Process-oriented Requirement Modeling for the Internet of Services

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Abstract. The Internet of Services (IoS) pinpoints the vision of how services are packaged, offered, and consumed over the internet. To allow flawless service-to-service integration (S2Si), participants must share a common understanding of services. To tackle both business and technical issues involved in S2Si, I propose to extend business process notations to model functional and non-functional properties, and to map them to semantic web services.

Keywords: Service value proposition, process notations, semantic web services

Introduction

The Internet of Services (IoS) [15] pinpoints the vision of how services are aggregated, offered, and consumed over the internet. Various disciplines must be combined to realize it. The concept of IoS and its participants rely heavily on business models [11] such as Business Value Networks (BVN) [18, 17], and service-oriented systems such as Service Ecosystems (SE) [3, 13]. Thus, the IoS comprises a business- and technical-oriented level, which both must be addressed.

Nowadays, business-to-business integration (B2Bi) is complex and lengthy, and usually results in high transaction costs. This is because companies must negotiate their terms of business each and every time they want to cooperate. Additionally, once they have agreed to cooperate, the companies' applications must be integrated as well. This is a complex process since companies employ heterogonous application systems, diversified interfaces and communication protocols. To allow seamless exchange and flow of services between different companies in the IoS and thus decreasing transaction costs and technical incompatibility, it is a necessity that each participant shares a common understanding of services. Furthermore, methods, frameworks, and tools must become available to describe (1) service value propositions for service offerings, (2) service value configurations for service aggregation, and (3) service requirements for service consumptions to facilitate a seamless service-to-service integration (S2Si). Figure 1 depicts these aspects with the example of Amazon's "sell books via electronic store" process.

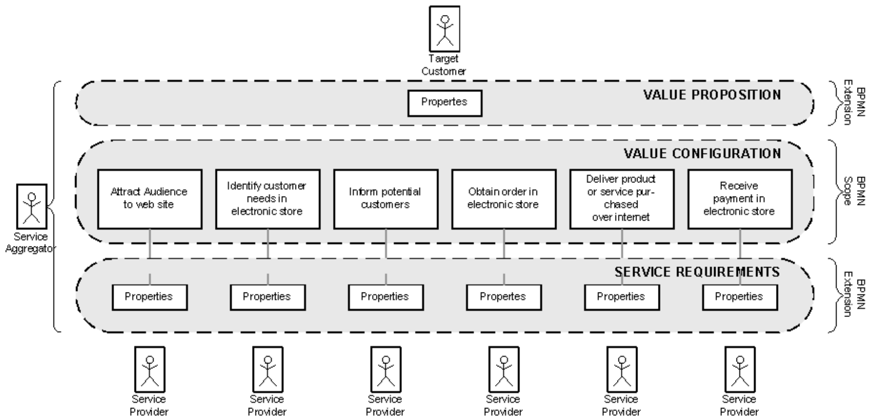

Fig. 1. Sell books via electronic store, Amazon.com, (MIT Process Handbook, 2003 [7])

Related Work

Gordijn [5] identified the lack of a sound value proposition to customers as a major source for the failure of e-commerce ideas. He offers a value ontology to formalize e-commerce ideas and their proposition to customers, and a value modeling method to explore e-commerce ideas. Baida et al. [2] offer a complete service ontology which includes a service value description, a service offering description, and a service process perspective. This ontology allows a component-based description of services, and capabilities to express customer-oriented service value conceptions. Osterwalder [11] offers a business model ontology based on a comparison of existing business models. This ontology includes the concepts value proposition, value configuration, and capabilities.

In this context, service value propositions and service requirements are described as functional and non-functional properties. Functional properties tell *what* a service does whereas non-functional properties are constraints over service functionalities and depict *how* a service provides its functionality. Oaks et al. [10] describe in their work a structured and machine readable meta-model to describe service capabilities. O'Sullivan et al. [12] offer a set of non-functional properties to describe services to allow better means for service discovery, service substitution, service composition, and service management. The Dublin Core (DC) [1] specification offers 15 concepts to describe information resources which are also useful to describe services. Mörschel et al. [9] depict 16 different description criteria to allow a more transparent service acquisition process.

Business process notations, such as the Business Process Modeling Notation (BPMN) [19] and the Event-driven Process Chain (EPC) [16], are semi-formal graphical notations to model business processes; that is the interaction and relationship of activities which need to be performed in order to run a business. The purpose of business process modeling is threefold: (1) it reduces business process complexity, (2) facilitates communication between business partners, and (3) allows the communication of business requirements for information systems. Zur Muehlen et al. [20]

describe in their work how to extend process notations with rule notations to achieve better expressiveness. For expressiveness measurement, they apply the Bunge-Wand-Weber Framework. Their results show to combine BPMN with Simple Rule Modeling Language (SRML) to get the highest expressiveness. Decker and Barros [4] show an extension to BPMN to model the interaction between different pools. The authors argue, that this extension reduces incompatible issues involved with choreography on the conceptual level, and that it is more suited to human modelers.

Web services [6] offer possibilities to describe, discover, and invoke functionality over the internet with well known standards and protocols. Additionally, the concept of semantic web services utilizes ontological sources to increase the formalization of web service descriptions in terms of functional and non-functional properties. The Web Service Modeling Ontology (WSMO) [14] allows to model web service functionality in terms of pre- and post condition. A condition describes the state of the world, either before or after web service composition. Non-functional properties are expressed with DC [1]. The Web Ontology Language for Services (OWL-S) [8] describes among other things a service profile. The service profile concept depicts the intended aim of the service in terms of functional and non-functional parameters. With OWL-S, functionality is described by services' information transformation and by state changes. Fix non-functional properties are service name, service contact, service description, and service category. In addition, the profile parameters concept allows to specify more non-functional properties.

Research Problem

The basic questions that my research attempts to answer is (1) how can one extend the semantics of existing business process notations in order to allow the modeling of service value propositions and service requirements, and (2) how can this be mapped to concepts of semantic web services?

Thus, my research spans (1) the concepts of business models, requirement analysis, business process notations, and web service descriptions; and (2) the relationship between requirement analysis, process notations, and web service descriptions. This problem can be divided into the following questions/challenges:

1. How can functional service properties for the IoS [10] be described?
2. What non-functional service properties are relevant for the IoS [12]?
3. How can functional and non-functional properties with business process notations, such as BPMN [19] and EPC [16] be modeled on a business-oriented level?
4. How can functional and non-functional properties for web services with semantic concepts such as WSMO [14] and OWL-S [8] be implemented on a technical-oriented level?
5. How can functional and non-functional properties from business process diagrams (cf. question 3) be mapped to semantic web services (cf. question 4)?

Contribution

The contribution of my research is to develop definitions and a shared understanding of the terms "Value Propositions", "Service Requirements", and "Value Configuration" on a business and a technical level which are valid for the IoS. Furthermore, business process notations will be enhanced to allow the modeling of functional and non-functional properties to represent value propositions and service requirements. This improves means for business process documentation and communication between process stakeholders, and a higher formalization of business requirements towards Service Ecosystems.

Real-world use cases include (1) that service providers are supplied with a framework and tools to describe their services (Value Proposition) in a business-oriented fashion, (2) that service aggregators use business process notations to formulate requirements for supporting services (Value Configuration and Service Requirements), and (3) that service customers are in the position to verbalize their market needs for services (Service Requirements) in a business-oriented fashion.

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