AN ASSESSMENT OF CLOUD COMPUTING: EVOLUTION

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Abstract

In this present work we have given a concise and systematic study of evolution of cloud computing from shared web hosting to public cloud computing along with multi clouds based on a wide spectrum of factors which include scalability, availability and performance. The proposed work studies hosting types and aims to promote the use of single and multi-clouds to reduce the risks. Cloud computing is a multi-paradigm technology which has evolved as a cost effective, flexible, performance oriented infrastructure for agile development of business operations. Cloud computing changes the way we think about computing by decoupling data processing, data retention, and data presentation – in effect, divorcing components from location. Today due to the need of hour and security constraints, single cloud computing is transforming to multi cloud computing. Focus has been done on Multi cloud which is also known as "inter cloud" or "cloud of clouds" which reduces the security risks like failure of service availability, data loss and confidentiality breaches that are drawbacks with single cloud.

Keywords: Cloud Computing, Evolution, Hosting Types, Multi cloud

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1. INTRODUCTION

Cloud computing enables a ubiquitous, easily accessible and an on demand infrastructure for sharing a resource pool of services. The characteristics of cloud computing includes: - on demand self-service, broad network access, resource pooling, rapid flexibility and measured performance. The consumers and industry have an extensive dependence on cloud computing in which security is a major issue. Cloud security is multi paradigm and includes computer security, information security and network security. Cloud computing in its real sense came into existence in October 2007, when IBM and Google collaborated and gave the concept of "Blue Cloud". The use of cloud computing has increased rapidly in many organizations. Cloud computing provides many benefits in terms of low cost and accessibility of data.[1] Ensuring the security of cloud computing is a major factor in the cloud computing environment, as users often store sensitive information with cloud storage providers but these providers may be untrusted. Dealing with "single cloud" providers is predicted to become less popular with customers due to risks of service availability failure and the possibility of malicious insiders in the single cloud. A movement towards "multi-clouds" or in other words, "inter clouds"or"cloud-of-clouds has emerged recently. In the paper we have discussed the evolution of cloud computing and laid emphasis on the emergence of multi clouds. The following section highlights a brief review of cloud computing. The remaining sections are organized as follows. In Section III discussion about Evolution of Cloud Computing is made. Section IV deliberates on Benefits and Challenges of Cloud Computing. Section V focuses on Evolution of Single to Multi cloud. Section VI presents the Results and Section VII presents the Conclusion.

2. REVIEW OF LITERATURE

This review surveyed the existing literature using a principled and systematic approach. The U.S. National Institutes of Standards and Technology defines cloud as" Cloud Computing is a model for enabling convenient, on demand network access to a shared pool of configurable computing resources(e.g. Networks, services, storage and applications) that can be rapidly provisioned and released with a minimal management effort or service provider interaction. This cloud model promotes availability and is composed of five essential characteristics, three delivery models and four deployment models." [1].Following are the factors which lead to the evolution of cloud computing: [2]

1. **Scalability**: The number of resources that are needed to be accessed by a wide range of users having varied requests is increasing day by day. This lead to the evolution of cloud computing.
2. **Heterogeneity:** Together with the number of devices, the range of types of resources currently increases significantly.
3. **Economic Reasons**: the business models around the IT service and resource provisioning have changed drastically over recent years, moving away from onetime license fees and licensing models tied to individual users or machines, to flat rates and free or low cost online applications.

4. **Mobility**: in the modern, globalized economy and with modern smart phones and powerful mobile devices, a growing demand for online availability, accessibility to data, mobile office like working environments etc. is notable.

Cloud services are usually divided in the three main types which are:

1. **Software as a Service (SaaS):** SaaS clients rent usage of applications running within the Cloud's provider infrastructure, for example Sales Force. The applications are typically offered to the clients via the Internet and are managed completely by the Cloud provider.

2. **Platform as a Service (PaaS):** PaaS Cloud providers offer an application platform as a service, for example Google App Engine. This enables clients to deploy custom software using the tools and programming languages offered by the provider. Clients have control over the deployed applications and environment-related settings.

