

## Chapter 15

# An Agent–Oriented, Workflow–Based Mobile Framework for Implementing Interoperable Healthcare Information Systems

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### ABSTRACT

*Healthcare is an increasingly collaborative enterprise involving many individuals and organizations that coordinate their efforts toward promoting quality and efficient delivery of healthcare. To these ends, today, more than any other point in time, increased reliance is being placed on interoperability among healthcare information systems (HIS) which have been developed as monolithic, stand-alone systems without significant interfaces between them. Enabling heterogeneous HIS to interact within a Service-oriented architecture (SOA), such as a Web Services architecture, can help healthcare organizations to consistently deliver sustainable business value, with increased agility and cost effectiveness, in line with changing business needs. However, in the context of a SOA approach, issues of semantic interoperability still remain unresolved while new challenges arise regarding web service interoperability. This paper presents a mediation framework which provides a uniform interface to the underlying HIS and is accessible via Android-enabled devices. The proposed framework is based on the agent paradigm for both healthcare process management and management of interactions among the participating systems. The healthcare processes and all interactions involved in each process are described according to the workflow metaphor.*

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## INTRODUCTION

Healthcare delivery involves a broad range of in-patient, out-patient and emergency healthcare services, typically performed by a number of geographically distributed and organizationally disparate healthcare providers who often invest significant resources in the development of large and complex information systems (Mathews & Pronovost, 2011). Technologically innovative efforts of the past have often resulted in the development of disparate, incompatible and heterogeneous systems based on the traditional transaction processing paradigm rather than on supporting business processes. However, healthcare providers' activities require increased collaboration and coordination in order to provide shared and integrated care when and where needed (Malamateniou & Vassilacopoulos, 2003; Ying et al., 2012).

Thus, the integration of diverse and disparate information systems with emphasis on communication and collaboration is a challenge often faced by healthcare organizations (Huizen & Backman, 2005; Lenz & Kuhn, 2004; Mathews & Pronovost, 2011). This challenge can be met by means of interoperable healthcare information systems (HIS) that support a process view of the healthcare delivery context and also facilitate communication among diverse systems on an ongoing basis, despite different purposes, structures, and underlying technologies. Such systems may assist in realizing collaboration among healthcare providers and in providing readily access to patients' longitudinal health records by authorized users at the point of care. This, in turn, will improve the quality, efficiency, and effectiveness of healthcare delivery – dimensions of healthcare in need of innovation and improvement.

When an interoperable HIS is envisaged, communication-level interoperability issues need to be solved in order to ensure that existing systems using different transport protocols and data formats can exchange information. Such interoperable HIS can be realized according to the Service-Oriented Architecture (SOA) which can solve these issues to a great extent while protecting past investments since existing information assets and applications are preserved (Wang & Wang, 2005). However, data integration issues are not fully addressed while new challenges are created regarding interoperability due to inconsistencies in web service implementations (Cohen, 2002). Thus, the movement towards such an interoperable HIS requires an architecture that implements interoperability among existing information systems in all levels, including service and data levels.

The effective management of interactions in heterogeneous and distributed environments is a fairly complex task. The conjunction of agent and workflow technologies provides the ability to execute such complex tasks and helps managing the complexity of the distribution in terms of both administration and fault tolerance. In particular, these technologies can be used for the integration of existing systems both within and across different healthcare organizations by integrating the common data and business logic into a specific architectural layer (i.e. middleware) distinct from individual applications and accessible through the whole HIS. In addition, mobile technology can facilitate the realization of a patient-oriented model focused on the patient by providing ubiquitous access to patient data, thus enabling the practice of care irrespective of the location of the healthcare professional. In particular, mobile technology, enhanced with context awareness features, can provide real-time access to relevant information by multiple parties in all care settings, thus tailoring care more closely to the needs of patients.

This paper presents a, compatible to the EN 12967 standard (ISO/TC 215, 2009), mediator-based system architecture that addresses HIS interoperability issues while it complies with the most stringent requirements of high performance, reliability, robustness, scalability, high flexibility and fault tolerance.

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