Cloud Computing Benefits for E-learning Solutions

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Abstract: E-learning systems usually require many hardware and software resources. There are many educational institutions that cannot afford such investments, and cloud computing is the best solution. This paper presents the impact on using cloud computing for e-learning solutions.

Keywords: cloud computing, e-learning

1. Introduction

Cloud computing allows to move the processing effort from the local devices to the data center facilities. The software is seen as a service and the applications and data are stored on multiple servers that can be accessed from the Internet.

The current cloud computing architecture involves the existence of data centers that are able to provide services to the clients located all over the world. In this context, the cloud can be seen as a unique access point for all the requests coming from the customers/clients.
2. E-learning Benefits

Many education institutions do not have the resources and infrastructure needed to run top e-learning solution. This is why Blackboard and Moodle, the biggest players in the field of e-learning software, have now versions of the base applications that are cloud oriented.

E-learning is widely used today on different educational levels: continuous education, company trainings, academic courses, etc.

There are various e-learning solutions from open source to commercial. There are at least two entities involved in an e-learning system: the students and the trainers.

The students:
- Take online course
- Take exams
- Send feedback
- Send homework, projects
- The trainers:
- Deal with content management
- Prepare tests
- Assess tests, homework, projects taken by students
- Send feedback
- Communicate with students (forums)
Usually, e-learning systems are developed as distributed applications, but not limited to. The architecture of an e-learning system, developed as a distributed application, includes a client application, an application server and a database server (see Figure 1), beside the hardware to support it (client computer, communication infrastructure and servers).

![Figure 1— E-learning system](image)

The client hardware could be a mobile device or a desktop computer. The client application can be a simple web browser or a dedicated application.

Even with the current hardware and software limitations, mobile devices are supporting multimedia based applications. Currently, compared with desktop applications, mobile applications, especially multimedia-based applications, have serious limitations due the processing power and memory constraints. Due the fact that the data processing is on the server side, the use of mobile devices for learning is
growing fast. Still, the mobile applications need to be optimized to be used for e-learning. The e-learning server will use cloud computing, so all the required resources will be adjusted as needed.

E-learning systems can use benefit from cloud computing using:

- Infrastructure: use an e-learning solution on the provider's infrastructure
- Platform: use and develop an e-learning solution based on the provider's development interface
- Services: use the e-learning solution given by the provider.

A very big concern is related to the data security because both the software and the data are located on remote servers that can crash or disappear without any additional warnings.

Even if it seems not very reasonable, the cloud computing provides some major security benefits for individuals and companies that are using/developing e-learning solutions, like the following:

- improved improbability – it is almost impossible for any interested person (thief) to determine where is located the machine that stores some wanted data (tests, exam questions, results) or to find out which is the physical component he needs to steal in order to get a digital asset;
- virtualization – makes possible the rapid replacement of a compromised cloud located server without major costs or damages. It is very easy to create a clone of a virtual machine so the cloud downtime is expected to be reduced substantially;
- centralized data storage – losing a cloud client is no longer a
major incident while the main part of the applications and data is stored into the cloud so a new client can be connected very fast. Imagine what is happening today if a laptop that stores the examination questions is stolen;

- monitoring of data access becomes easier in view of the fact that only one place should be supervised, not thousands of computers belonging to a university, for example. Also, the security changes can be easily tested and implemented since the cloud represents a unique entry point for all the clients.

Another important benefit is related to costs. If the e-learning services are used for a relative short time (several weeks, a quarter, a semester), the savings are very important.

**Conclusions**

The development of e-learning solution cannot ignore the cloud computing trends.

There are many benefits from using the cloud computing for e-learning systems. Also, there are some disadvantages that have to be taken into account.

Using cloud computing for e-learning solutions influences the way the e-learning software projects are managed. There are specific tasks that deal with finding providers for cloud computing, depending on the requirements (infrastructure, platform or services). Also, the cost and risk management influences the way the e-learning solutions based on cloud computing are managed.
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