3. **Infrastructure as a Service (IaaS):** IaaS delivers hardware resources such as CPU, disk space or network components as a service. These resources are usually delivered as a virtualization platform by the Cloud provider and can be accessed across the Internet by the client with the client having full control of the virtualized platform. Deploying cloud computing can differ depending on requirements in four deployment models which have been identified each with specific characteristics that supports the needs of services and users of the clouds. These are: public, private, community and hybrid clouds.
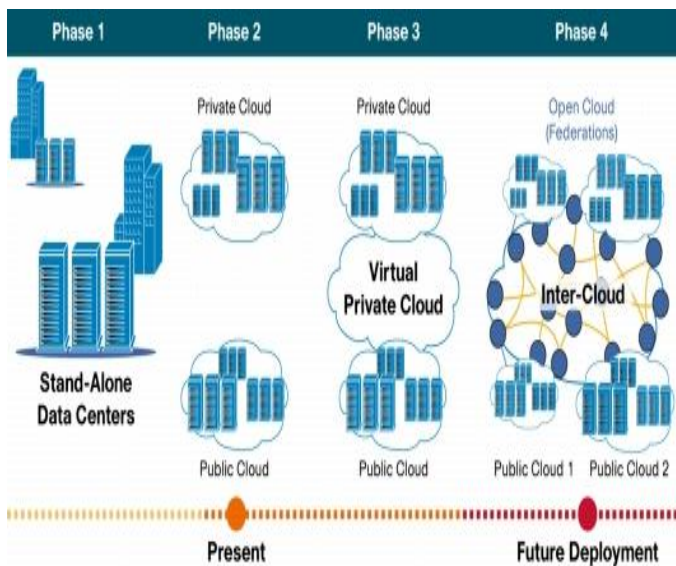
Fig-1: Types of Cloud

3. EVOLUTION OF CLOUD COMPUTING

The trend toward cloud computing started in the late 1980s with the concept of grid computing when, for the first time, a large number of systems were applied to a single problem, usually scientific in nature and requiring exceptionally high levels of parallel computation. The objective of Cloud computing is the newest name for what has been around since the mid-90s as "on-demand infrastructure." In 1995, it was known as "Shared Web Hosting" and had limited features such as multi-tenant, automated provisioning, easy-to-use interface. In 1998 VPS Hosting became available – this web host improved by having partial infrastructure demand and resource size flexibility. 1997 brought Dedicated Hosting, both managed and unmanaged. [3] This type of automated computing had dedicated servers with promises of full administrative access.[4] The 2000s was when automated computing came in the form of Grid /utility computing and had full infrastructure demand and multi-tenant, partial resource size flexibility and automated provisioning came closer to what is known as "cloud today". From 2012's through today the cloud computing has gathered a wide spectrum of audience making it more scalable, flexible and performance oriented. [5]

1. *Shared Web Hosting* – Shared web hosting service or virtual hosting service or derive host refers to a web hosting service where many websites reside on one web server connected to the Internet. Each site "sits" on its own partition, or section/place on the server, to keep it separate from other sites. This is generally the most economical option for hosting, as many people share the overall cost of server maintenance

2. *VPS Hosting* – A virtual private server (VPS) is a virtual machine sold as a service by an Internet hosting service. A VPS runs its own copy of an operating system, and customers have super user-level access to that operating system instance, so can install almost any software that runs on that OS. For many purposes they are functionally equivalent to a dedicated physical server, and being software defined are able to be much more easily created and configured. [6]

3. *Dedicated Hosting*– It is software installed on a separate virtual server to manage the end user connections with the virtualized desktops. A dedicated hosting service, dedicated server, or managed hosting service is a type of Internet hosting in which the client leases an entire server not shared with anyone else. This is more flexible than shared hosting, as organizations have full control over the server(s), including choice of operating system, hardware, etc. There is also another level of dedicated or managed hosting commonly referred to as complex managed hosting.[7]

4. *Grid computing*- Grid computing is the collection of computer resources from multiple locations to reach a common goal. What distinguishes grid computing from conventional high performance computing systems such

as cluster computing is that grids tend to be more loosely coupled, heterogeneous, and geographically dispersed. Although a single grid can be dedicated to a particular application, commonly a grid is used for a variety of purposes. Grids are often constructed with general purpose grid middleware software libraries.

