Cloud Computing-As a Service:
Small and Medium Enterprise of Developing Nations

Sharmeen Khemani[1], Syed Zeeshan Arshed[2]

[1]*MSCS SZABIST, Karachi*

[2]*SZABIST, Karachi, Karachi*
Zeeshan@szabist.edu.pk

Abstract: *The paper is based on the discussion of 21st century emerging technology and how it can be an opportunity for developing nations. Cloud Computing is a phenomena that is been introduced in recent years the paradigm uses the concept of utility computing. While, the paradigm is still infancy, it has to cater the needs and demands of the users, the paper discusses a proposed idea of a middle tier that acts a negotiator between the provider and SME of developing Nation it also discusses the opportunities that has been identified and can be utilized and from which the pace economic growth of developing nations can be accelerated at the same time Developing countries can contribute in the growth of cloud computing*

Keywords: *Cloud Computing, Virtualization, Grid computing, utility computing.*

1. INTRODUCTION

The developed world operates in a strong institutional setup and the content of the knowledge infuse and diffuse by these setups generating firm learning environment, today, it is operating in more advance Information framework. This institutional setup is shared among the rest of the world through a single cloud, as growing amount of knowledge becomes accessible on the network more opportunities are available.

The shape of communication has change since past century it has now became evident that opportunities of economic and social growth can easily be achieved by using IT enabled capabilities, to bring a change by using the technology among the masses, those who are entrepreneurs and are part of small businesses providing them the learning environment through reformulating their businesses through Information enabled technologies independent of their location, making them aware of the globalize market and let them be part of it through Cloud. Doing so, it is essential to understand the concept and working environment of Cloud Computing.

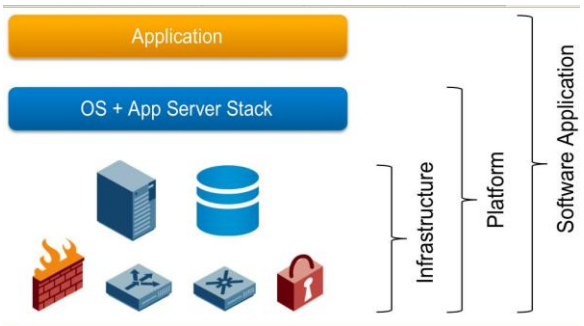
The objective of this study is how the emerging technology can be of any use of the Developing Nations. As we can only compare apples to apples, hence cloud computing comes from the economies of larger scale therefore the utilization has been done only by the users belonging to those countries. The first section of the report discuses the basic understanding of the cloud computing and the second phase of the report deals with how it can be utilized for small and medium businesses of developing nations.

1.1 Cloud Computing

Cloud computing has been defined in various ways but the most used definition by Wikipedia and Gartner is 'Cloud computing is a style of computing where scalable enabled IT capabilities are delivered as a service.' [2] IEEE defined cloud computing as "A paradigm in which information is permanently stored in the servers on the internet and cached temporarily on client side (for example, mobile, notebook, handheld etc)" [11].

Cloud Computing is a collection of scalable IT capabilities, which means that a paradigm which is a set of various technologies that is provided as a service [8];

Figure 1: Components of Cloud computing [13]



1.2 Background

John McCarthy in 1960 suggested that computation may someday be organized as a public utility [1]. In the age of mainframes all the storage capacity, computations were been centralized on big machines placed in huge cold rooms where only expert users of those machines were allowed to operate and deploy the operations of mainframe computers. In 1980's the concept of Personal or desktop computers were introduced were the storage, computation and installing an application were brought on a small desktop machines. Hence introducing the concept of 'liberating' of programs and data storages form centralization it became a monarch at a user end owning its own computational environment, storage and can install any software according to his/her needs and can customize when they feel like. [2]

Now, Cloud Computing facilitates users to reduce the investment cost of servers' data centers and use cloud (internet) as their only resource.

