

Cloud Computing: A Tool for Industrial and Educational Service Delivery

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Abstract

Cloud computing has utilized the coherent principles of internet connectivity features and infrastructure in bridging the divided world of resources and applications. It has also broken the barriers faced in the traditional system of computing where infrastructures, resources and applications work on a standalone machine which are subjected to manipulations. The advent of cloud has made it possible for information/data to be accepted, manipulated and produced in real time for effective use without prior knowledge of the end users. Therefore, this paper reviews its concept, model, usage and application. It goes beyond a review to unveil the architectural view of cloud system by way of placing more emphasis on the intermediate end of the architecture, often not discussed in literature.

Keywords: infrastructure, cloud, model, resources and structural design

1.0 Introduction

Synchronization of various hardware resources and applications via internet has made thousands of computer users to become much more interested in the use of cloud system. Cloud Computing involves the reduction of total sum of money required in purchasing hardware's, peripherals, software's or infrastructures. The cloud usage helped potential/current establishment to cut cost in the amount that could have been spent on the traditional method of computing whereby an establishment tend to have all computing gargets for easy/smooth running of its operations. The cloud usage which is called "consumption" is all about exploiting infrastructures which are logically link by a common connectivity model and it is frequently billed on utility/service (DSTV Subscription), this means that all users have the obligation/mandate to take a work whenever they find it deem fit. There are necessary legal right binding both parties, they can terminate their contract at any given time and are often covered by terms and conditions of service agreements (TCSA). This agreement helped to reduce the tensions associated with risk irrespective of the parties involved and then decreased the level of doubt and ensured continuous flow of services and money exchange. Some policies that helped to protect user's right were exhaustively discussed in RAND Corporation [1]. Cloud computing gained more emphasis when some companies realized that time and energy exerted in the traditional system of computing yield lesser result due to large amount of data processed and manipulated on a daily basis.

The increased degree of connectivity and the increasing amount of data has led many service providers and in particular data centre's to employ larger infrastructures with dynamic load and access balancing by distributing and replicating data across servers on demand [2]. This work explained that the use of cloud computing has gone beyond rendering of services that are not meeting users demand (Users Friendly) therefore creating harmonious flow of data replications and manipulations

Cloud holds its beginning to an opened speech made by John McCarthy in [3] on computing time sharing becoming a utility from the provisions of computing applications and resources. Since then to current generation, cloud computing has experienced a tremendous change and has gained more emphasis from various data centers employing the services to create availability, confidentiality, reliability and stability of their data hosted.

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2.0 Requirements for Setting up Cloud Computing

Amrhein, D. and Willenborg, R. in [4] gave clarifications on the layers of cloud computing and that setting up cloud system depends largely on the awareness of the various parties involved. There are different models in cloud computing, any person or establishment hoping to set up its own cloud system must know the three major requirements as enumerated below and should be able to define the terms and conditions of these requirements. Figure 1 and 2 shows the three key players of the cloud computing system having the infrastructure, platform and software layout, and its functionality is traceable to the key parties involved in the day to day running of this system services which are usually charged on demand. More often than not, what the end users visualized is application. The requirements for setting up cloud computing are as follows:

Platform Requirements

PaaS (Platform as a Service): The associated hardware resources, virtual machines and the peripheral interact with each other by the help of system software i.e the operating system.

Infrastructure Requirements

IaaS (Infrastructure as a Service): Infrastructure such as (virtual) platforms, networking, Mainframe Handheld device Scanner Printer Super computer Server are provided by cloud in which applications can be access

Software Requirements

SaaS (Software as a Service): The cloud helps in providing software applications for system communication. Examples of such applications are Amazon, Google, Yahoo, Microsoft, Gmail etc.

Cloud gained more recognition when Amazon Publication [5] made known the internal resources and also the managerial mechanism for customer's use. The term cloud became obvious to public due to its association with networking infrastructure on a real time access. From the above ideology, majority of the services provider infrastructure have now renamed its services to cloud.

