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Research and Development on Cloud Computing

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Abstract

The basic principles of cloud computing is to make the computing be assigned in a great number of distributed computers, rather than local computer or remoter server. The running of the enterprise's data center is just like Internet. This makes the enterprise use the resource in the application that is needed, and access computer and storage system according to the requirement. It provides services that set clients free from worrying about data processing problems so that they can focus on their major businesses. Cloud computing is a set of Information Technology services that are provided to a customer over a network on a leased basis and with the ability to scale up or down their service requirements. In this article, characteristics of it will be discussed with several examples, in order to show that how cloud computing will make the business world simpler, more efficient, and more specialized, in addition we'll describe types of cloud computing environments, cloud computing style, furthermore we discuss about different famous clouds include: IBM clouds, Google clouds and Amazon clouds and will tell applications, advantages and disadvantages of them. Cloud computing in education is an important issue in our world, so we explain about it and will clarify difficulties and its applications like: web-based learning, mobile video learning, observational learning and computer programming learning.

Keywords: cloud computing; grid computing; web-based learning

Introduction

Cloud computing is the next natural step in the evolution of on-demand information technology services and products. To a large extent, cloud computing will be based on virtualized resources. Cloud computing predecessors have been around for some time now but the term became popular sometime in October 2007 when IBM and Google announced a collaboration in that domain. This was followed by IBM's announcement of the ''Blue Cloud'' effort. A cloud is a type of distributed data center which delivers infrastructures as services. It consists of massive resources, and provides some mechanisms to provide, reimage, workload rebalance, de-provide, and monitor those resources.[1]

Computing is a virtual pool of computing resources. It provides computing resources in the pool for users through internet. Integrated cloud computing is a whole dynamic computing system. It provides a mandatory application program environment. It can deploy, allocate or reallocate computing resource dynamically and monitor the usage of resources at all times. Generally speaking cloud computing has a distributed foundation establishment, and monitor the distributed system, to achieve the purpose of efficient use of the system.[2]

Cloud computing is based on server, providing services to users and supporting equipment, reliable customized and dynamic computing environments for end-users. It has tremendous potential for meeting the current needs of education, as a result cloud computing will be of great significance to the improvement of U-learning. With the coming of the cloud computing, students and educators can choose their own content and means of learning according to the services of the cloud computing.

Cloud computing, seen as the great network-tech breakthrough, might bring us to the 'cloud society' after the PCs and the Internet brought people to the 'network society'. In the scheme of cloud computing, all the everyday usage of PCs will be transferred into the clouds (virtualized mass computational servers which cooperate on the Internet), all we need is an access to the Internet and then we do every work on it. Actually, we do not 'do' works on the access but require task-solving services from the cloud via the access, and the result is sent back on it. Undoubtedly, if such scheme comes true one day, the way that people live as well as work will be totally different then. However, cloud computing has been already changing the way that the business world runs; this is going to be discussed in this article.[3]

Literature Review

In recent 10 years, Internet has been developing very quickly. The cost of storage, the power consumed by computer and hardware is increasing. The storage space in data center can't meet our needs and the system and service of original internet can't solve above questions, so we need new solutions. At the same time, large enterprises have to study data source fully to support its business. The collection and analysis must be built on a new platform. Why we need cloud computing? It is to utilize the vacant resources of computer, increase the economic efficiency through improving utilization rate, decrease the equipment energy consumption.[4]

Types of cloud computing environments:

Public clouds

The cloud infrastructure is available to the public on a commercial basis by a cloud service provider. This enables a consumer to develop and deploy a service in the cloud with very little financial outlay compared to the capital expenditure requirements normally associated with other deployment options. This environment can be used by the general public. This includes individuals, corporations and other types of organizations. Typically, public clouds are administrated by third parties or vendors over the Internet, and services are offered on pay-per-use basis. These are also called provider clouds.[5]

Private clouds

The cloud infrastructure has been deployed, and is maintained and operated for a specific organization. The operation may be in-house or with a third party on the premises. This cloud computing environment resides within the boundaries of an organization and is used exclusively for the organizations benefits. These are also called internal clouds. They are built primarily by IT departments within enterprises who seek to optimize utilization of infrastructure resources within the enterprise by provisioning the infrastructure with applications using the concepts of grid and virtualization.
Hybrid clouds

