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Effective Proposal for using Cloud Computing in Educational Environments in Iran

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Abstract

Today using information technology in educational environments is important than ever. One of the main aspects of this area in Iran is "Tablets for Students Plan" which is developed by the ministry of education. This plan was founded in March 2012 and now is preparing for implementation. This plan is in line with the world plan: OLPC (one laptop per child) which has started since 2008 with the support of the World Bank.

It is known that the use of the tablet for educational environments has some problems: low processing power, low storage, the price of the software license per system, updating, troubleshooting and maintenances.

In this paper, in order to overcome these problems and obtain the benefits of cloud technology, "cloud computing model in educational environments" has been proposed. This model is evaluated in a real environment with virtualization tools for some popular software. The impact of this model on expenses, run time, energy consumption and performance has been shown.

Keywords: *Cloud Computing, Educational Environments, Energy Efficiency, Green Computing*.

1. Introduction

"Cloud Computing" is a technology that allows anyone to use hardware and software on demand via the internet. Cloud computing technology is based on grid computing, distributed computing and parallel computing coupled with virtualization. The virtualization technology defines images of the operating systems, middleware, and applications procreated and pro-allocated to physical machines or slices of a server stack [1] [2].

Application of Cloud Computing in Education not only relieve the educational Institutions from the burden of handling the complex IT Infrastructure management as well as maintenance activities but also lead to huge cost savings [3][4].

Now, tablets are one of the newest and most attractive tools in the information technology area, with amazing speed in the field of the digital multimedia device. The various models, the simplicity and charm of Use (Especially for teenagers) and various applications, has caused these tools be one of the best-selling gadget for people. In many countries, welcoming the use of e-books and other electronic documents are to be followed ICT market boom and the paper market downturn [5].

One model of incorporating technology in education that has gained Tremendous traction in Latin America and the Caribbean is One - to - One computing. The term "One - to - One" refers to the ratio of digital devices per child so that each child is provided with a digital device (often the laptop) to facilitate learning. One - to - One models have been implemented in many Latin American and Caribbean countries such as: Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Paraguay, Peru, Trinidad & Tobago, Uruguay, and Venezuela [6].

There are some similar projects in Iran. "tablets for students" plan is one of them, which was adopted in 2012. Mobile learning, reducing the digital and social gaps, attracting people who postpone their education, the dramatic reduction in training time, increasing depth of learning, preparing students to enter the IT society of the 21st century, science-based economic growth and acquiring business skills for students are major reasons for switching to electronic education. Also, eliminating of noise and the heat produced by PCs, lowering weight and portability, lowering energy consumption [7], saving money on buying books and papers, suitability of reading, watching films, browsing on the internet and simplifying

taking notes, have caused these tools to be used in the project [8] .

Although in most such schema, effects on health and culture haven't been mentioned, we can utilize any capacity of it to decrease expenses and increase learning skills, if these parameters are checked. In this paper, we have tried to investigate this plan by presenting "educational cloud computing model".

The first section is to illustrate this model and its applications and benefits, next section evaluates the presented model and analysis results of time, price, performance and energy. Finally, the last section is the conclusion. Before that, we briefly point to some of related works.

The objective of a paper which was written by Mircea and Andreescu is to find alternatives to the use of IT, while leading universities to improve agility and obtain savings. They have tried to identify the particularities of using Cloud Computing within higher education. Mainly, they have considered the risks and benefits of cloud architecture and proposed a cloud adoption strategy proper for universities. They said that an analysis of the data and the main activities that exist within a university was the starting point for choosing a cloud model that should take into account the special security requirements of higher education and the available cloud solutions as well [9] .

Chandra and Borah proposed that one existing computer centers of the Universities/ Engineering colleges can be upgraded to cloud computing center, which will lead optimal utilization of computing resources as well as the technical expertise of the faculty/ scholars of the institutions. They showed that the savings as a result of moving to the cloud is impressive study, they investigated the total cost saving for 10 users for office PCs was found to be $11,900/- for an analysis period of 3 years, whereas the savings for same no of users' for the same an analysis period was $33, 9613/- for cost per user per month model v.s total cost of ownership [2].

Sultan believes that cloud computing is an emerging computing paradigm which promises to provide opportunities for delivering a variety of computing services in a way that has not been experienced before. He demonstrated in his article how organizations (both small and large) are already taking advantage of the benefits which this technology is bringing, not only in terms of cost but also efficiency and the environment [10] [11]. Several general examples of cloud users were provided and a case study of the University of Westminster was presented and explored in more details in his paper. It was argued in this article that educational establishments are likely to embrace cloud computing as many of them are bound to suffer from under-funding due to the global economic crisis [12][13].

