VieDAME – Flexible and Robust BPEL Processes through Monitoring and Adaptation

Oliver Moser, Florian Rosenberg and Schahram Dustdar
Distributed Systems Group, Technical University Vienna
Argentinierstr. 8/184-1, 1040 Vienna, Austria
lastname@infosys.tuwien.ac.at

ABSTRACT

VieDAME is a tool for monitoring and dynamic service adaptation of BPEL processes. The tool monitors partner service interaction to compute Quality of Service (QoS) data and performs dynamic service adaptation based on various available service selection strategies, such as availability or response time. The service adaptation happens transparently at runtime by dynamically selecting an alternative service for an existing service used in the process, without any changes to the deployed BPEL process. To gain even more flexibility, the tool provides transformation components to compensate service interface mismatches, which are likely to occur when using alternative services offered by different providers.

Categories and Subject Descriptors

D.2 [**Software Engineering**]: Programming Environments; D.2.11 [**Software Engineering**]: Software Architectures—*Domain-specific architectures, Languages*

General Terms

Design, Languages, Reliability, Performance

1. INTRODUCTION

Business process automation is highly desirable for organizations from various domains. Recently, with the advent of service-oriented computing, the Web Service Business Process Execution Language (WS-BPEL [2] or BPEL for short) is becoming a popular means to create and manage business processes based on Web service technologies. When implementing service-oriented systems one major issue is that the quality of various services used in a process cannot be controlled since they are hosted by some external provider or business partner. Therefore, the Quality of Service (QoS) is an increasingly important aspect to determine the well-performing services from services with a poor performance. The quality of a given service can be expressed by various attributes such as response time, accuracy, availability or throughput [3].

When dealing with process-based solutions such as BPEL, the QoS of the different services invoked during the process execution determines the quality and robustness of the overall process. If one service in the process becomes slow or even unresponsive, the QoS of the whole process decreases rapidly and it creates a negative impact for an organization, ranging from bad reputation to a substantial loss of money.

The Vienna Dynamic Adaptation and Monitoring Extension (VieDAME[1] for short) addresses two very important issues when applying BPEL in enterprise applications where high-availability is essential, namely *monitoring* and *adaptation*. Firstly, the BPEL standard does not provide any means for monitoring a running process. Nevertheless, monitoring of business processes is crucial in enterprise systems, allowing to track the process execution and information about possibly undesired behavior. Currently, it is up to the BPEL engine to provide monitoring interfaces. However, to the best of our knowledge, available BPEL engines lack this ability. Monitoring of QoS is a necessary foundation to decide whether a replacement of a service should be performed and also what kind of QoS-based selection criteria should be used. Secondly, one major drawback of BPEL is its inherently static nature. If a process definition is deployed to the BPEL engine, it cannot be changed dynamically at runtime. Every information is hard-wired after a process is deployed, for example, references to other services (called *partner links*) used in the BPEL process cannot be changed and exchanged without editing and redeploying the process which implies a downtime of the overall system. Although it is possible for the process to bind to partner links at runtime, the process definition would contain a tremendous amount of code that is not related to the business process. A dynamic replacement of partner Web services (referred to as dynamic service adaptation) in the process is, therefore, a necessary requirement when the service provider quality in terms of response time (or other QoS) aspects is not good enough and affects the overall quality of the process.

2. VIEDAME APPROACH

In Figure 1 we have depicted our approach that we use for the dynamic service adaptation. The core part is the BPEL process which has a certain control flow and invokes a number of partner services. The partner services are generally hosted on different machines distributed over the Web. In VieDAME each service in a BPEL process can be marked as *replaceable* to indicate that alternative services can be configured and invoked instead of the original service that is defined in the process. An alternative service can either be *syntactically* or *semantically* equivalent. The former indicates that the interfaces of the original and the alternative

[1]The software is available as an online demo at `http://www.vitalab.tuwien.ac.at/prototypes/viedame`