This is a combination of both private (internal) and public (external) cloud computing environments. The cloud infrastructure consists of a number of clouds of any type, but the clouds have the ability through their interfaces to allow data and/or applications to be moved from one cloud to another. This can be a combination of private and public clouds.[6]

Community cloud

The cloud infrastructure is shared among a number of organizations with similar interests and requirements. This may help limit the capital expenditure costs for its establishment as the costs are shared among the organizations. The operation may be in-house or with a third party on the premises.[7]

Cloud Computing Characteristics:

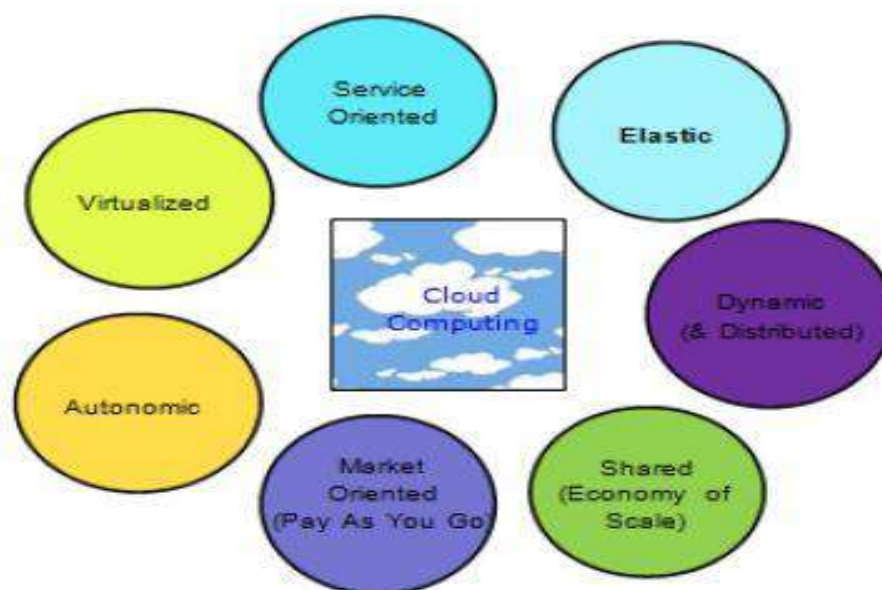The characteristics of cloud computing are as follows: (See Figure 1).

Figure1 - Characteristics of cloud computing

1- Virtualized

Resources (i.e. Compute, storage, and network capacity) in Clouds are virtualized achieve data various levels including VM (Virtual Machine) and Platform levels. The most basic on is at Virtual Machine (VM) level where different applications can be executed within their containers or operating systems running on the same physical machine. Platform level enables seamless mapping of applications to one or more resources offered by different Cloud infrastructure providers.[8]

2- Service Oriented

Cloud is implemented using service-oriented architecture model where all the capabilities/components are available over the network as a service. Whether it is software platform offered as a service.

3- Elasticity

Resources (i.e. compute, storage and network capacity) required for cloud applications can be dynamically provisioned and can be varied i.e. increase or decrease at runtime depending on user QoS requirements.

4- Dynamic and Distributed

They are often distributed to enable the delivery of high performance or reliable cloud services.

5- Shared

Clouds are shared where resources serve multiple users. This sharing model is also termed as "multi-tenant" model.

6- Market Oriented

In Cloud computing, customers pay for services on a pay-per-use (or pay-as-you-go) basis. The pricing model can vary depending on the QoS expectation of application.

7- Autonomic

To provide highly reliable services, clouds exhibit autonomic behavior by managing themselves in case of failures.

Cloud computing style

Though people have different views on the cloud computing, they have already reached an agreement on the basic style on it. Its style is as follows:[9]

1- SAAS (Software as a service):

This kind of cloud computing transfer programs to millions of users through browser. In the user's views, this can save some cost on servers and software. In the provider's views, they only need to maintain one program, this can also save cost. Salesforce.com is so far the most famous company that provides this kind of service. SAAS is commonly used in human resource management system and ERP (Enterprise Resource Planning). Google Apps and Zoho Office is also providing this kind of service.

