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An Enhancement of Medical Interoperability Using IHE profile in Cloud Computing

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ABSTRACT

Researchers are now focusing in the field of healthcare, since it is a great need to get available information at the correct moment with high accuracy. The cloud computing makes a new revolution of transferring and storing data in the field of medical and health care services. It helps to access information anytime which can be achieved when moving healthcare information to the cloud. This evolution becomes a vital part of all medical and healthcare solutions due to its benefits such as reduced costs of healthcare and increasing accessibility by both patients and its doctors. Though cloud computing is the major concern for both supplicants and healthcare centers like clinics, laboratories, etc. the secure communication becomes a important issue when the data is to be transferred from a patient to the doctor and vice-versa. An Integrated the Healthcare Enterprise (IHE) not only enhances the way healthcare systems communicate with one another, but also helps to diagnose the patients and to give an appropriate medical cares. Hence, this paper proposes a new model for Medical and Healthcare Services using IHE profiles that will supports end-to-end security in cloud computing.

Keywords : Cloud computing, IHE profiles, Healthcare system, Security, Interoperability.

I. INTRODUCTION

The advent of cloud computing makes the biggest changes not only in the computer industry but also in the medical field. Storing and accessing the patient history details, these are two hot issues However cloud computing makes these issues as simpler by using the concept of Pay-as-you-go i.e. buy only the resources you need them to use and pay accordingly[1]. Storing data in the cloud has become

a new trend. An increasing number of clients store their important data in remote servers in the cloud, without leaving a copy in their local computers. Sometimes the data stored in the cloud is most important that the clients must ensure that it is not lost or corrupted. While it is easy to check data integrity after completely retrieving the data to be verified, retrieving large amounts of data just for checking data integrity is an overhead of communication bandwidth. The cloud has infrastructure enabling consumers to deploy and run their applications [2]. Since organizations normally build applications in a complex environment, it involves networking, security, physical servers, firewalls. Presently the large number of people is losing their lives due to inappropriate medical cares. The primary reasons are due to lack of the patient's history, their diseases and unsuitable medical procedures. The technology that we choose to solve these problems is using IHE (Integrating the Healthcare Enterprise) profiles in cloud computing because the resources are dynamically scaled i.e. doctors can store and retrieve a lot of medical data whenever they need which is used over the Internet as services [3].IHE suggests the combined use of established standards such as DICOM and HL7 to point out specific clinical need in patient care. Systems developed in accordance with IHE communicate with one another in a better way, are easier to implement. They enable care providers to use information more effectively. This paper find that the right cloud based SaaS (Software as a Service) system that can integrate EHRs and medical imaging can offer cost savings and improved accuracy in the interpretation of clinical images. Using cloud

computing in medicine results along with IHE benefits for the medical units and patients. The safe storage of data with less cost, share the data among authorized people[4], less risk for data loss are the major benefits of this system.

The rest of the paper is organized as follows: Section 2 describes the literature review, Section 3 presents cloud computing applied in healthcare field, Section 4 deals with Interoperability using IHE profile. Section 5 explains the proposed concepts and Section 6 concludes the paper with future work directions.

II. LITERATURE REVIEW

In the recent years, research work carried out pertaining to transfer secure information in the field of health care. Privacy and security requirements enforce compliance with on health care organizations are the major challenges. The following are the few research contribution done by researchers to deal these challenges.

Bollineni et al [1] made an online survey and presented an idea to handle the problem. They have studied the issues that involves in the deployment of cloud computing and they also discussed about the future of cloud computing in health care field. However, they have failed to provide a solution for the feedback received from the associates.

Lupşe et al [3] implements interoperability among two departments in hospitals using HL7 standard. These systems are stored in a private cloud since in this way the information can be accessed only by authorized persons. Still this paper has a scope to extend the interoperability among more than two departments and data error recovery issue unexplored.

Cong Wang et al. [4] are concentrating in the security issues. They discussed the integration of storage correctness by giving security and analysis, to avoid malicious data modification attack, and even server colluding attacks. Hence, the authors have failed to localize the error while performing security mechanism. Pardamean et al [6], presented a model as integrated Electronic Medical Record sharing medical records between clinical centers. The system is developed in a cloud that keeps the EMR system in the form of Software as a Service and can be used by Clinical centers, Hospitals, Doctors etc through the Internet. However, the attacks can also affects the information while sharing the medical record and it makes the routing inconsistent.