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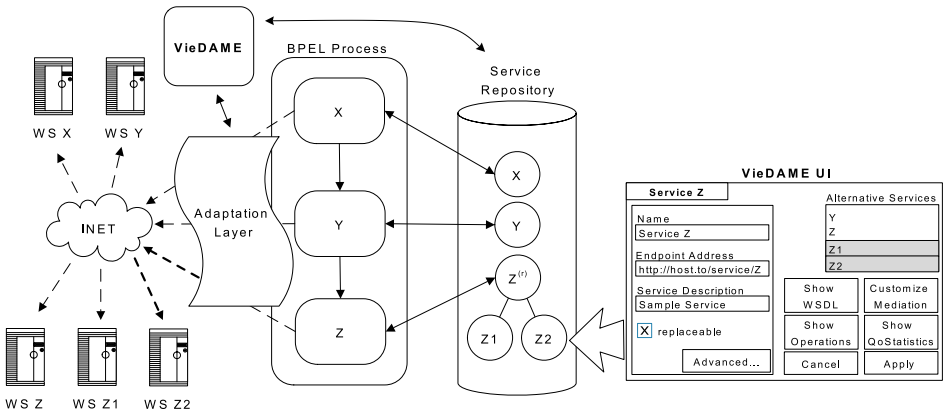

Figure 1: VieDAME enhanced BPEL environment

services match. This is, for example, the case, when multiple instances of the same service are hosted on different machines to provide increased reliability. The latter indicates that the services only have the same functionality but expose it using different interfaces, resulting in different representations of the same message payload. This mainly occurs when services need to be exchanged that come from completely different providers on the Web.

Each service and all of its alternative services' endpoints are stored in the VieDAME service repository. If a service should be dynamically replaced with an alternative service during process execution, the original partner service captured by the VieDAME's adaptation layer has to be marked replaceable in the VieDAME UI (right side of Figure 1). Alternative services that can replace the original service defined by the BPEL process may be added at any time by providing their interface description in the VieDAME UI. Once they are linked to the original service, a replacement policy can be selected to control which of the available alternatives will be used. Additionally, the VieDAME UI can be used to define mediation rules that allow alternative services to be used where the interfaces do not match the original interface of the partner service.

VieDAME is implemented as an extension to the ActiveBPEL[2] engine and allows monitoring of various QoS attributes of services within a BPEL process and to perform a fully dynamic service adaptation of existing processes in a non-intrusive way by providing a number of alternative services for a given service. Additionally, we provide a mechanism to handle *service interface mismatches* by allowing transformations to be applied to incoming and outgoing SOAP messages to adapt them to the interface currently used in the BPEL process. The performance overhead introduced by our extension is low and the overall system performance is sufficient for high performance service based applications (see [1]). Furthermore, we provide a Web-based administration interface allowing access to monitoring data and the configuration of adaptations and its possible transformations.

From an architectural point of view, the VieDAME system is split into the VieDAME core and the VieDAME engine adapters. The VieDAME core ties together the monitoring, service selection and message transformation facilities as well as provides services such as data store access, scheduling and configuration data, whereas the engine adapters represent the interface to the BPEL engine. These adapters are implemented using Aspect-Oriented Programming (AOP) which allows to keep the base system (i.e., the BPEL engine) and the VieDAME system as separate as possible. Thus, to support new BPEL engines, it is (only) necessary to implement an engine adapter specifically to the desired engine implementation.

[2] `http://www.active-endpoints.com`

3. CONCLUSION

In service-centric environments it is likely that different services are unresponsive or become completely unavailable. VieDAME addresses these concerns by monitoring QoS attributes and by providing a fully dynamic adaptation for services within a BPEL process. For a more detailed discussion of the VieDAME architecture, its implementation and evaluation we refer the interested reader to [1]. The evaluation of our tool shows that is has a very good performance under high load and demonstrates the little overhead introduced by its key components (monitoring, replacement and transformation).

4. REFERENCES

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