Several new "cloud" domains and providers have increased over the period of years and this should not be shocking because it has been able to find interrelated terms but on a dissimilar denotation entirely. The application of cloud can't be under estimated, it scope cut across all spares of computing and its functionality is of a different segments and these are as follows:

- 1) Maintenance of a high scalability and increase in availability domain centre;
- 2) Automating and maintaining server applications,
- 3) Individual stability of resources allocation/sharing;

However, the clarifications of cloud in this phrase is not a particular framework, technology or infrastructure but to an extent a total combination/integration of technologies, frameworks/structures and infrastructures. Cloud is totally different from Grid computing, so the use of Cloud and Grid comparison should be well understood by users in order to bring about a full functional cloud system, See Maria S. Perez [6]. The concept of grid is on systems linked together with the purpose of sharing resources. The architecture of grid is different, compared to that of "cloud architecture" and this must be properly understood for clarity purpose and to eliminate the confusions around "Grid" and "Cloud"

Every young computer users confuse cloud to internet, in the information above you read that it is the total application. Internet formed part of the applications because it gives access to infrastructure and applications integration. One of the greatest challenges people faced with cloud system is how to really know what the name stands for. In the work of Foster I. [7] explanations were made on the name "cloud". Cloud as the name sounds is a metaphor (symbol) for internet and this is linked to telephone network. Over the years it has experience tremendous growth as a result of the new modernization of the various equipments employed, the availability of network, speed, low cost of computer hardware, storage devices, and the amount of oriented users that navigate their way through internet on a daily basis with the hope of meeting friends via social media such as facebook, twitter, Whatsapp, skype etc gave the constant increase associated with "cloud"

As explained in John McCarthy paper, he said "Computation may someday be organized as a public utility. Today everything via internet has become pay as you go and this has become the modern day computing (flexible provision, online, endless transactions such as E-commerce). Computing presently likes to the traditional market where a consumer makes exchange of money on a particular product. The electricity supply by the PHCN or any Transmission Company to consumers are perfect example on how cloud computing works, consumers are billed on usage. This can be better understood from the work of Douglas Parkhill [8]

Some scholars divulge via their work that cloud computing holds it line to the 1950s. *Herb Grosch* [9] a scientist, i.e (*Author of Grosch's Law*) claimed that the world would function on dumb terminals with about 15 large data centers. The postulation by Grosch has found his feet in today's information world. Thousands of information are actually now been powered by a few data center and this has now made the world a global village. The integration of hardware's, software's alongside with the peripherals has brought about the simplicity found in the current trend associated with computing.

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Companies and establishments do not spend money and time trying to master the functionalities of these infrastructures. All requires by the companies is to be able to log on to cloud via internet and every other transactions required are billed as pay as you go.

3.0 Definitions of Cloud Computing

Hannah Wald [10] define Cloud computing as a computing that uses 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.” It is a technology that uses the internet and central remote server to maintain data and applications

Another definition of Cloud Computing in [11] says it is an internet based computing where virtual shared servers provide software, infrastructure, platform, devices and other resources and hosting to customer on as pay-as-you use basis.

In this work we shall define **“Cloud Computing (CC)”** as the act of carrying out business transactions, and every other applications activities that aid smooth running of online input, process, storage and output using well defined infrastructures which enable resources pooling, sharing and allocating, such as hardware equipments, applications (software’s) and peripherals (network’s cable etc.) engineered by data center via internet.

From this definition, it is expected that users of cloud need not to have prior knowledge of how to configure the remote infrastructures or pay huge amount of money to an expert to help bridge the divided world of data before accessing/navigating via internet. This pushed for a fundamental understanding of how hardware can interact with each other using applications and these applications worked on pay as you go (utility). The data are decentralized to various service provider infrastructures creating room for proper security and flexibility. All data/information performed on these services have the ability to centralize their storage, and create its network for more effectiveness and efficiency. Examples of such services (service providers) are Amazon, Google, yahoo mail, hotmail, Gmail, ebay, etc.

As an end user, what is required is a computer (laptop), with network, i.e a “modem” that will enable you log on to internet and charges are based on usage. Cloud computing has no direct or indirect link to a particular offer. It has different areas covered by different organizations or individual company and these are:

- 1) **“Connectivity”** which has to do with the network,
- 2) **“Application”** such as the various software services platform provided by the service providers
- 3) **Data Storage (memory)**. It ensures data are kept for the purpose of fetching.. Etc.