5. *Public Cloud Computing-* In Public clouds the cloud infrastructure is available to the public on a commercial basis by a cloud service provider. This enables a consumer to deploy and develop a service in the cloud with a very little financial outlays compared to other deployment models. Private cloud incorporates specific services and is maintained and deployed for a specific organization. In Community cloud the cloud infrastructure is shared among a number of organizations with similar interests and requirements. The Hybrid cloud comprises of a number of clouds of any type but the clouds have the ability through their interfaces to allow data or applications to be moved from one cloud to another. How to access data in single cloud using one of these four deployment methods or a combination is shown in fig 2.

6. *Multi clouds-* Multi cloud computing is a new dimension in cloud computing which is the concurrent use of two or more cloud services to minimize the risk of widespread data loss or downtime due to localized component failure in a cloud computing environment as shown in fig 3. A multi cloud approach can offer not only the hardware, software and infrastructure but redundancy necessary to optimize fault tolerance.
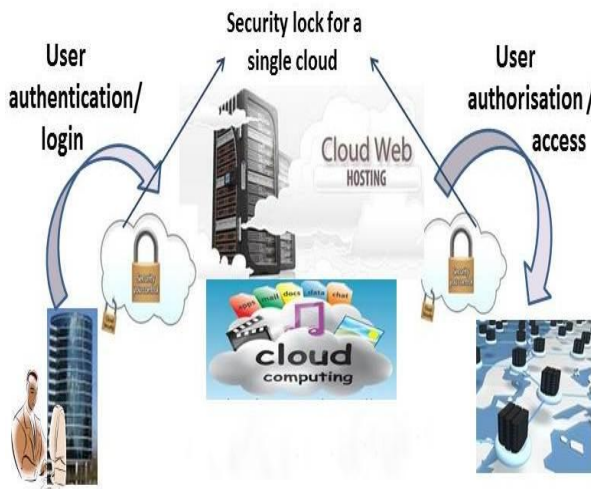

Fig-2: Accessing data in single cloud

Fig-3: Accessing data in multi-cloud

4. BENEFITS AND CHALLENGES

Organizations pay for the usage of cloud which is carefully monitored and measured — in past managed services models, it was difficult to see actual results based on IT spending centralized computing resources, within the cloud provider, are managed by fewer personnel with heavy use of automation and consistent processes resulting in lower cost to the consumers. Consuming organizations do not need a sophisticated IT staff which is expensive, hard to find transition of work for a cloud provider. This improves quality, maintainability, security, and reduces cost to the consumers of cloud. [8] Numerous legacy IT integrators are claiming to provide cloud solutions but are essentially still legacy managed service providers. Organizations have significant legacy computing resources (servers, data centers, and IT personnel) that will need to be transitioned or eliminated in order to achieve true cost savings and flexibility provided by cloud providers/services. Mission critical applications that are core to the business or the consuming organization must be transitioned to the cloud. This is neither quick nor easy, and will take some time. Businesses need to evaluate whether their custom/legacy application is truly needed and worth the re-investment budgeting for cloud services is a challenge to some commercial and government organizations. Existing procurement policies may need to be adapted. Following are the major challenges to cloud computing which encompass lack of ownership of data, Overdependence, Information Security, Privacy, Availability, Performance, Data Migration and Stability of Provider. [9]

5. EVOLUTION OF SINGLE TO MULTI-CLOUD

This section provides brief summary review of prior works on cloud computing with respect to security. Cloud computing security was explored in single cloud environment [10]. Service availability was focused in [11] in single cloud environment. Multi-shares with secret sharing algorithm was proposed in [12] for cloud security and data integrity. Cloud security was explored using cryptographic methods [13]. The security risks addressed include service availability, data

