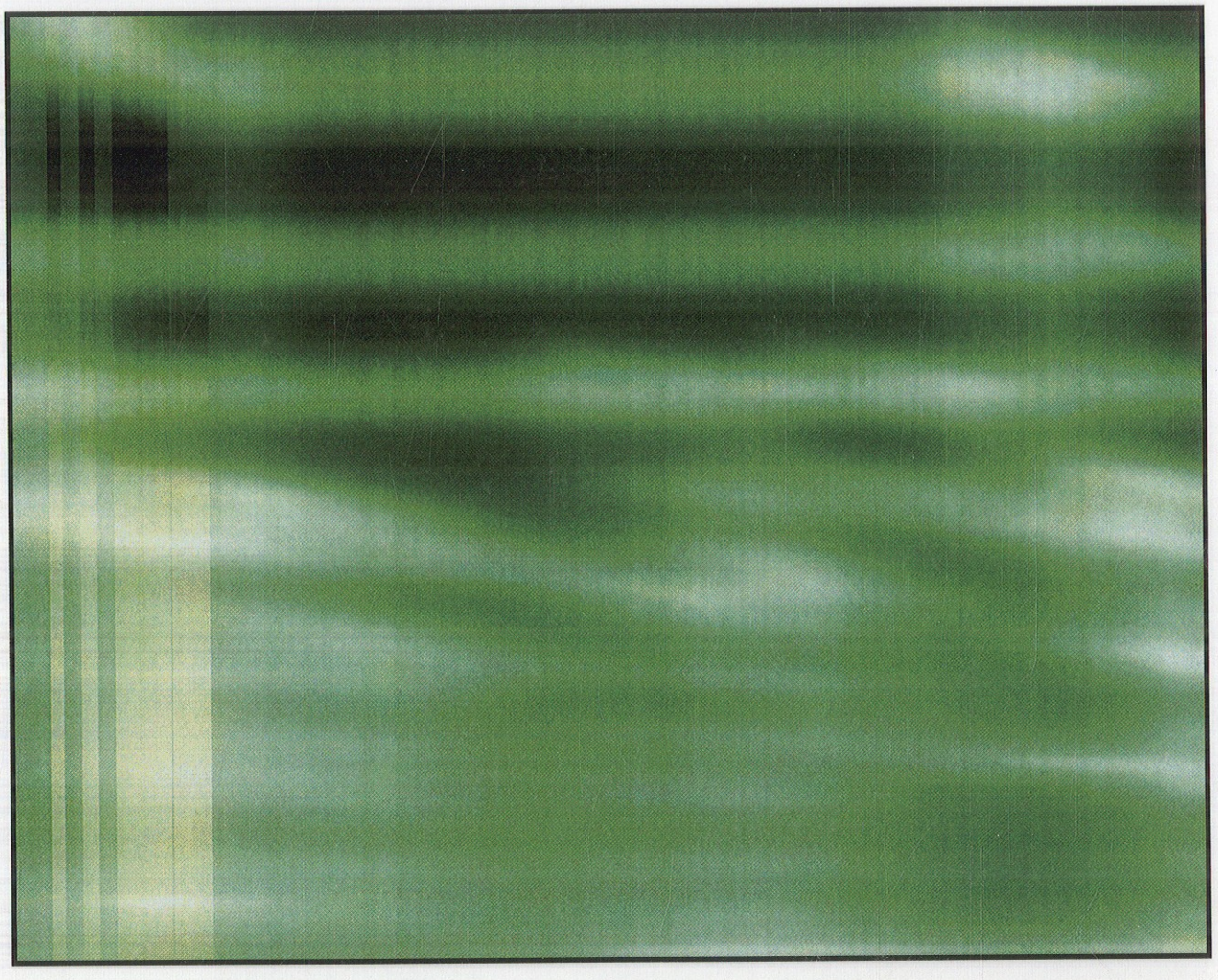
PREMIER REFERENCE SOURCE

Semantic Enterprise Application Integration for Business Processes

Service-Oriented Frameworks



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ing execution time by providing formal transformations of the output and input messages (of the participating services) to a common reference business data model, that is, the enterprise interoperability ontology. Moreover, we present a tool that has been developed to support the user to provide business data-related semantic annotations and XSLT transformations of the input and output message parts of collaborative enterprise services. Finally, we demonstrate the utilization of the proposed approach and tool in a real-world EAI scenario.

