

Cloud Services for E-learning

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ABSTRACT

Cloud computing is growing rapidly in almost every sector including education. Many educational institutions do not have the ability to maintain the resources and/or infrastructures required to run e-learning systems and are looking for cloud based solutions. This paper introduces the benefits and limitations of cloud based e-learning.

Categories and Subject Descriptors

K.3.1 [Computers and Education]: Computer Uses in Education – Collaborative learning, Computer-managed instruction (CMI), Distance learning

General Terms

Management, Human Factors

Keywords

Cloud Computing, E-Learning, M-Learning Education, Mobile Devices

1. INTRODUCTION

Cloud computing has emerged as one of the fastest-growing segments of the information technology industry. The ability to leverage economies of scale, geographic distribution, open source software and automated systems to drive down costs makes cloud computing an attractive option for education. We live in a world where information is readily available anytime and anyplace. Not only do we have a computer at work and another at home, we also have one or more computing devices like smartphones and tablets that we carry around at all times. Significant advances in operating systems and software applications that power and connect all of these devices represent one of the driving forces behind modern computing. Major software companies like Google, Apple and Microsoft will continue to develop more innovative software that will stimulate development of the new intelligent devices that provide users with flexibility to meet their computing needs anywhere, anytime. This infusion of intelligence and connectivity into a wide range of devices complements the growth of Internet-scale services to create a new paradigm for computing based on the concept of client and cloud.

Many smaller educational institutions often lack the resources or ability to take full advantage of information technology. Cloud computing offers a way to expand the quality and accessibility of education, particularly in remote and underserved communities. It can enable more dynamic and interactive learning experiences and

allow teachers/students in multiple locations to collaborate/communicate more effectively [17]. In addition, cloud-based services can offer clients/academic institution cost savings and access to cutting-edge computing. Cloud solutions can slash technology budgets drastically with the reduction of hardware, software, licensing, and maintenance costs. Institutions no longer have to support and replace expensive servers when they can utilize a cloud structure built on hosted datacenters [1, 2, 12, 14, and 18].

The next step for e-learning is referred by many as m-learning or mobile learning. Content can be displayed on mobile devices and shared over fast wireless networks. Access with mobile devices will be much easier than with a traditional pc or laptop and just as user friendly. These devices will provide the next big platform for learning. Users expect to run computational intensive applications on these devices. However, mobile devices are still low potential computing devices, which are constrained by battery life time, CPU potentials, and memory capacity. Mobile Cloud Computing (MCC) is the latest practical solution for alleviating this incapacitation by extending the services and resources of computational clouds [16].

2. CLOUD COMPUTING SERVICE MODELS

Cloud computing employs a service-driven business model. Hardware and platform-level resources are provided as services on an on-demand basis. Conceptually, every layer of the architecture described can be implemented as a service to the layer above. Conversely, every layer can be perceived as a customer of the layer below. However, in practice, clouds offer services that can be grouped into three categories: software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS).

Software as a Service (SaaS): at the highest level of abstraction, users are mostly unaware of the fact that are using cloud-enabled applications, and are hence not able to control the underlying resources. Instead, they simply use client interfaces such as web browsers. Educational institutions are beginning to take advantage of existing applications hosted on a cloud that enable end users to perform tasks that have usually required site licensing, installation, and maintenance of individual software packages [10].

Platform as a Service (PaaS): users are able to develop and deploy applications within the provider's hosting environment, e.g. a Java application framework. Low-level resources are not controlled by the cloud user. In this model, the cloud providers deliver a computing platform including operating system, programming language execution environments, databases, and web servers. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software.

Prominent example is the Google App Engine and Microsoft Windows Azure.

Infrastructure as a Service (IaaS): at the lowest level of abstraction, cloud users use computing resources such as databases, CPU power, memory and storage from an IaaS provider and use the resources to deploy and run their applications. In contrast to the PaaS model, the IaaS model allows users to access the underlying infrastructure through the use of virtual machines which automatically can scale up and down. IaaS gives users more flexibility than PaaS. However, flexibility comes with a cost and users are responsible for updating and patching the operating system at the IaaS level [13]. A popular example is Amazon EC2.

The service model of cloud computing is depicted by Figure 1. According to the layered architecture of cloud computing, it is entirely possible that a PaaS provider runs its cloud on top of an IaaS provider's cloud. However, in the current practice, IaaS and PaaS providers are often parts of the same organization. This is why PaaS and IaaS providers are often called the infrastructure providers or cloud providers [1].

