Chapter 4

Integrated JXTA Based Mobile P2P Cloud Emergency Health Care

4.1 INTRODUCTION

JXTA based mobile P2P plays vital role in health services especially in case of accidents. The present treatment methods for accidents is to admit the patients and undergo all necessary tests like blood group, haemoglobin etc. A better treatment is provided to the patients if the history of treatments is readily available in case of emergency. This framework proposes an idea which helps the rural health care to promote and render an effective emergency service. The hospitals share a common database through cloud service technology. The proposed framework combines the feature of cloud services and peer to peer network that uses JXTA for communication between hospital database and on the other end to ambulance which brings patient to the hospital. Peer to Peer can be visualized as host to host concept, where the client server architecture is overridden. Peer is nothing but an electronic device that is capable of network participation like mobile, computer or laptop, where they can communicate and share the contents among themselves or within a group. Each device will be able to access resources of any other device on the network while making its own resources available to others.

JXTA is a platform specific system developed by apache open source model by Sun Microsystems under the direction of Bill Joy and Mike Clary (2002).

The Emergency Goals on the network includes the following

- Node 0 peer discovers other peers.
- Ambulance, blood bank and doctors Peers self-organize into Peer groups
- Hospitals peers advertise and discover network resources.
- Communication between the peers.
- Hospital peers monitor other peers.
- Data’s require authentication and security.
- Adaptable to all operating systems.
JXTA services are handled by six protocols which are used to model the entire system. It can be characterized as a distributed network system in which all the participated nodes have symmetric capabilities and responsibilities. All the participants in peer-to-peer system acts as both clients and servers to one another. Conventional client/server model brings all participants together with the purpose of sharing resources such as Patient details, patient record and previous treatment history. In P2P JXTA network, the sharing of systems set up a network or pool of peers on internet and provides facilities for searching and transferring data between them.

JXTA enables interoperable peer to peer mobile cloud applications which take in for the following

- Find other peers on the network with dynamic discovery
- File sharing across JXTA network.
- Peer Group (Record, Doctors, Ambulance) creation
- Cloud controller which remotely monitors peer activities.
- Hospital community cloud

## 4.2 PROXY PEERS

Proxy peers connect JXTA network through relay peers. Customer’s Mobile nodes will have less capability and limited resources are connected to the JXTA network with the help of relay. The Relay peers represent the hospital, blood bank and relative nodes. Relay peer help proxied peers in the consequent ways:

- Message Listen and response.
- Message store for proxy peers
- Message translation to make the proxy peers understand.

### 4.2.1 PROXYLESS PEERS

Ambulance nodes are the peers which are directly connected to the JXTA network. Input and output via TCP communication through the pipe.

## 4.3 CLOUD COMPUTING

Cloud computing plays an important transition and paradigm shift in health care services. A survey is done for key technologies, partition offloading and context-
based service. It provides a Mobile paradigm that enables shared information about managed health care resources that deliver on demand to doctors over JXTA GPRS and other available networks. The advances in technologies of mobile cloud computing have become integrated into the fabric of our everyday life. Enormous increase in mobility, users need to run stand-alone or access remote mobile applications on mobile devices. The information available in the “cloud” can be processed by cloud controller and hence the patient data are distributed among the medical staff. Cloud Mobile emergency management, is an upcoming and a most wanted concept for now and future.

The proposed framework integrates JXTA network and cloud database. Thus the former is used for communication between the nurses who attend the patient in the ambulance and the doctor’s available in the hospital chosen, where both the ends have JXTA installed handheld devices which could be laptop’s or mobile phones. The nurse and the doctor will be having a unique id during their communication.

The peers are not required to remain on the JXTA network for any known period. Peer using the services cannot be guaranteed and the peer will remain on the network until its services are no longer needed, and hence the doctor can leave anytime away the network once the patient has reached the destination. The latter is used to store, maintain and retrieve patient’s information across several hospital databases which are administered and controlled by a Cloud Controller and the same controls the ambulance also.

4.4 MOBILE CLOUD JXTA NETWORK ARCHITECTURE

Mobile devices and PDAs are playing an important role, thus becoming a trend of living where people are more dependent on the handheld devices. Health care conscious has prone the growth of such applications ensuring and enabling the patient care by the hospitals. This architecture means only for the registered users where his/her information will be stored in any one of the hospital database which will be referred as Hospital community cloud. Each Hospital community cloud is controlled by a Cloud controller.

This Cloud Controller will be responsible to retrieve the patient’s information and send to the nurse in the hospital. Secondly it suggests the nearest hospital within the accident area where the patient has to be taken to the specialized hospital. For
instance a patient had a fracture in his leg, he has to be taken to ortho specialists for treatment. The Cloud controller also plays a vital role of identifying the hospital of specialization and also manages and controls the communication between the ambulance and hospital.

