

Cloud Computing Advantages and Challenges for Developing Nations

* Varnika VS

Abstract

This paper discusses a new wave in the field of information technology, that is, cloud computing. It describes its advantages and some issues. There is no doubt that cloud computing is the development trend for the future. We can have approximately infinite computing capabilities, scalability, pay-per-use scheme, and so on. However, this wave still needs to resolve some of its existing issues with urgency to make it more appealing and suited for developing countries.

Keywords: Advantages of cloud computing, challenges of cloud computing, cloud computing, developing nations

I. INTRODUCTION

With the advent of the internet in the 1990s to the present-day facilities of ubiquitous computing, the internet has changed the computing world in a drastic way. It has travelled from the concept of parallel computing to distributed computing, to grid computing, and recently to cloud computing. Although the idea of cloud computing has been around for quite some time, it is an emerging field of computer science. Cloud computing can be defined as a computing environment where computing needs of one party can be outsourced to another party and when need arises to use the computing power or resources like database or emails, these can be via internet. Cloud computing is a recent trend in Information Technology that moves computing and data away from desktop and portable PCs into large data centres.

The main advantage of cloud computing is that customers do not have to pay for infrastructure, its installation, or manpower to handle such infrastructure and maintenance.

Cloud computing is an information technology (IT) paradigm that enables ubiquitous access to shared pools of configurable system resources and higher-level services that can be rapidly provisioned with minimal management effort, often over the internet. Cloud computing relies on sharing of resources to achieve coherence and economies of scale, similar to a public utility.

Third-party clouds enable organizations to focus on

their core businesses instead of expending resources on computer infrastructure and maintenance. Advocates note that cloud computing allows companies to avoid or minimize up-front IT infrastructure costs. Proponents also claim that cloud computing allows enterprises to get their applications up and running faster, with improved manageability, and less maintenance, and that it enables IT teams to more rapidly adjust resources to meet fluctuating and unpredictable demand. Cloud providers typically use a "pay-as-you-go" model, which can lead to unexpected operating expenses if administrators are not familiarized with cloud-pricing models.

Since the launch of Amazon EC2 in 2006, the availability of high-capacity networks, low-cost computers, and storage devices as well as the widespread adoption of hardware virtualization, service-oriented architecture, and autonomic and utility computing has led to growth in cloud computing.

II. HISTORY

The underlying concept of cloud computing was introduced way back in 1960s by John McCarthy. His opinion was that "computation may someday be organized as a public utility. Also, the characteristics of cloud computing were explored for the first time in 1966 by Douglas Parkhill in his book, *The Challenge of the Computer Utility*. The history of the term cloud is from the telecommunications world, where telecom companies started offering Virtual Private Network (VPN) services with comparable quality of service at a

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* Varnika VS is with Acharya Institute of Technology, Acharya Dr. Sarvepalli Radhakrishnan Road, Hesaraghatta, Bengaluru, Karnataka, India - 560107. (email : varnika.beis.11@acharya.ac.in)

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much lower cost. Initially before VPN, they provided dedicated point-to-point data circuits which was a wastage of bandwidth. However, by using VPN services, they can switch to balance utilization of the overall network. Cloud computing now extends this to cover servers and network infrastructure. Many players in the industry have jumped into cloud computing and implemented it. Amazon has played a key role and launched the Amazon Web Service (AWS) in 2006. Also, Google and IBM have started research projects in cloud computing. Eucalyptus became the first open source platform for deploying private clouds.

III. CHARACTERISTICS OF CLOUD COMPUTING

In cloud computing, users access data, applications or any other services with the help of a browser regardless of the device used and the user's location. The infrastructure which is generally provided by a third-party is accessed with the help of the internet. Cost is reduced to a significant level as the infrastructure is provided by a third-party and need not be acquired for occasional intensive computing tasks. Less IT skills are required for implementation.

Reliable service can be obtained by the use of multiple sites which is suitable for business continuity and disaster recovery. However, sometimes many cloud computing services have suffered outages, and in such times its users can hardly do anything.

Sharing of resources and costs amongst a large collection of users allows efficient utilization of infrastructure. Maintenance is easier in case of cloud computing applications as they need not be installed on each user's computer. Pay per use facility allows measuring the usage of application per client on a regular basis. Performance can be monitored and thus, it is scalable.

Security can be as good as or better than traditional systems because providers are able to devote resources to solving security issues that many customers cannot afford. However, security still remains an important concern when the data is quite confidential. This delays adoption of cloud computing to some extent.

IV. ADVANTAGES OF CLOUD COMPUTING

A. Easy Management

The maintenance of infrastructure, be it hardware or

software is simplified. Thus, there is less headache for the IT team. Also, applications that are quite storage intensive are easier to use in the cloud environment compared to the same when used by the organization on its own. Also, at the user level, what you mostly need is a simple web browser with internet connectivity.

B. Cost Reduction

The main advantage for Small and Medium Enterprises (SMEs) lies here. Cloud computing drastically reduces IT spending for SMEs. Costly systems need not be required for occasional use of intensive computing resources. Also, the manpower required for such systems is not required. Even simple applications like email can be set up and mostly read through applications like Google Apps. Also, as most of the time such providers are quite reliable in terms of availability, it is a clear winner.

C. Uninterrupted Services

Lower outages are provided by cloud computing services, thus providing uninterrupted services to the user. However, some occurrences of outages have occurred in the past, like the Gmail outage in 2009. Also, other cloud vendors like EC2 have failed at some point of time. However, they are much more dependable compared to the infrastructure installed in the organization.