In [8] the author says that it is essential for an educational and learning organization, with its budget restrictions and sustainability challenges, to use the cloud formations best suited to its IT activities. He presents a cloud computing formation model, called the Complete Cloud Computing Formation Model (C3F). It is based on the Cloud Cube Model (CCM) developed by the Jericho Forum [14][15].

Another related work is proposed in [16]. They proposed a cloud-based educational environment in which students can act as administrators. These Clouds offer services that can be used over the network, and thus no high-performance machine is necessary for the network to provide these services. In the study by using a virtual Ubuntu machine created on a cloud system, students can build and manage their own server as the super user. The authors showed that it is possible to create 60 low virtual machines in same time on a core i7 machine with 16 GB memory.

2. Cloud Computing Model

Many universities have already utilized the potential and efficiency of cloud computing in higher education. Among which we mention University of California, Washington State University's School of Electrical Engineering and Computer Science, higher education institutions from the UK, Africa, U.S and others. By utilizing the cloud services, North Carolina State University achieved substantially decreasing expenses of software licensing as well as reduced the campus IT staff from 15 to 3 employees with full working schedule [2].

In addition, cloud computing offers many benefits to e-learning solutions by providing the infrastructure, platform and educational services directly through cloud providers and by using virtualization, centralized data storage and facilities for data access monitoring.

We have already been told about the benefits of the student tablet plan. This plan can eliminate book and paper from schools greatly and students can use of e-books instead of paper books. If the cloud computing model is to be implemented in these environments, it can save money on buying PCs for families and educational centers, especially in this term of sanction. It's because of using tablets and connect to a server and using the applications instead of using PCs per each user.

Our scope of study in this paper is educational environments in Iran especially high schools. The goal is to present a model to get some popular software and powerful hardware with lower price and less energy anytime and anywhere. This can be a tablet or an old unusable PC. These are some advantage of this model:

- Software and its license are purchased only one time.
- Intensive applications such as MATLAB is installed in one system.
- Powerful hardware is just needed in server and other system should be connected to the server.
- Users don't need to update and repair software faults and Maintenance are done on the server.
- If users rarely demand this software, they won't need to buy it for a short usage.
- This model has energy, time and price providence with an acceptable performance.

One of the approaches to implement this model is to use "virtualization". Virtualization refers to technologies designed to provide a layer of abstraction between computer hardware systems and the software running on them. By providing a logical view of computing resources, rather than a physical view, virtualization solutions make it possible to do a couple of very useful things: They can allow you, essentially, to trick your operating systems into thinking that a group of servers is a single pool of computing resources. And they can allow you to run multiple operating systems simultaneously on a single machine [17] [18].

The benefits of using this technology in educational environments are:

- Optimized using of server hardware
- Installing needed educational softwares in the server
- Installing needed operating systems on servers
- Setting up access control
- Scheduling user's log in
- Using on-demand software and hardware
- Code migration
- Balloon memory

3. Evaluation

3.1. Model testing and its tools

In this paper, we used VirtualBox to create some virtual machines. This software has been installed on the server. For the first time we created a virtual machine with any required software. These operations tended to the construction of an image file. Then we created five virtual machines from this image file –Our small network had a sever and five clients.

To evaluation of the proposed model, we declare two states: "ownership" and "cloudy". Ownership is the state in which each user has a personal computer with any required hardware and software facilities. In cloudy, each user has a simple tool for connecting to server and doing his arbitrary operation by server software and hardware. This tool can be a mobile phone or a tablet or a weak PC with any operating system and a software for remote desktop connection. Clients can log in to a virtual machine into server remotely and use their facilities. For example, we installed the MATLAB software on server and clients could use of this software from their systems concurrently in a good way. We can use other needed softwares in this way. To continue, we evaluate some parameters of virtualization.

3.2. Parameters and its measurement tools

Performance is an important factor for users. The "PassMark rating" is the performance testing software that calculates weighted an average of some performance metrics and gives a single overall indication for the performance. The bigger number indicates the faster computer. For example, a typical old Intel Pentium 4 1GHz, has a rating of about 100, while a 3.4GHz Pentium 4 with 2GB of Memory has a rating about 650.