2- Utility Computing:

Recently Amazon.com, Sun, IBM and other companies that provide storage services and virtual services are appearing. Cloud computing is creating virtual data center for IT industry to make it can provide service for the whole net through collecting memory, IO equipment, storage and computing power to a virtual resource pool.

3- Network service

Net service has a close relation with SAAS. The service providers can help programmers develop applications based on internet instead of providing single machine procedure through providing API (Application Programming Interface).

4- PAAS (Platform as a service)

Platform as a service, another SAAS, this kind of cloud computing providing development environment as a service. You can use the middleman's equipment to develop your own program and transfer it to the users through internet and servers.

5- MSP (management service provider)

This is one of the ancient applications of cloud computing. This application mostly serves the IT industry instead of end users. It is often used in mail virus scanning and program monitoring.

6- Commercial service platform

The commercial service platform is the mixture of SAAS and MSP (Mixed signal Processor), this kind of computing provides a platform for the interaction between users and service provider. For instance, the

user individual expense management system can manage user's expense according user's setting and coordinate all the services that users purchased.

7- Integrating internet

It can integrate all the companies that provide similar services, so that users can compare and select their service provider.

Methodology

Cloud computing is the newly born Internet-based computing technique which integrates, optimizes and provides computing ability, aiming to simplify the clients' computing jobs by the way of renting resources and services. In fact, currently, there is no recognized authoritative definition of cloud computing, for the agreement of the universal protocol of cloud computing has not been reached.

Years ago, grid computing became the hot issue in the IT world for it opens a new era of integrating resources to solve problems. The same idea (distributed computing) is shared with cloud computing. However, cloud computing is considered to be the technology derived from grid computing with different problem-dealing-aspects of processing but core concept unchanged. The paramount notion of grid computing is collecting all available resources to solve problems (mainly scientific ones) that individual computing center cannot deal with. The most famous case of grid computing, SETI@HOME, searches for extra-terrestrial intelligence using the spare resources from the volunteer Internet-connected computing computers all over the world. On the other hand, cloud computing aims to supply efficient, qualified services with part of the available large scale of computing resources. The major differences between grid computing and cloud computing is listed as follows (See Table 1).

Table1 - Compare Between Cloud and Grid Computing

	Grid computing	Cloud computing
Core idea	Gain as much computing resources as possible	Use the resources as effective as possible
Process	Separate big missions into small ones, then deal with them on computing nodes	Deal with requirements by offering sufficient computing ability in the resource pool
Key point	Assign separated tasks to the nodes by matching the computing ability and task requirement (by software)	'cut' the available resource pool in order to satisfy the needs (by virtualization)
Main usage	Scientific	Commercial

The most significant characteristic of cloud computing is that it offers Internet-based on-demand services with low prices. 'On-demand service' means that Cloud computing can offer storage ability, computing ability, or even the applications or software and computing resources in the same time due to the clients' requirements; 'Internet-based' or 'Web-based' indicates that the entire process of dealing with demands is on the Internet, so the clients just need to worry about what they want but not how to get it, all works will be done by the cloud computing servers. The 'Web-based' way would surely offer more efficient ways to use applications, in other words, we may be able to use the Office software with anything that can access the Internet, such as a laptop, a PDA, or even a mobile phone. And with cloud computing, companies would be able to rent computational services from the cloud servers and then focus on their professional main businesses. So it can be believed that Cloud computing will make the business world more specialized, convenient and efficient.

Clouds

1- IBM clouds

Recently, IBM keeps emphasizing their new concept of 'Smart Planet' in nearly all conferences. One major part of the 'Smart Planet' plan is the cloud computing. The IBM clouds (Blue Cloud) is the combination of grid computing and virtualization, that is to say, the Blue Cloud uses the technical ways of grid computing to integrate resources into a resource pool and then virtualizes the server, separates and offers resources from the pool due to the clients' requests. 'Servers are the base of the computer systems' is a sentence widely spreads in IBM. The Blue Cloud focuses more on the professional or enterprise markets with the strategy of selling or leasing specific servers, software and services to the various enterprise clients.