D. Disaster Management

In case of disasters, an offsite backup is always helpful. Keeping crucial data backed up using cloud storage services is the need of the hour for most of the organizations. Also, cloud storage services not only keeps your data off site, but they also ensure that they have systems in place for disaster recovery.

E. Green Computing

Harmful emissions due to extensive use of systems in organizations, electronic waste generated as time passes by, and energy consumption is the main disadvantage of the present-day computing systems. This can be reduced to some extent by using cloud computing services. This leads to environment preservation. Also, e-waste is generated to a minimum extent.

As with most technological developments, the rise of cloud computing accrues benefits in different forms and at different rates for early and late adopters. The

developing world has benefitted at times from the “leap-frogging” effect of skipping earlier generations of technologies and moving straight to a more mature, sustainable form. Notable examples to date include the widespread adoption of the mobile phone without widely established landline networks in many parts of rural sub-Saharan Africa, and Southeast Asia, and the adoption of scalable solar technologies, and other forms of renewable energy without a pre-existing fossil fuel energy systems which are currently underway in many areas. Cloud computing provides a number of clear benefits for the developing world. However, the widespread adoption of technology is not without its risks.

V. OPPORTUNITY

The ongoing adoption of cloud services and the potential for future will have a significant impact on wide-ranging aspects of developing economies:

A. Entrepreneurial Applications

Utilizing the cloud significantly reduces barriers to entry for entrepreneurs in the developing world by providing customized and scalable computing, storage, and development solutions without the need for significant capital outlays. Developing businesses can purchase only what they need at the time while being able to accurately forecast future costs in the face of growth. Similarly, developers and software engineers in these regions benefit from access to the same computing power availability as those they are competing with in the West, allowing them to produce applications, and services that are better tailored to their local and regional market due to their increased understanding of the cultural and economic needs of the area. They are also able to compete against developers from developed areas for shares of the global marketplace due to their lower operating costs in other areas, which ultimately lowers the price of applications and services worldwide.

B. Health Applications

Cloud technologies are able to match patients with medical providers in ways that were previously impossible at the turn of the millennium. In areas that are often underserved by qualified medical facilities and providers, the future potential of the cloud to jumpstart the implementation of telemedicine is enormous. Effective telemedicine would allow providers to access remote patients, track disease outbreaks, and reduce the

burden on physical hospital resources by prioritizing care. Finally, the storage and management of medical records in the cloud would streamline record keeping and reduce overall operating costs.

C. Government Applications

The most striking example of the benefits of cloud technology is the reduction in infrastructure required, including electrical, computing, storage requirements. Similar to applications in healthcare record management, the utilization of cloud computing, and storage could greatly expand the quality, reliability, and affordability of government services. This would also greatly improve the redundancy of record keeping in areas prone to conflict, reducing the time required to return to normality & the following supports. Municipal governments in the Balkans are still dealing with the effects of targeted destruction of land records during conflicts in the area over two decades ago, and cloud storage provides a method for avoiding this fate in the future.

VI. CHALLENGES AND RISKS

The adoption of this technology is not without its challenges and risks.

A. Data Security

Many developing countries are equally worried about the risks to cloud based storage of data. India is one of several countries with strict data sovereignty laws that require all data centres handling Indian data to be located within the country's borders. Similar decisions will severely limit the access and application of cloud services in poorer countries but storing a country's data offshore exposes the data to increased risk of theft from cybercriminals, snooping from larger nations' intelligence services, and improves the leverage of large data companies as well as of governments that prefer them to developing economies.

B. Privacy

Individual citizens in these areas also face risks from their own governments. If users believe their own governments will be observing their activity and storing their data, they will be less likely to utilize the technology for critical activities.

C. Economic Dependence

The advantages in infrastructure development accrued through early adoption in the developed world has the potential to further increase the dependence of developing economies on these resources, which will ultimately constrain their development. This could take the form of decreased opportunity for home grown professionals that can be replaced by remote operators from areas with better economy of scale, restricting native workers to low-skilled positions. Other examples include the challenges of vendor lock-in and the rise of proprietary software that will force those in developing nations to remain with whatever large providers are able to service their location due to barriers to entry for providers in these areas.

Despite these challenges, the cloud presents an incredible opportunity for developing economies to integrate with the networked economy.

The biggest concerns about cloud computing are security and privacy. Handing over of crucial confidential data to another company gives jitters to some people. Corporate users hesitate to some extent in adopting cloud services as they can't keep their company's information under lock and key.

However, companies offering cloud computing services counter argue to say that they live and die by their reputations. Customers pay these companies as they are reliable in security measures, otherwise, they would lose their clients. It is their job to provide best services to their clients.

Privacy is another factor. As these data are accessed from any location, it is possible that client's privacy can be compromised. One way to solve this issue is the use of proper authentication techniques. Another solution is to provide with an authorization so that each user can access only the data and applications relevant to his or her job.

Replication time and costs also play an important role. How fast the data can be replicated is important for data resiliency.

Reliability is an issue. Servers in the cloud can have the same problems as the organization's resident servers. Downtimes can occur with cloud servers too.

VII. CONCLUSION

Cloud computing is the future of computing and can be a very useful tool for a developing country.

Cloud computing can enable a developing country product to be at par with the western developed countries, and also be a factor in cheaper production with higher economic value.

Developed countries have their own limitations and boundaries (cultural, political, technological, etc.) which can be a challenge in penetration of cloud computing to the masses and these need to be tackled first at the grass root level for a prosperous future of this technology.

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About the Author



Varnika VS is IT Development Manager at Acharya Institute of Technology, Bengaluru, India.