SUITABILITY OF USING SOAP PROTOCOL TO SECURE HEALTH DATA EXCHANGE GENERATION AND UPDATION OF CLINICAL DOCUMENT ARCHITECTURE BASED ON CLOUD COMPUTING

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Abstract: Clinical Document design (CDA) document generation Open API service supported cloud computing through that hospital's space area unit enabled to handily generate CDA documents whereas not *having to get proprietary computer software.* CDA document system generates multiple CDA documents per patient into a database, physicians, and patients can browse the clinical data in chronological order. It provides security to the CDA document and unique identity (id) is generated and given to the patients for avoiding the interchanging and duplication of medical reports. Each detail in CDA Document is Encrypted and hold on the information in the database. Electronic Health Record (HER) helps improve patient safety and quality of care; however, it's the necessity of interoperability between health data exchange at completely different hospitals. In this, the CDA document generation and updating depend on cloud computing and SOAP protocol. All Details in CDA Document is secured utilizing using Simple object access protocol (SOAP) Algorithm. SOAP originally outlined as protocol specification for exchanging structured data. SOAP depends on XML for its message format and different application protocols, significantly RPC and hypertext transfer protocol. XML thought of because the universal language for information transmission on the web, however, end-to-end protection of messages should either be enforced inside applications or it may be provided by middleware above the SOAP layer. The aim of SOAP protocol structure over XML can be to spot the doable approach towards implementing a secure protocol to transfer electronic medical records databases or creating electronic medical records backups over unsecured channels.

Index Terms **- Health Information System (HIS), Cloud Computing, Health Level 7 (HL7), Electronic Health Record (EHR), Simple Object Access Protocol (SOAP).**

I. INTRODUCTION

As the number of services and products offered and sold through the Internet grows rapidly, with the need to ensure the same level of security as we have in the practical world has become associate pressing want within the web environment. Information security is defined as the field of science that concern about protecting the information and data from attackers or security threats number of method are available to secure data like cryptography ways or to make sure secure access(i.e. ,Authentication) using biometrics Data privacy refers to the relationship between technology and the legal right to public expectation of privacy in the collection and sharing of data about one's self Information about health care or electronic medical records classified under high sensitive data that required high secure systems. According to USA government, 100 billion dollars will be spent on developing electronic medical record for the next 10 years services become progressively more important element of national economies and it is crucial to understand the characteristics qualities of services and resulting management implications with a selected concentrate on healthcare services.

Electronic Medical records is a digital information for a specific patients, this record could also be created for every service to the current specific patient, like his/her radiology, pharmacy or laboratory, or as a results of an administrative action like making a claims. Moreover, some clinical systems also allow electronic capture of physiological signals such as nursing notes, electrocardiography, orders or physician Creating backups or transferring electronic medical records database is hard task, not solely on security however on finding an appropriate middleware. Securing a single electronic medical record transmission wherever making a security solution deals with small data is quite easy comparing with transferring huge database in a secure channel. XML is a short form for Extensible Mark-up Language (XML) and considered as the universal language for data transmission on the Internet. Unlike HTML (which is only for displaying data), XML allows us to define our own tags; XML allows the users to define their own tags written between angled brackets, i.e. a tag in XML opens with symbol and finish with symbol [1].

An XML document can be a database file, printer file, other device files e.g. mobile device file, data processing tool file, editing application file, in-house printing file or browsing file. There are some benefits XML over the web are as follows. Simplicity, when we say simplicity that is because Information coded in XML is easy to read and understand, in addition, it can be processed easily by computers. Openness, due to XML is a W3C standard. Extensibility that is because there is no fixed set of tags, tags can be created whenever needed. Self-description in ancient databases, data records require schemas set up by the database administrator. XML documents will contain any potential knowledge sort like massive objects like video, sound, image and etc. The SOAP protocol is XML-based that allowed applications to exchange the knowledge over hypertext transfer protocol [2].

II. LITERATURE SURVEY

In this section, we conduct literature survey of work done till now in this domain. Our literature survey is an independent summary of published research literature relevant to the topic of our consideration.

