NECESSITYOFCLOUDCOMPUTING IN EDUCATION SYSTEM: A Study

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Abstract For several reasons cloud computing is offering attractive solutions for academic and research institutions. In this work we propose how cloud computing can be used for teaching activities in higher educational and research institutions in developing countries. This paper stresses on the use of cloud computing for satisfying ad hoc needs of computing resources in research and teaching activities. Thorough analyses of benefits of utilizing cloud computing at various levels of education system are also included. Cost benefit of adopting this technology in research work is also discussed here.

Keywords- Cloud, Cloud Computing, Education system, Research institutions.

I. INTRODUCTION

The classroom is changing. From when the school bell rings to study sessions that last well into the night, students are demanding more technology services from their schools. It's important not only to keep pace with their evolving needs, but also to prepare them for the demands of the workplace tomorrow. At the same time, education institutions are under increasing pressure to deliver more for less, and they need to find ways to offer rich, affordable services and tools. Those educators, who can deliver these sophisticated communications environments, including the desktop applications that employers use today, will

be helping their students find better jobs and greater opportunities in the future. CloudComputing can help provide those solutions. It's a network of computing resources—located just about anywhere—that can be shared. They bring to education a range of options not found in traditional IT models. In fact, the integration of software and assets you own with software and services in the cloud provides you with new choices for balancing system management, cost, and security while helping to improve services.

This vision is attractive to research and educational groups in many developing countries where even big academic and research institutions are still lacking resources (and funding for acquiring resources) to sufficiently support their research and education activities. For research and educational groups without adequate computing resources in developing countries, cloud computing offerings could be a viable solution.

II. Defining the Cloud

Cloud computing is 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.

Clouds in nature may appear loosely defined, but at the National Institute of Standards and Technology (NIST, USA), cloud computing means the following:

- On-demand service. You can get what you need when you need it.
- Broad network access. The cloud brings network-based access to, and management of, software and services— meaning access is anywhere, anytime.
- Resource pooling. A large pool of users shares location-independent resources and costs in an environmentally sustainable way.
- Flexible resource allocation. As demands fluctuate, cloud services can scale rapidly. You don't have to worry about bringing new servers online or reallocating resources.
- Measured service. Most cloud usage is metered, often per user or per hour. With those services, you pay for what you use.

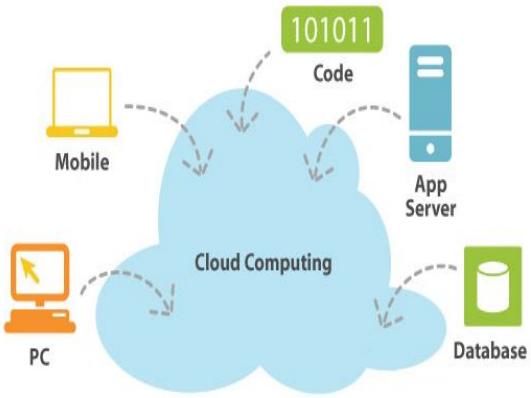


Figure1.1. Cloud Computing

III. Cloud reality check

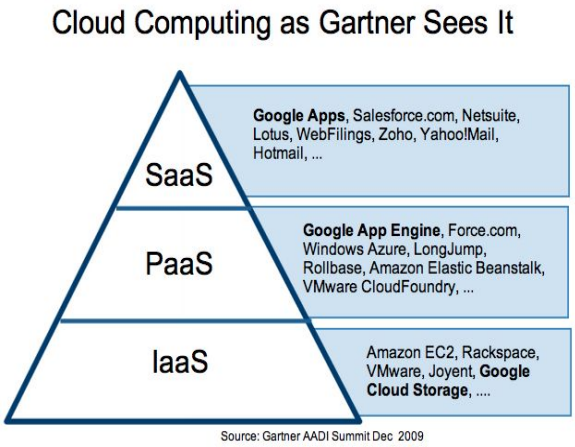
With cloud computing comes with hype. What can you expect?

