International Journal of Advanced Research in Engineering and Applied Sciences

ISSN: 2278-6252

# SURVEY OF ADAPTING CLOUD COMPUTING IN HEALTHCARE

**H.Madhusudhana Rao***

**Md. Rahmathulla****

**Dr. B Rambhupal Reddy*****

**Abstract:** *This paper targets on the productivity of cloud computing technology in healthcare industry. Even though Information Technology entered healthcare sector with telemedicine in 1940s, we do not see much new technology adaption trend in healthcare. Healthcare sector is one of the largest service sectors in the world. Healthcare industry depends mainly on Information Technology to provide best service and accuracy of information to their patients. Cloud technology used to create network between patients, doctors, and healthcare institutions by providing applications, services and also by keeping the data in the cloud. The impact of cloud computing which simplifies data availability anywhere and accessible to the patient in need of healthcare information in patient care and service especially in India is considered.*

***Keywords:*** *Cloud Computing; Hospital; IaaS; PaaS, SaaS*

*Associate Professor, Department of MCA, KSRM College of Engineering, Kadapa, A.P, India

**Associate Professor, Department of MCA, KSRM College of Engineering, Kadapa, A.P, India.

***Associate Professor, Department of Mathematics, KSRM College of Engineering, Kadapa, A.P, India

## I. INTRODUCTION

Cloud computing is internet-based computing, where shared servers provide computing power, storage, development platforms or software to computers and other devices on demand. This frequently takes the form of cloud services, such as 'Infrastructure as a Service' (IaaS), 'Platform as a Service (PaaS)' or 'Software as a Service' (SaaS). Users can access web-based tools or applications through a web browser or via a cloud-based resource like storage or computer power as if they were installed locally, eliminating the need to install and run the application on the customer's own computers and simplifying maintenance and support. There are several possible deployment models for clouds, the most important being public, private and hybrid.[1] Cloud computing is the fastest growing field that provides many different services, which are provided on demand of the client over the web. Cloud computing is based on the model of pay-as-you-go.

This gives the user cost reduction, fast and easy way to deploy the applications. Cloud computing usage in the Information Support Systems will facilitate businesses to run smoothly and efficiently. A number of virtual machines and applications can be managed very easily using a cloud. With the use of cloud in businesses will not only save the cost of staff required to maintain servers, but will also require lesser servers and with that less power consumption. [2]

As healthcare providers need cost effective automating processes which gives more profits, cloud computing will provide perfect platform in the healthcare information technology space. Many hospitals may share infrastructure with large number of systems linked together. By this pooling the hospitals automatically reduce the cost and increase utilization. The resources are delivered only when they are required. This also means real-time availability of patient information for doctors, nursing staff and other support services personnel from any internet enabled device [3].

***COMPONENTS OF CLOUD***

Once the Internet protocol connection is established among several computers, it is possible to share services within any one of the cloud layers. Following are the cloud layers:

***Client*:** A cloud client consists of computer hardware or software that relies on cloud computing for application delivery. It includes some computers, phones, some devices, operating systems and browsers.

***Platform*:** Cloud platform services is also known as Platform-as-a-Service (PaaS), delivers a computing platform or solution stack as service, often consuming cloud infrastructure and sustaining cloud applications. It facilitates deployment of application without the cost and complexity of buying and managing the underlying hardware and software layers.

***Infrastructure**:* Cloud infrastructure services also known as Infrastructure-as-a-Service (IaaS) deliver computer infrastructure typically a platform virtualization environment as a service along with block storage and networking. Rather than purchasing servers, software, data center space or network equipment, clients instead buy those resources as a fully outsourced services. Suppliers typically bill such services on a utility computing basis, the amount of resources consumed that will reflect the level of activity.

***Server**:* The server layer consists of computer hardware or computer software products that are specifically designed for the delivery of cloud services, including multi-core processors, cloud specific operating systems and combined offerings.

***CHARACTERISTICS***

***On-demand self-service**.* A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

***Broad network access.*** Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

***Resource pooling.*** The provider's computing resources are pooled to serve multiple consumers using a Multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

***Rapid elasticity**.* Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

***Measured service.*** Cloud systems automatically control and optimize resource use by leveraging a Metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service. [4]

***CATEGORIES OF CLOUD COMPUTING***

The cloud computing can be categorized into three parts;

- Software-as-a-Service (SaaS)
- Platform-as-a-Services (PaaS)
- Infrastructure-as-a-Service (IaaS)

The following figure 1 show the basic high level layout of the cloud computing where the provider would create their solution on the Internet and one or more users can use those services on demand.

