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Formalizing WSBPEL Business Processes Using Process Algebra

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Abstract

Industry standards for Web Service composition, such as WSBPEL, provide the notation and additional control mechanisms for the execution of business processes in Web Service collaborations. However, these standards do not provide support for checking interesting properties related to Web Service and process behaviour. In an attempt to fill this gap, we describe a formalization of WSBPEL business processes, that adds protocol information to the specifications of interacting Web Services, and uses a process algebra to model their dynamic behaviour — thus enabling their formal analysis and the inference of relevant properties of the systems being built.

Keywords: Web Services, orchestration, WSBPEL, formal methods, process algebra, interoperability, adaptation.

1 Introduction

Web Services workflow systems emerge as the natural evolution of workflow systems and business processes in organizations. This is due to the evolution that business operations have experimented in the last few years. Nowadays a process may not necessarily be based only on a single or even a group of internal applications, as in traditional workflow systems. Examples are resource management, production control, or any kind of collaborative process in general.

Organizational workflow tends to be more interdepartmental and involve different partners. Each one of these entities owns its own processes, which

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can be more or less heterogeneous and complex. In order to build applications that can give support to these processes, new systems which overcome the limitations of traditional workflow systems have been developed. These are usually denominated Business Process Management Systems (BPM). BPMs are capable of coordinating long "conversations" between the entities involved in the process, managing different aspects such as execution threads, or error handling.

Many implementations of these BPMs have been developed and tested during the last few years. However, none of them has obtained wide acceptance. This situation has recently changed with the arrival of the Web Services Business Process Execution Language, or WSBPEL [5] (formerly known as BPEL4WS), supported by major industrial partners and totally based on Web Services. This standard allows the description of the interactions between the different entities involved in a business process.

WSBPEL uses an XML-based description language which basically identifies partners, interactions, and the global process coordinating them. The coordination model that WSBPEL uses is referenced as Web Service "orchestration". In contraposition, we have Web Services "choreography", used in other standards such as the W3C's Web Service Choreography Description Language, or WS-CDL [12]. While in a choreography interaction occurs between any pair of partners arbitrarily, in orchestration all interactions have a single partner and the coordination process as endpoints. A classical example of a Web Service orchestration is the booking process of an Internet travel agency, where there are different partners such as airlines, car rental services, and hotels. With WSBPEL we can describe, for instance, how to coordinate (orchestrate) these partners in order to produce a travel plan, by defining interaction rules and specifying how to handle any potential incidence throughout the process.

Unfortunately, elaborating the description of service orchestrations is still a very demanding task in terms of effort and domain knowledge, making the development of integrated Web Services a time consuming and expensive task. The need to achieve a higher degree of automation in the orchestration of Web Services has generated an important research effort by the Web Services community in order to address this issue. The software industry is also devoting more resources to solve interoperability problems, through organizations like W3C or WS-I [13]. These organizations promote the development and deployment of applications and services able to interact among them in a simple and efficient way through the Internet, independently of their underlying platforms or languages.

We believe WSBPEL is a medium-term realistic approach towards automa-