

**Rajeev Puri**

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## **Cloud Computing in Education and Sports in India**

**Rajeev Puri, Dept. of Computer Science, DAV College, Jalandhar.**

[rpuri@davjalandhar.com](mailto:rpuri@davjalandhar.com)

### **Abstract**

**Cloud computing is becoming a backbone for many ICT Enabled applications. The education domain being the focus of ICT in the modern days is having great expectations from cloud computing. With e-learning already increasing its reach across the country, a bigger challenge in terms of deployment and maintenance of infrastructure is becoming nightmare for many public and private organizations. Similar is true with the sports domain. The ever increasing use of modern computing technologies in sports in developed countries is benefiting the players to beat the tough competition and improve their performance. The cloud computing with its scalability, versatility and robustness is gaining popularity these days. This paper provides an overview of the various cloud based services that can be used for benefiting the various aspects of education and sports domains.**

### **1. Introduction**

The cloud computing, in simple terms, means to store, process and access the data and programs over the Internet, instead of doing it on local machines or networks. In cloud environment, the programs may run in parallel on several machines, which are inter-connected with each other over the Gigabit networks. Since the data in cloud environment is stored on remote computers, any client may connect to the cloud network by using moderate to high speed Internet connections, using their desktops, laptops or even portable devices like tablets and mobile phones etc. The cloud computers were primarily designed for research purpose only, but the potential of cloud computing is pushing it to be used in diverse areas.

### **2. Cloud deployments**

The cloud services are offered using any of the following deployment models of cloud -

i) **Private Cloud:** A cloud platform exclusively used by a single organization and its clients. It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises. Since the cloud is private, no external access is allowed to the cloud contents. The private clouds are secured by creating Access control lists.



ii) **Public Cloud:** The cloud services are available in public domain and are available in pay-per-use mode. The cloud is managed by the service provider. The cloud users have restricted access to their own area only. These type of clouds are generally used for caching purposes.

iii) **Community Cloud:** A cloud service shared by a group of people having common interests. The service is limited to a group of people only instead of being available in public domain. Various source code repositories use the community cloud services.

iv) **Hybrid Cloud:** A composition of two or more clouds (private, community or public) that remain unique entities but are bound together, offering the benefits of multiple deployment models.

### **3. Cloud services business model**

The cloud computing works on a service driven business model, with services falling in the following categories -

#### **i) Infrastructure as a Service (IaaS)**

The clients, instead of investing on computing infrastructure, get the infrastructure on rental basis from cloud service providers. The services offered range from simple storage of data to processing and distribution of data. IaaS users are responsible for managing Operating systems as well as the applications installed on top the operating systems. The cloud service providers manage all hardware and networking infrastructure along with the virtualization of the server operating systems in case of shared cloud services. The cloud users are responsible for updating the operating servers as well as the applications if the new versions of the applications are required. The typical example of IaaS include Amazon Web Services (AWS, launched in 2006), Microsoft Azure (Launched in 2010) and Google Compute Engine (Launched in 2012).

#### **ii) Software as a Service (SaaS)**

Software as a Service (SaaS) is also known as Cloud application service. It has the largest potential out of all the cloud services and is rapidly growing each day. The clients need not do outright purchases of expensive software and instead pay small fee for using the software as a service. SaaS uses the web based technologies to deliver applications that are managed by a third-party vendor and whose interface is accessed on the clients' side. Most SaaS applications can be run directly from a web browser without any downloads or installations required, although some require plugins. The typical examples include CRM, HRM, Healthcare, LMS and other out of the box solutions for the enterprise. The typical examples include Google Apps, Moodle, Salesforce, Quickbooks and may more.



### iii) Platform as a Service (PaaS)

The clients can opt for cloud platform based software development services, wherein the majority of software development tasks are done using Internet Browsers. The advantages include the facility to boost application development using various add-ons, public libraries and collaborative developments.