Increasingly, enterprises are using service-oriented architecture (SOA) as an approach to enterprise application integration (EAI). SOA has the potential to bridge the gap between business and technology and to improve the reuse of existing applications and the interoperability with new ones. In addition to service architecture descriptions, architecture abstractions like patterns and styles capture design knowledge and allow the reuse of successfully applied designs, thus improving the quality of software. Knowledge gained from integration projects can be captured to build a repository of semantically enriched, experience-based solutions. Business patterns identify the interaction and structure between users, business processes, and data. Specific integration and composition patterns at a more technical level address enterprise application integration and capture reliable architecture solutions. We use an ontology-based approach to capture architecture and process patterns. Ontology techniques for pattern definition, extension, and composition are developed and their applicability in business process-driven application integration is demonstrated.

In cross-organisational business interactions, integrating different partners raises interoperability problems especially on the technical level. The internal processes and interfaces of the participating partners are often pre-existing and have to be taken as given. This imposes restrictions on the possible solutions for the problems which occur when partner processes are integrated. The aim of this chapter is the presentation of a three-tier framework for managing and implementing interoperable and cross-organizational business processes. Thereby the authors want to fill the gap currently existing between processes defined on a strategic level and executed models. We describe a solution which supports rapid prototyping by combining a model-driven framework for cross-organisational business processes with an agent-based approach for flexible process execution. We show how the W3C recommendation for Semantic Web service descriptions can be combined with the model-driven approach for rapid service integration.

In service-oriented architectures (SOA), service descriptions are fundamental elements. In order to automatically execute SOA tasks, such as services discovery, it is necessary to capture and process the semantics of services. We review several Semantic Web services frameworks that intend to bring semantics to Web services. This chapter depicts some ideas from SOA and Semantic Web services and their application to enterprise application integration. We illustrate an example of logic-based semantic matching between consumer services and provided services, which are described in ontologies.

The availability of sophisticated Web service discovery mechanisms is an essential prerequisite for increasing the levels of efficiency and automation in EAI. In this chapter, we present an approach for developing service registries building on the UDDI standard and offering semantically-enhanced publication and discovery capabilities in order to overcome some of the known limitations of conventional service registries. The approach aspires to promote efficiency in EAI in a number of ways, but primarily by automating the task of evaluating service integrability on the basis of the input and output messages that are defined in the Web service's interface. The presented solution combines the use of three technology standards to meet its objectives: OWL-DL, for modelling service characteristics and performing fine-grained service matchmaking via DL reasoning, SAWSDL, for creating semantically annotated descriptions of service interfaces, and UDDI, for storing and retrieving syntactic and semantic information about services and service providers.

Semantics needs to be considered in two major integration tasks. First, semantically corresponding data types that can be used for communication between components need to be identified. Second, natural language documentation needs to be studied today in order to understand component behavior, that is, dependencies between operation invocations and how semantically different outcomes of operation calls are represented in the technical output format. The approach presented in this chapter supports the two tasks as follows. First, closed frequent itemset mining (CFIM) is employed to help identifying

semantically corresponding data types. Second, a formal representation for component behavior is introduced. However, as component behavior is specified during component development, but used during integration–two distinct phases involving distinct teams–we provide model transformations to ensure the consistent transfer of generic behavioral information to specific integration constraints before automated integration techniques can be applied. We applied the CFIM on the message types exposed by SAP's standard software components and show that we are able to find semantically relevant correspondences. Furthermore, we demonstrate the practical applicability of our behavioral model transformations on the basis of an SAP best practice business scenario. With the little more effort to specify behavioral information at development time in a formal way instead of in natural language, our approach facilitates the reuse of behavioral component descriptions in multiple integration projects and eases the construction of correct integrations.