K. Ashish, presented purposeful use of electronic health records the road ahead. For active clinicians, the origins and certain effects of this rule could also be opaque. It might be useful to grasp the motivation behind the key parts of the purposeful use rules, wherever they're possible to require the U.S. health care system (and the obstacles on the way), and therefore the advantages and risks of a fast transformation from paper to electronic record systems [1].

D. F. Sittig, A. Wright, R. B. Ness et.al proposed the promise of the CCD: challenges and opportunity for quality improvement and population health. Interoperability is demand of recent Electronic Health Record (EHR) adoption incentive programs within the United States. One approved structure for clinical knowledge exchange is that the continuity of care document (CCD).Whereas primarily designed to push communication between suppliers throughout care transitions, Coded knowledge at intervals the CCD square measure typically reused to combination data from utterly completely different EHR's [2].

A. Rabkin, I. Stoica, and M. Zaharia et.al presented a view of cloud computing that describes cloud computing. In this authors describes is to scale back that confusion by instructive terms, providing straightforward figures to quantify comparisons between cloud and traditional computing and distinguishing the highest technical and non-technical obstacles and opportunities of cloud computing [3].

S. Lee, J. Song, and I. Kim, projected clinical document architecture integration system to support patient referral and reply letters. Several Clinical Document Architecture (CDA) referrals and reply documents are accumulated for patients since the readying of the Health information Exchange System (HIE'S) Clinical information were scattered in several CDA documents and this took an excessive amount of time for physicians to read. Physicians in Korea pay solely restricted time per patient as insurances in Korea follow a fee for service model. Therefore, physicians weren't allowed comfortable time for creating medical decision, and follow-up care service was hindered. To handle this, authors tend to developed CDA Integration Template (CIT) and CDA Integration System (CIS) for the HIE'S [4].

S. R. Simon, R. Kaushal, P. D. Cleary et.al proposed correlates of electronic health record adoption in office practices: A wide survey within which despite rising proof that electronic health records (EHRs) will improve the potency and quality of medical aid, most physicians in office practice in the United States do not currently use an EHR. We tend to sought after to live the correlates of EHR adoption [5].

J.L ahteenmaki, J. Leppanen, and H. Kaijanranta proposed the establishment of the purposeful Use criteria has created a critical need for robust interoperability of health records. A universal definition of a Personal Health Record (PHR) has not been approved. Standardized code sets are designed for specific entities; however, integration between them has not been supported. The aim of this analysis study was to explore the hindrance and promotion of interoperability standards in relationship to PHR's to explain interoperability progress in this area. The study was conducted following the fundamental principles of a systematic review, with 61 articles used within the study. The insulant ability has stemmed from slow adoption by patients, creation of disparate systems due to speedy development to fulfil needs for the Meaningful Use stages, and speedy early development of PHR's before the mandate for integration among multiple systems. Findings of this study advocate that deadlines for implementation to capture meaning Use incentive payments square measure supporting the creation of PHR information, thereby hindering the goal of high-level interoperability [6].

S. Kikuchi, S. Sachdeva, and S. Bhalla Proposed cloud computing model in PHR architecture. They stated that some practical and commercial Personal Health Records and some related services such as Google Health and Microsoft Health Vault have been launched. On the other hand, Cloud Computing has matured additional and become the most important streams to appreciate a simpler operational environment. However, there have been few studies in regards to applying Cloud architecture in the PHR explicitly despite generating volume data. They review the overall architecture design style by applying the Cloud elements for supporting healthcare tending record areas and clarify the desired conditions to understand it [7].

Sundararaman, K. Parthasarathi, Appa Rao et.al proposed a solution to monitor cardiovascular disease using personal digital assistant (PDA) and applying Grid Computing as a technology enabler. Medical staff can use an application in software as a service (SaaS) basis. The resulting solution provides some requirements of work; however, it focuses on a different solution thus not covering how vital data is acquired, i.e. it should implement the ways to gather method and distribute patient's vital data, from beside to remote accessibility [8].

M. Bellare introduced Health Information Privacy, Security and Your EHR. If your patients lack trust in Electronic Health Records (EHR's) and Health Information Exchanges (HIE's), feeling that the confidentiality and accuracy of their electronic health information are at risk, they will not reveal health information to you. Withholding their health information could have life-threatening consequences. Digital health information is to attain higher health outcomes, smarter defrayal, and healthier folks; suppliers associated people alike should trust that an individual's health information is non-public and secure. EHR developer is responsible for taking the steps needed to protect the confidentiality, integrity, and availability of health information in your EHR system [9].