- "It's cheaper." The truth is, you need to balance the up-front savings with ongoing subscription costs to determine actual savings. The free services from various companies and pay-as-you-go approaches let you balance your IT budget with operational expense spending instead of capital expenses. So you can expect to reduce costs associated with server hardware, support and deployment, and power consumption.
- "It's faster." Data-intensive computing in the cloud can be six times faster than in isolated data centers. You can deploy applications more quickly, too, compared to traditional means. And it's certainly fast to procure on-demand services.
- "It's greener." In 2006, the Department of Energy estimated that U.S. data centers consumed about 1.5 percent of all U.S. electricity use, and current projections show worldwide carbon emissions from data centers will quadruple by 2020. Consolidating and sharing resources can curb the waste of data center sprawl and reduce greenhouse gas emissions.

IV. Which cloud is right for you?

The choice to move to the cloud is not an all-or-nothing proposition. With different types of cloud offerings, you have flexible options about which services to obtain in the cloud and which to keep on-site. Your priorities and security requirements determine the level of cloud capabilities to explore.
If you look closely at the cloud, you'll see three distinct sets of offerings:

- Software as a Service (SaaS): The applications, such as e-mail, people use every day.
- Platform as a Service (PaaS): The operating environment in which applications run.
- Infrastructure as a Service (IaaS): The on-demand data centers.



Fgure1.2. Cloud Computing as gather.

Outsourcing some capabilities to the cloud makes the most of what's on-site by freeing time, budget, and people. For example, with SaaS, you can add services, like e-mail, affordably. With PaaS, you can deliver services broadly without having to manage the infrastructure. With IaaS, you get pay-as-you-go data center capacity for adding CPUs, storage, networking, or Web hosting.

a) *Anytime, anywhere apps: Saas*

The cloud hosts the applications you use every day for productivity, contact management, payment processing, and more. In the current and future economy, SaaS makes sense. It can lower expenses associated with software acquisitions in the near term. Longer term, it helps organizations with limited IT resources to deploy and maintain needed software in a timely manner while, at the same time, reducing energy consumption and expense.

A growing number of academic institutions are turning to SaaS for their desktop applications. For example many Community College uses an e-mail solution hosted in the cloud. Students now have the free collaboration tools they want, people on campus have the tools they need to work together, and administrators are finding it easier and more cost-effective to manage.

b) *Platforms in the cloud: PaaS*

The scalable architecture of the cloud is transforming how academic institutions think about how they serve their students, teachers, faculty, and staff. Size—of your service, budget, or staff—does not limit IT when the platform for custom services is as readily available and broadly deployable as the Web. Cloud platforms free you to focus on the services you can offer without worrying about or managing the infrastructure needed for those services.

PaaS is the operating environment of the cloud with the tools you need on demand to create and host online services, software, Web sites, and mobile applications. With PaaS, you can concentrate on delivering applications rather than on the underlying infrastructure, which a service provider maintains and updates in its data centers. You can also use PaaS to create multi-tenant applications—that is, services accessed by many users simultaneously.

With PaaS, you can develop new applications or services in the cloud that do not depend on a specific platform to run, and you can make them widely available to users through the Internet. PaaS delivers cloud-based application development tools in addition to services for testing, deploying, collaborating on, hosting, and maintaining applications. The accessibility of PaaS offerings enables any programmer to create enterprise-scale systems that integrate with other Web services and databases—an aspect of cloud computing that fosters additional opportunities for education IT and allows bigger thinking.

The open architecture of PaaS can support integration with legacy applications and interoperability with on-site systems—important considerations because education operates in a mixed IT world. Interoperability gives you the flexibility to take advantage of cloud benefits while retaining data and applications on-site as needed.

c) *Data centers on demand: Iaas*

How many data centers does it take to run a K−12 or higher education institution? Now that the cloud offers storage, networks, and servers as a service, technology is no longer bound by the traditional on-site IT department. On-demand data centers put virtually unlimited computing power into the hands of even the smallest education institution.