Who owns cloud computing? Is like, asking the same question, as who owns internet? Cloud Computing resource can be used in three different ways a- as a Provider, b- as a Vendor and c- as a Client/user

2. ECONOMIC GROWTH OF DEVELOPING NATION

Economy of a developing nation or third world has always been considered as fragile economy, because either these countries are victims of civil conflicts or their basic needs and civil rights have not been attain yet. The prominent factors that effect the economic growth is the literacy rate, role of both physical and human capital and technologies progress.

IT accelerates the economic growth but it also brings certain challenges along the way. The following sections deal, how technologies can help the developing nations to improve their economic growth. In developing nations a common notion for the technology, is that it substitutes for human skills and implied knowledge hence many hesitates in investing in technologies. Instead technologies should be used as the tool to formalize and support the use of the implicit knowledge [14].

2.1 Small and Medium Enterprise (SME)

In developing countries small and medium enterprise plays an important role. As the majority of the population belongs to either middle class or lower middle class, the business activity that is performed also has minimal revenue. For example- Pakistan's, major economic growth depends upon the SME, they contribute about 30% of GDP around 140 billion to exports, 25% in manufacturing export earnings, and 35% in manufacturing the value added [19].

3. PROBLEM DOMAIN

To diffuse the understanding and change to adapt the IT among the SME of developing nation, is a difficult task. The following are the reasons for not adapting the technologies:

i) The most important obstacle is the language barrier which makes the SME to understand the technical terms.
ii) The knowledge awareness and skills to use the technology, lacks. As they are unable to identify which technology is appropriate for their business.
iii) High investment cost are involved in developing, deploying, maintaining and upgrading an application, which also involves the human resource cost that is involve performing all the IT functions.
iv) Unable to recognize the IT opportunities that can help them test their R&D plan and help them grow their business

3.2 Hype Vs Reality

By, evaluating individually the content of cloud computing which shall lead to an understanding as;

i) How developing economies can be facilitated from the services of cloud computing.
ii) Contributing my perception of what is the plausibility to use the services of cloud computing for SME of developing nations.

4. CLOUD COMPUTING AN OPPORTUNITY

The risks of cloud computing are not to be feared of. The paradigm however provides opportunity for various areas of cloud computing. The most developed model of cloud computing is Software as a Service. Hence while new software's are built for the cloud it is still a challenge to convert companies mind set to transfer and compute all the critical information either financial or non financial over the cloud. So far only Salesforce.com is providing a complete suit of CRM solutions.

For cloud computing developing countries are land of opportunity as the economy mainly relies on SME who are looking for the cost effective solution to manage and improve the scalability of their business.

Cloud Computing has been driven from the large scale economies. The change in the developed nations has always effected the growth and development of the developing nation [14]. How Pakistan or any other developing Nation can utilize this opportunity?

Primarily, it is important to understand the concept behind cloud computing as the paradigm.

The next session contributes towards an idea as how cloud computing services can be facilitated to the SME.

4.1 Acting as a Middle Tier

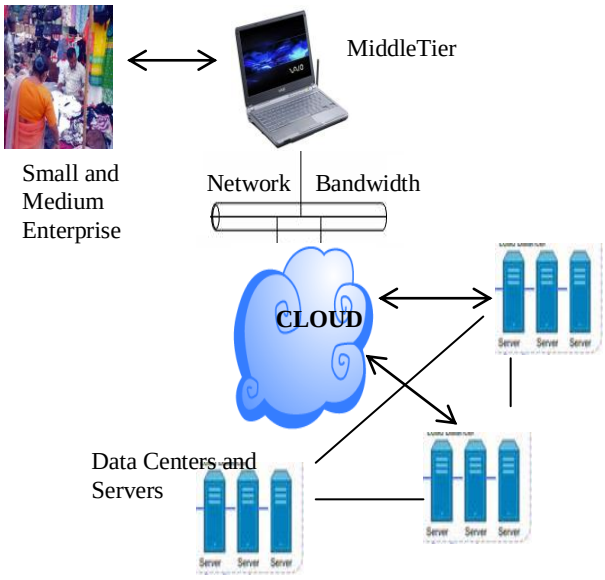


Figure 2: Basic structure of Middle tier.