2- Google clouds

Different from IBM which locates itself as an IT company offers services, Google always see itself as a company relevant and based on the Internet; different from the Blue Cloud, Google clouds faces mainly the common users of the Internet. This is why currently Google clouds are the best known clouds to the public. The core concept of Google's clouds is to offer the service platform in which the software is not run on the clients, nor is the data stored in the clients. Google clouds gain requests from the users then return results: all process is completed on the Internet servers who offer cloud computing services – we can see examples like using office software (Google Docs) only with an Internet explorer. In Google's declarations, 'The Google File System demonstrates the qualities essential for supporting large-scale data processing workloads on commodity hardware.' By using their cloud computing technologies, the computational cost has been lowered to 1/100, and the storage cost has been lowered to 1/30. Five characteristics can result in such tremendous cost reduction:

- In Google's clouds, except the few managing nodes like GFS Masters, nearly all nodes in the Google cloud are symmetric. These nodes can store data, manage data and deal with tasks in the same time. So the cost of the equipment of nodes can be reduced by standardization and bulk purchases.

- Contributed by the data managing ways of distributed computing, the computing ability needs of individual cloud nodes is lowered so that expensive UNIX servers or SAN storage equipments are no longer essential to offer qualified services.
- Google clouds provide fault tolerance by constant monitoring, replicating crucial data, and fast and automatic recovery. Resource redundancy rate can be impressively decreased in such way.
- The cost of software in Google clouds is very low, because the majority of Google cloud software and applications are open-source or written by Google itself.

3- Amazon clouds

Amazon is considered to be the first company which provides cloud computing services on a large scale. Having reached the needs of offering sufficient accessing capacity, Amazon found that in much time its servers are partly used while the others remain free from load, and then began thinking of renting its idle servers to other companies. Of course, such renting is not in physical ways but on the Internet. Based on such will, Amazon develops a series of web services (Amazon Web Services, AWS), such as Amazon Elastic Block Store (EBS), Amazon Elastic Compute Cloud (EC2), Amazon Simple Storage Service (S3), etc.

Amazon EC2 is seen as the first typical mode of cloud computing since it has the features of virtualization, on-demand provisioning, and 'pay as you go' usage-based pricing. It is also proved that though Amazon EC2 might not be able to deal with extreme complicated scientific issues, it can easily satisfy the common computing or data managing demands of a company or an individual with no doubt. Different from both Blue Clouds and Google clouds, Amazon EC2 mainly offers service to neither enterprise nor personal usage but the software companies based on the Internet – can be seen as some sort of combination of Blue Clouds and Google clouds. Due to the strong computing ability and the mass storage capacity of Amazon clouds, EC2 attracts large amounts of users and earns much money for Amazon. It is said that EC2 and other services play an important role in Amazon's defeating its rivals like EBay Inc.

Cloud computing in education:

1- Cloud computing for web-based learning:

There are several cloud computing service providers that offer support for educational systems. Microsoft and Google have launched their own cloud computing platform. Students are now using Google Earth to carry out the geography. Educators can create documents in Amazon Docs and share them in the internet. They can watch and add video clips to video sharing websites (See Figure 2). Cloud computing provides learners various learning software that can be obtained on the internet without installation.
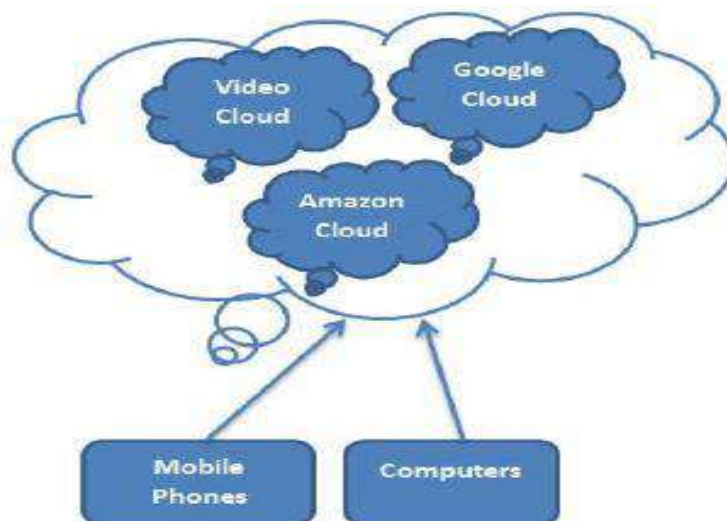
Figure2 - The model of web-based cloud computing learning

2- Cloud based mobile video learning

Cloud computing is the best solution for many hardware and software resource requirements in video learning systems.