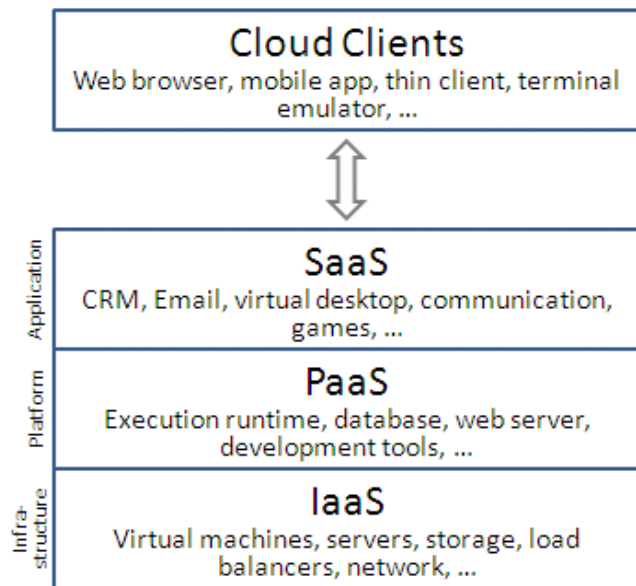


Figure 1. Service model of cloud computing [19]

3. E-LEARNING IN THE CLOUD

The concept of e-learning is based on the concept that different technologies could be used in order to improve the learning process; the use of such technologies may vary depending on the needs of the population. Educational institutions like colleges and universities recognize the need for the adaptation of new technologies as didactic support.

Criteria for selecting new technologies should include adaptability, performance and the effectiveness it will provide to students, faculty and administration. One must also consider how these new technologies will integrate into established programs.

There are six major needs to which institutions need to adapt [2, 10, and 12]:

- Cost effectiveness – The technology should be economical with a low cost to implement and also to maintain.

- Reliability – The technology should be scalable and stable with the ability to handle periods of heavy traffic.
- Adapting to the lifestyle and schedules of people – The technology should be able to adapt to trends with the various ways people choose to view information. [Mobile platforms and devices].
- Dynamic, relevant and timely curricula – Time sensitive content should be updated dynamically in a timely manner to keep the relevance of the information up-to-date.
- Bridging space and time between individuals – Not only should the technology adapt to the ways people view information but also the time and places. Be aware that not all people have access to broadband. Maintain the ability to alter content for those with slower connections.
- Adapting to multiple teaching and learning styles – Any new technologies implemented should be able to provide multiple ways to deliver information. They should have the ability to render content in various styles and languages to reach all in the community who may have different learning styles.

All major universities have already adopted some type of online technology allowing students to take complete classes online. Many educational institutions have adopted online technologies so well that they have eliminated the need for a physical classroom, converting them into online institutions.

4. CLOUD COMPUTING FOR MOBILE DEVICES

Wherever one looks, evidence of portable/mobile penetration is irrefutable: cell phones, PDAs, MP players, portable game devices, tablets, and laptops abound. Consequently, it comes as no surprise that sooner or later people would begin to look for ways to integrate mobile computing into e-learning to make courses more accessible and portable [3, 4, and 15]. For instance, a smart phone combines a multitude of communication and computing features in one compact system and thus has potential instructional uses. Students can download audio and video lectures and podcasts to their smart phones. They can play audio, video, display and edit text documents; access e-mail and Web content; send IM and text messages; and use the phone for mass storage. Smart phones also enable global collaboration and scientific experimentation and research. Users also can access information globally. Smart phones thus support interactive learning.

The next step for e-learning is referred by many as m-learning or mobile learning. Information will be displayed and shared using mobile devices. Although mobile devices lack big screens that can display a lot of information or fast speeds to download big amounts of information, they still provide the next big platform for learning [9, 10]. Mobile devices can provide access on the move to relatively light amounts of data, they will be faster than accessing a computer and still very user friendly. Students could also be able to take and access tests via mobile applications like those being developed for the iPhone or smartphone. The use of these applications will greatly depend on the bandwidth that the service providers carry; 3G, 4G, GPRS, etc.

Portable computing/communication devices connected to wireless networks enable mobility and facilitate mobile learning. Mobility

allows teaching and learning to extend beyond the traditional classroom; in the case of distance learning, users of portable devices can break the tether of the home computer. Within the classroom, portable computing/communication devices give instructors and students increased flexibility and provide new opportunities for interaction. Mobile technologies also support learning experiences that are collaborative, accessible, and integrated with the world beyond the classroom.

The main objective of mobile-learning is that the learners can get the knowledge from the centralized shared resources at anytime and anywhere they like. Mobile-learning is a system where one can learn through any source on topics of his choice without the need of storing everything in his device. As-you-pay and that much can you can use the services from the cloud data centers for learning selected topics over mobile phone even you in the country side or remote area. For example, if student want learn a JAVA technologies from his agricultural land.