The Middle tier works as a negotiator and service supplier between the cloud providers and clients who owns small and medium businesses; considering the literacy rate of the underdeveloped nations it is evident that they lack of awareness has kept them behind to explore the opportunities of Information Technology which can help in the growth of their economy. The middle tier provides such an opportunity; they can not only improve the efficiency of their businesses but also make it more scalable and manageable.

4.2 Purpose and Need

High investment cost is involved in building business software solutions, maintaining them. And as the business grows the need to upgrading the software is also costly. On the other hand, lack of awareness and knowledge about information technology that perplexes them to decide which technology can accelerate the growth of their business,

Due to these reasons many small and medium business avoid using the IT support and keep themselves close to the conventional method of keeping and managing their businesses on paper.

4.3 Roles

The middle tier has three major roles that contribute in the entire process:

i) *Provider:* the provider, provide services of cloud computing, these services can vary from providing infrastructure as a service, using their platform as a service to run a customized web application and most importantly using software's as service.

ii) Negotiator/Broker: The negotiator/broker plays and important role in this entire process it negotiates and finalizes the deals as to what services can be best utilized by the client; the decisions are taken on behalf of the clients these decisions are taken on the business capacity and its needs.

iii) Client/user: the client is an entrepreneur of a small or medium business, who is utilizing the services of cloud computing.

4.4 Features

SME are the economic growth drivers, especially for the developing nations as it shares the major portion of the economic market. The SME has faced several issues in flourishing itself, one such reason is the insufficient support of IT. The middle tier helps them to grow and find new opportunities for their businesses. The main feature inculcates:

i) *Centralization:* The dabbawala association is plausible example to understand that associations and centralization belongs to any level successfully manages and prove the structure of a business. The middle tier provides a centralized body were they can utilize the service of computing and storage capacity.

ii) *High Network Bandwidth*: In order to utilize the services you require a right bandwidth for best utilization hence to deploy the right bandwidth is costly and for SME it is again a worrisome proposal to deploy and maintenance of the bandwidth. Since the computation and data storage is centralized there is one time investment to set a network technology to deliver the services.

iii) *Cost Effective:* The pricing feature is standardize and dynamic according to the needs of the business. Hence a SME entrepreneur can not only utilize the cloud services in a cost effective manner but also is free form worries of data security.

4.5 Environment and Usage

The needs and capacity of different business are different hence the availability of the services should be

allocated in accordance to the business requirements. In order to meet these requirements QoS has to be provided for different parameters.

4.5.1 Structure

Cloud/ Internet appears to be a collection of clusters and grid however in reality the internet reside over the data centers using the technology of virtualization as defining the nodes across the cloud that are referred to data centers, these virtual machines are provisioned to meet the on demand resource allocation through a specific service level agreements [7].

Since Middle tier does not have massive data centers or web servers, it uses cloud computing computational environment and storage capacity, using the above mentioned resources the middle tier first initiates to setup instance at its end to run the application on. While reviewing different providers, Amazon EC2 offers the most reasonable proffer. $0.10 per instance-hour consumption, $0.20 per GB of data transferred over internet traffic and $0.15 per GB-Month of Amazon S3 storage. Each instance offered by Amazon is 1.7Ghz Xeon CPU, 1.75GB of RAM, 160GB of local disk, and 250Mb/s of network bandwidth these instances can be upgraded with capacity [19].

The services are metered, as much the client requires he/she will charge on the utilized service. The environment helps to create a multiple virtual systems on one machine; an important advantage is the mobility which also gives a benefit to Middle tier to be operated from anywhere across the world. It's important to keep in mind that the idea that is been proposed is to help the SME of developing nations to improve and flourish themselves hence the middle tier should be the cost-effective solution.

