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Critical Analysis Of Cloud Computing And Its Advantages Over Other Computing Techniques

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***Abstract*—Cloud computing is the process of hosting data, information and resources remotely to enable organization quickly and effectively access the information and resources in almost real-time basis. However, it is an indisputable fact that the traditional Internet service delivery helps people to access data from the internet through certain rules known as the internet protocols. These data transmissions or receptions by the host computers that are connected to the Internet are made possible through the internet protocols. These protocols, such HTTP, TCP/IP etc determine how data can be sent over the network. But, the security of these infrastructures (hardware and software) on the network and the organization data are not guaranteed as they are merely being controlled by the local administrators. There is need for a periodic Backing up of data in this type of setting as failure to do so will entail running multiple servers and could spell doom to already stored data in the event of any disaster. Moreover, the other challenges of this technology are security threats, cost of acquiring the internet facilities and cost of updating hardware and software as at when due. In order to allay the fears already mentioned, there is need for an alternate technology that will ensure the safety of organizational, individual and classified information. However, in this paper after due considerations and thorough research on the problem at hand, we are able to come up with an alternate technology that can address the already enumerated drawbacks of the traditional internet services; that is the Cloud Computing Infrastructure. Cloud Computing embodies in itself three services, which are; infrastructure as a service (IaaS), Platform as a service (PaaS) and software as a service (SaaS). These services could solve the problems of cost implication involved in establishing internet/traditional computing. The unlimited storage and backup benefits of cloud computing are also x-rayed. Other types of computing like grid computing, distributed computing, cluster computing and Internet/traditional computing were also analyzed and we are able to establish that cloud computing has advantages of saving cost, a better backup facility and easy of updating.**

Keywords*—Cloud Computing, Protocol, infrastructure, platform, traditional computing, distributed computing

1. Introduction

1.1. Background of the Study

There are different types of computing technologies. We have grid computing which has the ability to manage and organize resources and service that are distributed across several control domains, utility protocols and interfaces and supply high quality services (Foster I et al 1999). In this technology, these resources and services that are distributed across several control domains are acquired, managed and maintained by an organization locally. Cluster computing is another computing type where computers are linked together so that it appears as if it is a single computer. The components of clusters are connected to each other through fast local area networks. Clusters are usually deployed to improve performance over o single computer. In cluster computing, the problem of cost and management of the resources are still done locally. Lastly before cloud solution is Internet computing. In this traditional computing environment for internet usage, the set up includes the servers, routers, switches hubs and computers and all policies, access control and security is handled in-house. The infrastructure is on-site and all aspects of security are left to the local administrators, from updates to audits to backups. (Lon D. 2000). The problem of cost of acquiring facilities to meet up with an organizational IT requirement, security of data and meeting with the demand of increasing storage and cost implication of keeping with the state of the art technology. Hence the need for this paper which clearly treats cloud computing that proffers solutions to the above mentioned drawbacks of all other computing technologies. Cloud computing is simply the provision of hardware and software on the Internet as a third party service. Typically it gives access to advanced software application and high – end networks of server. Cloud computing is an On-demand computing service offered by providers like Microsoft, Amazon and Google, (Kousik D. et al 2013). It enables computing infrastructure to be used by individual and organizations to access applications and other resources anywhere in the world on – demand. The providers or service providers offer software and

storage as a service. Cloud computing system makes computing activities to be more scalable, reliable and efficient. Individual and organizations need not to spend on providing storage devices as it has been provided by the service providers on the cloud. This platform that enable people to use services provided from cloud or develop applications that run in the cloud are referred to as platform as a service (PaaS) or on – demand platform. (David Chapell 2008).

1.2 Aim of this Paper:

The aim of this research is to explore issues relating to cloud computing with the view of comparing it with other computing infrastructures. This is to enable us come up with a good analysis of what the systems are all about, with the intention of projecting the right information about the system and to x-ray the gap which cloud computing come to close as a better computing technique over other computing techniques.