On-demand data centers—also known as IaaS—provide compute power, memory, and storage, typically priced per hour according to resource consumption. Some call IaaS bare metal on demand. You pay for only what you use, and the service provides all the capacity you need, but you're responsible for monitoring, managing, and patching your on-demand infrastructure. One big advantage of IaaS is that it offers a cloud-based data center without requiring you to install new equipment or to wait for the hardware procurement process. This means you can get IT resources at your school, college, or university that otherwise might not be available.

With IaaS, savings come from hardware and infrastructure costs but not necessarily from staffing because you are still responsible for system management, patch management, failover and backup, redundancy, and other system management tasks. Depending on the service, an IaaS provider typically handles load balancing, monitoring, and scaling automatically, and you manage your cloud deployments.

V. What does this mean for your school or college?

Teaching and learning platforms: Servers can provide some or all software applications, operating systems, and Internet access, rather than having these installed and maintained on each platform separately. Servers deliver on demand, as needed by the school population, to the full spectrum of learning platforms and devices. For example, a single application might be shared by hundreds of students and teachers on notebooks, tablets, and desktops.

School IT: Cloud computing allows for cost- and energy-efficient centralization of school infrastructures. It takes advantage of server capabilities to adjust allocation based on demand—all invisible to teachers and students. Remote management and maintenance can save time and increase security. For instance, an application or operating system served by the cloud can be upgraded once at the server level, rather than on each individual platform. Platform access can be restricted or denied in the event of a loss or theft

Access: Along with the greater control for IT comes increased flexibility for teachers. They can select from the entire pool of available applications those which best complement their curriculum and students at any given time. The wide range of Internet-based software and tools can also be quickly and easily served by the cloud.

VI. Why store in cloud?

There was a time when, to use files (word processing files, spreadsheets, etc.) on different computers, you needed to save your files on a thumb drive or CD-ROM disk. The drive or disk then travelled around with you so that you could load your information onto other computers while holding your breath until the document or PowerPoint slide was actually retrieved! Not any longer. The safety, stability, and ease-of-use of cloud computing in education are resulting in widespread adoption in educational institutions of all sizes and types. A recent conversation about cloud computing with several colleagues in the education field, including school teachers and university professors, revealed significant advantages:

- **No more carrying around devices:** such as thumb drives or CDs. You don't need to worry about losing the device, breaking the CD, or not having your information load properly.
- Easy access: Lesson plans, labs, grades, notes, PowerPoint slides – just about anything digital that you use in teaching is easily uploaded and accessed anytime.
- Stability: Cloud computing is now to the point of being a very stable technology that you can rely on.
- Security: Your data, content, information, images – anything you store in the cloud usually requires authentication (ID and password, for example) – so it is not easily accessible by anyone. In addition, should something happen to the technology at school, your content will still be available to you and your students if it is stored elsewhere.
- Share ability: Working on an instructional assignment with other teachers? You can share some or all of your files that you have stored in the cloud. No more obtaining an extra thumb drive or burning another CD or DVD. You just need to send a link to the file(s) destination.
- Track ability: Make changes to a lesson and want to change it back? No problem. Cloud computing will save multiple revisions and versions of a document so that you can chronologically trace back the evolution of an item.
- Collaboration: You can set-up various student groups to work on projects and assignments in the cloud.
- Good-bye copier: That's right! With cloud computing, the amount of photocopying is reduced significantly – even more so if each student has their own smart device (computer, laptop, tablet, etc.). Quizzes, tests, assignments all can be taken, scored, shared with student and parents, and stored.

- Good-bye file cabinets: With cloud computing redundancy, there is no longer the need to both save files digitally as well as in paper format. Cloud computing systems are regularly backed-up, so the chances of losing content are quite small. And, no more file cabinets mean more classroom space for you and your students.