4.0 Architecture of Cloud Computing

Cloud computing has an active design if viewed from both software and hardware paradigm and the related intermediate application facilitating each service. This software design makes the application software much more readily available to the end users and data center by way of application service. The structural design is made up of three components:

- (1) **“Sending End”**: This end involves not just the application but the total components required in login in and out of “cloud” and accessing cloud computing system. The access to cloud computing system by users requires that the functionality of the entire sending end architectures which might be the network, computer and any input peripheral that work together with the purpose to access “cloud” and to carry out all transactions in the cloud computing system must have understanding on the sending end gargets. What this mean is that, every individual that accessed any of the service provided by cloud does that by utilizing the “Sending End” architecture
- (2) **Intermediate End**: This involves the total pooling of resources together. For any end users to fully carry out daily transaction via cloud system there must be synergy between the sending end and receiving end. The intermediate end plays an important role in ensuring constant interaction between the “sending” and “receiving” end of the architecture. This part is actually the network proper, the various protocols (IP Address) that must have full compliance of OSI/ISO model and this ensures that both ends of the architecture interact.
- (3) **“Receiving End”** (back). As the name implies it is the cloud that required access (cloud itself), it is not just two or more computers working together as one but a total computer infrastructures (machines) as illustrated in Figure 1 above and this involves computers, data storage system, server and the peripherals. The combinations of all architectures (front, middle and end) sum up to a system called cloud computing.

Middleware software is used to ensure constant flow of data (communication) between components and infrastructures. This software helps to track the amount of demanded data and various users using the cloud at a particular point in time

5.0 Uses of Cloud

- 1) Processing
- 2) Application integration
- 3) Storage,
- 4) Communication
- 5) Services

Advantages of Cloud Computing

The advantages of cloud cannot be over emphasized, business enterprise do not need to make millions of naira investment in purchasing computer resources, set up infrastructures and administration, *etc.* the vendors of the cloud provides all these resources to the end users of cloud. All that is needed by an enterprise or the end users is to pay on demand for the resources use.

Cloud as the name implies, it means there is no location/geographical barrier, it is a borderless society, and the infrastructures can be located anywhere in the world as far there is access to internet (network) and this makes it independent. It helps establishment to be more flexible, thus enhancing speedy deployment of cloud computing model that enable them meet said goals and objectives, creating competitions among service users render by cloud computing which is one of the major advantages. The role of cloud in the modern world cannot be underestimated. It creates platforms for increase in security which cost less compared to the amount of money spent on securing data by establishments on a standalone system. It also has a lower cost of maintenance due to the integration of infrastructures.

The expectations of cloud is highly promising and expectant because the end users believe that the cloud example (paradigm) will fully take over the processing world in future when the total awareness must have been made know to at least 95% of establishments that are IT oriented and on how their infrastructures alongside with that of the provider can be manage and it should be able to take the role of encouraging smaller establishment overcome the huge amount of money they planned and spend or buying larger infrastructures' to aid their establishments.

The term cloud computing to some means something that has to do with processing information, but is far from just processing, it involves total applications (input, process and output) that have to be carried out via internet. This paper helped to introduce and brings to every reader the real meaning of cloud, its purpose and its role in the modern world. Some well informed establishments of cloud usage are already (currently) seeing how it is plays positive role in the change of data storage, processing and service delivering.