The "PassMark Rating" can only calculate if the results of all tests are available. The value is calculated by using the weighted average of the results (see equation 1). Hence, some results are considered to be more important than others. For example the CPU performance has a larger overall importance than the CD result. On a typical desktop computer the weight of results is as shows in table 1.

$$PMR = \sum_{i=1}^{n} W_i \times R_i \qquad (1)$$

In the above equation PMR is "PassMark Rating", Ri is the test result for the test i and Wi is the weight for Ri (see table 1).

These weights are based on the "average" computer usage and are intended to give the user of performance test an overall indication about how this computer will perform in general use. Needless to say, this weighted average will be inappropriate for some users. Game players will think 3D is more important, while Network admin types will be looking for disk speed.

Table 1: the weighting of different parameters for performance

	Test Suite	Weighting
1	Disk	20%
2	CD / DVD	9%
3	Memory	18%
4	3D Graphics	12%
5	2D Graphics	14%
6	CPU	27%
	Total	100%

Another parameter is "energy consumption". To make different loads (idle, low, medium, busy and maximum) on the CPU we use "CPU stress" benchmark. This software has been run on the server and clients with different states and the power consumption has been measured by "power meter" [19].
The next parameter is the price of server and client system which obtain from the current market rate in Iran. Now, a server in our case study is about $650, one Akash tablet which has proposed in TFS plan, is about $100 and a PC in our case study is about $420.
The latest parameter is run time of operations. We use from a benchmark, standard and heavy floating point map in two states When measuring how fast something is, there are two kinds of measures. "You can measure how long it takes to do something or you can measure how much gets done per unit time. The former is referred to as response time, access time, transmission time, or execution time depending on the context. The latter is referred to as throughput [20][21].

3.3. Experimental Results

3.3.1. Performance

Performance test has been done in different modes with different numbers of virtual machines. According to table 2 whatever the number of running machines is less, the performance is higher than the case that number of VMs is large. In the best case, the scale of performance is 420.8 and in the worst case is 221.76. This shows that when the number of online users is low, the system resources are divided between these users. People in educational environments usually don't work together. So, we assume an average scale for five users: 315. This scale for PCs in ownership model is 435. With this account, performance in the cloudy state is 27% lower than ownership in this study.

Table 2: performance of virtual machines in cloudy state (PMR)

Number of running systems	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5
1	420.8	-	-	-	-
2	358.5	364.1	-	-	-
3	296.6	301.0	296.6	-	-
4	264.2	257.1	274.5	297.3	-
5	209.9	201.7	213.5	250.7	233

3.3.2. Energy

As seen in figure 1, energy consumption in different loads on CPU for five PCs is about 5-fold in a server with five virtual machines, which means a 80% saving in money. For example, in idle mode of processors, power consumption is 32*5 watts for cloudy state and 37 watts for ownership state when each five machines are running.

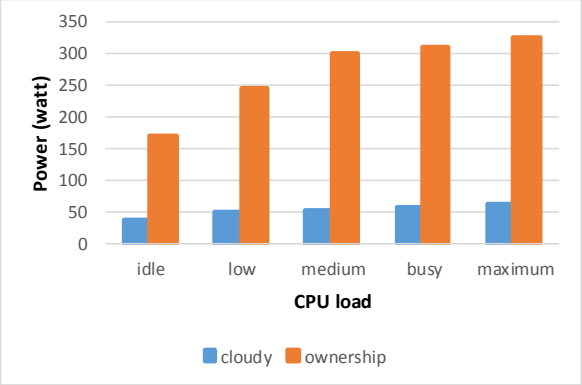

Fig 1: energy consumption in ownership and cloudy states

3.3.3. Run time

In cloudy mode, the results of running a benchmark code has been shown in table 3.

As can be seen, the average of speed of concurrent virtual machines running is 413.39 million operations per second. This scale in a PC is 424 million per second. This means that only 2% reductions exist in cloudy mode.

Table 3: run time of floating point operations (million per second)

Number of running systems	Machine 1	Machine 2	Machine 3	Machine 4	Machine 5	average
1	456	-	-	-	-	456
2	440	452	-	-	-	446
3	435	431	440	-	-	435.33
4	438	407	414	413	-	418
5	335	314	276	330	303	311.6

3.3.4. Price

The price of systems for 5 users is about $900. It means 27% frugality.

4. Conclusion

This paper proposes a new model for the use of cloud computing in educational environments. The results of implementation in a real environment show that the proposed model is effective and efficient in term of energy and cost.

In order to evaluate the proposed method in a real Cloud, we plan to implement it by extending a real-world cloud platform, using cloud stack environment. Besides the reduction in energy consumption in IT infrastructure, this work also has social significance as it decreases carbon dioxide footprints.

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