The services are provided through a Service Level Agreement which is set between clients and middle tier, and on the other-side, between the services provider and middle tier. In Cloud computing environment SLA are negotiated and are accessible by using the Web 2.0 technologies. That signifies the concept of virtualization and accessibility. In order to monitor theses services the cloud environment enables you to monitor the performance of the virtual machine that is set on your output device (like PC, Laptop, PDAs etc).

4.5.2 Network Usage

The backbone of delivering Cloud Computing Services is internet bandwidth. The maturity of cloud computing is often questioned as how reliable it services are and how secure the data is over the internet. Internet has always been a vulnerable place although it had brought miracles in IT industry like data convergence that had advanced from its initial place, different protocols and algorithm are made to secure the internet.

The data that is been transferred is critical to individual SME hence to make sure that the connection made provides confidentiality, to ensure the QoS of the delivered services it is important to have strong SLA to ensure the latency and packet loss. Hence all these benefits are provided by using MPLS/VPN services. But private WAN connection is sometimes unreliable as they involve multi-hommed connections by multiple ISP's. The solution to use the cloud computing services through MPLS/VPN; as reliability is the important feature while utilizing the services of cloud computing.

4.6 Maintaining QoS

Middle tier is facilitates the clients to interact with services of Google application, analytical module of salesforce.com or running application like SEM toolkit of IBM which helps them manage their information, monitor them, moreover they can forecast their future growth.

In order to maintain the services and provide QoS the middle tier has the following approach.

i) It first identifies the business potential and requirements of various SME.
ii) Then categorizes it in two categories. The categories are made on the business capital gain or profits and resources that are used.
iii) The small businesses are clustered in associations and medium businesses are kept as it is. The relative capital and human resource of small business is minimal than medium business therefore it is easier and simpler to work with the association format. Each small business association is mapped against the respective area. This process let the client review its opportunity for its economic growth in various regions.
iv) After identifying and categorizing the business. Middle tier provide them computing environment this environment is according to their needs. Helps the client to review and manage their businesses through suggested software's.
v) Middle tier set a computation environment for its clients and helps the client to review and manage their businesses through suggested software's.
vi) Once the clients have utilized the facility of the computational environment the termination instance occurs.
vii) At the end of each month the bill is been charged from the clients.

4.7 Pricing Risks

The price structure of any product is a crucial business as the decision can either let to the profitability or declining of a business. IT pricing have been same as retail pricing the cost of hardware sold is on per- unit base, the most important IT pricing are dealt either on hardware or software up gradation. The hype of the concept of cloud computing it had enabled a prominent feature that cloud computing behaves on the model of utility computing, where the usage of the IT enabled resource is metered. [9]

4.7.1 Price Difference of computation usage: Cloud Computing Vs Non Cloud computing environment.

The following charts show the pricing contrast for the small and medium size enterprises.

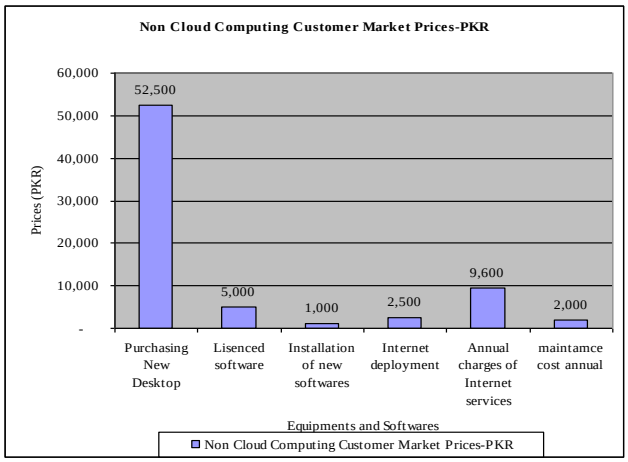


Chart a; Annual basic pricing for a Non-cloud user.

