Quality-Oriented Execution and Optimization of Cooperative Processes: Model and Algorithms

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Abstract

Cooperative business processes supporting the collaboration of companies and organizations are of increasing importance as they help to reduce the complexity of cooperation scenarios and optimize time and costs. More and more organizations use Internet technology such as Web services to support their cooperative business processes. Web services are an emerging technology to encapsulate services offered by different providers thus helping to preserve the autonomy of the service providers. Web services may realize a broad range of business functions ranging from database queries or calculations over complex applications to entire workflows. Furthermore, the applications encapsulated by Web services are heterogeneous, reaching from legacy applications over complex automatic applications to manual activities. To implement cooperative processes it is necessary to integrate a large number of heterogeneous services from autonomous providers.

To ensure that such processes reliably serve their purpose and meet the users' expectations implies achieving a high execution quality of the processes. The execution quality of the process is based on quality characteristics imposed on the services executing the process tasks. The quality characteristics have to be ensured for heterogeneous services and have to be monitored and controlled without violating the autonomy of the service providers. Violation of quality characteristic should be handled dynamically to ensure the overall execution quality and to achieve high flexibility and robustness of the cooperative process. This also applies for other events that may hinder a successful and reliable process execution such as failed service executions.

In this thesis we propose the Web-Flow architecture that provides a new approach to support quality-oriented execution and optimization of processes in cooperative scenarios. The Web-Flow architecture provides a generic infrastructure that allows to monitor and ensure the quality-oriented execution of processes executed in different process engines and with different cooperation models.

Web-Flow provides a classification of quality characteristics describing the execution quality of services. The quality characteristics can be monitored automatically and violations can be detected automatically. To handle constraint violations and other events occurring during process execution Web-Flow offers a rule-based exception handling approach. This approach accomplishes any exception handling that is provided by the process engines executing the cooperative processes and thus contributes to providing a generic solution for quality support. The exception handling is also accomplished with a semi-automatic, log-based derivation of appropriate actions to relieve the administrator from having to define and maintain rules for all possible events. Furthermore, recommendations for the optimization of cooperative processes may be derived based on the analysis of log entries.

The Web-Flow architecture has been implemented in a runnable prototype which shows the usability and applicability of the approach. Also some first evaluations have been performed.