Cong Wang et al [9] enabling public auditability for cloud data and they insist that TPA would not learn any knowledge about the data content stored on the cloud server. Hence, in a multi-user setting, their data is not provably preserving the privacy, and thus make user to leak data information to the auditor.

Raines [11] discussed the overlaps of SOA and the cloud, and mentioned that SOA is capable to make system-to-system connections in a consistent way. The major constraints of cloud computing is having more storage area, so there may have some computational problem. The model presented by the author is failed to consider these issues. While all above papers provide the method for securing the data but none of them meet the interoperability. Therefore in our proposed model, we have incorporated Integrating the Healthcare Enterprise (IHE) in the public cloud for interoperability.

III. INTEROPERABILITY IN IHE (Integrating the Healthcare Enterprise) PROFILE

Interoperability is the ability to communicate two or more systems, or two or more medical healthcare systems to exchange information and use the information that has been transferred. In e-health it is necessary to use a specialized communication. In presenting the proposed system, one profile is used: IHE (Integrating Healthcare Enterprise) Effective health information exchange involves a different set of activities and many challenges, when the exchange takes place between adopted and unaffiliated healthcare providers. IHE has faced many of these challenges by creating many integration profiles to address the problem of exchanging healthcare information.

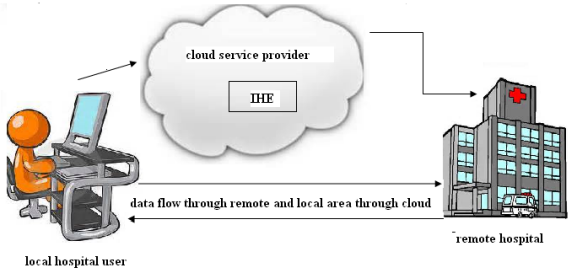

Figure 1. Data flow using cloud

Hospital which has large data files to be stored in the cloud with the help of Cloud Storage Server (CSS) which is managed by Cloud Service Provider (CSP), It has significant storage space and computation area to maintain the hospital patients' data on the cloud for data maintenance and computation. Third Party Auditor i.e. IHE, which gives necessary operation on data that hospital do not have. It is trusted to access data from the remote hospital and helps to challenge the risk of cloud storage services on behalf of the clients request [4].Mobile Alert, which makes an alert to the cloud storage service provider or administrator**.**

A. Reference Information model (RIM)

The RIM (Reference Information Model) maintains enormous information from the healthcare domain. Data content can be referring by RIM of all HL7 versions. The RIM has graphical representation and an accompany with data dictionary. It is necessary to create since the integration of clinical, administrative, and financial information is required, converting from sickness care to health maintenance. And it is expressed using the Unified Modeling Language notation (UML). The IHE profiles used to address interoperability of document sharing and how they work together to solve common document sharing problems in a public cloud[3].Cloud computing supports to exchange the data's, assures that by making the availability of resources. Systems are always ON, so that it can be able to communicate with other systems in the cloud.

B. Document Sharing

IHE enables interoperable to share the documents but assumes this sharing occurs under a document sharing structure and it should be agreed by all parties involved [12].

- Persistence – Documents are existence over time.
- Wholeness - A document is a whole unit of information.
- Stewardship–A document is maintained over its lifetime by a administrator, either an organization or a authorized person with its care.
- Context - A document should establishes the default context for its client contents.
- Authentication - A clinical document is a collection of information that is needed to be correctly authenticated.

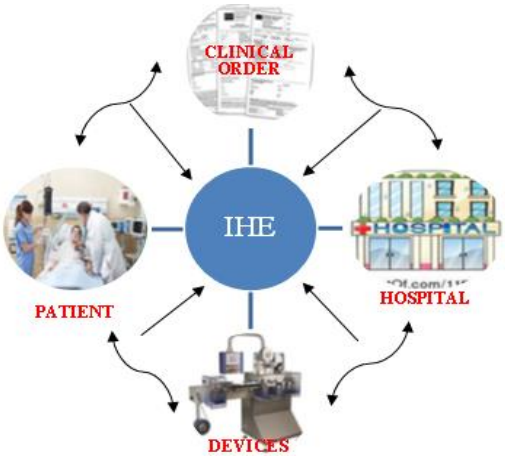

Fig. 2 Document sharing

C. MetaData

Metadata are data that gives details about one or more views about the document. IHE defines a collection of metadata about the document that aid to identity the data through discovers the routing and authenticates the user by asking the private code.

