ABSTRACT

Business processes, the next-generation workflows, have attracted considerable research interest in the last 15 years. More recently, several XML-based languages have been proposed for specifying and orchestrating business processes, resulting in the WS-BPEL language. Even if WS-BPEL has been developed to specify automated business processes that orchestrate activities of multiple Web services, there are many applications and situations requiring that people be considered as additional participants who can influence the execution of a process. Significant omissions from WS-BPEL are the specification of activities that require interactions with humans to be completed, called human activities, and the specification of authorization information associating users with human activities in a WS-BPEL business process and authorization constraints, such as separation of duty, on the execution of human activities. In this article, we address these deficiencies by introducing a new type of WS-BPEL activity to model human activities and by developing RBAC-WS-BPEL, a role-based access-control model for WS-BPEL, and BPCL, a language to specify authorization constraints.

Keywords: activity; authorization constraints; business process; permission; role

INTRODUCTION

Business process management (BPM) systems have gained a lot of attention due to the pressing need for integrating business processes of different organizations. Research efforts have been devoted to improve current workflow technologies in order to support collaborative business processes. BPM systems can be considered as an extension of classical workflow management (WFM) systems. Older proprietary workflow systems managed document-based processes where people executed the workflow steps. Today’s BPM systems manage processes that include person-to-person work steps, system-to-system communications or combinations of both. In addition, BPM systems include integrated features such as enhanced (and portable) process modeling, simulation, code generation, process execution, and process monitoring. All these functions and features have resulted in an increased interest in BPM suites because they enhance business process flexibility while at the same time reducing risks and costs. Therefore, BPM suites are a way to build, execute,
and monitor automated processes that may go across organizational boundaries: a kind of next-generation workflows.

Recently, Web services have provided the basis for the development and execution of business processes that are distributed over the network and available via standard interfaces and protocols. Business processes or workflows can be built by combining Web services through the use of a process specification language. Such languages basically allow one to specify which tasks have to be executed and the order in which they should be executed. Because of their importance, process specification languages have been widely investigated, and a number of languages have been developed. One such language is WS-BPEL 2.0 (Web services business process execution language), an XML-based workflow process language, which provides a syntax for specifying business processes in terms of Web services (Jordan & Evdemon, 2007). WS-BPEL resulted from the combination of two different workflow languages, WSFL (Leymann, 2001) and XLANG (Thatte, 2001), and adopts the best features of these languages. WS-BPEL is layered on top of several XML standards, including WSDL 1.1 (Web services definition language; Christensen, Curbera, Meredith, & Weerawarana, 2001), XML Schema 1.0 (Biron & Malhotra, 2004), and XPath 1.0 (Clark & DeRose, 1999), but of these, WSDL has had the most influence on WS-BPEL.

However, despite the significant progress toward the development of an expressive language for business processes, significant challenges still need to be addressed before we see the widespread use of business process management systems in distributed computer systems and Web services. Even if WS-BPEL has been developed to support the specification of automated business processes that orchestrate activities of multiple Web services, there are cases in which people must be considered as additional participants who can influence the execution of a process. Recently, a WS-BPEL extension to handle person-to-person processes has been proposed called BPEL4People (Agrawal et al., 2007b). In BPEL4People, users that have to perform the activities of a WS-BPEL business process are directly specified in the process by user identifiers or by groups of people’s names. No assumption is made on how the assignment is done or on how it is possible to enforce constraints like separation of duties.

WS-BPEL does not provide any support for the specification of either authorization policies or authorization constraints on the execution of activities composing a business process. We believe, therefore, that it is important to extend WS-BPEL to include the specification of human activities and an access-control model able to support the specification and enforcement of authorizations to users for the execution of human tasks within a business process while enforcing constraints, such as separation of duty, on the execution of those tasks (Bertino, Ferrari, & Atluri, 1999; Casati, Castano, & Fugini, 2001; Crampton, 2005a; Wainer, Barthelmess, & Kumar, 2005).

In this article, we propose an approach to extend WS-BPEL with an authorization model that also supports the specification of a large number of different types of constraints. Role-based access control (RBAC) is a natural paradigm for the specification and enforcement of authorization in workflow systems because of the correspondence between tasks and permissions.

In recent years, several extensions to RBAC have been proposed with the goal of supporting access control for workflow systems (Ahn, Sandhu, Kang, & Park, 2000; Bertino et al., 1999; Wainer et al., 2005). We make use of this work in defining RBAC-WS-BPEL, a role-based access-control model based on the specification of authorization policies for business processes defined in WS-BPEL. However, a role-based model alone is not sufficient to meet all the authorization requirements of business process management systems such as separation-of-duty constraints and binding-of-duty constraints. Separation-of-duty requirements exist to prevent conflicts of interest and to make fraudulent acts more difficult to com-
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