Cloud Computing Model

The beauty of clouds is seen from the employment of different styles when hosted and this solely rest on the rate at which end users navigate their way through cloud irrespective of the kind of businesses of the provider. Hence, cloud has move from the private (internal) answers to problem into a total control of the local infrastructures and making sure requests are readily available on demand, the reason is because data centers are keen in satisfying their internal affairs before moving attention to the public for exchange of services. The following are the six types of cloud computing model:

- 1) Private Cloud
- 2) Public Cloud
- 3) Hybrid Cloud
- 4) Community Cloud
- 5) Special Purpose Cloud

Private Clouds

Private cloud means a dedicated cloud model usually own by the same organization and is in charge of the operations and functionality of the cloud system. It can also be in the form of a cloud services dedicated to a private organization but being monitor by the provider. A private cloud is fully secured if adequately put to use and being that the end user (organization) is also the one directing the activities and the functionality of the cloud. eBay is an example of private cloud which operate software as a service

Public Clouds

The public cloud is quite different from the private cloud. In public cloud, organizations subscribe to cloud functionality of others i.e making use of the functionalities of others. This enable them to reach out to the end users who wished to use their services and reduce the amount that would have been spent in building or setting up personal infrastructures. This brings about division of services example are Amazon, Google App, Window Azure etc.

Hybrid Clouds

This kind of cloud combined two or more cloud services such as private cloud and public cloud. Particular organization can choose to keep its sensitive data in its own private cloud and also becoming a partner to public cloud by way of keeping less sensitive data. Organizations operating this type of model use the integrated single sign-on system. The problem with this model is the vulnerability (insecurity) due to the integration of the both model. The main objective of Hybrid cloud (i.e integration of private and public cloud) is to maximize cost of infrastructures.

Community Clouds

A community cloud is standing in the range of public and private service models, the community cloud share both benefits and interest. The main objective of the cloud is to serve two or more end users, these users are not unfamiliar with the system but they are copartners who share common characteristics and desires. Though, community and public cloud is two different models but both offers almost the same economic varieties of advantages which helped to reduce data redundancy. There are some infrastructure providers who collaborate with other infrastructure providers with the purpose of selling their infrastructures to other client who wishes to use their services. There is a connection between community cloud and the technology capitulating Grid Computing

Special Purpose Clouds

Special Purpose Cloud is an expansion of the normal cloud. The aim purpose is to focus on a specific area, having standalone capabilities i.e. having more capabilities which are strong enough to win more customers and expert in the field of cloud system. An example of this dedicated capability is the Google App Engine. It provides access to documents stored and shared in different server. The interface plays a major role in synchronizing these information's. Paas and Iaas originating from the data centre's provides specialized functions to cloud end users

Characteristics of Cloud Computing

Cloud efficiency cannot be under estimated. The current trend of cloud services, where cloud is meant to meet cloud on a better platform, offering differ in depth, breadth, style, and fine print; beneath the heady metaphor lurk familiar pitfalls, complex pricing, and many questions as stated in the work of Wayner, P.[12]. There are different services offer by cloud today and its characteristics are ever green.

- 1) Constant service delivering
- 2) Flexibility
- 3) Demand balancing
- 4) Scalability

Threat In Cloud Computing

- 1) Abuse and Nefarious use of Cloud Computing
- 2) Insecure Application Programming Interfaces
- 3) Malicious Insiders
- 4) Shared Technology Vulnerabilities
- 5) Data Loss/Leakage
- 6) Account, Service, and Traffic Hijacking
- 7) Unknown Risk Profile
- 8) Code Crackers
- 9) Intruders

6.0 Conclusion

Today there is a paradigm shift from the traditional way of computing and processing information's. According to Gartner analysts, [13] he said there are important strategic issues facing the IT industry. "Organisations are switching from company-owned hardware and software assets to per-use service-based models. This will impact the industry in various ways," Mr. Tully said. "The projected shift to cloud computing, for example, will result in dramatic growth in IT products in some areas and in significant reductions in other areas. In general, assets will be utilized with greater efficiency, and we are assuming that the overall effect on market growth will be neutral. We also recognize that there is considerable upside potential for higher growth".