Liu et al. have illustrated an EHR system developed in China to solve the challenges of preventive medicine and management of chronic diseases. The healthcare system based on a Cloud-computing architecture was developed and deployed in Xilingol county of Inner Mongolia. The system used several computing resources to deliver services over the healthcare network using the Internet. There are some challenges to the system like integrating different levels of the healthcare system which makes it difficult for obtaining the information needed to implement public health records and to manage chronic diseases [10].

Rodriguez-Martinez et al. have introduced MedBook, a platform to exchange EHR's and billing activities to assists patients, healthcare suppliers and healthcare player's collaboration and knowledge exchange. MedBook has some benefits as it matches the US HIPAA standardization and privacy. MedBook is a SaaS platform built on top of open-source cloud technologies and running atop an IaaS platform. The platform offers the full benefit of cloud computing. The server applications are implemented using different web services and web applications, Python, Django, PostgreSQL, HBase, and the Apache web server in order to benefit from each technology. MedBook uses Ubuntu Linux 10.04 for security assurance and MedBook Eucalyptus 2 for management and resource allocation which is considered one of the challenges in cloud computing. MedBook has constructed exploitation free cloud technology that grants users the liberty of

customization, modification, and distribution. On the other hand, MedBook has limitations on its privacy and legislation status since it's built using open-source cloud computing [11].

Hus et al. have proposed a solution for protecting personal health records in the cloud by encrypting patient data before sending them to the cloud. The solution proposes two encryption keys. The first key is owned by the user called "a right-to-decrypt code", while the second key is called "a substitute-key-half code." Thus, patient data stored in the cloud will be secure and will not be disclosed to anyone without proper authorization [12].

Fernndez-Cardeosa et al. have introduced a cloud-based solution for different scenarios of an EHR management system. The proposal lined a large hospital and a network of Primary care center. They estimated the cost of the implementation using the Amazon calculator tool. EHR's with no images have been migrated to the Cloud environment, because of the large size of the DICOM images. They said that the implementation might be dependent on the bandwidth of the center and the amount of money that health centers want to spend [13].

III. METHODOLOGY

3.1 Cloud Computing

Cloud is everywhere, and that we use cloud storage daily in several platforms. There are different ways through which cloud computing is intervened in our lives. We use cloud computing in several formats like storages, marketing, education, healthcare and much more. Google's Gmail is one in all the most effective examples for cloud computing. You can access the files stored in Gmail through any device using the web. There are plenty of cloud computing components we tend to use every day like Gmail, Dropbox, Spotify, Facebook, Google Drive, Amazon Web Service, One Drive.

Cloud computing is a method wherever all the information, files and images are stored in cloud storage. This data then is accessed from a computer using .net. There is no necessity for a hard drive to store the data. Also, cloud storage allows more information when compared with the hard drive. The above-mentioned examples are stated in the consumer perspective. When it involves business, it is a different cloud. There are alternative ways using that we tend to implement it for business.

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

Company or organization that value more highly to implement a software system for running the business by storing, accessing and delivering the data will use SaaS. Using internet, the business accesses the application. If a business wants the software available to all the employees in the office to access, then Platform as a Service (Paas) will be suitable. For example, Salesforce. Infra structure as a Service (IaaS) works with a structure where the services can be rented out from a big cloud provider. For example, Netflix offers services to the Amazon customers because Netflix rented out cloud services from Amazon [3][4].

3.2 XML Technology

XML is a great technology because it can deal with any data, any software system and any programing language. Due to the successes of this technology, XML start growing rapidly. SOAP protocol is XML-based that allowed applications exchange the knowledge over hypertext transfer protocol. W3C begin regarding about XML and SOAP security, therefore, they implemented different solutions to secure their data which are as follow:

Encryption: Sensitive data can be encrypted using either symmetric or asymmetric cryptography. Although, the information is distributed within the clear; the encrypted part will be opaque and onerous to crack. The process and format of the encrypted XML data defined by W3C.