Cloud computing can help this field with centralizing storage, memory, processing, bandwidth and reducing the cost effectiveness for the implementation of the hardware, software.

The main objective of mobile video learning to be implemented in the cloud environment is to provide educators the knowledge from the centralized shared resources at anytime and anywhere, that too at free of cost.

The interface design for M-learning services must avoid overloading Mobile devices with unnecessary complexity or operating too slowly.

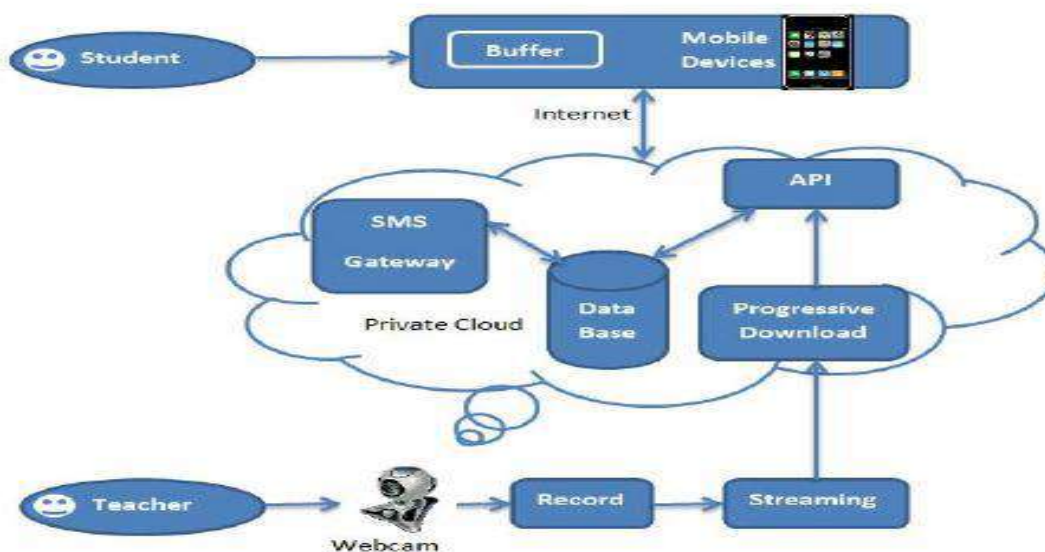Figure 3 shows the architecture of an implemented environment for education using cloud computing.

Figure3 - Architecture of a cloud based mobile video learning system

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In this environment, the teachers must register first, once they finish registration, they can login using their registered username and password, also students and educators who want to use live videos have to register and get the required credentials.

Once the teacher logs in, webcam is enabled automatically and starts to capture the session. Every two second the video is progressively downloaded to the server.

Once the students logs in, they can view the set of available online teachers and can select the one they want.

Students can use different types of data which is buffered from the server to their devices. They can read text based documents, watch video tutorials and listen to the lectures or seminars. This design can include the following characteristics and features:

- Sms Gateway: It is a service added to the architecture, the lecturer can view the student and his message in the application and as a response he can reply back to the students mobile.
- Media API: This API supports multimedia J2ME applications in mobile phones. It supports internet protocols such as Hyper Text Transfer Protocol (HTTP) or Real Time.
- Videos: In this figure, a list of recorded lecture and tutorial videos can be viewed by students via mobile phones.
- Live lectures: In this feature students can watch real time streaming, live lectures and tutorials.
- Screenshots: This feature provides with the screenshots of power point presentations, etc.
- Library: In this feature students can access images of books, and download them by clicking on the links.

