Chapter 2.19
Exploring a UML Profile Approach to Modeling Web Services in Healthcare

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ABSTRACT

The Web services paradigm offers numerous potential benefits to the health care area. These include interoperability, portability, scalability, and compliance with universal standards. However, development of large-scale Web services applications in health care is relatively scarce. Multiple challenges are slowing the diffusion of information technology practices in health care, starting with the absence of modeling tools and methodologies that are the bases for building such technology. This article describes a UML profile approach to developing Web services applications in the health care area, emphasizing the use of such extensions as stereotyping and tagging to model the unique elements of health care processing. We apply these ideas to a health clinic example. From here, one can imagine building incrementally upon these ideas to develop frameworks for Web services applications in health care. The benefits would enhance the overall quality of health care delivery and lower costs.

INTRODUCTION

Web services are self-contained, Internet-enabled applications capable not only of performing healthcare-related activities independently, but also possessing the ability to engage other Web services to complete higher-order business (health) transactions (Papazoglou & Dubray, 2004). The key is modularity characterized by open standard and internet-oriented interfaces. Examples of such patient services include verifying appointment availability, producing a bill, ordering lab tests, prescribing medication, and discharge planning. The platform-neutral nature of Web services (Kreger, 2001) creates the opportunity for building composite services using existing elementary or complex services, possibly offered by different service providers (Meredith & Bjorg, 2003; Yang, 2003). On a larger scale, these services can be considered a set of interoperable technologies and standards, designed to support the integrating of several autonomous and heterogeneous systems. Web services are particularly geared toward the service-oriented computing paradigm, which can be considered a collection of services, coordinating, and communicating with each other to support a system's specific function or concept. Service-oriented computing has the potential to be the healthcare industry's new foundation for distributed systems and internet-based processing. Web services specifications, such as SOAP, WSDL and UDDI, facilitate open, XML-based methods to support application interoperability, service description, and service discovery (Estrella, McClatchey, Rogulin, Amendolia, & Solomonides, 2004).

The rapid adoption and diffusion of service-oriented architecture (SOA) and Web services in various industries indicate that the advantages and benefits (componentization, interoperability, platform-independence, modularity, reusability, etc.) therein could provide similar benefits for healthcare. Overall, there has been a major change in the way large scale software applications are designed, modeled, implemented and used (Stojanovic, Dahanayake, & Sol, 2004). Services are autonomous, platform-independent processes that can be identified and defined, published, discovered, choreographed, and programmed using universally accepted protocols for building health applications that work together seamlessly, both intra-enterprise (i.e. the healthcare delivery organization) and inter-enterprise (i.e. the consortium of healthcare delivery participants). When services are delivered via the Web we call them Web services. These have emerged as a framework for application-to-application interactions, making these applications available as Web services (Vara, De Castro, & Marcos, 2005). While Web applications via the Internet have been used in the healthcare industry for a few years now, these applications are mostly intra-enterprise, that is, services are within the specific healthcare organization using them. There is limited capability for supporting cross-functional and inter-enterprise applications. Recently, however, practitioners and researchers have started to address the distributed and inter-enterprise nature of healthcare delivery (the interaction arising out of the exchange of information among physicians, insurance companies, hospitals, labs, and pharmacies, for example). The desire to exploit the scalability of Web services within the SOA is understandable. Catley, Petriu, and Frize (2004) describe a prototype Web services architecture for physicians designed to provide clinical decision support. The objective is to integrate and access clinical decision support systems (CDSSs) and medical databases from various medical domains. Their rationale for integrating distributed databases is that different medical domains often exhibit complementary abilities in predicting medical outcomes. They give the example of the collective domains that include obstetrical, prenatal and neonatal databases. The overall goals have been multifold: the Web services are expected to integrate different types of CDSSs; provide for a way to link disparate distributed databases on multiple platforms; and making the CDSSs available locally as well as remotely (Catley et al., 2004).

Estrella et al. (2004) describe another application based on grid computing and the SOA. The MammoGrid project is expected to support collaborative medical image analysis. An important objective is to manage federated mammogram databases distributed across Europe. The framework would include regions with varying protocols, lifestyles and diagnostic procedures and would enable a range of functions including data mining, epidemiological studies, statistical analyses, and deployment of a standardized Standard Mammogram Form. The goal is to