Authentication: SOAP services users can be authenticated in many ways such as digest authentication and token-based authentication. Token-based authentication requires users to supply credentials through a secure channel (i.e. request). SOAP servers respond with an authentication token which can be used for further request.

Digital signature: Signature is a technique to confirm the integrity of the information. SOAP messages either partially or the full documents are initial digestible. The digest, along with other sensitive data, is then digitally signed using the sender's certificate after that encrypted by the receiver's public key. As the signature is encrypted using the receiver's public key, only the receiver can decrypt it then verify the signature and message digest. Signature or hash verification failure offers Associate in proof for manipulation throughout the transmission. However, several people have illustrated the weaknesses and drawbacks of SOAP. Even though, the options of SOAP-XML are encouraging; the recent versions of SOAP don't seem to be secure. The available security solutions are by hybrid approaches exploitation the prevailing security mechanisms like crypto graphy, digital, tokens and etc [5][6].

XML is a short form for Extensible Markup Language (XML) and considered as the universal language for data transmission on the Internet. Unlike HTML (which is only for displaying data), XML allows us to define our own tags, XML allows the users to defi ne their own tags written between angled brackets, i.e. a tag in XML opens with symbol and finish with symbol.

Example:

```
<note>
<to>Piter</to>
<from>Parth</from>
<heading>Reminder</heading>
<body>Appointment has been fixed</body>
</note>
```

The example on top of delineates however XML tags are written. For example and are not defined in any XML standard. However these tags are created by the author of the XML document and this is possible because XML language has no predefined tags [7][8].

XML documents may be wont to represent data severally from the platform and language, and it is universally accepted as the standard technology for information interchange. XML documents may be in a very variety of a file, data or the other document varieties and might be created below any languages. Therefore, XML is used to carry out any kind of data, XML document can be any document defined by Document Type Definition (DTD), DTD defines legal building block of an XML document including:

- Names of element and how and where they can be used
- The order of elements
- Proper nesting and containment of elements
- Elements attribute