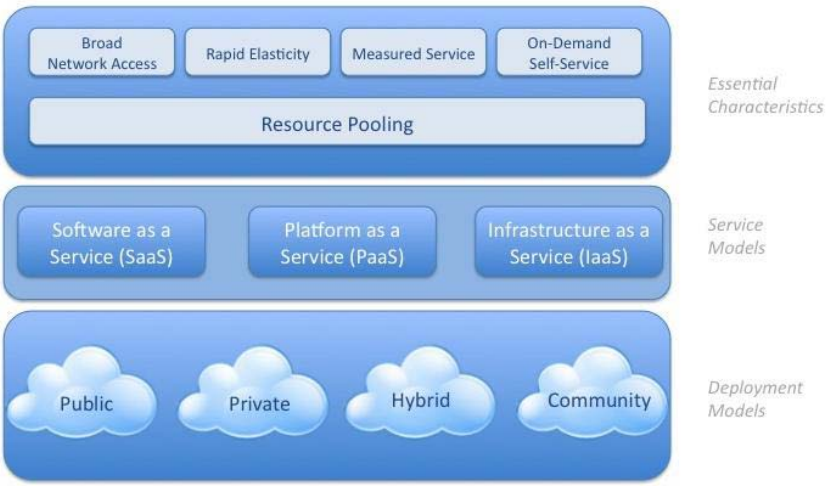


**Figure 1: Cloud Computing Model (NIST)**

***Software-as-a-Service (SaaS)****:*

It is one of the methodologies of cloud computing which is based on one-to-many model whereby an application is shared across multiple clients. SaaS is going to have a major impact on software industry since it will change the way the people build, sell, buy and use software. SaaS is a way of delivering applications over the Internet-as-a-Service, instead of installing and maintaining software it is accessed through Internet relaxing the user from the complex hardware and software management. SaaS applications can sometimes be called as Web-based software, on-demand software, or hosted software.

SaaS applications run on SaaS provider's server. The provider manages access to the application, including security, availability, and performance. SaaS customers need not buy any hardware, software, install, maintain and update them. Accessing applications is very easy with just an Internet connection.

***Platform-as-a-Service (PaaS)**:*

This layer offers the development platform for the developers. Developers write the code and the PaaS provider provides a very simple method to upload that code and present it on the Internet. The PaaS provider provides the hardware, software, operating system, security and everything required for the day-to-day application hosting.

There are basically four types of PaaS solutions;

- Social applications platform
- Raw compute platforms
- Web application platforms
- Business application platforms

Facebook is a social application platform where third parties can write new applications that are made available to the end users. Developers can upload and execute their applications on Amazons infrastructure which is an example of raw compute platform. The Customer Relation Management (CRM) solutions provided by the companies are examples of business application platform.

***Infrastructure-as-a-Service (IaaS):***

This is the base layer of cloud stack which offers the computing power and storage space on demand. It serves as a foundation for the other two layers for their execution. The keyword behind this stack is virtualization. A good example of IaaS is Amazon EC2 (Elastic Compute Cloud), in which the application will be executed on a virtual computer. The user can choose his own virtual computer i.e user can select his own computer with his required configuration of CPU, memory, storage that is necessary for his application. The IaaS provider provides the whole cloud infrastructure through servers, routers, and hardware based load-balancing, firewalls, storage and other network equipments. The customer buys these resources as a service on required basis.

The difference between IaaS and other two layers (SaaS, PaaS) of cloud is the software that it executes.

***DEPOLYMENT MODELS***

***Private cloud.***

The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). 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.

***Community cloud.***

The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or some combination of them, and it may exist on or off premises.

***Public cloud.***

The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

***Hybrid cloud*.**

The cloud infrastructure is a composition of two or more distinct cloud infrastructures (Private, community, or public) that remain unique entities, but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds). [4]

For healthcare system private model could be used as it will provide data privacy and security. Only authorized healthcare professionals can access the data.

## 2. CLOUD IN INDIAN SCENARIO

The Indian healthcare sector, currently valued at USD 65 billion, is expected to reach USD 100 billion by 2015. Its growth rate is about 20 percent a year. Between 2000 and 2011 the foreign direct investment in hospitals and diagnostic centers was USD 1.1 billion. According to Rural Health Survey Report 2009 of the Ministry of Health the rural healthcare sector is also growing very fast, around 15,000 health sub-centres and employing 28,000 nurses and

midwives during the last five years. Primary health centres in the country have grown by 84 percent. Due to economic boom in country, middle class has now more money to spend on healthcare. Due to the new government policies for healthcare, many convincing opportunities like improvement of new infrastructure and better medical equipment are being used. [5]

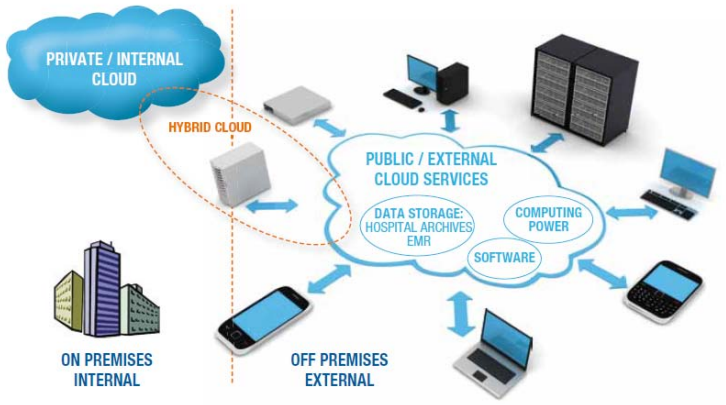


Figure 2: Cloud Computing in HealthCare

Small and medium business will have great benefits from the use of cloud computing. As we know, small and medium businesses contribute about 600 billion USD to Indian GDP. But these business spend very less on their IT infrastructure, therefore they will be the main target user of cloud computing. Clouds computing will help them not to make huge investments in the start. Cloud computing offers state-of-the-art IT infrastructure, software, security, customization, and access to emerging technologies. They only need to pay for the resources they use. Indian IT companies are also working on cloud computing services. There are many cloud applications on the Windows Azure platform by companies like Wipro, Infosys, TCS, HCL Technologies, Mahindra Satyam and many others, for the healthcare, banking, and manufacturing sectors, applications for both Indian and International clients [6].