2. Literature Review

2.1 Overview of Cloud Computing

Cloud computing is the delivery of computing services over the Internet. Cloud services allow individuals and businesses to use software and hardware that are managed by third parties at remote locations. Examples of cloud services include online file storage, social networking sites, webmail, and online business applications. The cloud computing model allows access to information and computer resources from anywhere that a network connection is available. Cloud computing provides a shared pool of resources, including data storage space, networks, computer processing power, and specialized corporate and user applications. The cloud makes it possible to access information from anywhere at any time. While a traditional computer setup requires the user to be in the same location as your data storage device, the cloud takes away that step. The cloud removes the need for user to be in the same physical location as the hardware that stores their data. Your cloud provider can both own and house the hardware and software necessary to run your home or business applications. However, according to NIST definition, 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. This cloud model promotes availability and is composed of five essential characteristics, three service models, and four deployment models

2.2 The Concept of Cloud

According to Rajkumar B., James B. & Andrzej G. (2011), Cloud Computing is the process of hosting data, information and resources remotely to enable organization quickly and effectively access the information and resources in almost real-time basis. Because of the increased demand for data and resources access in cloud computing, the requirements for higher storage system (both in size and performance) have increased. Designers of file system continue to seek for better architecture to facilitate system scalability. In cloud computing, device intelligence is leveraged to provide reliable, scalable and high performance file services in a dynamic cluster environment. The storage platform for OpenStack cloud computing is all about Infrastructure as a service (IaaS), which include Software as a service (SaaS) and Platform as a service (PaaS).

Figure 1: The diagram of cloud computing infrastructure
Source: http://greatsaleroom.com/computing

2.3 Cloud Computing Compared With Other Types of Computing

2.3.1 Internet Computing

In a traditional computing environment for internet usage, the set up includes the servers, routers, switches, hubs and computers and all policies, access control and security that are connected to interacted with each other over a network but are managed and maintained in-house. The infrastructure is on-site and all aspects of security are left to the local administrators, from updates to audits to backups. (Lon D Gowen 2000). Cloud computing is a computing paradigm where computing is moved away from personal computers or an individual application server to a “cloud” of computers. Users of the cloud only need to be concerned with the computing service being asked for, as the underlying details of how it is achieved are hidden. This method of distributed computing is done through pooling all computer resources together and being managed by software rather than a human.

Figure 2: The diagram of Internet computing Infrastructure
Source:
http://greatsaleroom.com/computing#sthash.HHpAekpl.dpuf

2.3.2 Cluster Computing

In this computing technology, computers are linked together, working together closely so that in many respects they form a single computer. The components of a cluster are commonly, but not always, connected to each other through fast local area networks. Clusters are usually deployed to improve performance and/or availability over that provided by a single computer, while typically being much more cost-effective than single computers of comparable speed or availability, but unlike cloud computing the devices involved are bought and maintained by the individual or organization.

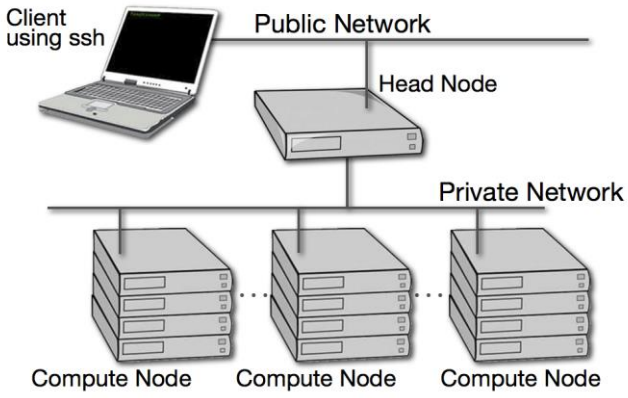

Figure 3: The diagram of cluster computing Infrastructure
Source:
http://www.udel.edu/it/research/training/config_laptop/images/

2.3.3 Distributed Computing

A method of computer processing in which different parts of a program are run simultaneously on two or more computers that are communicating with each other over a network. Distributed computing is a type of segmented or parallel computing, but the latter term is most commonly used to refer to processing in which different parts of a program run simultaneously on two or more processors that are part of the same computer. While both types of processing require that a program be segmented—divided into sections that can run simultaneously, distributed computing also requires that the division of the program take into account the different environments on which the different sections of the program will be running. For example, two computers are likely to have different file systems and different hardware components. L. M. Vaquero, L. R. Merino, J. Caceres, M Lindner. (2009).

