

# Chapter 15

## Privacy-Based Multiagent Brokering Architecture for Ubiquitous Healthcare Systems

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### ABSTRACT

*Ubiquitous healthcare is an emerging technology that promises increases in efficiency, accuracy and availability of medical treatment; however it also introduces the potential for serious abuses including major privacy violations. Brokering is a capability-based coordination approach for ubiquitous healthcare systems (UHS). A major challenge of brokering in open environments is to support privacy. Within the context of brokering, the authors model privacy in terms of the entities' ability to hide or reveal information related to its identities, requests, and/or capabilities. This work presents a privacy-based multi-agent brokering architecture that supports different privacy degrees. Unlike traditional approaches, the brokering is viewed as a set of services in which the brokering role is further classified into several sub-roles each with a specific architecture and interaction protocol that is appropriate to support a required privacy degree. To put the formulation in practice, a prototype of the proposed architecture has been implemented to support information-gathering capabilities in healthcare environments using FIPA-complaint platform (JADE).*

### INTRODUCTION

Nowadays in modern and ubiquitous computing environments, it is imperative more than ever that the delivery of healthcare quality is clearly crucial in any society. Healthcare workers are expected to continuously improve the quality, timeliness, and

cost of their services to the community. An important feature of the various ubiquitous healthcare systems is that they share similar problems and are faced with common challenges for decentralized systems in open environments. In this chapter we focus on the following challenges:

- In open ubiquitous healthcare environments, it is no longer practical to expect healthcare

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clinicians, staff, care providers and patients to determine and keep track of the information and services relevant to his/her requests and demands. For example a patient shall be ubiquitously able to access his/her medical record, i.e., from anywhere at any time through any means.

- The distributed nature of data, information, knowledge and services among multiple healthcare locations may require effective coordination and collaboration amongst the participants. The provision of care to hospitalized patients involves various procedures and requires the coordinated interaction amongst various staff and medical members.
- Open healthcare environments usually characterized by multiple participants that may require different degrees of access authorities on data, information, knowledge and services. In such environments, ubiquitous healthcare systems must satisfy different levels of security and privacy requirements.

The proactive health systems have the potential to improve healthcare access and management which significantly decrease the incurred costs through efficient coordinated information flow between various physicians, patients and medical personnel, yet the privacy concerns are key barriers to the growth of health based systems in. Legislations to protect personal medical information were proposed and put in effect to help building a mutual confidence between various participants in the healthcare domain. All these suggest that healthcare needs a major shift towards building cost-effective privacy-based solutions for pervasive and ubiquitous embedded e-Health environments, given that limited financial and human resources will be committed. Without broad trust in medical privacy, patients, professionals, and service providers may diminish the value

and resist the adoption of ubiquitous healthcare services.

The high degree of collaborative work needed in healthcare environments implies that developers and researchers should think of other alternatives to manage and automate this collaboration efficiently. The main goal of this chapter is to provide a thorough analysis, investigation and to develop a privacy-based coordination solution for decentralized systems in open environments that is applicable to ubiquitous healthcare domain. In this chapter we focus on one aspect of coordination that deals with capability-interdependency problem, i.e. to achieve a goal by a group of participants that may go beyond the capability of the individuals. To this end, the chapter presents an in-depth analysis of the capability-based coordination and proposes a novel privacy-based brokering framework and interaction protocols that support different privacy degrees that are applicable to ubiquitous healthcare systems.

## **BROKERING – CAPABILITY BASED COORDINATION**

In developing ubiquitous healthcare environments, coordination is a major challenge. Entities need to locate and interact with others who possess the capabilities to achieve a particular goal. For distributed systems, fulfilling a request may go beyond the capability of the individual entities, this is known as the *capability-interdependency problem* (Ghenniwa and Huhns, 2004)

In the conventional point-to-point interaction configuration, entities interact directly with each other to provide controlled and directed coordination. However, this configuration is both inflexible and computationally expensive. For instance, there is no separation of concerns between computation and coordination. The absence of a separate medium that deals exclusively with the coordination aspects in the system means that the entities, in

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