intrusion, and data integrity. The solution used cloud storage and multi-clouds. In [14] a survey has been made to know security issues and solutions with respect to single cloud. RACS and RAID kind of techniques were used for cloud security using multi-clouds [15]. Client centric distributed protocols were explored for data integrity with multi-clouds usage [16].Service availability problem was focused in single cloud environment. [17] There was discussion about cloud security issues [18]. Cryptography is used to protect cloud data in single cloud environment [19]. A security mechanism by name "Depot" is used to single cloud environment [20]. A security mechanism by name "Venus" was proposed in [21] which focused on data integrity issue in single cloud environment. In [22] a survey is made on cloud security. In [23] cloud data integrity is focused in single cloud environment. In [24] a new security mechanism was proposed by name "HAIL" for improving service availability in multi-cloud environment. In [25] a survey was done on cloud data integrity in multi-cloud environment. Encrypted cloud VPN technique is used in [26] for data integrity in multi-cloud environment. Cloud security was discussed in [27] in single cloud environment. TCCP techniques for cloud data integrity issues and service availability were presented in [28] in single cloud environment tokens and erasure codes were used in [29] to ensure cloud data integrity in single cloud environment. PDP schemes were used to protect data integrity in clouds.
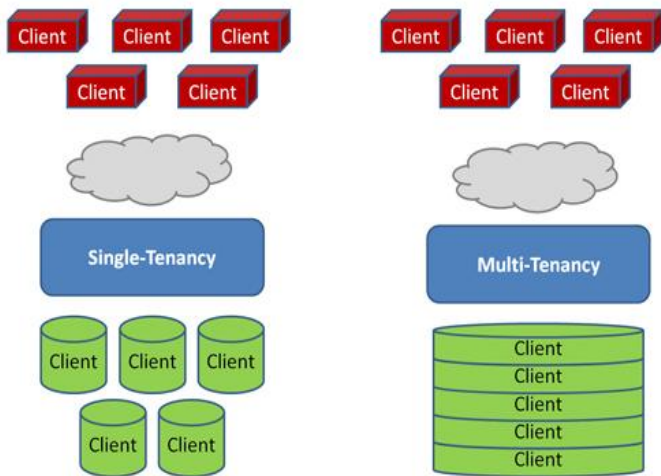

Fig-4: Multi-Tenancy of Cloud Computing

For ensuring more security in cloud environment, we can use data encryption. If the data is distributed in multi cloud. Environment as well as it is encrypted, we can protect our data in even better way. The data which is uploaded by the user can be encrypted first and then we can store it on the cloud server which is shown in fig: 5 and fig: 6. this will be helpful in providing two-way security to the customer's data. To store the data in multi-cloud environment the symmetric key or secret key algorithms are the best choice. Symmetric key

algorithm is also known as the secret key encryption. It is a cryptographic technique in which both the sender and receiver of data use the same key for the purpose of encryption and decryption of data. Symmetric key algorithms are suitable for storing data in cloud multi cloud, as user should be able to access his data easily.
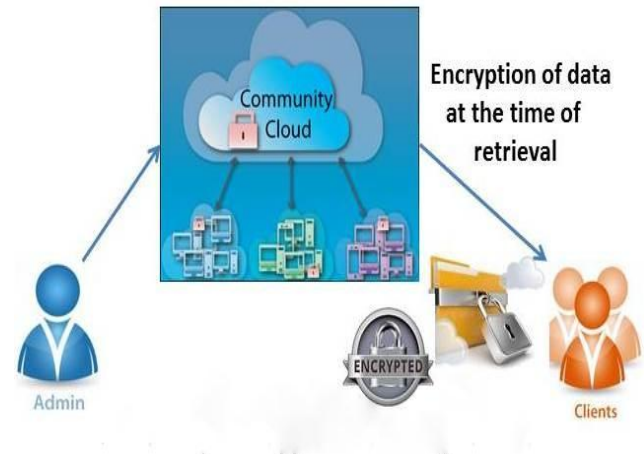