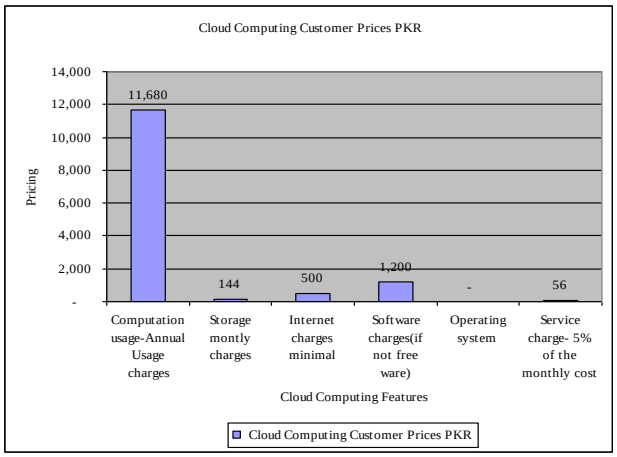


Chart b; Annual cost involve for using cloud computing computational environment.

The above mentioned prices of desktop components and software are taken for the renowned Pakistan online shopping website www.beliscity.com, the cost for cloud computing computation is taken form www.Amazon.com of EC2 computing prices. The cost for internet deployment is the average cost that is charged by various providers.

A clear signification is seen, the computation cost varies with the usage hours. All the figures mentioned are the per year representation. Hence the SME who do not have cloud computing have pay significant price than the cloud computing user.

5. LIMITATION/FUTURE WORK

Cloud Computing data centers though provide the reliability of information, support of data discovery plan, but cloud computing where it resides, the internet, it self is a vulnerable place and less reliable, hence the dependency of the maturity of this paradigm depends upon the three major areas; Internet reliability, proper pricing Model.

The challenges that will be faced are to change the mind set of the entrepreneurs to use the technology for their businesses.

Cloud Computing, being announced a 100 billion dollar business for IT industry has room for many opportunities that are been identified while debates to

evaluate its maturity model continues. Therefore to deliver the maturity model and conducting the future work over the paradigm can be done in the following areas:

i) Details analysis of Network security risks in cloud computing.

ii) Assurance of Data reliability over cloud computing.

Development and deployment of Middle tier along with practical implementation of the cloud computing services and running a pilot project on a Medium enterprise.

6. CONCLUSION

Cloud Computing defined as scalable and elastic paradigm where the services are to be metered in accordance with their usage. Cloud Computing is a cost-effective solution for users however not so cost – effective at the other end, its has estimated as a 100 billion dollar IT market, along with its services and benefits this new concept comes with various challenges

and limitations. The upcoming years will be the peak years or will be a cloud computing era.

If the growth level of cloud computing progressed their will be new opportunity that will be made available in the IT industry, that can be in the areas like building audit reports, assurance of data integrity, generating and implementing a globalize pricing structure. The SME also has opportunities to uses the open source software and computation capacity to enhance their businesses.

REFRENCES

[1] Brain Hayes, Communication of the ACM News 'Cloud Computing'. Internet: http://mags.acm.org/communications/200809/?searchterm=Cloud+Computing&pg=61, September 2008. [April 1, 2009].

[2] Rachael King. "Cloud Computing: Small Companies take Flight." Internet: http://www.businessweek.com/technology/content/aug2008/tc20080083_619516.htm, August 4, 2008. [April 1, 2009].

[3] Gartner's research by Joe Skorupa, Mark Fabbi, Lydia Leong, Ted Chamberlin, Jay E. Pultz, David A. Willis. "You Can't Do Cloud Computing without the Right Cloud." Internet: http://mediaproducts.gartner.com/reprints/f5networks/vol3/article4/article4.html. June 23, 2008. [April 1, 2009].

[4] Asfandyar Qureshi (MIT CSAIL) "Plugging Into the Energy Market Diversity." Internet: http://nms.csail.mit.edu/papers/index.php?detail=186, October, 2008. [April 1, 2009].