Businesses and organizations who wish to create a cloud computing option, either for their in-house use, or for the development, deployment and running of custom application need a Platform as a Service solution.

## 4. ICT in Education and Sports

ICT is becoming a vital component for the education system. With the advent of more and more new technologies emerging day by day, it has become essential for coaches, educators, players as well as students to know about these new developments and effectively use the emerging ICT tools for the uplifting of the education and sports standards. India being a country of diverse economic backgrounds is facing challenges in fully utilizing the potential of ICT in education, sports and research. The educational contents ranging from simply multimedia based presentations to complex 3D graphical presentations and video lectures need good computational speeds for the rendering the course material. Similar is true for the sports fraternity. The players need to know the techniques used by their opponents and other international level players for designing the winning strategies. The economically weaker training and education institutes are finding it difficult to invest in costly hardware that is going to be obsolete in the next 5-6 years. Apart from the investment in the hardware resources, there are other hidden costs as well which need to be accounted for while calculating the total cost of ownership of various ICT equipments. Some of these hidden costs include

#### i. Expense on Power

Although the electricity in India is cheaper as compared to the other western countries, the reliability of the un-interrupted service is a big question and hence an alternate arrangement of the power has to be made, which is a costly affair. Apart from the investment in the alternate power sources, their recurring costs have also to be taken into account.

#### ii. Expense on Internet Connectivity

Internet in India is still not available to the entire country as specially the dedicated leased circuits are not affordable for many in the country. For any data center made to distribute the contents specially video lectures to masses via in-house servers needs huge bandwidth.



### iii. Human Resource

The high-end servers as well as the other networking infrastructure deployed in-house needs highly skilled persons for the regular maintenance.

### iv. Redundancy

The contents generated for the students need regular backups, so that in case of any disaster, the precious data generated over the years does not get lost. The redundant backup at some other remote site involves almost the same cost as that of the live site.

### v. E-Threats

With the ever increasing internet connectivity across the world and the increase in the number of virus, spam, malware and other cyber attacks, the robust security arrangements need to be made to protect the data as well as the infrastructure. Coping with these e-threats needs additional budgets as well as manpower for dealing with such incidents.

## 5. The cost advantage of Cloud based services

Keeping in mind the above mentioned costs for in-house deployment of the ICT hardware infrastructure, the cloud services can prove to be a boon to the budget deprived education and sports domain in India. The cloud based services since are available with a subscription cost, which is almost same to the tune of in-house deployment of the services in the shorter run, however, taking the longer periods into consideration, the cloud costs are far less as compared to the in-house deployments. More-so the organizations do not need to upgrade the servers as the cloud providers are regularly updating their servers as per the emerging technologies. Keeping this in mind, while the yearly recurring costs up 3-4 years are fairly small, but there can be a sudden spike in 5<sup>th</sup> year that includes the cost of new hardware, software, labor fees, and related costs to replacing one physical server at end-of-life. The figure [1] below shows an on-premise vs cloud based solution that clearly evident the fact mentioned above.

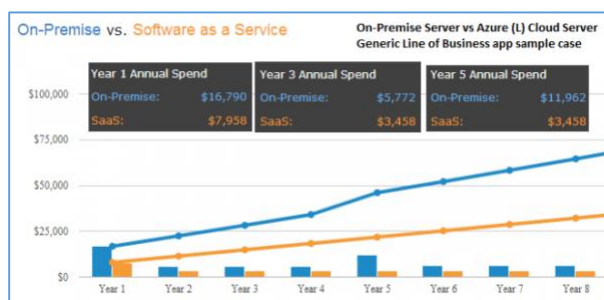


Figure 1.

(Source: <https://betanews.com/2013/11/04/comparing-cloud-vs-on-premise-six-hidden-costs-people-always-forget-about/>)



## 6. Cloud services in Education and Sports

The various cloud services that can be used in the education and sports in India are listed below.