Mobile cloud computing (MCC) is the latest practical computing paradigm that extends utility computing vision of computational clouds to resources constrained mobile devices. MCC is defined as a new distributed computing paradigm for mobile applications whereby the storage and the data processing are migrated from the mobile device to resources rich and powerful centralized computing data centers in computational clouds [16].

In spite of all the advancements in recent years, most of the available mobile devices are still low potential computing devices. Compared to stationary nodes, mobile devices are constrained by CPU potentials, memory capacity, battery life time, slower processing speed, and unreliable communication links. Running complex and complicated services on a mobile device will consume most of its resources and may obstruct the device to perform its core functions (e.g. voice calls). It is not feasible and necessary for a single mobile device to execute complex processes independently. Services should be designed in a way to put less workload on the mobile device and delegate heavy-duty tasks to backend servers on the cloud. MCC implements a number of augmentation procedures for leveraging resources and services of cloud datacenters. Examples of the augmentations strategies include; screen augmentation, energy augmentation, storage augmentation and application processing augmentation of mobile devices [16].

5. CLOUD COMPUTING CHALLENGES

Although cloud computing is a step in the evolution of information technology, cloud computing has inherent issues that may impede user adoption of cloud computing as mentioned in [7, 8, 11, and 16]:

- System and Data Security and Privacy – This is the most important factor that faces the adoption of cloud computing not just in academic institutions, but in all industries. The protection of systems - either on the client or cloud provider side - for running smoothly and being capable of providing their services to the legitimate user is crucial for any educational system. This challenge has to do with securing the systems and deploying proper security policies and procedures so as to be able to deter and repel attacks. It also requires insuring the integrity, privacy and confidentiality of the

data stored and transferred for the needs of the educational process. Therefore, the provision of robust mechanisms to support learner authentication, authorization, non-repudiation, management of data, content copying, editing and downloading, and safeguarding learner examination and assessment processes from attackers and impostors are only some prerequisites for the e-learning arena [7].

- Bandwidth – If the Internet bandwidth insufficient, it will be difficult to deliver the educational services. Also, service quality relies on the connection speed which can require investment on the network side.
- Long WAN Latency – Latency adversely impacts on the energy efficiency and interactive response of cloud-mobile applications by consuming excessive mobile resources and raising transmission delays.
- Acceptance – It is not easy to convince decision makers to shift from one pattern to another. Cloud computing is a new idea and it will subvert the traditional pattern that users are familiar with.
- Educational management rules – There are differences between traditional education management and education management with cloud computing. So, implementing cloud computing will cause a lot of management problems such as how to manage teaching and learning, the content and courses, the examinations and students.

6. CLOUD COMPUTING SECURITY AND DISASTER RECOVERY CONCERNS

The benefits of cloud computing are very clear, but there are several security concerns that must be addressed before an attempt is made to move business critical applications and potentially sensitive data to the cloud. Where is my data stored and who has access to it? Although data is “in the cloud” it must be stored at some physical location. You should ensure that your cloud provider guarantees in writing a high level of security measures to ensure protection of your data. It’s important to know that many attacks to data occur from the inside. It’s important to know who manages your data when it’s in the hands of providers and what controls are in place and applied to them. Cloud based services are targets that hackers are attracted to. It’s important to make sure your provider has security measures in place in case of an attack. With your applications and data moving to the cloud up time is critical. Service level agreements (SLA) are contracts that guarantee a level of service between the provider and the customer. It’s essential to know the amount of time it will take to get your systems back up and running in the event of an outage.

It’s important to remember that your data will reside at some physical location. Just like any place of business these locations are susceptible to natural disasters like fire, earthquakes or some other event that may cause a loss of power. You should make sure your provider has taken measures to protect your data in the event of a natural disaster. They should also provide documentation of how they are prepared to recover and the steps they will take to ensure that they can restore from the most current backup [6].

7. CONCLUSION

Cloud computing will have a profound impact on the future of e-learning across institutions world-wide. Institutions will have the burdens of high cost IT operations lifted out of their budgets and

replaced with scalable and accessible cloud solutions. This will allow institutions to focus on providing students, faculty, and administration with the ability to adapt to today's modern mobile world. Cloud computing also allows moving the processing effort from the mobile devices to the data center facilities and thus can provide energy savings as a service to mobile users.

But while the benefits of a cloud solution are clear, one must also be prepared to address security and disaster recovery concerns. You should make sure security measures are in place before you place your important and private data off of your servers and onto someone else's. It's also critical to ensure that they have a disaster recovery plan in place. This paper presented the impact on using cloud computing for e-learning solutions.

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