slow for most commercial RDBMS to cope with.

Cloud computing either has them too or has the potential to bring them to you. So cloud computing brings you applications, a way of viewing, manipulating, and sharing data. Like their desktop brethren, many "staple" applications exist in cloud computing, but what will differ for you is how you interact with those applications. Basically, four cloud deployment models have been defined in the Cloud community:

4.1 Private cloud:

The cloud infrastructure is operated solely within organization, and managed by the organization or a third party regardless whether it is located premise or off premise. The motivation to setup a private cloud within an organization has several aspects. First, to maximize and optimize the utilization of existing in-house resources. Second, security concerns including data privacy and trust Private Cloud an option for many firms. Third, data transfer cost [8] from local IT infrastructure to a Public Cloud is still rather considerable. Fourth, organizations always require full control over mission-critical activities that reside behind their firewalls. Last, academics often build private cloud for research and teaching purposes.

But private clouds have some disadvantages. For example, on-premises IT -- rather than a third-party cloud provider -- is responsible for managing the private cloud. As a result, private cloud deployments carry the same staffing, management, maintenance and capital expenses as traditional data center ownership. Additional private cloud expenses include virtualization, cloud software and cloud management tools[11].

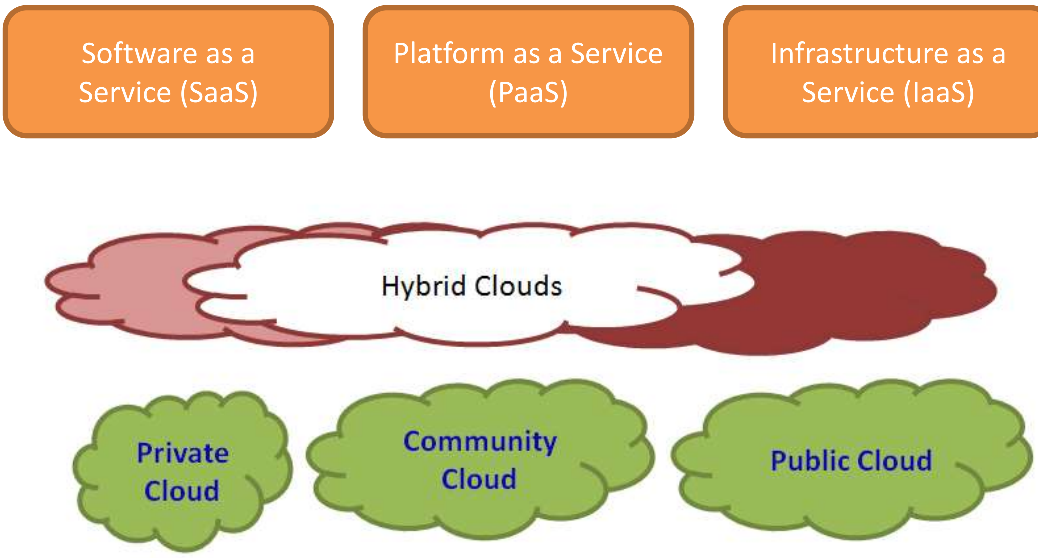

Figure3. Deployment Models

4.2 Community cloud:

Community clouds are a hybrid form of private clouds built and operated specifically for a targeted group. These communities have similar cloud requirements and their ultimate goal is to work together to achieve their business objectives. Community clouds are often designed for businesses and organizations working on joint projects, applications, or research, which requires a central cloud computing facility for building, managing and executing such projects, regardless of the solution rented.

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

4.3 Public cloud

This is the dominant form of current Cloud computing deployment model. The public cloud is used by the general public cloud. Consumers and the cloud service provider has the full ownership of the public cloud with its own policy, value, and profit, costing, and charging model. Many popular cloud services are public clouds which include Amazon EC2, S3, Google AppEngine, and Force.com. The public model offers the following features and benefits:

- **Ultimate scalability** : Cloud resources are available on demand from the public clouds' vast pools of resource so that the applications that run on them can respond seamlessly to fluctuations in activity
- **Cost effective**: Public clouds bring together greater levels of resource and so can benefit from the largest economies of scale. The centralised operation and management of the underlying resources is shared across all of the subsequent cloud services whilst components, such as servers, require less bespoke configuration. Some mass market propositions can even be free to the client, relying on advertising for their revenue.
- **Utility style costing:** Public cloud services often employ a pay-as-you-go charging model whereby the consumer will be able to access the resource they need, when they need it, and then only pay for what they use; therefore avoiding wasted capacity
- **Reliability**: The sheer number of servers and networks involved in creating a public cloud and the redundancy configurations mean that should one physical component fail, the cloud service would still run unaffected on the remaining components. In some cases, where clouds draw resource from multiple data centres, an entire data centre could go offline and individual cloud services would suffer no ill effect. There is, in other words, no single point of failure which would make a public cloud service vulnerable
- **Flexibility**: There are a myriad of IaaS, PaaS and SaaS services available on the market which follow the public cloud model and that are ready to be accessed as a service from any internet enabled device. These services can fulfil most computing requirements and can deliver their benefits to private and enterprise clients alike. Businesses can even integrate their public cloud services with private clouds, where they need to perform sensitive business functions, to create hybrid clouds
- **Location independence**: The availability of public cloud services through an internet connection ensures that the services are available wherever the client is located. This provides invaluable opportunities to

enterprise such as remote access to IT infrastructure (in case of emergencies etc) or online document collaboration from multiple locations.