VII. Going Paperless

Students and teachers can share their work without having to use paper. Using paper is costly both to the environment and in monetary terms and is therefore no longer a viable way to educate. In the early 1980s, F.W. Lancaster predicted a paperless society. We are not quite there yet and many not are for many years to come. There are some instances where paper is still the preferred format. Even though we have e-books, people still prefer to hold an actual paper book in their hand. There are situations; however, that going digital makes sense. Classroom and school administrative management is a perfect example. If your school has information technology infrastructure (wired and/or wireless), it is easy to implement cloud computing. And, the advantages of cloud computing far outweigh any disadvantages. From the administrative perspective:

- Staff and teacher time spent printing, filing, and distributing can be better used on more educationally-directed activities that impact student learning.
- Cost savings in terms of buying, leasing, and maintaining photocopiers and printers, ink cartridges, and paper.
- Return-on-investment by not needing to invest in purchasing, housing, and maintaining servers, software, and related IT items, such as thumb drives, and CD-ROMs.
- Greater efficiencies as teachers and staff can easily access documentation anytime, anywhere without needing to rely on someone being at their desk to sign-out a paper file.
- Streamlined workflow: Workflow can be tracked using various analytical tools to see how often files are accessed, busiest times of the day and days of the week, etc.
- Short learning curve: It does not take long – a few hours (if that) – to learn how to manage digital documents in the cloud.

VIII. The benefits of clouds in case of computing power required for research work

In many senses the primary advantages the cloud brings are to do with cost and efficiency, which are closely intertwined. Essentially the capital costs of computing can be done away with if an organization relies on the public cloud, buying virtual server time and storage space on demand. Expenditure on IT becomes operational, rather than capital. Moreover, the physical space required for racks of servers is no longer necessary and the organization no longer incurs energy costs for running and cooling its servers. For many start-up businesses, cloud computing offers access to computing power that would otherwise be beyond their reach. The entry barrier for large-scale computing task is effectively removed by the cloud. As costs are incurred on a per use basis, the risks of committing to large capital purchases are removed. Scalability allows the organization to add capacity as and when it's needed and to scale down as well as up, driven by demand. As an example, Amazon's Elastic Cloud Compute (EC2) service allows the rental of virtual servers by the hour, with a variety of processing and OS options. Amazon term a virtual server an 'instance'. So, a small instance comprises: 1.7 GB of memory, 1 EC2 Compute Unit (1 virtual core with 1 EC2 Compute Unit), 160 GB of instance storage, 32-bit platform (Amazon, 2009) and would cost $0.11 per hour of use for a Linux server based in Europe. A further $0.10 is charged per gigabyte of data moved in or out of EC2. Running Windows raises the costs somewhat, to $0.135 per hour for the small instance but the differential between Linux and Windows increases with larger instances. There is no long term commitment and an organization is only charged for what it actually uses. If more instances need to be added, it is literally a matter of minutes to configure new server instances. Google's AppEngine takes a slightly different approach but with some benefits. With Google you are not renting a virtual server as such, but an amount of processing power. If your processing needs increase then Google's AppEngine will scale dynamically with load, rather than requiring manual setup of new servers. Even if ditching all physical servers is seen as a step too far (and many University IT managers may well consider this to be the case), building a private cloud with virtualized servers, even if the organization owns and maintains the physical infrastructure, can deliver large efficiency gains. A McKinsey survey cited by The Economist (2008) suggests that, without virtualization, on average only 6% of server capacity is used. However, the kinds of economies of scale that large cloud providers can take advantage of will typically be absent. Nonetheless, in this private cloud approach an organization can still take advantage of the on-tap computing power in the public cloud. 'Cloud bursting' is a service that provides 'overflow computing' for dealing with spikes in web
traffic or processing load (Naone, 2009a). Flexibility, as well as cost, is thus another compelling advantage of the cloud.

As Erik Brynojolfsson of MIT states, *"The ability to be agile in your infrastructure is what separates the winners from the losers… cloud computing is one of the most important technologies that affect the ability to maintain that level of flexibility"* (quoted in Cass, 2009).

IX. Conclusion:

We have analyzed requirements from groups in educational and research institutions in the country. We have identified several requirements and possible cloud adoption for these requirements that are very specific to the context of research and educational groups. From our research we conclude that cloud computing will help in betterment of our education system at various levels.

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