Hundreds of companies are still not convince on what cloud computing can offer. This paper helped to explain the concept of cloud computing, the models, application, its role in industrial and educational service delivery, and bringing to the understanding of the public/consumers the financial perspective and benefits of cloud system if fully utilized. This was exposed in this paper definition of cloud computing. The revolution in the telecommunications sector is increasing the speeding growth of cloud computing daily. Some establishments have cut cost on the amount of money spent on data security, hardware's and software. Channeling the money into other meaningful projects and cutting cost on daily basis. Establishments that have employed cloud computing technology are not only saving cost but are now fully flexible in their daily routine/operations, gaining more customers on daily basis and producing the desire result on a real time. Furthermore, the contribution of this study has exposed the in-depth setup of cloud computing architecture (intermediate end). Though, many authors have discussed the architecture of cloud computing in two forms (sending end and receiving end). This study

has moved further in looking into what happened at the cloud and how the integration of these ends form a transaction of services billed on demand. The Intermediate end is actually the end that plays the significant role in the three layers of cloud interaction/integration and more emphasis were given to this end in the architecture of cloud computing in order to understand how both ends works.

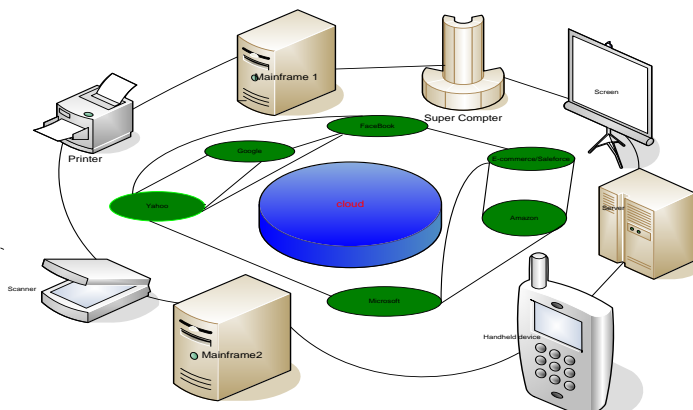


Figure1: Layout of Cloud Computing

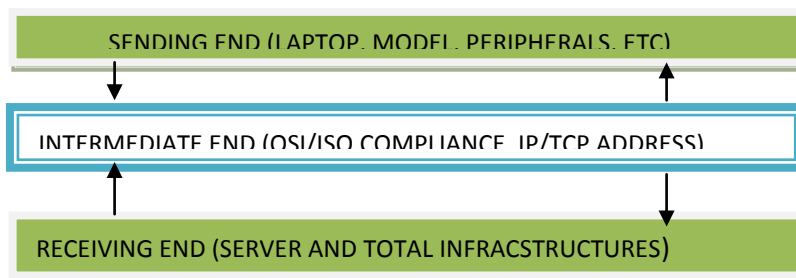


Figure 2: A Typical Diagram of Cloud Computing Architecture

References

[1] The Cloud – RAND Corporation. European Commission for Information Society and Media (2010). www.ran.org/content/dam/rand/pubs/technical.../RAND_TR933.pdf

[2] Fellows, W. (2009). ‘The State of Play: Grid, Utility, Cloud. <http://old.ogfeurope.com>.

[3] John McCarthy (1961). A brief history of cloud computing / Enterprise CIO Forum. www.enterpriseioforum.com/en/blogs/.../brief-history-cloud-computing

[4] María S. Pérez. Grid and Cloud Computing. Madrid Facultad de Informática, Universidad Politécnica de Madrid. mperez@fi.upm.es

[5] Amrhein, D. and Willenborg, R. (2009), ‘Cloud computing for the enterprise. <http://www.ibm.com>.

[6] Barr, J., (2006) ‘Amazon EC2 Beta’ - available at http://aws.typepad.com/aws/2006/08/amazon_ec2_beta.html

[7] Foster, I. (2008). Cloud, Grid, what's in a name?' <http://ianfoster.typepad.com>.

[8] Douglas parkhill's.(1966).The challenges of computer utility. www.britannica.com.

[9] Harb Grosch (1950). Grosch Law www-columbia.edu/computinghistory/grosch.html.

[10] Hannah W. (2010). Cloud Computing for the federal community Kevinneal.com

[11] Aberdeen Group, www.luitinfotech.com/kc/whatiscloud-computing.pdf.

[12] Wayner, P (2008), ‘Cloud versus cloud: A guided tour of Amazon, Google, AppNexus, and GoGrid’ - available at <http://www.infoworld.com>.

[13] Gartner R. (2008). Worldwide IT Spending on Pace to Surpass Trillion in 2008. www.gartner.com.