4.4 Hybrid cloud

The cloud infrastructure is a combination of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds). 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. Hybrid cloud has raised the issues of standardization and cloud interoperability that will be discussed in later sections.
Interestingly, Amazon Web Services (AWS) has recently rolled out a new type of deployment model - Virtual Private Cloud (VPC) , a secure and seamless bridge between an organization's existing IT infrastructure and the Amazon public cloud [6] [9].

V. Challenges & issues in Cloud

Cloud Computing, the long-held dream of computing as a utility, has the potential to transform a large part of the IT industry, making software even more attractive as a service and shaping the way IT hardware is designed and purchased. Developers with innovative ideas for new Internet services no longer require the large capital outlaying hardware to deploy their service or the human expense to operate it. They need not be concerned about over-provisioning for a service whose popularity does not meet their predictions, thus wasting costly resources, or under-provisioning for one that becomes wildly popular, thus missing potential customers and revenue. Moreover, companies with large batch-oriented tasks can get results as quickly as programs can scale, Since using 1000 servers for one hour costs not more than using one server for 1000 hours. This elasticity of resources, without paying a premium for large scale, is unprecedented in the history of IT[14].

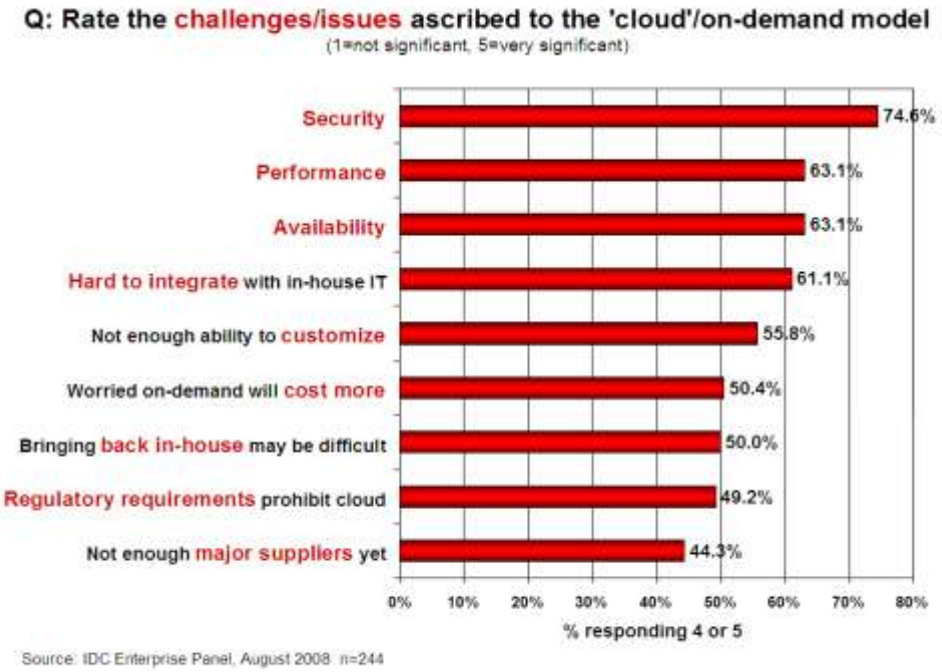

Figure 4 Issues in Cloud

The facets from which the security threat might be introduced into a cloud environment are numerous ranging from database, virtual servers, and network to operating systems, load balancing, memory management and concurrency control (Hamlen et al., 2010). Data segregation and session hijacking are two potential and unavoidable security threats for cloud users. One of the challenges for cloud computing is in its level of abstraction as well as dynamism in scalability

which results in poorly defined security or infrastructural boundary. Privacy and its underlying concept might significantly vary in different regions and thus it may lead to security breach for cloud services in specific contexts and scenarios (Chen & Zhao, 2012). Data loss and various botnets can come into action to breach security of cloud servers. Besides, multi-tenancy model is also an aspect that needs to be given attention

(Kuyoro et al., 2011; Ogigau-Neamtiu, 2012) when it comes to security. Security in the data-centres of cloud providers are also within the interests of security issues, as a single physical server would hold many clients' data (Okuhara, Shiozaki& Suzuki, 2010) making it a common shared platform in terms of physical server or operating system. The storage security at the cloud service providers data centres are also directly linked with the security of the cloud services (Mircea, 2012). All the traditional security risks are thus applicable with added degree of potency in a cloud infrastructure which makes the ongoing success of cloud computing a quite challenging one. Confidentiality, availability and integrity are the generalized categories into which the security concerns of a cloud environment falls. Threats for a cloud infrastructure are applicable both to data and infrastructure (Agarwal&Agarwal, 2011).[15]

VI. Conclusion and Future Work

Cloud computing has recently emerged as a managing and delivering services over the internet. The rise of cloud computing is rapidly changing landscape of Information technology and ultimately turning to the long-held promise of utility computing into a reality. Cloud computing can help communities and nations, can transform education. An entire world of knowledge can now be made available through cloud based services that can be accessed anytime, anywhere, from any device. By helping countries worldwide, lowering the cost and simplifying the delivery of educational services, cloud computing enables the people across the globe to acquire the 21st-century skills and training they need to compete and succeed in the global information society.
Present economic situation will force different educational institutions and organizations to consider adopting a cloudsolution. Universities have begun to adhere to this initiative and there are proofs that indicate significant decreasing of expenses due to the implementation of cloud solutions. The aim of our work was to identify an architecture which will beusing Cloud Computing within higher education. Mainly, we have considered the benefits of cloud architecture. Futureresearch will include a study regarding the attitude and strategy for migration to the proposed architecture based onclouds.

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