Enabling Efficient Service Distribution using Process Model Transformations

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ABSTRACT

The challenge of service distribution has been considered in the fields of cross-organizational interoperability, grid computing and task delegation but little addressed for cross-zone application deployment in Cloud Computing. This paper proposes a process model transformation technique based on activity aggregation to efficiently distribute services for the Web of Data between various Cloud availability zones. The authors propose a workflow decomposition method based on SPQR fragments and the definition of an efficient service distribution algorithm according to a defined cost model. This cost model considers not only the transmission of information between activities for data and control scopes but also the cost of activity execution in different regions. Finally the authors validate their method by providing a tool that introduces the distribution information into the workflow, applying their distribution algorithm in a use case and describing the transformation process to distributed BPEL code that can be easily deployed to back-end instances.

KEYWORDS


INTRODUCTION

The Web of Data is a trend towards an open Web that has recently experienced an outstanding growth and currently provides publicly large amounts of interconnected data through different domains. Services that generate and manage this data must be distributed according to data sets location, to enable an efficient data provision to users.

The problem of service distribution has been widely addressed in recent years. Besides cross-organizations interoperability, service distribution is explored in the field of grid computing and more recently in task delegation, specifically in the field of distributed execution of services, with the rise of smartphones (Alcarria, Robles, Morales, & Cedeño, 2014).

Task distribution between different domains increases the efficiency in service execution and also hides some implementation details of the business process from certain participants.

Business process transformation is often associated with process views, which can adapt processes to new requirements, reuse parts of processes and involve different stakeholders in the process design. The advantage of this approach is that process changes become easier as they are performed in a specific view, abstracted from the complete workflow, whereas synchronization (provision of consistency between levels) plays an important role.
Figure 1 shows a business process of a service described in BPMN (Business Process Modeling Notation) language, in which activities are linked in the control plane (with arrow connectors) and in the data plane (with dotted connectors). The service is fragmented into two domains, through the Pool1 and Pool2 swimlanes, defined in the BPMN specification.

The aim of our work is to achieve efficient decomposition into domains of a user-defined service, considering a cost model that measures the difficulty of separating any pair of activities in two different domains.

The following sections describe the motivation of our work and some background and definitions regarding service decompositions. Then we explain our service distribution and fragmentation models and the main contribution of our work, the efficient distribution algorithm and the corresponding cost model. As a validation of our work, a proof of concept based on a use case is presented, with a performance evaluation of our solution. Finally, we describe some related work in workflow decomposition, model transformations and activity distribution.

SERVICE DISTRIBUTION FOR THE WEB OF DATA

The Web of Data is an evolution of the semantic web trying to overcome the limitation of machine-accessibility to web pages and to take advantage of the countless structured data sets distributed all over the world and containing all kinds of information. A new generation of application and services should manage this massive, freely accessible knowledge base, providing data integration, interoperability, mapping, portability, availability, security and distribution.

Related to data security, cloud computing environments provide mechanisms to classify accesses, classes of users, perimeter and risk mitigation assets. Other important property is data mapping, which defines the best route for connecting different Linked Data entities. Data mapping and security affects datasets reuse and distribution as well as the efficient data access for the service ecosystem. In the ecosystem it is possible to find domain-independent services enabling transforming data between different schemas or determining how trust-worthy a piece of data is.

The application of the Data as a Service (DaaS) Cloud model allows a distribution of data repositories and associated services in availability zones, forming domains. Service distribution in these domains enables a more efficient access to data. Figure 2 describes the service model considered in this work.

We divide our service model into three levels, from bottom to top: The Data provision, Web of Data, and Service Composition levels.
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