3.3 System Architecture

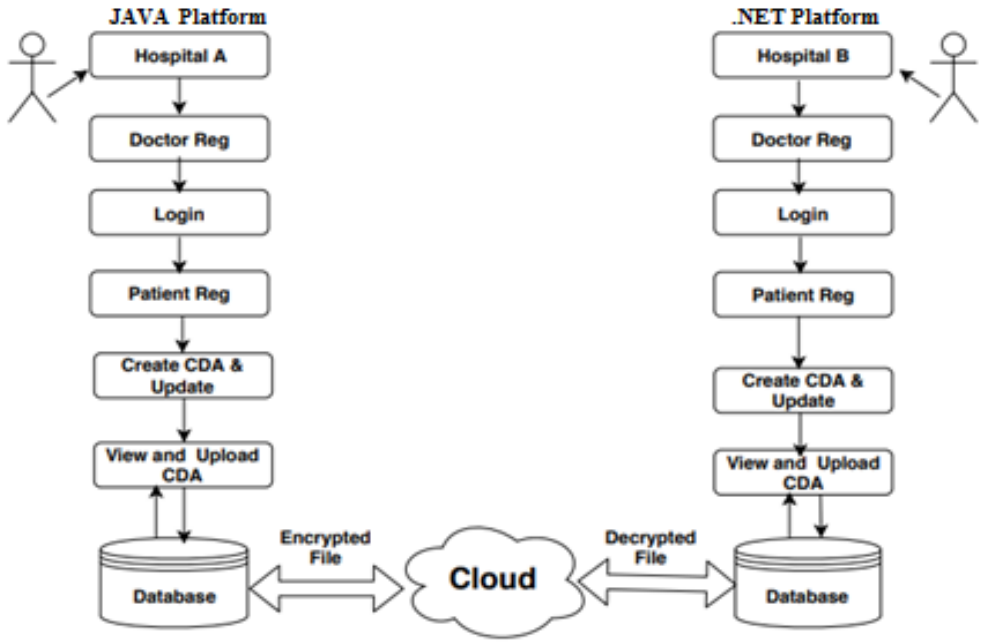

Fig. 1: System Architecture

Hospital A and Hospital B are demonstrated to show that it is easy to generate CDA documents on a variety of platforms if done via cloud. The purpose of each of the components is as follows: The DBMS at each hospital and the HIS are linked as follows. Hospital A, which uses a .Net-based system is connected via ODBC to connect to the DBMS while Hospital B, which uses a JAVA-based system, is linked with Hibernate. At a hospital, the clinical information of patient, hospital, and physician is entered via CDA Generation Interface and sent to the cloud server via CDA Generation API. We utilize SOAP (Simple Object Access Protocol) as transmission protocol for the purpose of enhancing interoperability among different HIS when a hospital sends data to the cloud. CDA Generation API relays the data in the CDA Header/Body in the list type. The items included in CDA Header are: PatientID, BirthDate, Gender, GivenName, and Family-Name [9].

3.4 SOAP Protocol Structure

SOAP may be a straight forward XML-based protocol that allowed applications to exchange the data over a protocol. Applications within the web communicate using Remote Procedure Calls (RPC) between objects like DCOM and CORBA, however, the most effective way to communicate between applications is over HTTP protocol, since the protocol is supported by all Internet browsers and servers. The vital of SOAP bestowed on providing some way to communicate between completely different applications with different technologies running on different operating systems and programming languages. SOAP works as follows in Fig. 2.

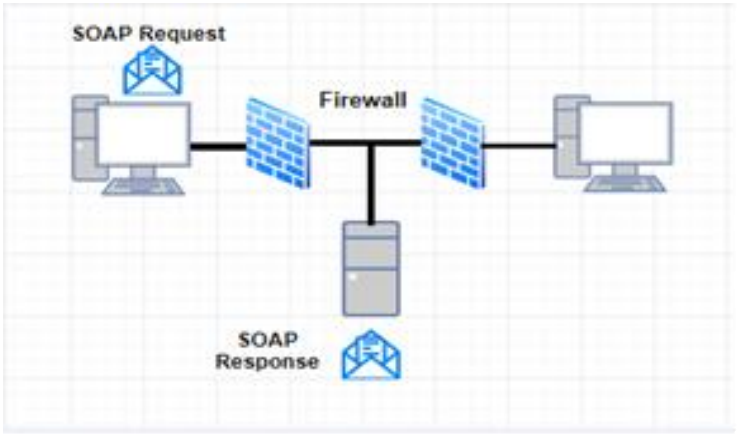

Fig. 2: SOAP Request and Response

SOAP has not outlined any transport protocol; instead, SOAP works on existing transport protocols, like HTTP, SMTP, and MQSeries. A SOAP methodology is an HTTP request/response that complies with the SOAP encoding rules. A SOAP request may well be an HTTP POST or HTTP GET request. SOAP stands for Simple Object Access Protocol is a protocol used between applications which have a specific format for sending messages on the Internet. SOAP relies on XML thence, SOAP communicates through the Internet Independent of the platform and language used. When an XML document consists of nested components which are distributed over multiple remote servers the XML document can seem like an enormous database over the World Wide Web.

The best way for communication between applications is using HTTP and that is because HTTP is supported by all internet browsers and servers. Hence, SOAP protocol is made to accomplish this task, it uses communications protocol (HTTP) and XML for communication between applications, in shell, HTTP + XML = SOAP [10].

3.5 SOAP Protocol Algorithm

- The message sender component of the Web services client, runtime processes the request by sending a SOAP request message to the request queue identified by the endpoint location URI associated with the invocation.
- The message sender component uses the standard HTTP layer provided by the underlying messaging provider to send the request message.
- The SOAP request message is delivered to the request queue by the messaging provider the message receiving component of the Web services server runtime uses the HTTP to receive the SOAP request message.
- The Web services server runtime uses the EJB container to dispatch the request to the Web service implementation class.
- After the Web service operation ends, the Web services server runtime uses the HTTP to send the SOAP response message to the reply queue [11].

