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Cloud Computing: A New Foundation Towards Health Care

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Abstract— ***With the development of parallel computing, distributed computing, grid computing a new computing model has appeared that is 'cloud computing'. The concept of computing comes from grid, public computing and SaaS. It is a new method that shares basic framework. The basic principles of cloud computing is to make the computing be assigned in a great number of distributed computer, rather than local computer or remote computer. This paper introduces the application of the merit of cloud computing, such as it does not need the user's high level equipment resulting in cost reduction. This paper proposes an application of cloud computing to store medical records in cloud minimizing the resources needed. It provides dependable data storage for the user to store the patient's data in the cloud. The uses of the cloud computing can be implemented in health care and can be effectively used to maintain the patient's records on the cloud.***

Keywords: Cloud computing, Electronic medical report, IaaS, PaaS, SaaS.

I. INTRODUCTION

Cloud computing is the delivery of computing as a s service (CaaS) rather than the product, whereby shared resources, software and information are provided to computers and other devices as a utility over a network. Cloud computing provides computation, software, data access and storage services that do not require end users knowledge of the physical location and configuration of the system that delivers the services. Cloud computing encompasses any subscription based or pay-per-use services that in real time over the Internet extends information technology's existing capabilities. This may take the form of web-based tools or applications that users can access and use through a web browser as if they were programs installed locally on their own computers.

A. 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;

1. ***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.
2. ***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.
3. ***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.
4. ***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.

B. Categories of cloud computing

The cloud computing can be categorized into three parts;

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

The following figures 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.

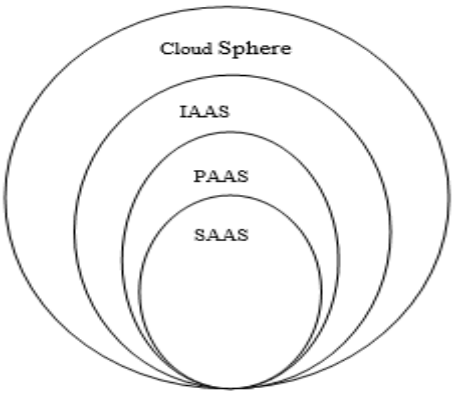

Fig 1: Categories of Cloud Computing

a. *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.

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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. A cloud can public or private. A public cloud sells services to anyone on the Internet. A private cloud is a individual's network or a data center that supplies hosted services to a limited number of people.

b. *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;

1. Social applications platform
2. Raw compute platforms
3. Web application platforms
4. 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.

c. *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.

II. APPLICATIONS OF CLOUD COMPUTING IN HEALTHCARE

Many software applications, services and data once in the area of the local computer or local server are now in the domain of public Internet. Private health information once confine to these local networks is migrating, wholesale onto the Internet. Patients voluntarily grant access to their health records every time they sign a waver to the health insurance that then decides on the payment disposition to the doctor, pharmacy or hospital. For the most part, the collection and organization of this data is completely legal. It then follows the companies that want to automate and accelerate access to these records in order to offer the products, services to the patients, doctors through the cloud.

The fact that Google and Microsoft are heavily invested in the cloud extends to their new offering for medical records services such as Microsoft's Health Vault and Google Health. While still in beta testing, these software giants have partnered with large healthcare providers for their programs. Microsoft and Google are two promising examples of many other company offerings that are following the accelerating trend of placing previously local and private health records in the cloud. This coming explosion of information will be stored in massive data centers around the world and will provide to healthcare records for patients, insurers, doctors, pharmacies and institutions.

A. Electronic Medical Records (EMR)

An electronic medical records (EMR) is a computerized medical records created in an organization that delivers care, such as a hospital or physicians office. Electronic medical records tend to be a part of a local stand-alone health information system that allows storage, retrieval and modification or records.

Electronic medical data (EMD) offers a host of affordable solutions for physicians and facilities looking to modernize or enhance their services with the latest electronic health record (EHR)/ EMR technology. EMD is committed in providing affordable and integrated EHR/EMR and Practice Management Software solutions, including clinical, financial and document management modules designed to automate medical practices processes and chart management delivering the clinical tools needed to succeed in today's health care environment.