D. Models of sharing the documents:

IHE has three different Document Sharing Models that share the common principles:

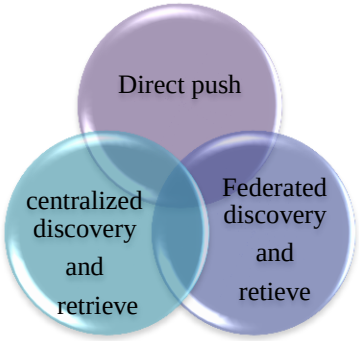

Fig. 3 Document sharing model

1) Direct Push

Here the documents are sent directly to the authorized recipient, it works for end to end delivery and it makes enable infrastructure or manual directory. Direct push having two models Cross-Enterprise Document Reliable Interchange (XDR) and Cross-Enterprise Document Media Interchange (XDM)[7]

2) Centralized Discovery and Retrieve

It is a place where sharing documents among the members in the XDS and allow them to use an infrastructure and grant them to share the health

document. Cross-Enterprise Document Sharing (XDS) is the model for Centralized Discovery and Retrieve.

3) Federated Discovery and Retrieve

It includes Cross-Community Access (XCA). Here every document having content and it can be retrieved from content holder by checking directory or using manuals.

IV. PROPOSED CONCEPT OF USING IHE PROFILE IN CLOUD COMPUTING

Nowadays huge number of people facing many consequences due to inappropriate medical cares. The preliminary reasons are do not know the history of patient's details and their diseases. This paper deals three major issues of interoperability using IHE in cloud computing:

A) Doctors can refer Medical records of another hospital(XDS profile):

In public cloud it is capable to retrieve the information from any other area, but communication barriers may occur it could be avoid by using Cross-Enterprise Document Sharing (XDS).

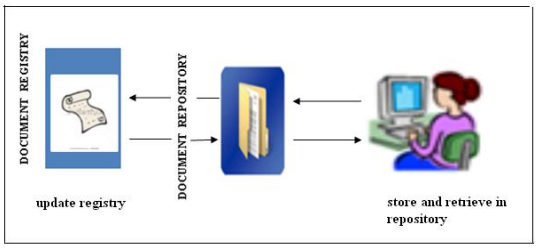

Fig. 4 Accessing and updating document in registry

It has three steps to follow: From the external system to find the record of patients, view the records which was found, make it as selected and copy it into their local system. It should occur recurrently in the health care settings. The two main documents works together to do this process, they are document registry and document repositories. It can't do the process lonely and it needs the help of each others to maintain the document. The document repository accepts copy of medical documents and metadata from the document source and then document repository sends the metadata to the document registry. In health care system, there is a standards needs to enable interoperability in functional and operational area.So we can use RIM since it defines concepts and its attributes and its relationship.

Fig. 5 Components needed for RIM

- ✓ Every things happened in a hospital is an Act – Procedures, registration, observations, checking, supply etc.
- ✓ Acts are related through an Act-relationship, composition, support, pre-conditions, revisions, etc.
- ✓ Participation sets the context for an Act
- ✓ -creator, performer, records, subject, location, etc.
- ✓ The participants are Roles-patient, supplier, practitioner, doctor, healthcare facility etc.
- ✓ Roles are played by Entities-owners, persons, organizations, material, places, devices, etc.

B) Patient identity

Patient identifiers in IHE used to identify the patient in a patient identification domain. Thus it gives prior to interchange the information among the partners with the help of patient identifier to refer to the patient.

1) Patient Identity Cross-Reference (PIX):

IHE specifies the concept of Patient Identifier Domains which shows a domain of patient identifiers, like identifiers assigned within an organization, assigned by authority which is single and provide an identifier for each assigning authority.