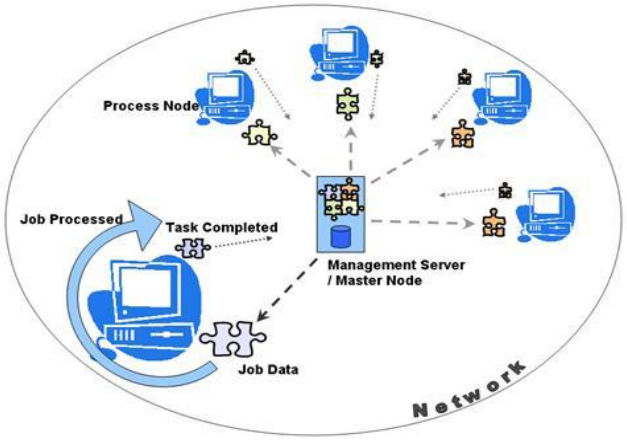

Figure 4: The diagram of distributed computing infrastructure
Source:
http://www.streaming.ug.edu.gt/mediawiki/images/

2.3.4 Utility Computing

Conventional Internet hosting services have the capability to quickly arrange for the rental of individual servers, for example to provision a bank of web servers to accommodate a sudden surge in traffic to a web site. “Utility computing” usually envisions some form of virtualization so that the amount of storage or computing power available is considerably larger than that of a single time-sharing computer. Multiple servers are used on the “back end” to make this possible. These might be a dedicated computer cluster specifically built for the purpose of being rented out, or even an under-utilized supercomputer. The technique of running a single calculation on multiple computers is known as distributed computing.

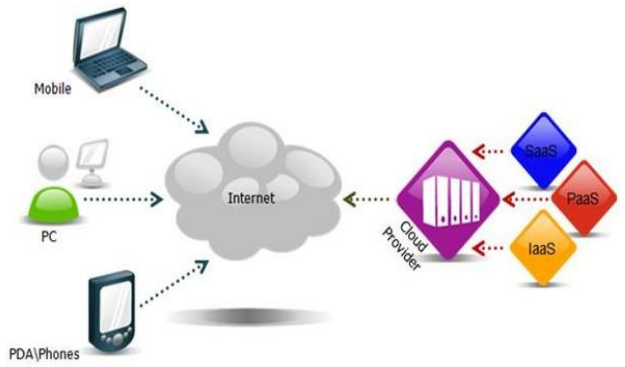

Figure 5: The diagram of utility computing infrastructure
Source:http://www.cdn2-b.examination.com/sites/default

2.3.5 Grid Computing

Multiple independent computing clusters which acts like a "grid" because they are composed of resource nodes not located within a single administrative domain. It offers an online computation or storage as a metered commercial service, known as utility computing, computing on demand, or cloud computing. It creates a "virtual supercomputer" by using spare computing resources within an organization.

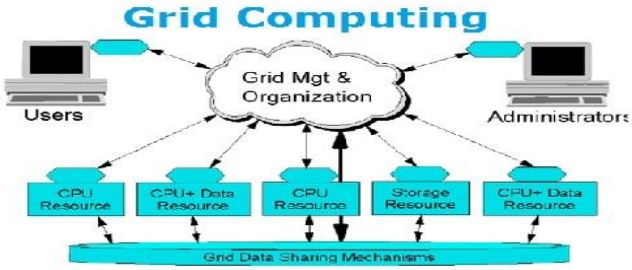

Figure 6: The diagram of grid computing infrastructure
Source: http://www.assignmenthelp.net/grid-computing-assignment-help

3. Cloud Computing Models

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

1. 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 customers' 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 is needed to be hosted & maintained. Today SaaS is offered by companies such as Google, Salesforce, Microsoft, Zoho, etc.

2. 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 Operating System and application servers, such as LAMP platform (Linux, Apache, MySql and PHP), restricted J2EE, Ruby. Google's App Engine, Force.com, etc are some of the popular PaaS examples.