Chapter 8

In service-oriented business applications, B2B integration happens when a service requester invokes services of one or more service providers. Typically, there are several candidate services with similar capabilities that can be chosen by a requester in order to serve his business needs. The selection of the service to be invoked may depend on different functional and non-functional properties. The non-functional properties usually address security, reliability, performance, and so forth. The functional properties address the business process interplay at the level of the technical Web service interface and the message choreography associated with it. At the technical integration level, the description of functional and non-functional service properties has been exhaustively addressed in the scientific literature in the past. The business level however, namely, the requester's business need, the business meaning of an offered service, and the capability of a service provider to successfully perform the requested business transaction, has been rather ignored. This chapter describes a solution for service discovery and selection at the business level, that is, at the level of offered business capability of a service provider and the ability to serve a concrete requested business transaction. The proposed solution is based on semantic interpretation of offered service capabilities, contractual restrictions, business rules of the requestor specifying selection preferences, and the parameters of the run-time service request. The applicability of the proposed solution is demonstrated on a shipper-carrier integration scenario.

Chapter 9

Currently in the travel domain, most of the travel products are sold through global distribution aystems (GDSs). Since only major airline companies or hotel chains can afford to join GDSs, it is difficult for small and medium enterprises to market their travel products. In this chapter, we describe a middleware, called SATINE, to address this problem. In the SATINE middleware, existing travel applications are wrapped as Web services. Web services, as such, is of limited use because the service consumer must know all the details of the Web service like the functionality of the Web service (what it does) and the content and the structure of input and output messages. Therefore, we annotate both the service functionality and the service messages with Web ontology language (OWL) ontologies. Service functionality ontology is obtained from the "Open Travel Alliance (OTA)" specifications. Service message ontologies are automatically generated from the XML schema definitions of the messages. These local message ontologies are mapped into one or more global message ontologies through an ontology mapping tool developed, called OWLmt. The mapping definitions thus obtained are used to automatically map heterogeneous message instances used by the Web service provider and the consumer using a global ontology as a common denominator. This architecture is complemented by a peer-to-peer network which uses the introduced semantics for the discovery of Web services. Through the SATINE middleware, the travel parties can expose their existing applications as semantic Web services either to their Web site or to Web service registries they maintain. SATINE middleware facilitates the discovery and execution of these services seamlessly to the user.

Chapter 10

The research project FUSION aims at supporting collaboration and interconnection between enterprises with technologies that allow for the semantic fusion of heterogeneous service-oriented business applications. The resulting FUSION approach is an enterprise application integration (EAI) conceptual framework proposing a system architecture that supports the composition of business processes using semantically annotated Web services as building blocks. The approach has been validated in the frame of three collaborative commercial proof-of-concept pilots. The chapter provides an overview on the FUSION approach and summarises our integration experiences with the application of the FUSION approach and tools during the implementation of transnational career and human resource management services.

Chapter 11

The application of semantic technologies promises boosting business process management because semantic integration of business and IT is achieved. To enable the vision of semantic business process management, semantic technologies like ontologies, reasoners, and semantic Web services must be integrated in BPM tools. We extended a professional BPM tool to allow semantic business process modelling using the EPC notation. In addition, we adapted the tool's EPC to BPEL transformation to preserve the semantic annotations. By introducing a proxy service, we are able to perform Semantic Web service discovery on a standard BPEL engine. We evaluated our approach in an empirical case study, which was replicated 13 times by 17 participants from 8 different organisations. We received valuable feedback, which is interesting for researchers and practitioners trying to bring semantic technologies to end-users with no or only limited background knowledge about semantics.