IV. RESULTS AND DISCUSSION

Interoperability between hospitals not only helps improve patient safety and quality of care however additionally reduces time and resources spent on data format conversion. Interoperability is treated more important as the number of hospitals participating in HIE increases. If one hospital doesn't support interoperability, the opposite hospital square measure needed to convert the information format of their clinical information to exchange data for HIE. When the number of hospitals that do not support interoperability, complexity for HIE inevitably increases in proportion. Unfortunately, hospitals are reluctant to adopt EHR systems that support interoperability, because changing AN existing system adds price for computer software and maintenance [12] [13]. The advantages of an API service as ours are at the number of resources that hospitals need to allocate for interoperability is minimal. Therefore, offering a system that supports interoperability with cloud computing is a good alternative for hospitals that have not yet adopted which shows below comparisons in Table I and Fig 3.

Table 1 Content of Comparison

Sr. No.	ATTRIBUTES	PROPOSED SYSTEM	EXISTING SYSTEM
1	SECURITY	3.9	1.4
2	SEARCH	4.3	3.5
3	DATA CLUSTERING	3.5	1.8
4	COST	2	4

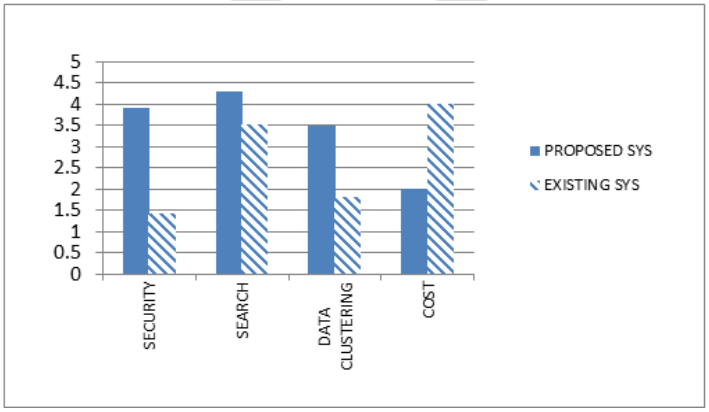

Fig. 3: Comparison of Existing System and Proposed System

EHR because of cost issues, the HEALTH document format a clinical information standard designed to guarantee interoperability between hospitals, a large number of HIE projects that use the HEALTH document format have been undertaken in many countries. It shows various HIE projects and whether they generate HEALTH documents or integrate multiple HEALTH documents.

XML document can be database file, printer file, other device file (e.g. mobile device file), word processing tool file, editing application file, in-house printing file or browsing file [14][15].

The benefits of exploitation XML over the web are as follows. Simplicity, when we say simplicity that is because Information coded in XML is easy to read and understand, in addition it can be processed easily by computers. Openness, due to XML is a W3C

standard. Extensibility that is because there is no fixed set of tags, tags can be created whenever needed. Self-description in ancient databases, data records need schemas originated by the database administrator. XML documents can be stored without such definitions, because they contain XML is a self-descriptive that is because metadata is stored in XML in the form of tags and attributes. Can have multiples data types, XML documents can contain any possible data type such as large objects like video, sound, image and etc. Distributed data, XML document can contain elements that are distributed over multiple remote servers so that the World Wide Web can be seen as a one huge database [16][17].

SOAP has not outlined any transport protocol; instead SOAP works on existing transport protocols, like HTTP, SMTP, and MQSeries. A SOAP methodology is associated with HTTP request/response that complies with the SOAP cryptography rules A SOAP request could be an HTTP POST or associate with HTTP GET request [18].

V. CONCLUSIONS

The CDA document format for clinical information in traditional style to vow ability between hospitals. This cloud computing based CDA production and combination structure has a few articulated advantages over other existing projects.CDA file generation system based on cloud server is more useful over accessible services for CDA file if the variability of CDA file will increase. It provide a security in upload a CDA Document and Download /View the CDA Document using real time cloud with SOAP protocol which is used for proper integration of the system and cloud. Future work is to detect file modification on cloud side and also detect attacks on cloud data which is used to improve security while accessing and view the file. SOAP-XML cannot provide the level of confidentiality for transferring electronic medical databases. In nutshell, SOAP cannot propose alone as a secure protocol for sensitive data such as electronic medical records. In Future work, we will implement secure protocol for EMR-database transmission or create remote backups for EMR-database, we need to employ secure and fast cryptography algorithms for instance, Hashing and Auditing Algorithm to overcome the weakness of SOAP in term of security, time and confidentiality.

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