Chapter 10
Message-Oriented Middleware on the Cloud for Exchanging E-Health Data

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ABSTRACT

Cloud infrastructure has been one of the latest technologies in the e-health sector. Despite many research studies focusing on the privacy of the e-health data stored on the cloud, the ways of exchanging e-health information between client and cloud have not yet been fully addressed. Moving from this initial consideration, in this chapter, the authors evaluate the possibility of using Message-Oriented Middleware (MOMS) for exchanging data between the cloud storage and the remote device used in telemedicine and remote monitoring software. The evaluation is done using a cloud testing environment and a low bandwidth connection modem and a simulation of 50 patients taking a 10 minutes 3Lead EGC test. Some possible future directions on this architecture are suggested as well as some possible improvements.

INTRODUCTION

The objective of this chapter is to describe the possibilities offered by using Message Oriented Middleware in telemedicine and remote monitoring application. Telemedicine and remote monitoring seem the only successful ways for the clinician to monitor and check the health status of the patients whose number is increasing. Above all the number of chronic patients that require a constant monitoring is increasing.

The problem of monitoring is not only related to the western countries but also affects the development ones. Recent studies, which were done by the CDC (CDC, 2013) suggest that, for example, in the US, 5.1 million people suffer from Chronic Heart Failure. So, a long term monitoring could be practically impossible. Moving to the China population, for example, 20 million people need constant monitoring. The remote monitoring applications are promising not only when we deal with big numbers but also when we deal with big distances. In development countries like Africa or Asia, in most of the cases direct clinician consultation is very difficult due to the difficulties and the lack of transportation. Telemedicine applications

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used the well-established client server technology using a remote connection with the server using the TCP-IP and HTTP/HTTPS protocol. So, in general, we have some remote sensor devices, both hardware and software, that exchange medical observation with a central server, which is used as a repository for the collected data.

In the latest years the cloud paradigm entered the field of server side software technology. So, new telemedicine and remote monitoring applications have been created or re-coded using this new approach. However, as regards the communication layer, there has been no significant evolution on the use of Message Oriented Middleware.

Despite the specification is quite established in other fields as the financial one, surprisingly the use of Message Oriented Middleware in a cloud environment applied to the telemedicine field has not been yet fully studied. The use of MOMs in remote monitoring applications where the server is a cloud based one and the exchange of Electronic Health Records (EHR) is done using MOM infrastructure has never been discussed before.

The purpose of our study is to fill this gap. After a basic introduction, we will propose a simulation on the use of Message Oriented Middleware in a real-life chronic patient remote monitoring. We will detail a possible scenario where we have a 3Lead ECG device that sends data to a central cloud infrastructure. The communication is established using the Java Messaging Service (JMS) protocol, and an open-source implemented framework (HornetQ). The format of the message was similar to HL7 Observation messages. The core part of the chapter is focused on describing this infrastructure and on providing a simulation where 50 software coded devices send a 3Lead ECG to the cloud infrastructure. This simulation will describe a fully coded infrastructure based on low bandwidth transmission line, so to avoid simulation based on higher technologies. After a simple test, we will perform some evaluations of the results, based on some simple statistical data analysis. The statistical data analysis suggests that this approach could outperform the old client server technology using Web-services endpoints.

This very first try suggests that Messaging Oriented Frameworks and cloud infrastructures could be successfully integrated for exchanging medical data in telemedicine or remote monitoring environment. Some possible improvements to the overall architecture are suggested as well as some configuration adjustments to boost performance.

BACKGROUND

Despite the Moore law (Schaller, 1997) first postulated back in 1965, postulating a limit on the individual computing capacity of any computer both from the perspective of CPU, storage capacity, we have seen a computational growth mainly driven by the cloud computing paradigm. Even if the cloud computing involves a wide range of the technological aspect, and even if there is still no wide agreement on a single definition (Armbrust et al., 2010), we could argue that cloud computing is infrastructure both hardware or software that is able to connect various computational devices such as desktop, pc, high performance server, through a communication network.

The key idea is simple if we have a computational task so important in terms of computational power involved that we divide the full task into simpler tasks that are elaborated separately from a different machine.

The computational power of such an infrastructure at least on the paper is of higher magnitude than using a single machine for this purpose.

The cloud paradigm is only one step forward. Some older projects were in the production stage back in the last five years of the ’90. The SETI@ Home (Seti 2013) project was probably the first distributed computational task that involved users outside the academic circle. The project consists in finding trace of extra-terrestrial transmission by scanning observational data coming from the Arecibo radio Telescope (Figure 1).

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