There are several cloud based video conferences websites that can offer live video conferences. It's not possible to load videos or screenshots into their database and does not contain any libraries for students to use.

3- Cloud education system for observational learning

Observational learning is the field of social learning theory refers to the behavior or attitude learned by observing others behaviors. Observational learning is also a significant method of art education. In this field students should learn and understand how to paint shapes according to their understanding in order to achieve the optimization of shapes.

High definition paintings contain huge amount of information and large file size. In order to record the changes of works, the system needs a huge space.

Cloud computing systems often are used through browsers or other web programs and the software and data are stored in the web server. It provides computing resources, creates a safe, stable and easy-to-expand platform, and makes information ubiquitously available for users.

In a cloud based observational learning system, all the data is stored in the cloud. Learners can observe others and play repeatedly and pause at any time and understand their skills.

4- Cloud based environment for computer programming learning

Cloud computing can provide personalized and collaborative learning in computer programming courses through a live and interactive cloud learning environment.

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The architecture of a cloud-based computer programming learning environment using a collection of Google cloud computing services is shown in Figure 4.
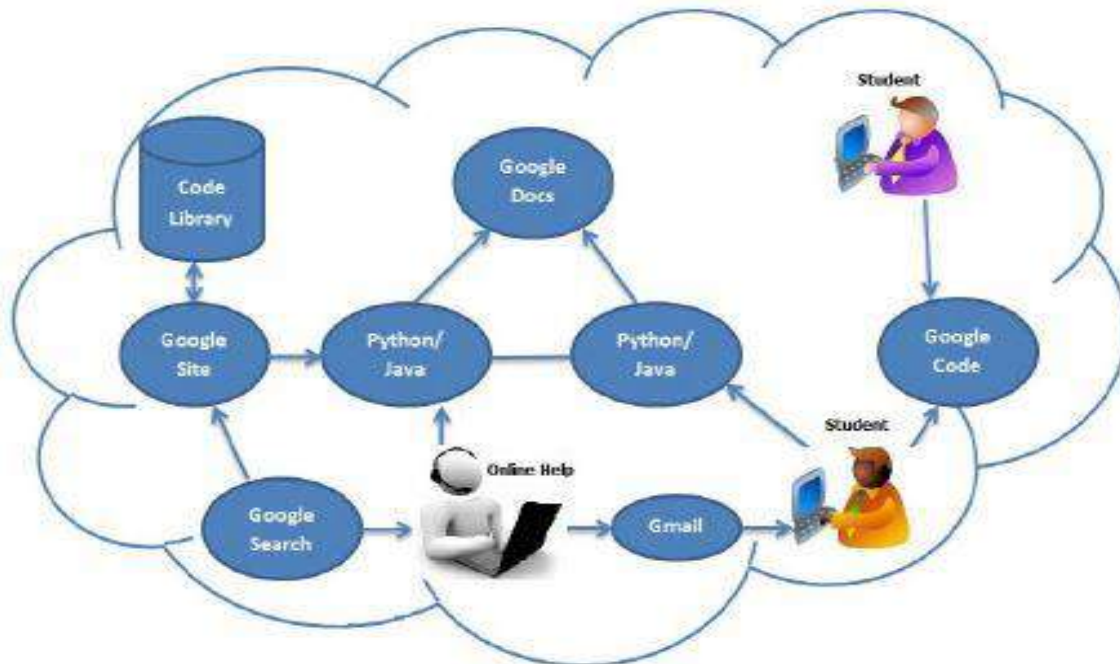

Figure4 - Interface of the system

Conclusions

cloud computing can surely make the business world more convenient and efficient and it is even potential to bring about revolutionary changes to the human society, people would use more and more 'Web-Based' applications instead of the current 'Desktop-Based' ones. However, after all, all the stuff that cloud computing can offer is only a platform and some new ways for running services. No matter how well the platform is developed, if the services provided are not brilliant enough, it will surely end up with an eventually failure.

Cloud computing builds on decades of research in virtualization, distributed computing, utility computing, and, more recently, networking, web and software services. It implies a service-oriented architecture, reduced information technology overhead for the end-user, great flexibility, reduced total cost of ownership, on demand services and many other things.

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