### i. Registration Services

The students and players registrations can be done at the centralized portal, so that a combined repository of all the students and players can be made. Being central in nature, it will become easy for universities and training institutes to monitor the growth and activities of the students and players. Since this is going to be huge data, the cloud services can be used to distribute the load to the regional nodes.

### ii. Library Services

The local libraries of schools and colleges sometimes fail to afford the costly books, journals, periodicals as well as computer based lectures/tutorials. The government can plan a central library that can be cloud based, with a centralized catalogue maintained at the cloud servers. The student requisitions can be received via a web based portal and the books/ study material can be dispatched across the libraries for the benefit of the students. One such initiative is currently being adopted by the Inflight project in India. However, the project is restricted to the books and other reading material only.

### iii. Video lectures catalogue

The faculty from state of the art institutes like IITs and IIMs can record their lectures and these lectures can be edited/tailor made as per the needs of the students of remote institutes. These lectures can be distributed via the cloud services across the nation.

### iv. Research grids

The advance research projects in the emerging fields of sciences like nano-technology, bio-technology, medical imaging etc. need high speed computing facilities. The complex calculations sometimes take even days to process on a single high end computer. The cloud computing can help such calculations using the distributed and scalability feature, where the cloud servers can automatically grow as well as shrink dynamically as per the current requirements. Moreover may cloud providers only charge as per usage, so there is no need to pay for the underutilized capacity and no need to wait for scaling up the system to match the current requirements. The cloud based research grids are perfect solutions for such requirements.



#### v. Data grid for Sports

Game and player performance analysis is one of the emerging techniques being used these days for the player training purposes. An example includes capturing the live data of cricket players viz. the bowling speed of the bowler, the batting technique and fielder positioning and response etc. The video data can be captured on per player basis and suggestions can be made to bowlers to bowl faster or slower as per the response/reflex limit of the batsman. Similar suggestions can also be made to batsman to apply more power in the strokes to surpass the fielders and hit boundaries. The fielders can be trained to tune their reflexes as per the speeds / movements of the cricket balls.

#### vi. Fully Indexed VOD for players

The indexed video on demand can be an exciting feature for the players, where the players can browse a fully indexed database of videos. An example includes searching videos of all the wickets taken by a particular player against a particular team in a particular series. The indexing data is huge and can be easily ported on a cloud based service, where search and retrieval takes fractions of milliseconds, thereby saving the valuable time of players.

### 7. Challenges of Cloud Computing

Information flow and management techniques can have far reaching political, social and economic effects on the students, faculty and the society. Cloud computing is a relatively new concept and the marketplace for the cloud based services is still emerging. With only a limited number of players providing their services in cloud environment, the market has yet to be consumer oriented. For higher education, decisions to adopt cloud computing is influenced by more than technical and cost considerations. The content developers need to develop the content keeping in mind the platforms on which the contents are to be deployed and delivered. The cloud administrators need to have good knowledge of the systems administration, network and infrastructure management along with the skills to handle the backup and recovery procedures for the cloud based systems. The educators need to be prepared to efficiently use the cloud based services.

### 8. Conclusion

The ICT based teaching-learning has led to the quality enhancements in the higher education and sports. Traditional teaching and learning techniques are increasingly being substituted by online and virtual environments. ICT is offering endless opportunities for those who want to learn but are unable to attend the regular classes due to various constraints like course timing and location etc. The use of ICT in education not only improves classroom teaching learning process, but also has enhanced distance learning. The e-contents are now reaching remote areas and learners are able to access qualitative learning environment from anywhere and at anytime. The ICT has been



made affordable by using the cloud based solutions. The immense computing power of cloud is now available on pay-per-use bases, that has made the cloud an affordable solution. Adoption of cloud computing presents many risks and other challenges like security, interoperability, control, performance, integrity and reliability instead of using a traditional outsourcing arrangement. Cloud Computing is yet to be understood and adopted by the general public, including governments, workers, and corporations.

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