The following figure summarizes the activities that take place in such an emergency situation. The process that takes place will be explained in the forthcoming section named “Work at Ambulance”.

![JXTA Emergency health care Network Architecture](image)

Figure 4.1: JXTA Emergency health care Network Architecture
4.4.1 WORK AT AMBULANCE

This section explains the scenario that takes place within the ambulance. Node 0, Node 1, Node 2 and Node 3 are the peers in the architecture that are mentioned in the Figure

- Node 0 is the nurse peer group within the ambulance.
- Node 1 is a peer group within which there are three other groups they are as follows
  - Node 1.1 is the peer group of doctors working in the hospital.
  - Nodes 1.2 comprise specialized doctors for the purpose of emergency consultation.
  - Node 1.3 will be a peer group of nurses for assistance where they may be required to the hospital as and when needed.
- Node 2 is a peer group of blood banks.
  (Note: Peer group at Node 1 can communicate with the Peer group at Node 2 and vice versa)
- Node 3 is a peer group of retrieved relatives lists of the Hospital Community cloud.

- Patient inside the ambulance: the nurse identifies the patient details with the help of Node 0 that communicates to the hospital cloud community with cloud controller he belongs to.
- As per the patient status he/she will be taken to the nearest specialized hospital for the requirement and the doctor available is identified with help of Node 0.
- The shortest path will be found with the help of GPRS enabled devices fixed near the driver seat of the ambulance. The functionality of movable camera is to capture the image of the patient and sends to the doctors peer group.
- Node 0 immediately send messages to doctor peer group Node 1.1 the specialized doctors in the peer group Node 1.2 can be contacted with doctors at Node1.1 for any first aid that has to be given to the patient.
- Depending on the status of the patient the doctors in the peer groups 1.1 and 1.2 may send first aid messages to the nurse in the ambulance.
• In the case of heavy blood loss or surgery required the doctor in the peer group 1.1 may suggest number of units of blood required to treat the patient and sends message Node 2.

• Node 1 communicates with the Node 3 peer group (patient’s father/mother/brother/sister/wife/husband) about the accident based on the data available in the Hospital cloud community.

The below figures give the External and internal view of the ambulance.

Figure: 4.2 External & Internal view of ambulance

4.4.2 EMERGECNY CARE AT AMBULANCE

The internal view of ambulance and the work done at ambulance is represented in the Figure below with different nodes.
The standard model of an ambulance with patient’s berth, space for a nurse, first aid for life support systems, fire extinguishers and driver’s area. In the proposed framework model a JXTA networked mobile device or a laptop is present with an operator, a movable camera and speakers.

**4.5 ALGORITHMS IMPLEMENTED FOR THE ACTIVITIES**

The three activities represented as algorithms for retrieving patient’s information status and patient’s relatives information with input, output and procedure to be handled.

**4.5.1 RETRIEVE PATIENT INFORMATION**

Table 4.1: Patient information retrieval Algorithm

<table>
<thead>
<tr>
<th>Input</th>
<th>Patient Identification number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>Patient Health History</td>
</tr>
</tbody>
</table>
| Procedure      | 1. Send_patient_id () // to the Hospital community cloud like SSN.  
                 2. Get_patient_history () // patient basic history from cloud controller.  
                 3. Find the hospital where the patient has to be taken with help of GPRS enabled ambulance vehicle. |
4.5.2 STATUS OF THE PATIENT

Table 4.2 Patient status Algorithm

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Image (Captured by movable camera)</td>
<td>First aid messages</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Send_patient_image () // to the Node 1.</td>
</tr>
<tr>
<td>2. Send_bloodUnits_required () Node 1 sends information to Node 2 peer group if blood is required.</td>
</tr>
<tr>
<td>4. Nurse treats the patient as per the first aid messages.</td>
</tr>
</tbody>
</table>

4.5.3 PATIENT RELATIVE DETAILS

Table 4.3 Patient Relative details Algorithm

<table>
<thead>
<tr>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient Identification number.</td>
<td>Patient Immediate Relative List</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Send_patient_IdentificationNumber() //Node 0 sends to the Cloud Controller.</td>
</tr>
<tr>
<td>2. Get_Relative_List () //Cloud Controller sends to Node 0.</td>
</tr>
<tr>
<td>3. On receiving list of relative, Node 0 sends to Node 3 which in turn sends accident message to relative list.</td>
</tr>
</tbody>
</table>

4.6 DISTRIBUTED ELECTRONIC PATIENT HEALTH RECORD

A person who visits the physician, his record is created through JXTA in database. Data’s from different professionals is linked together to get a complete data set.
Data records from laboratories, hospitals and chemists are obtained with patient’s identification. i.e. Mobile number or Social security number (SSN) is kept as reference id. A family physician maintains the record set on an individual so that the data transfer is easy to avoid long time delay. Health professionals form a peer group and are able to select the kind of data available online and keep data’s confidential. Direct downloads from central cloud servers makes data storing superfluous.