## 3. LIMITATIONS OF CURRENT E-HEALTH SYSTEM

Some of the limitations of current e-health (electronic system) are as follows [1]:

- *Rising healthcare expenditure and unsustainable healthcare systems*: - In India we see every year the health expenditure is continuously rising faster than the economic growth of the country.
- *Rise of chronic diseases*

- *Medication errors*
- *Medical errors due to poor communication*: - Poor communication is the causal factor in over 60% of medical errors.
- Corruption.
- Economic Challenges.
- Waiting Lists
- Health impacts of living and working environments

## 4. FIVE WAYS CLOUD COMPUTING WILL TRANSFORM HEALTH CARE

Cloud computing is still a relatively new force in computing, but it's already it is beginning to make big inroads in health IT as well. Following are the five of the major ways the cloud will transform healthcare.

***Data security:***

***Resiliency:*** The cloud infrastructure offers durability and up-time that far exceed what any hospital's IT department could offer. Because of economies of scale, large cloud service providers are able to build large redundant data centers that place a higher emphasis on backup, data resiliency and uptime for lower costs.

***Privacy*:** The levels of security are much higher than what you see in a local IT department. Security in a hospital's server room can be as little as just keeping the door locked; when data is in the cloud, however, it forces you to put all of your security in the application layer.

***Speed of innovation*:** For reasons discussed above, cloud-based services can upgrade and improve their services rapidly, cheaply, and with minimal or no interruption to service. Traditionally, a healthcare provider would see hassles in installing and implementing new software, rather than simply having to update to a new major release every two or so years. "The cloud is all about rapid innovation," Allowing the cloud provider to continually improve the data and computing power frees up the local IT staff for "value-added tasks," such as infrastructure maintenance and administration.

***Mobile applications*:** Every great mobile application is backed up by some cloud infrastructure. The two trends of cloud computing and mobile health are inextricably linked: Mobile uses a lot of backend cloud services. By storing all of its data and computing power in the cloud, a healthcare provider enables staff to have access to information anywhere it wants to make it available. Or large institutions, or partnered organizations, that data may

be needed in two places at once and can be synchronized and shared in real time. Transitioning to a cloud service enables greater speed and access for healthcare providers, as well as patients.

***Developing trend:*** Along with all the ways cloud computing, can integrate into existing uses, it seeks to replace more uses and empower more people and systems. It makes sense to transition to cloud based services. Because they enable doing similar kinds of things for less money on a bigger scale. They remove inefficiencies in IT. Another strength that cloud services provide is their ease of access. Cloud service providers have been good about pushing open formats instead of closed formats. The structures and file systems employed are open and easily adaptable. This makes adopting a cloud system as a replacement for a localized one much easier, more efficient and cheaper.

## CONCLUSIONS

Cloud technology used to create network between patients, doctors, and healthcare institutions by providing applications, services and also by keeping the data in the cloud. There are tremendous opportunities and reasons to choose Cloud Technology in healthcare. It is time to join hands with clinicians and computer specialists to proceed in order to implement the broad technology which suits small practices to large hospitals.

## REFERENCES

[1] Advancing healthcare delivery with cloud computing, European Coordination Committee of the Radiological, Electro medical and Healthcare IT Industry, http://www.cocir.org/site/fileadmin/4.4__eHealth/eHealth_Toolkit_INT_2012_chap2.pdf

[2] Rabi Prasad Padhy, Manas Ranjan Patra and Suresh Chandra Satapathy, Design and Implementation of a Cloud based Rural Healthcare Information System Model, UNIASCIT, Vol 2 (1), 2012, 149-157

[3] Praveen Srivastava, Rajiv Yadav and Priti Razdan, Cloud Computing in Indian Healthcare Sector, http://www.cdacnoida.in/ascnt2011/Health%5C1.Cloud%20computing%20in%20Indian%20healthcare%20sector.pdf

[4] P. Mell and T. Grance, "The NIST Definition of Cloud Computing," NIST Special Publication 800-145, September 2011

[5] Malav Kapadia, Cloud Adoption in Indian Healthcare, http://ehealth.eletsonline.com /2012/04/cloudadoption-in-indian-healthcare/

[6] Dr. Vinod L Desai, Prof. (Dr.) Nilesh K., ModiProf. (Dr.) V R Rathod, Analytical study for applicability of Cloud Computing in Indian Environment, Int. J. of Data Modeling and Knowledge Management, Vol. 1, No. 2, December 2011