[5] Rajkumar Buyya, Chee Shin Yeo, and Srikumar Venugopal. Grid Computing and Distributed Systems (GRIDS), Laboratory Department of Computer Science and Software Engineering, The University of Melbourne, Australia, Manjrasoft Pty Ltd, Melbourne, Australia. "Market-Oriented Cloud Computing: Vision, Hype, and Reality for Delivering IT Services as Computing Utilities." Internet: http://www.gridbus.org/papers/hpcc2008_keynote_cloudcomputing.pdf, September 25, 2008. [April 1, 2009].

[6] Eight IEEE International symposium on Cluster Computing and the Grid: Huan Liu, Dan Orban Accenture Technology Labs. "GridBatch: Cloud Computing for Large-Scale Data-Intensive Batch Applications." [16th October 2008].

[7] Gartner Research; Daryl C. Plummer, Thomas J. Bittman, Tom Austin, David W. Cearley, David Mitchell Smith. "Cloud Computing: Defining and Describing an Emerging Phenomenon." Internet: http://www.gartner.com/DisplayDocument?id=697413. June 17, 2008. [April 1, 2009].

[8] Barath Raghavan, Kashi Vishwanath, Sriram Ramabhadran, Kenneth Yocum, and Alex C. Snoeren: Department of Computer Science and Engineering University of California, San Diego. "Cloud Control with Distributed Rate Limiting." Internet: http://www.cs.ucsd.edu/~kvishwanath/papers/fp076-raghavan.pdf. August 2007. [April 1, 2009].

[9] G. A. Paleologo (2004). "Price-at-Risk: A methodology for pricing utility computing services." IBM System Journal, IBM journal, Vol 43, No 1. Available: www.research.ibm.com/journal/sj/431/paleologo.pdf. [April 1, 2009].

[10] Wikipedia. "Cloud Computing." Internet: http://en.wikipedia.org/wiki/Cloud_Computing. April 1, 2009. [April 1, 2009].

[11] Erika Morphy, TechNews World. "Cloud Computing, Part 3: SLA Spirit in the Sky." Internet: http://www.linuxinsider.com/story/must-read/65137.html. November 13, 2008. [April 1, 2009].

[12] Gartner Newsroom. "Gartner Highlights 27 Technologies in the 2008 Hype Cycle for Emerging Technologies." Internet: http://www.gartner.com/it/page.jsp?id=739613. August 11, 2008. [April 1, 2009].

[13] "Laird OnDemand: Visual Map of the Cloud Computing/SaaS/PaaS Markets: September 2008 Update." Internet: http://cloudfeed.net/2008/09/08/laird-ondemand-visual-map-of-the-cloud-computingsaaspaas-markets-september-2008-update/. September 8, 2008. [April 1, 2009].

[14] Erik S. Reinert. "Globalization, Economic Development and Inequality." Chapter 09- Information technology in the learning economy: challenges for developing countries. Internet: http://books.google.com.pk/books. [2004].

[15] RightScale Blog, Amazon Web Services (AWS). "Amazon releases CloudFront: a cloud content distribution network." Internet: http://blog.rightscale.com/2008/11/17/amazon-releases-cloudfront/. November 17, 2008. [April 1, 2009].

[16] Hairong Kuang, Grid Team, Yahoo! Inc. 'Take an internal look at Hadoop." (Presentation) Internet: www.ewh.ieee.org/r6/scv/computer/nfic/2008/. 2008. [March 27, 2009].

[17] UNDP. "World Adult literacy map.2007/2008" Internet: http://hdrstats.undp.org/indicators/3.html. [April 1, 2009].

[18] Small and Medium Business Enterprise Authority. "Developing SME Policy in Pakistan." January 17, 2007.

[19] Dan Farber. "EC2 extends Amazon's S3 with pay-per-use server" Internet: http://blogs.zdnet.com/BTL/?p=3540. August 24, 2004. [April 1, 2009].