4.6.1 AMBULANCE ALERT ALARM (AAA)

The Ambulance alert Alarm (AAA) placed on all the traffic signals on the town or separate posts in case of rural areas with a break of every 5 kms. At Node N₀ the operator finds path to the nearest hospital and fixes the location on the map and intimates driver’s cabin. The activated JXTA or GPRS network message is passed by operator at node 0. Alert signals or command is passed to the nearest or first traffic post which will alert the traffic signals about the ambulance and paves way for the ambulance to pass.

The signal or command will then be passed on to the second or next traffic post and makes the process continues till ambulance reaches hospital which reduces the time delay to a significant extent.

Figure 4.4 Ambulance Alert Alarm
4.7 SIMULATION SETUP

We developed a Cloud mobile JXTA emergency application and a server architecture test bed to simulate the proposed solution, prove its feasibility and evaluate performance. Implementation is done with Zend studio 10.0.0 with php cloud of designing a hospital community cloud. Cloud controller of Datacenter1 and Datacenter2 as administrators in the cloud. For development of the JXTA mobile application we used Java SE environment and JXTA Shell.

The main reasons for choosing JXTA Shell as Mobile developer platform for the applications are portable with Java code and wide implementation on all mobile Android and windows platforms. The possibility to process data locally on a mobile device and reduce network traffic, enhances possibility to implement a flexible application. Mobile information device on the ambulance at Node0 supports for creation and usage of JXTA cloud connection and also enables mobile application signing.

The Ambulance node is divided between five zones through JXTA Network: Ambulance Alert Alarm (AAA), Hospital which includes Doctor peer group, Specialized doctors and Nurses peer group, Blood bank peer group, Relatives Peer group. The cloud controller performs authentication of the user as access gateways, the same role as described before for all mobile users.

- The proxy server is implemented on a WAMP server and is used as a proxy in communication with the cloud. Authentication server that represents the Cloud Controller in our test environment.
- The patients information is registered and implemented in the Cloud environment so there is no need to make additional Manual document with a third party entity for offering functionalities of the records. In our test bed we developed Proxy Application server in Cloud JXTA platform and deploy it with php cloud and Zend Studio on WAMP server.

4.8 CLOUD SETUP AND SERVER CONFIGURATION

Creating account with phpcloud.com

- Creating cloud container (cloud healthcare)
- Downloading access private key
• Installing Zend studio 10.0.0 version.

4.8.1 CREATING CLOUD CONTAINER

A container is a small version of the Zend Application Fabric. The Fabric is a standardized system of runtimes, components and APIs based around Zend Server. It is the most general feature and most other features will be housed within the container. It contains an instance of Zend Server, through UI (User Interface) we can access within that container’s UI via a button on the top.

This container also contains our MySQL instance and any applications that needs to access that application. Each individual application for our container will need to share that database. If you need to have applications segmented from each other then we will need to either create an additional container which will use the standard MySQL extensions. All applications are housed within a container on Zend Server. This container is separate from all other containers and has its own database instance and is easily connected to our IDE. We can easily get started by publishing your application for Zend Developer Cloud container or by starting

![Create Container](image)

Figure 4.5 Creating container
with one of the pre-packaged applications and integrating them into your local IDE or by pushing your existing project to one of your containers using Zend Server's deployment mechanism.

### 4.8.2 DOWNLOADING RSA PRIVATE ACCESS KEY

PEM Files are the standard format for OpenSSL and many other SSL tools. This format is designed to be safe from inclusion in ASCII or even rich-text documents.

![zendcloud-v7n_2kal2k3g8v0ge656.pem](zendcloud-v7n_2kal2k3g8v0ge656.pem)

A single PEM file can contain a number of certificates and a key. For example, a single file will have:

- Public certificate
- Intermediate Certificate
- Root certificate
- Private key

The PEM file type is primarily associated with 'Privacy Enhanced Mail Security Certificate'. In cryptography, a public key certificate (or identity certificate) is a certificate which uses a digital signature to bind together a public key with an identity. This certificate can be used to verify a public key which belongs to an individual. These can be a personal certificate or a Certificate Authority certificate. Each application container is provided with a database, instance that can be used as backend storage for your PHP applications. The database instance is fully compatible with MySQL 5.1, and we can create multiple tables within the one schema (database) provided with us. From within your PHP code, you can access the database using one of PHP's MySQL interfaces (MySQL, mysqli or PDO_MYSQL), or of course using Zend_Db with one of the PDO_MYSQL or MySQLi adapters. Assuming our container name is my container, you should use the following credentials to connect to your database:

- **Database host**: `mycontainer-db.my.phpcloud.com`
- **Database port**: `3308`
- **Database schema name**: Hospital cloud (`my container`)
- **Database user**: Hospital Community Cloud (`my container`)
4.9 PERFORMANCE ANALYSIS

In the financial year 2012-13, under Tamilnadu Health system project 108 emergency ambulance services, we have considered the weekly performance report as an initiation for our proposed system. Table below represents budgets allotted in the financial year.

Table: 4.4 Weekly performances Report

<table>
<thead>
<tr>
<th>Years</th>
<th>2008-2009</th>
<th>2009-2010</th>
<th>2010-2011</th>
<th>2011-2012</th>
<th>2012-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allocation in crores</td>
<td>29.29</td>
<td>55.13</td>
<td>90.24</td>
<td>94.6</td>
<td>106.5</td>
</tr>
</tbody>
</table>

Description:

To increase the effectiveness of treatment The Tamilnadu Government has allotted budget for different financial years as shown in Table4.4 for the following advantages

- Fast data transmission between ambulance and server
- Modernized equipment’s for technical treatment
- High reach of service for emergency care
- Death rate is controlled
- Continuous monitoring and evaluation is easier
- Online Patient assessment is faster

From the study figure below shows that time spent per state such as

- Connection time
- SSL (Secure Socket layer)
- Waiting time
- DNS (Domain Name Server) time
- Receive time
- Send time.

This is obtained online during testing application performance on tools. Pingdom.com. Figure indicates comparatively time spent per domain like my.phpcloud.com (this is cloud application container), s3.amazonaws.com, and
Google etc. shows that page size with respect to request count of that page throughout the user log session in academic cloud ecosystem.

**Figure 4.6 Time spent to connect**

**Figure 4.7: Php cloud vs other domains**

### 4.10 EXPERIMENTAL RESULTS

The effectiveness of this method is verified and the performance is evaluated from September 2011 to July 2012.
• Total of 1856454 cases was transported during this period and referred to hospitals for identifying health problems and also monitored.

• We selected all the peer groups and the control server $N_0$ which controls $N_1N_2N_3$ proxied peer groups. The hospital cloud controller maintains the database of the patients in the JXTA Network.

• Among 1856454 transported cases, beneficiaries of 1712877 cases with lives saved 1662834 and 8500 cases lifted per day, 104530 transported cases found to be registered on JXTA network.

• The registered cases history was referred from Hospital Community Cloud (HCC). SMS sent from node $N_0$ to the relay peers who connects the nodes $N_1N_2N_3$ controlled by the cloud controller through JXTA network.

Table 4.5 Criteria Selected for Performance Evaluation

<table>
<thead>
<tr>
<th>Criteria Number</th>
<th>Criteria Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total Number of Vehicles on road</td>
</tr>
<tr>
<td>2</td>
<td>Total Number of Beneficiaries</td>
</tr>
<tr>
<td>3</td>
<td>Critical Lives saved</td>
</tr>
<tr>
<td>4</td>
<td>Case Lifted Per day</td>
</tr>
</tbody>
</table>
Here the selection criteria is provided with an average value each with respect to both the case of Traditional as well as JXTA Based Cloud Emergency Health Management system is compared in the above specified graph.

### 4.11 IMPLEMENTATION

Implementing a performance management infrastructure also help you to provide better service, improve communications, and deliver greater responsiveness. Improve operational decision by making information easily accessible to caregivers, staff and management. Strengthen the ambulance clinical performance by identifying opportunities for improvement. In developing countries death rate increases every year due to lack of emergency treatments in rural areas.

This approach proposed will help us to overcome the situation and to provide efficient system to treat patients in rural areas in the case of emergency helps to minimize the death rate.

The hospital community cloud can be accessed from the webpage

Figure 4.9 Cloud health care webpage

Figure 4.10 JXTA Node 0 Ambulance Alert Alarm
Figure 4.11 (i) Blood Bank Details (ii) Specialized Doctors Available

Fig 4.12 Graph Galore representing Different nodes
4.12 CONCLUSION

The necessity of the system is to avoid and overcome the death rate because of the time delay in case of patient transportation and necessary first aid not given. The system will be reliable, data readily available, synchronized, ease in communication. This framework enhances emergency treatments that can be given to anyone in rural areas. So many key challenges to this domain including automatic resource provisioning, Big data analytics, data security are starting to receive attention from the research community as real world problems.