Chapter VI
Extending Loosely Coupled Federated Information Systems Using Agent Technology

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**Abstract**

Different FIPA-compliant agent development platforms are available for developing multiagent systems. FIPA compliance ensures interoperability among agents across different platforms. Although most agent implementation platforms provide some form of white- and yellow-page functionalities to advertise and identify agent roles and descriptions, there are no clear architectural standards that define how an agent community can effortlessly adapt to operate in a federated information system (FIS) where new content sources are constantly added or changes are made to existing content sources. This chapter presents a framework based on the semantic Web vision to address extensibility in a loosely coupled FIS.
INTRODUCTION

The process of automating the interorganizational information exchange between trading partners has been an ongoing challenge. In recent years, information exchange in business-to-business (B2B) workflow models have started migrating to Internet-based technological solutions such as Web services and service-oriented architectures (SOAs) over older systems based on electronic data interchange (EDI) and object request brokerage (ORB). UDDI (universal description, discovery, and integration) business registries allow businesses to list themselves on the Internet and be discovered by others while offering the benefits of platform independence and minimal implementation costs to the trading partners. In a federated environment where a finite set of partner institutions collaborate and exchange information, federated information systems (FISs) have evolved as a fertile area of research seeking new methods and tools to help provide integrated access to a finite, predefined set of autonomous and heterogeneous databases. Busse, Kutsche, Leser, and Weber (1999) define an FIS as a set of distinct and autonomous information system components: the participants of this federation. The participants operate independently, but negotiate some levels of autonomy among themselves in order to participate in the federated environment (Busse et al.). Conceptually, an FIS can be characterized by the presence of an integration layer that allows a degree of autonomy, heterogeneity, and interoperability among the underlying legacy applications and databases (Busse et al.; Sheth & Larson, 1990).

The success of an FIS is strongly dependent on the generation of federated schemas from the participating source database schemas. A federated schema allows business analysts to accomplish complex goals such as generating data-mining reports, perform computations along multiple dimensions of data stored in different sources, and help developers by providing incremental views for quick access to information along with data warehouses’ capabilities (Jarke, Jeusfeld, Quix, & Vassiliadis, 1999). It is a common practice in FIS to view an organization’s business model as conceptual perspectives based on shared information and build a higher level schema representation as a logical model (Busse et al., 1999; Jarke et al.). Defining higher level representations in the form of federated schemas offers a convenient logical perspective to store and find data linked to the disparate local schemas. As the source of information changes due to the insertion of new data sources or deletion of existing data sources, timely changes are necessitated on the federated schema. Prior research has made significant strides in addressing many problems related to the communications and interoperation issues covering data sources as well as nondatabase information sources (Hasselbring, Heuvel, & Roantree, 2000). Unfortunately, little research addressed issues related to dynamic updates to a loosely coupled federated schema as data sources are added and/or removed.

The objective of this chapter is to develop a framework that provides extensibility in a loosely coupled FIS. This study proposes to integrate semantic Web and multiagent systems to enhance the extensibility of loosely coupled federated schemas derived from heterogeneous database components within an FIS architecture. The semantic Web architecture can provide a common framework for semantics and data to be shared and reused across applications and enterprise boundaries (Berners-Lee, Hendler, & Lassila, 2001; Thomas, Redmond, Yoon, & Singh, 2005). A goal-based agent community can be overlaid on an FIS model (Jennings, Sycara, & Wooldridge, 1998; Zou, Finin, Ding, Chen, & Pan, 2003). By integrating the semantic Web and an agent community, the chapter aims to develop an extensibility model in which ontological documents describe the semantic structure of the data sources in an agent-enriched FIS environment. The next section presents a high-level overview of FIS and the necessity for the extensibility of a loosely coupled FIS. This section also presents the use of the ontology Web language (OWL)
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