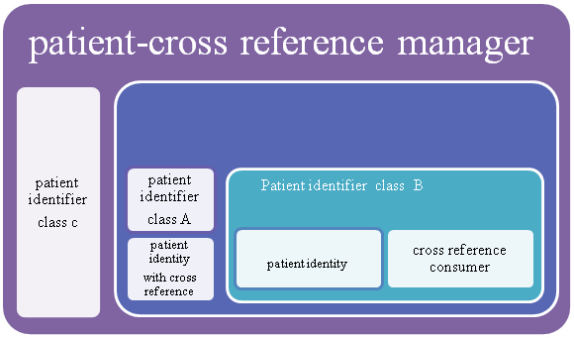

Fig. 6 PIX

2) Patient Demographics Query (PDQ):

An important use of PDQ is to discover the patient's XDS Affinity Domain Patient ID. For instance imagine that Alice is the coordinator to the local public health department for a laboratory. The public health department's clinical system does not give priority to assign local patient identifiers so she cannot use the PIX. The public health department suggests PDQ to discover resemblance for Alice and then will receive Alice XDS Affinity Domain Patient ID as well as the demographics returning profile to find Alice XDS Affinity Domain Patient ID.

3) Cross-Community Patient Discovery (XCPD)

To illustrate the use of XCPD, imagine that Dr. Helan has an encounter with his patient, Teena. At the moment, Teena lives in chennai; however, she recently moved there from kerala. Thus, the majority of Teena's past medical history is stored in the clinical systems of provider institutions in Kerala. Fortunately, Dr. Helan's EMR has the ability to discover patient data that exists outside of the local, Chennai-based community. Dr. Helan's queries to the kerala community and finds the relevant patient identifiers.

C) Security and Privacy controls

These security and privacy controls are:

1. Audit Log Controls – The controls that can prove the system is protecting the resources in accordance to the policies. This set of controls includes security audit logging, reporting, alerting and alarming.
2. Identification and Authentication Controls – The controls that prove that a system or person is who they say that they are.
3. Data Access Controls – The controls that limit access by an authenticated entity to the information and functions that they are authorized to have access to. These controls are often implemented using Role Based Access Controls.
4. Secrecy Controls– As sensitive information is created, stored, communicated, and modified; this control protects the information from being exposed.
5. Data Integrity Controls – The controls that prove that the data has not changed in an unauthorized way.

The profile that provides this basic security principle is Audit Trail and Node Authentication (ATNA). This profile requires three things of each system:

1. User authentication and Access Controls are enforced accordingly,
2. Security Audit Logs are recorded, and
3. Strong network authentication and encryption for all communications of sensitive patient data.

IHE has published the Basic Patient Privacy Consents (BPPC) Profile that can be used to enable basic privacy consent controls. Some examples of the type of policy that can be enabled by BPPC are:

- ✓ Explicit Opt-In: patient elects to have some information shared
- ✓ Explicit Opt-Out: patient elects to not have information shared
- ✓ Implicit Opt-In: allows for document sharing
- ✓ Explicit Opt-Out: of any document sharing. Etc...

Based on the experience of the IHE participants in implementing community environments there is a common set of Security and Privacy controls that have been identified.

IHE profile for Security and Privacy controls	**BPPC**
Audit Log Controls	Expicit Opt-in
Identification and Authentication Controls	Explicit Opt-Out
Data Access Controls	Implicit Opt-In
Secrecy Controls	Explicit Opt-Out
Data Integrity Controls	Implicit Opt-In
Non-Repudiation Controls	Implicit Opt-In
Patient Privacy Controls	Explicit Opt-Out
Availability Controls	Implicit Opt-In

Table 1. security and privacy control

V. CONCLUSION AND FUTURE WORKS:

Using the cloud computing technology a medical act may considerably improve the access to information, which can be done be much easier. The scalability, that is the key of the cloud computing, can offer more resources needed for certain operation at any time. The collaboration between medical units is an opportunity offered by cloud computing for healthcare staff. With this technology can be checked the availability of a physician, a medical specialist, a product or a service at different times and in different cases. Patients can be guided to appropriate persons or units where they can find what they need. This is a huge benefit for patients and health professionals, increasingly the quality of the medical service.

The costs of the IT infrastructure will be cheaper because the medical units will only rent the infrastructure to store medical data as it need and will no longer need the latest equipment for the applications used, managed or maintained. They need only computers or devices with access to Internet.

The public cloud with IHE profile ensures the security of data and communication between departments, hospitals, and messaging is done in a secure way. The application is equipped with a module that verifies the received and sent information. Future work will improve the security solution in sharing the data.

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