3. Infrastructure as a Service (IaaS): IaaS provides basic storage and computing capabilities as standardized services over the network. Servers, storage systems, networking equipment 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.

3.1 Understanding Public, Private and Hybrid Clouds

Enterprises can choose to deploy applications on Public, Private or Hybrid clouds. Cloud Integrators can play a vital part in determining the right cloud path for each organization.

3.1.1 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. Some examples include services aimed at the general public, such as online photo storage services, e-mail services, or social networking sites

3.1.2 Private Cloud

Private clouds are built exclusively for a single enterprise. The aim is 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.

3.1.3 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. It is therefore is a combination of different methods of resource pooling, NIST (2010).

3.2 Cloud Computing Implementation Architecture

According to Mell, Peter et al, (2011), the Storage Platform for Open stack cloud computing is about clouds and public Infrastructure as a Service (IaaS). In fact, Cloud computing architectures tend to focus on a common set of resources that are virtualized and exposed to a user on an on-demand basis. These resources include compute resources of varying capability, persistent storage resources, and configurable networking resources to tie them together in addition to conditionally exposing these resources to the Internet.

Table 1. OpenStack projects and components

Project	Component	Description
Horizon	Dashboard	User and admin dashboard
Nova	Compute/block device	Virtual servers and volumes
Glance	Image service	VM disk images
Swift	Storage as a Service	Object storage
Quantum/ Melange	Networks	Secure virtual networks

3.3 Characteristics of Cloud Computing

The characteristics of cloud computing include on-demand self service, broad network access, resource pooling, rapid elasticity and measured service. On-demand self service means that customers (usually organizations) can request and manage their own computing resources. Broad network access allows services to be offered over the Internet or private networks. Pooled resources means that customers draw from a pool of computing resources, usually in remote data centres. Services can be scaled larger or smaller; and use of a service is measured and customers are billed accordingly.

3.4 Applications of Cloud Computing

Cloud computing is used to deliver applications down to your system through resources viewing, manipulating, and sharing data. Like desktop applications, many "staple" applications exist in cloud computing, but the difference is in terms of how they interact with those applications. The most common are storage and database. However, in this section, we shall consider data storage and database functionalities as it regard to cloud computing.

4. Cloud Storage System

4.1 Database

Databases are repositories for information with links within the information that help make the data searchable. Distributed databases, like Amazon's SimpleDB, spread information among physically dispersed hardware. But to the client, the information seems to be located in one place. The advantages of cloud database include the following:

- **Improved Resources Availability:** If there is a fault in one database system, it will only affect one fragment of the entire information, not the entire database.
- **Improved performance:** Data is located near the site according to their rate of demand while the database systems are parallelized, which allows the load to be balanced among the servers.
- **Price:** It is less expensive to create a network of smaller computers with the power of one large server.
- **Flexibility:** Systems can be changed and modified without harm to the entire database. It is very easy to implement in any system

5. Discussion

The main difference in cloud computing and Internet computing is the way they are managed. In a cloud setting, the infrastructure is set up and maintained by a third party, meaning that a company or organization keeps data, runs programs and services on servers that are not owned and maintained by their own employees. In Internet computing, it is managed by employees of the company and there is usually an Information Technology department consisting of System administrators, technicians, and network specialists. This difference is one of the main concerns in cloud computing today which cloud computing wishes to address. It is therefore worthy to note that Cloud Computing is a term that doesn't describe a single thing – rather it is a general term that sits over a variety of services from Infrastructure as a Service at the base, through Platform as a Service as a development tool and through Software as a Service replacing on-premise applications. This paper however, in clear terms, have been able to explain what this system is all about, the infrastructures involved and also compared it with other computing platforms.

CONCLUSION

For organizations seeking to move to Cloud Computing, it is important to understand the different aspects of Cloud Computing and to assess their own situation and decide which types of solutions are appropriate for their unique needs. It is therefore

pertinent to note that Cloud Computing is a rapidly accelerating revolution within IT and will soon become the default method of IT delivery– organizations are advised to consider their approach towards beginning a move to the Clouds sooner, rather than later.

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