Digitized heath records are a component of the more efficient IT (Information Technology) infrastructure by the Health information technology for economical and clinical health (HITECH) Act. Most health care IT infrastructure needs a massive upgrade to easily capture and share information and also to make organizations more intelligent and to manage the data. Several EMR vendors are now offering solutions that are cloud-based which provides and alternative approach to help hospitals to manage the massive capital IT investments that are to be made to support EMR implementations.

Considering cloud computing for health care organizations the following points must be considered;

a. Systems must be adaptable to all departmental needs and organization sizes.
b. The vendors must encourage a more open sharing of information and data sources.
c. The capital budgets and any new technology introduced must not overburden the healthcare unit.
d. Scalability is must as more patients enter the system, and more data becomes digitized.
e. Portability is needed as doctors and patients would benefit from the ability to remotely access systems and data.
f. Security and data protection are very much essential.

B. Health Cloud (h-Cloud):

There is large resistance point across all health information technology (HIT) for the adoption of cloud computing due to patient's information security and privacy. HIT systems deals with all complex processes and procedures. Cloud computing for healthcare will need to have a highest level of availability and a high level of security to gain acceptance in the marketplace. One solution for having high availability and security the healthcare organization should adopt to have private cloud.

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Since cloud computing offers multiple benefits for enterprise computing environments, h-cloud provides an infrastructure that allows hospital, medical practices, insurances companies and research facilities to have improved computing resources at lower initial capital outlays due to the on-demand nature of cloud computing. In addition to it h-cloud environment will lower the barriers for innovation and modernization of HIT systems and applications.

Information contained within an h-cloud can also be better analyzed and tracked so that data on treatments, costs, and performance and effectiveness studies can be analyzed and acted upon. Patient's information can be shared among authorized physicians and hospitals providing more timely access to life-saving information and reducing the need for duplicate testing. H-clouds are providing one of the most promising opportunities to reduce technology and treatment costs within healthcare. Acceptance to this cloud based solution brings at least two distinct advantages over the existing systems;

1. Low upfront fees since little or no technology is installed onsite
2. A living database of insurance payments rules that is continually updated based on the denials of its clients.

If a requirement changes for submitting a claim then they can apply that knowledge across its entire client base.

All the healthcare organizations should establish health information exchanges (HIEs), which are cloud based information clearing houses where information can be more easily shared between hospitals, health systems, physicians and clinics. The main idea behind the HIEs should be to improve the patients care by making information sharing more timely and efficiently. Many pharmacy vendors are starting to tap the cloud to improve research and drug development. Commercial cloud vendors including Amazon, IBM and Oracle have developed pharma-specific clinical research cloud offering with the goal of lowering the cost and development of new drugs.

Hospitals and physicians are starting to see cloud-based medical records and medical image for better services. The objective is to offload a burdensome task from hospital IT departments and allow them to focus on supporting other imperatives such as EMR adoption and improved clinical support systems. Early success of cloud-based physician collaboration solutions such as remote video conference physicians visits is being trialed. Extending such offerings to a mobile environment is becoming more real with broader wireless broadband and Smartphone adoption.

Partial solutions will not win over industry resistance. H-cloud solutions from vendors that understand health care nuances can build winning solutions. There is a need for innovation in health care needs to come from outside of the industry. Today Amazon, Dell, Google have built early visions for cloud computing and are seeing a role for themselves as health care solution providers. It is convincing that traditional HIT vendors will benefit from aligning with these groups such that their domain specific knowledge can attach itself to the approaches of cloud (private, public, hybrid) creating a transformational shift in health care industry.

III. 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.

1. ***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.
2. ***Data security: 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.
3. ***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.
4. ***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.
5. ***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.

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IV. CONCLUSION

Regardless, of the challenges facing in the health care, it requires innovative solutions. In this paper the author has presented a comprehensive analysis of how cloud computing can play a vital role in the maintenance of patient records in the cloud.

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