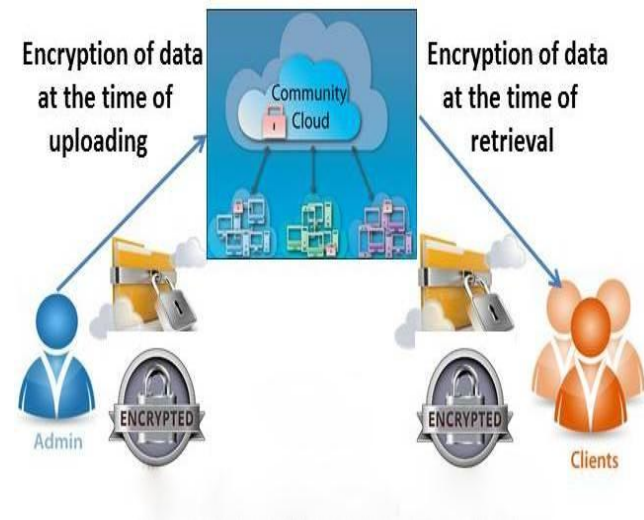**Fig-5:** One way encryption in single cloud

Fig-6: Two way encryption in multi-cloud

6. RESULTS AND DISCUSSION

This work takes notes of the critical analysis of various features provided by hosting types that includes Infrastructure on Demand, Resource Size Flexibility, Multitenant, and Application on demand, Network Flexibility, Automated Provisioning, Scalability, Billing Type and Easy to use Interfaces. Thus giving us the advantages of one type of hosting over another and the advent of the concept of cloud.

In Traditional Hosting there are controlled environment and power and forms parts of foundation of cloud computing. As

compared to shared web hosting on the cloud hosting our data is hosted not on one but on several servers connected to work as one. The VPS servers are less efficient since they allocate a guaranteed amount of resources to each client that can never be rerouted to others. In Dedicated hosting unlike cloud computing the web hosting still owns the machines and has to monitor the performance of the server ensuring uninterrupted work flow of server .In Grid computing all machines process different parts of a larger task.

The advantages of cloud computing over traditional hosting are cloud computing is sold on demand typically as pay per lease or leased service. Users are able to control and budget costs more efficiently. Users determine how much of the service they wish to use typically at the enrolment time or by changing configuration dynamically through a web administered interface. Users can typically access the service from any location. User services are managed and provided by cloud services. Table 1 depicts the various hosting types along with their year of evolution and a comparison of the various features and infrastructure provided by these hosting services.

Table-1: Evolution Of cloud Computing

S NO.	FEATURES	HOSTING TYPES					
1	Services	Shared web Hosting	VPS hosting	Dedicated Hosting	Grid/utility Hosting	Public Cloud Computing 1.0	Public Cloud Computing 2.0
2	Year	1995 to today	1998 to today	1999 to today	2007 to 2010	2006 to today	2012 to today
3	Infrastructure on Demand	No	Partial	No	Yes	Yes	Yes
4	Resource Size Flexibility	No	Partial	No	Partial	Partial	Fully Customizable
5	Multi-tenant	Yes	Yes	No	Yes	Yes	Yes
6	Application on Demand	Yes, Sometimes	No	No	No	No	Sometimes
7	Network Flexibility	No	No	No	No	No	Yes

8	Automated Provisioning	Yes	Yes	Sometimes	Sometimes	Yes	Yes
9	Scalable	No	No	No	Partial	Partial, Horizontally	Partial, Vertical, Horizontal
10	Billing type	Monthly	Monthly, Quarterly, Annually	Monthly, Quarterly	Monthly, Quarterly, Annually	Hourly	Minute
11	Easy to use interface for controlling resources	Yes	Sometimes	Sometimes	Rarely	Partially	Full Drag and Drop Control

7. CONCLUSIONS AND FUTURE SCOPE

Cloud hosting is reliable, easily scalable and affordable hosting solution that differs from traditional hosting solutions in many aspects. Cloud computing is promising paradigm for IT services as computing utilities. This approach has several advantages over the traditional web hosting services and grid computing including higher security, lesser costs, better efficiency, and simplified data storage. It is clear that although the use of cloud computing has rapidly increased; cloud computing security is still considered the major issue in the cloud computing environment. Customers do not want to lose their private information as a result of malicious intruders in the cloud. Furthermore, data intrusion leads to many problems for the users of cloud computing. The purpose of this work is to survey the recent research on single clouds and multi-clouds to address the security risks and solutions. We have found that much research has been done to ensure the security of the single cloud and cloud storage whereas multi clouds have received less attention in the area of security. We support the migration to multi-clouds due to its ability to decrease security risks that affect the cloud computing user.

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